CRANFIELD UNIVERSITY

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IDENTIFYING HOW SMALL- AND MEDIUM-SIZED ENTERPRISES GENERATE DEEP CUSTOMER INSIGHT FOR RADICAL INNOVATION

CRANFIELD SCHOOL OF MANAGEMENT
Management

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Supervisor: Professor Keith Goffin
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(NB. This section can be removed if the award of the degree is based solely on examination of the thesis)

ABSTRACT

It is widely recognized that *Radical innovation* drives growth in Small and Medium-sized firms (SMEs). However, relatively few SMEs develop highly innovative new products and services. An underlying cause of this could be SMEs' failure to identify customers' *latent* — unarticulated — needs. Such *Deep Customer Insight* (DCI) is a prerequisite to radical innovation and should emerge during the innovation process. DCI requires firms to acquire and absorb new knowledge from customers, something that is known to be challenging for many SMEs.

The relevant theoretical perspectives underlying DCI are found in the *Market-Based Learning*, *Customer Involvement*, *Innovation Management*, *Design* and *Entrepreneurial Marketing* literatures. However, the extant knowledge was found to be fragmented and incomplete. For example, it is unclear whether formal learning processes and market research methods are applicable to SMEs and the roles of managers and employees in DCI have not been clarified. In addition, extant research has not delineated a clear relationship between the type of insights generated (either *current needs* or *latent needs*) and the processes and resources by which they were created. As a consequence, it is unclear how SMEs, with their limited resources, can generate DCI effectively.

Using systematic case research, with multiple sources of data, radical innovation projects at six companies were studied. This investigated: 1) SMEs' DCI practices; 2) The level of insights generated; 3) Managers' perceptions of the process. The results show that some SMEs generate high-quality insights, while others do not; demonstrating that a company's *research skills* are a key prerequisite for successful customer interactions and tap customer knowledge. This shows that managers need to prioritize 'skills' when allocating resources to radical innovation projects and contributes to Entrepreneurial Marketing theory. The study also provides a precise understanding of two new concepts, the *quality of insights* and *customer involvement*, opening up interesting avenues for future research on SMEs.

Keywords:

latent needs, market research, customer involvement, insight quality, Practice Theory

ACKNOWLEDGEMENTS

Here it is: the result of a six-year study into innovation, latent needs, and small- and medium-sized enterprises (SMEs). Topics that run like a thread through my professional life, and topics that have given my career direction. As a marketer and market researcher, I have a natural tendency to consider customer needs and, at my first job, I was taught how customer insights are invaluable to SMEs seeking venture capital to fund their new endeavours. Later, I realised how many questions about markets and customers are asked early in the innovation process. My motivation to research the trifecta of innovation, customer needs, and SMEs came from one particular book: *Identifying Hidden Needs: Creating Breakthrough Products* (2010) by Keith Goffin, Fred Lemke and Ursula Koners. When I read about hidden (latent) needs, and how to identify and capitalise on them, it was clear that this understanding would be particularly valuable to entrepreneurs in my region. I wondered why I hadn't encountered this before in practical application when working with entrepreneurs. Looking for answers, I decided to call Keith Goffin. I can't exactly recall the details of this first conversation, but what is engraved into my memory is the moment I decided to take up Keith's suggestion and look for answers myself in the form of a PhD.

Therefore, the first thank you goes to Professor Keith Goffin, who supervised me so patiently in this project. Earning my PhD degree was something I had secretly wished for; however, I had no real idea what I wanted to explore or what deserved my energy and focus. Keith's suggestions, and our subsequent conversations, gave me both direction and the courage to begin. His feedback resulted in many sleepless nights but it always improved weaknesses and inconsistencies in my research, and thus was invaluable. In the months leading up to my submission, our Skype conversations had become intense, but always ultimately brought clarity. I've especially appreciated the change in our dialogues that has given way to more personal anecdotes and discussions. Mountain vacations, complete with donkey stories, were shared, but also the latest news around the impact of COVID-19 and US presidential elections was debated intensively.

My PhD has not only enriched me intellectually, it has also given me unforgettable experiences and unexpected business contacts. I would like to extend special thanks to John Dane and Adri de Buck, members of HZ's advisory board in 2014, both of whom gave me the confidence to start this project, and I don't know how I could have done this without that support. I have very special memories of the workshops with the companies interviewed for my thesis, and the criss-crossing through Holland needed for those interactions. Three HZ students, who accompanied me on these travels to learn about DCI, enhanced these treasured memories. Mehmet, Stef, and Joost, your presence energised me, gave me drive, and made my uncertainties vanish. Stef, the fact that you still work as an Insights researcher makes me proud; you are a very reliable and dependable colleague.

I could not have imagined the impact this project would have on my personal life. My PhD work accompanied my family and me on our vacation to Begur, Spain. While everyone was asleep, and with a tranquil view of the Mediterranean, I devoured Yin's book on case study research from which I developed my methodology. My PhD project went along with my family to London for Christmas. While strolling through the Natural History Museum, I received an email from Keith with some constructive feedback regarding my Scoping study. Needless to say, this altered the plans — my family finished the museum tour by themselves while I addressed Keith's concerns in the Museum café. So it is clear that this project would not have been possible without the support and patience of my family.

Yves, my husband, never made it an issue to explore things on his own during our vacations, or even to take a trip on his own to the US to visit my brother. Yves, you were there for me during the most difficult moments. Especially during the last nine months of COVID-19 restrictions, we have worked faithfully, side-by-side, in our small office without any misgivings — you made it all the more bearable.

And then, of course, I wish to express special appreciation to both of my daughters, Sterre and Soetkin, who showed great patience while I 'quickly' finished a sentence or needed 'one more minute' to finish an article. And much more than just waiting, both of them stepped up to take over certain household duties — thank you. Especially to Sterre, for all the times she made dinner which meant all I had to do was to move from my desk to the dining room table and back.

Lastly, thank you to my brother, Hendrik Jan, who regularly visited us. While here, I gratefully tapped into his knowledge of innovation while I formulated my own thoughts and translated them to paper.

This thesis is dedicated to my late mother and father who have always encouraged me to embrace new opportunities. My father has supported me throughout the entire project and kept doing so until he finally had to give in himself. I am convinced that he would have been very proud knowing that I managed to finish this challenging project.

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GLOSSARY OF TERMS AND ABBREVIATIONS

Activities	Happenings or work-related tasks.
Actual activities	Things that actually happen in daily practice, as opposed to perceptions of ideal behaviour. Also defined as the performative aspect of a practice: "Specific actions, by specific people, in specific places and times" (Feldman and Pentland, 2003, p 101).
Ambidexterity at the project level	Hybrid way of learning about customer needs, in which both explorative and exploitative learning is combined on behalf of an innovation project (Gupta, Smith and Shalley, 2006; Liu and Leitner, 2012).
Boundary-spanning individuals	Individuals who act in a diffuse problem context on a daily basis and are often the first to recognise new needs.
Bricolage	Creative use of resources.
Capabilities	A set of processes through which firms convert inputs into valuable outputs (Parmigiani and Howard-Grenville, 2011).
Champions	Those who develop internal commitment to the project.
Circumstances of DCI	Extrinsic qualities of Deep Customer Insight , which exist independent of the content and refer to qualities such as 'acceptable' and 'cost-efficient' insights.
Close-at-hand resources	Resources that are relatively easy to acquire, such as contacts via university networks, internet sources, or nearby customers.
Co-creation	An approach in which customers participate actively in new product development processes. For example, by engaging in co-development, problem-solving, and decision making.
Cognitive skills	Research-driven skills.
Comprehensive knowledge	Knowledge which is based on a wide variety of knowledge types and offers the potential to both achieve deeper levels of understanding and to stimulate creativity (De Luca and Atuahene-Gima, 2007).
Conceptual use of information	Using information as a source of inspiration. For example, to generate ideas or to develop a new strategy.
Content of DCI	Intrinsic qualities of Deep Customer Insight, which refer to qualities such as 'comprehensive' and 'novel' insights.
Creational Perspective	Theory regarding the nature of opportunities. In this perspective, opportunities do not exist *a priori*; rather, they are created and emerge iteratively.
Critical Realism	Argues that reality exists independent of the observer. It asserts that, beneath the surface of observed events, less transparent structures and mechanisms operate. It also recognises that these structures and mechanism are highly context dependent and need a

	clear view of the different organisational levels of a system (Sayer, 2000).
Customer Involvement Theory	Theory that gives a central role to the customer. It studies the customer's background characteristics and the modes for involving the customer.
Customisation	Tailoring specific solutions to needs of specific customers. It requires that careful attention is paid to the expressed needs of the customer.
Data	A collection of objective recorded facts.
DCI	Deep Customer Insight. An intimate and shared understanding of the latent, unarticulated needs of the customer.
Deutero Learning	Understanding of processes; know-how, as opposed to know-what or know-why.
Design Thinking	A set of principles, tools, and methods enabling the development of radical innovations.
Discovery Perspective	Theory regarding the nature of opportunities. In this perspective, opportunities are believed to exist independently. They 'just' need to be recognised before they can be exploited (Alvarez, Barney and Anderson, 2012).
Effectuation Theory	Theory developed by Sarasvathy (2008), which defines the flexible, means-driven way of decision making within SMEs.
Entrepreneurship	The opportunistic, pro-active, and innovative activities through which new market opportunities are formed.
Entrepreneurial alertness	Noticing valuable new information without deliberate search.
Entrepreneurial processes	Activities that entrepreneurs undertake for the identification, evaluation, and exploitation of new market opportunities (Shane and Venkataraman, 2000).
Entrepreneurial Marketing	Theory describing the unique, flexible, and operationally focused way of forming opportunities when faced with limited resources (Hills, Hultman and Miles, 2008).
Epistemological aspects	Theory discussing how knowledge of reality can be developed.
Explorative market learning/ research	Open-ended research enabling the development of new thoughts, skills, and experiences. It is based on new information about customers. Market-Based Learning literature equates explorative market learning with Proactive Market Orientation.
Exploitative market learning/research	Research that refines or confirms insights previously collected. Market-Based Learning literature equates exploitative market learning with Responsive Market Orientation.
Extrinsic quality of knowledge	Qualities that belong to knowledge in general, regardless of the type of knowledge (c.f. Reid and De Brentani, 2010).

Gatekeepers	Individuals who decide how and when information is further transmitted to the organisational level.
Improvisation	Real-time learning, largely based on unscripted actions (c.f. Weick, 1998).
Incremental innovation	New products that are improved versions of already existing products. They are, therefore, less unique than radical new products.
Information	Data that is organised and describes current and past situations.
Instrumental use of information	Using information in decision making or problem solving.
Intrinsic quality of knowledge	The essence, or unique nature, of knowledge which may include the content type or form of knowledge, such as the type of needs insights (current or latent).
Intuition	A feeling of rightness which does not include 'knowing why' (e.g. Eling, Griffin and Langerak, 2014; Roberts and Palmer, 2012).
Knowledge	Information that is interpreted, holding the capacity to predict future events.
Latent needs	Needs that are not yet known and not readily articulated.
Lead users	Individuals who are inclined to develop their own solutions for the particularly demanding situations with which they are faced. Also known as 'extreme users'.
Lead user method	Process steps to identify and engage lead users during concept development and testing.
Learning	The result of information processing.
Learning agility	"A nimble approach to learning, easily generating and transferring knowledge within the firm and across partners in a way that encourages knowledge spill-over" (Coviello and Joseph, 2012, p. 99).
Learning from	A mode of customer involvement, in which the customer acts as a source of input and learning results from processing customers' input.
Learning with	A mode of customer involvement in which the customer is actively involved in innovation activities. By working actively together, needs and solution information is transmitted in a natural way (without formal research) from the customer to the innovating firm (e.g. Cui and Wu, 2016, 2017; Nambisan, 2002).
Learning without	A mode of customer involvement in which the customer is not involved at all and learning results from input acquired from sources other than the customer.
Life cycle phases	Evolution phases of firms, such as start-up, young, and mature small firms.

Market Intelligence	Defined by Kohli and Jaworski (1990) as insights of current and future needs.
Market research	May be used more generally to signify market information processing, but is often treated as a synonym for quantitative market analysis (e.g. Gruner and Power, 2017; De Moor et al., 2014; Price and Wrigley, 2016; Roberts and Darler, 2017).
Market vision	An encompassing form of understanding regarding the attractiveness of advanced technology (Reid and De Brentani, 2010).
MBL	Market-Based Learning. Also defined as: "Customer-focused market-oriented learning" (Baker and Sinkula, 2005, p. 483). MBL is the result of Market Information Processing (MIP).
Mindful trial and error	Planned and unplanned forms of gathering customers' feedback (Coviello and Joseph, 2012).
MIP	Market Information Processing. Defined by Kohli and Jaworski (1990) as the steps taken for processing market-based information. Generally, includes acquisition, dissemination, and utilisation of information.
MO	Market Orientation. MO may be a set of activities, or a business philosophy, guiding the implementation of marketing principles (e.g. Deshpandé and Farley, 1998; Kohli and Jaworski, 1990; Narver and Slater, 1990).
Mobilisation of sources	The identification and activation of input sources (such as customers) for Market-Based Learning.
New methods	New methods for capturing insights relying foremost on collaborative and qualitative approaches.
New models	New ways of thinking. For example, a value proposition, requirements list, or marketing plan.
NPD	New Product Development.
Objectivist Epistemology	Follows an objective process of reasoning to develop knowledge about reality.
Objectivist Ontology	Argues that the social world exists objectively.
Ontological aspects	Theory that discusses the nature of reality.
Opportunities	New combinations of products, processes, organisation, and markets.
Perceptions	Ideas or opinions about activities.
Positivism	Theory that assumes the social world can be understood through quantifiable, universal laws, and which emphasises generalisability.
Practice performance	The sum of all components forming part of a practice; hence, the total set of activities and resources used in a practice.

Practice Theory	Theory which argues that a practice is a bundle of activities, resources, and meanings, that forms part of a bigger constellation of practices, joined together to accomplish higher-order goals (c.f. Jarzabkowski et al., 2016; Nicolini and Monteiro, 2017; Vaara and Whittington, 2012; Whittington, 2006). Practice-based scholars recognise that the daily "doings and saying ('practices')" of actors are key to understanding organisational phenomena (Nicolini and Monteiro, 2009, p 110).
Pragmatism	Philosophy which regards the world as complex and constantly changing, and considers theory an instrument for problem solving. Pragmatic researchers engage in an ongoing, cyclical process of problem framing, articulation, hypothesis generation, and practical evaluation (Dalsgaard, 2014).
Pragmatic-Realism	Philosophy which claims that structural powers exist as long as people believe in them (Kivinen and Piiroinen, 2004). Actors and their perceptions are, therefore, an important gateway to understanding people's practices.
Presentation of DCI	Extrinsic qualities of Deep Customer Insight, which exist independent of content and refers to qualities like 'timely', 'inspiring', 'format' and 'scope' of insights.
Proactive MO	Proactive Market Orientation. MO activities aiming to satisfy customers' latent needs.
Probe-and-learn approach	Method for gaining continuous feedback from customers during new product development.
Prior knowledge	In contrast to new knowledge, prior knowledge is already available within a firm or project.
Radical innovation	New products with new and unique features compared to current market offerings.
Repertory Grid	A structured interview process identifying customers' hidden thoughts about products (Baxter, Goffin and Szwejczewski, 2014).
Requirements statement	Expresses a customer need, informing and guiding decision making during new product development (Ulwick and Bettencourt, 2008).
Resources	(Financial) means and skills, supporting actors in the execution of their tasks.
Responsive MO	Responsive Market Orientation. MO activities aiming to satisfy customers' current needs.
SD Logic	Service-Dominant Logic. Theory regarding value creation, defining customers as co-producers of knowledge and value, and introducing the term 'co-creation' (Vargo and Lusch, 2004).
SME	Small and Medium-Sized Enterprise. Firm with a maximum staff headcount of 250 and a turnover not exceeding 50 million euros. This study uses the terms 'SME' and 'small firm' interchangeably.

Sponsors	Those who provide encouragement and financial backing for a radical project.
Subjectivist Epistemology	Philosophy which relies on interpretations of reality.
Subjectivist Ontology	Philosophy which argues that reality does not objectively exist, but, in contrast, is defined by human actors and social forces.
Symbolic use of information	Using information to establish relationships and create commitment.
Quality criteria	Criteria defining the quality of insights.
T-shaped professionals	Professionals capable of handling both technical and customer-related tasks (Brown, 2008; Hansen, 2019).
Understanding	A deeply embedded and holistic form of knowing.
VoC	Voice of the Customer. An approach for understanding customer needs that starts with capturing customers' input.

CHAPTER 1 INTRODUCTION

1.0 INTRODUCTION

This thesis investigates how small- and medium-sized enterprises (SMEs)[1] generate Deep Customer Insight (DCI) during their innovation projects. DCI is widely recognised as a key resource for firms that develop *radical* new products. Such radical products are defined as having new and unique features compared to current market offerings and are, therefore, a source of superior value (Cooper and Dreher, 2010; Coviello and Joseph, 2012). DCI is defined here as an intimate and shared understanding of the *latent*, unarticulated, needs of the customer. It is the result of understanding many individual pieces of information gathered during market research, all of which are brought into a coherent view about how new products can address customers' latent needs (Goffin, Lemke and Koners, 2010; Price and Wrigley, 2016).

DCI should emerge during the New Product Development (NPD) process (Cooper, 2008; Hultink et al., 2011) and requires firms to engage in *explorative market learning*, developing new thoughts, skills, and experiences based on new information about customers. Without explorative learning, firms are likely to draw upon existing knowledge and continue addressing customers' current needs; this is known to lead to less distinctive, incremental new products (Kim and Atuahene-Gima, 2010; March, 1991; Pettit, Crossan and Vera, 2017). Given the uncertain returns of explorative learning, the generation of DCI is highly challenging for companies of all sizes and in all sectors (Kim and Atuahene-Gima, 2010; Nijssen et al., 2012).

In 2019, 99.8% of all businesses in the EU were small- or medium-sized enterprises. SMEs are defined as having a maximum of 250 employees and a turnover not exceeding 50 million euros. They represent 61.4% of all employment and 54.5 % of value added (Muller et al., 2019). SME activity is strongly associated with job creation and economic growth (OECD, 2010; Thurik, 2009). It is, therefore, vital to understand what determines SMEs' success. Radical innovation is recognised as a deciding factor in the success of SMEs (Eggers et al., 2013; Rosenbusch, Brinckmann and Bausch, 2011; Schindehutte, Morris and Kocak, 2008), but it is also noted that relatively few SMEs excel in it (OECD, 2010). Considering the common critique that SMEs are not good at explorative market learning (e.g. Maes and Sels, 2014; Marion, Friar and Simpson, 2012; Moultrie, Clarkson and Probert, 2007), one of the underlying causes of SMEs' poor radical innovation results may lie in weak insights into customers' latent needs. However, the currently available literature does not recognise the difference between current and latent needs. It does not offer a comprehensive view of how DCI is gathered, interpreted, or acted upon. Therefore, based on the currently available research, a clear understanding of how SMEs can effectively generate DCI is not available.

A Systematic Literature Review (SLR) informed this study into the DCI practices of SMEs. This enabled the identification of six knowledge gaps in current understanding and led to three Research Questions (RQs):

[1] This study uses the terms 'SMEs' and 'small firms' interchangeably.

- RQ1: *How do small firms' practices enable them to generate DCI for radical innovation projects?*
- RQ2: *What is the level of insight resulting from DCI practices?*
- RQ3: *What are the perceptions of small-firm actors of DCI practices?*

A case study approach was selected as an appropriate method to provide answers for these research questions. The analysis of the case studies was based on *Practice Theory* (Schatzki, 1996). This theory focuses on the actions of individuals, like managers and employees, in pursuing their goals, thus enabling the identification of their daily "doings and saying ('practices')" (Nicolini and Monteiro, 2017, p. 110), as well as the outcomes of such practices. Literal and replication logic guided the selection of six Dutch SMEs, all of which were nominees for a coveted Dutch innovation award. Comprehensive data were collected through documentation inspection, interviews, surveys, and workshops. The results of these data collection methods were systematically analysed using five different analysis instruments.

Chapter 1 is organised into eight main sections:

1. The first section discusses current understanding gleaned from the available literature
2. The second section gives an overview of the six knowledge gaps
3. The third section presents the research questions
4. The fourth section considers the research methodology
5. The fifth section synthesises the key findings
6. The sixth section presents the main contributions
7. The seventh section gives an overview of the structure of this thesis
8. The eighth section summarises Chapter 1

1.1 CURRENT ACADEMIC UNDERSTANDING OF DCI

Although the focus of this study is on SMEs, it was deemed essential to also review the substantial literature available on large firms. This elaborate review facilitated a deeper understanding of available theoretical concepts describing DCI and helped to explain the key differences between SMEs and large firms. The SLR identified that research on DCI is grounded in four key theories: Market-Based Learning (MBL), Customer Involvement, Innovation Management and Design, and Entrepreneurial Marketing. Each of these theories offers a unique set of concepts with which to understand DCI.

1.1.1 Market-Based Learning

Market-Based Learning (MBL) offers perspectives on the processes and cultures required to generate DCI. Kohli and Jaworski (1990) defined *market intelligence* as a key resource to connect companies with their marketplaces and to enable insights of the current and future needs of customers. Moreover, Kohli and Jaworski viewed processes for the generation, dissemination, and utilisation of market knowledge as crucial in order to learn about customer needs and termed this *market orientation* (MO). Other MBL authors defined MO not so much as a set of activities, but rather a business philosophy (Narver and Slater, 1990) or a set of beliefs (Deshpandé and Farley, 1998). As such, MO consists not only of methods and market information processing, but also of values and norms (Baker and Sinkula, 2005; Hultink et al., 2011; Moorman, 1995; Narver, Slater and Maclachlan, 2004).

MBL literature has only just begun to recognise DCI as a distinct form of market knowledge with important implications for radical innovation. The findings of MBL papers clearly indicate that DCI requires a collaborative, people-oriented, and open-minded approach,

characterised by both formal and informal processes. It builds on key activities of analysis and interpretation and embraces distinct NPD phases. In the earliest NPD phases, the activities are focused on generating a wide understanding of topics explaining customer needs. In later NPD phases, the generated insights are refined and reach a more distilled state. MBL studies focusing on how SMEs use market knowledge demonstrate that small firms struggle with formal processes and sometimes omit data acquisition. Instead, SMEs are found to rely on the views and prior knowledge of owners, pointing at the owner as an important influencing factor for DCI.

Despite this initial understanding, MBL literature does not consistently define DCI. Many papers (on both large and small firms) fail to clearly state what type of market intelligence, or what type of needs insights, are involved. Consequently, it is difficult to draw conclusions regarding the effectiveness of distinct DCI approaches. Moreover, MBL literature does not offer a sufficiently detailed view on how DCI emerges across the entire NPD process (c.f. Hultink et al., 2011; Veldhuizen, Hultink and Griffin, 2006). Further, it hardly addresses input sources and other resources supporting market information process (MIP) steps. Although the literature recognises the importance of DCI, there is a significant gap in understanding regarding how it can be achieved.

1.1.2 Customer Involvement

Customer Involvement theory focuses entirely on the customer as the source of input for DCI. Crucially, this stream of research is influenced by *Service-Dominant (SD) Logic* (Vargo and Lusch, 2004), which defines customers as co-producers of knowledge, and introduces the term *'co-creation'*. Relevant papers consider modes for communicating and interacting with customers, and explore the value of participative techniques, such as ethnographic market research. Customer Involvement theory has also recognised a "dark side"; customers involved too closely in the innovation process tend to stress their current needs, thus impairing ideas for radical innovations (e.g. Christensen and Bower, 1996; Macdonald, 1995; Prahalad, 2004).

The findings of this stream of literature suggest that dedicated methods prevent the collection of only current needs insights. This is of particular relevance to SMEs which are highly motivated to involve customers in NPD, as this enables them to supplement their scarce resources with customers' knowledge (c.f. Chang and Taylor, 2016). However, the findings of small firm research reveal that SMEs encounter many barriers in the utilisation of these methods. Moreover, the findings seem to suggest that SMEs do not necessarily aim for customer insights during radical innovation. It remains, however, unclear to what extent SMEs' insights include an understanding of latent needs, and, if so, how this is typically generated.

Similar to MBL literature, gaps in the knowledge of Customer Involvement literature result from the high level of abstraction of the many survey-based studies. Conditions and processes are roughly situated in the distinct NPD phases and do not focus on concrete data collection or analytical activities. Although frequent references are made to DCI, none of the contributions offers a separate definition. Similarly, the concept of customer involvement itself appears ill-defined. Consequently, this stream of literature insufficiently explains how SMEs' develop effective customer involvement practices, and how this can lead to DCI.

1.1.3 Innovation Management and Design

The Innovation Management and Design literature concentrates on the management aspects of radical innovation projects and is, therefore, the most operationally focused of the four schools of thought. The Innovation Management and Design literature has established the importance of understanding customers' latent needs for radical innovation and, crucially, basing this

understanding on the *Voice of the Customer* (VoC) (e.g. Cooper and Dreher, 2010; Griffin, Abbie; Hauser, 1991; Markham and Lee, 2013). The literature distinguishes distinct NPD phases in which DCI typically informs problem definition, idea generation, and concept development. The findings within this stream of literature are qualitative by nature and provide understanding of the skills, methods, and people required to generate DCI.

The findings of this school of thought reinforce the conclusions of the MBL and Customer Involvement literatures, which prescribe dedicated methods for the exploration of needs and problems in the first NPD phases, as well as for refining ideas and concepts in later phases. Moreover, the findings suggest that tools and techniques should be applied systematically in order to capture reliable insights and prevent biases, thus emphasising the level of requisite skills. Studies looking at the actual practices indicate that reality is different from theory; firms do not seem to use a well-balanced set of methods but place special focus on the validation of ideas and concepts. Furthermore, firms seem to lack the necessary skills and do not seek support of market research specialists. Similar findings are found for SMEs and allude, once more, at SMEs' inability to generate DCI.

Again, however, reliable conclusions are not available. Despite the clear focus on DCI, Innovation Management and Design literature has not yet fully developed the DCI concept. Similar to the other theoretical foundations, it does not offer a construct with which to measure the performance of the tools and efforts put into DCI. Moreover, the quality of the many case studies found within the small firm literature is generally poor. As a consequence, it is unclear whether the individuals engaging in DCI activities within SMEs, indeed, identify DCI.

1.1.4 Entrepreneurial Marketing

The Entrepreneurial Marketing literature focuses on small firms, which may comprise start-ups or existing SMEs. It discusses DCI as part of the activities that entrepreneurs undertake for identification, evaluation, and exploitation of new market opportunities (Shane and Venkataraman, 2000). Such *entrepreneurial processes* are inherently radical due to their focus on future customers, markets, and technologies (Covin and Slevin, 1991; Lumpkin and Dess, 1996; Miller, 1983). Concurrently, however, these processes are impacted by limited *resources* — (financial) means and skills — lack of experience, and process maturity (Brüderl and Schüssler, 1990; Stinchcombe, 1965). *Entrepreneurial Marketing* describes the unique, flexible, and operationally focused way of forming opportunities when faced with limited resources (Hills, Hultman and Miles, 2008). The driving force within Entrepreneurial Marketing is the entrepreneur, who is personally engaged and, crucially, relies on prior knowledge and expertise (Bettiol, Di Maria and Finotto, 2011; Read et al., 2009; Schindehutte, Morris and Kocak, 2008).

Research within this stream of literature concentrates on the entrepreneur. However, the findings of this stream of literature are contradictory and difficult to interpret. Some studies observe that the prior experience of the entrepreneur leads to more extensive market research (e.g. Gruber, MacMillan, and Thompson's, 2012), while others conclude that experienced entrepreneurs refrain from market analysis (Read et al., 2009).

Entrepreneurial Marketing is the only stream of research offering a concept that is adapted to SMEs' typical resource situation. Nevertheless, the quality of research within this relatively young field of research does not allow for strong conclusions to be drawn. Similar to the other theories, DCI remains undefined and studies lack specificity regarding how the entrepreneur collects, analyses, shares, and interprets market data. This stream of research does not describe how the entrepreneur collaborates with others. Nor is it made clear under what conditions prior knowledge is of value and forms part of DCI.

1.2 SIX KNOWLEDGE GAPS

Comparing the four bodies of reviewed literature — Market-Based Learning, Customer Involvement, Innovation Management and Design, and Entrepreneurial Marketing — revealed six inter-related knowledge gaps in current understanding : (1) the intention to generate DCI; (2) the modes and nature of DCI processes; (3) actors and their roles in DCI generation; (4) the skills and resources for generating DCI; (5) capability building; (6) the level of insight.

Knowledge Gap 1: The Intention to Generate DCI
The first knowledge gap is a consequence of the many debates on the role of market research within SMEs. Contradictory findings inhibit a detailed understanding of to what extent SMEs value DCI and have the explicit intention to generate insights. Addressing this gap is vital because of the key role of intentions in organisational learning and change (c.f. Argyris and Schon, 1978; Feldman and Pentland, 2003; Zollo and Winter, 2002). Clarifying SMEs' perceptions with regard to DCI will, therefore, provide valuable understanding regarding how SMEs adapt to the demanding conditions of radical innovation.

Knowledge Gap 2: The Modes and Nature of DCI Processes
The second knowledge gap is a result of the lack of dedicated concepts for studying the daily activities of SMEs in sufficient detail. Currently available research on SMEs tends to use large firm concepts, despite lingering debates on their applicability, which inhibits understanding of the typical processes by which SMEs generate DCI. Addressing this gap is important because generating a detailed understanding of SMEs' process, while considering their specific challenges, supports small firms in developing effective radical innovation capabilities (c.f Berends et al., 2014; Coviello and Joseph, 2012; Marion, Friar and Simpson, 2012).

Knowledge Gap 3: The Actors and Their Roles in DCI Generation
The third knowledge gap is the result of a lack of focus of current literature on *who* is doing *wha*t in order to generate DCI within SMEs. It, therefore, remains unknown how DCI defines the tasks of innovation actors within SMEs. When considering the significant impact that individuals within SMEs have on radical innovation success, it is clear that addressing this knowledge gap is crucial (c.f. Gruber 2008).

Knowledge Gap 4: The Skills and Resources for Generating DCI
The fourth knowledge gap is the result of many open questions regarding the resources of SMEs. Current understanding stresses SMEs' lack of sophisticated resources but fails to specify what alternative resources underscore the radical innovation success of SMEs. Addressing this gap is imperative; resource combinations have different trade-offs and impact radical innovation success in distinct ways (Kyriakopoulos, Hughes and Hughes, 2016). Gaining a detailed understanding of resources will, therefore, contribute significantly to radical innovation success.

Knowledge Gap 5: Capability Building
The fifth knowledge gap is the result of the sparsely available literature on the implementation of capabilities, inhibiting fine-grained understanding of how SMEs differ in terms of their level of mastery of DCI generation. Addressing this gap is critical because such a level of process mastery determines both current and future radical innovation success (c.f. Schindehutte, Morris and Kocak, 2008).

Knowledge Gap 6: The Level of Insight
The sixth knowledge gap is a consequence of the lack of any dedicated concept for DCI, inhibiting understanding of the quality and type of insights (about current needs or latent needs) generated by SMEs. Addressing this gap is necessary because collecting knowledge of the right type is an important driver of radical innovation (Hultink et al., 2011; Reid and de Brentani, 2010).

1.3 RESEARCH QUESTIONS

Three Research Questions (RQs) have been composed to address the knowledge gaps identified in Section 1.2. First, to address the lack of well-suited concepts for DCI generation processes (Knowledge Gaps 1, 2 and 5), and to achieve a more complete and balanced understanding of the actors and resources fuelling the processes (Knowledge Gaps 3 and 4), RQ1 asks: *How do small firms' practices enable them to generate DCI for radical innovation projects?*

Second, to address the lack of well-suited concepts for DCI itself (Knowledge Gap 6) and link this clearly to DCI generation processes, RQ2 asks: *What is the level of insight resulting from DCI practices?*

Third, to achieve deeper levels of understanding of the DCI generation processes (Knowledge Gaps 1) and gain insight into how actors within SMEs would improve their capabilities (Knowledge Gaps 3, 4 and 5), RQ3 asks: *What are the perceptions of small-firm actors of DCI practices?*

1.4 RESEARCH METHODOLOGY

This study aims to generate a complete understanding of Small and Medium-sized Enterprises' approach to DCI and will, therefore, address the six knowledge gaps identified in Section 1.2. To generate a comprehensive understanding of DCI, the Research Questions are informed by Practice Theory (Schatzki, 1996). Practice-based scholars recognise that 'practices' (*daily doings and saying)* are key to understanding how organisations function (Nicolini and Monteiro, 2009, p 110). Practices are similar to capabilities but exist at a more detailed level, thus providing a better understanding of the micro-processes that often remain 'black-boxed' within capability research. Compared to capability researchers, practice researchers are more concerned with how capabilities develop and change, defining activities as 'effortful' and placing less focus on their regularity and repetitiveness. Additionally, practice researchers pay greater attention to both the actors undertaking such activities and the outcomes of those processes (Parmigiani and Howard-Grenville, 2011). Both the scope and level of detail of Practice Theory meet the research objectives of this thesis. Moreover, a practice-based perspective matches SMEs' general lack of experience, and complements the uncertain nature of radical innovation and DCI generation which requires firms to experiment with new processes (Kim and Atuahene-Gima, 2010; McDermott and O'Connor, 2002).

Given the complexities involved in understanding the processes surrounding a radical new product, case study research was chosen as the most appropriate methodology. Exploratory case studies, based on the radical innovation projects of six award-nominated SMEs in the Netherlands, were conducted. The six case studies were selected out of list of 700 through a process of desk research and a telephone survey, thus ensuring that each case study targeted a new customer segment and involved new technology. To ensure external validity, the selection criteria also considered different levels of technological and marketing experience.

Multiple methods of data collection were employed for each case study, including: (1) interviews with all actors involved in development of the selected project; (2) inspection of documents produced during the NPD process (which often provided evidence of the practices and outcomes); (3) surveys to identify the level of insight and perceptions of the actors with regard to the importance and implementation of DCI practices; and (4) a workshop discussion to validate the findings with regard to observed practices and actor perceptions. The data collected allowed for methodological and data triangulation, thus contributing further to the quality of the study.

Data analysis followed a six-step procedure, involving open and axial coding of the qualitative data, which identified a total of 13 different groups of practices. Surveys were analysed by means of frequency counts and graphical displays, both of which enhanced findings from the qualitative data. In the cross-case analysis, the findings of case studies were aggregated, revealing a typical DCI process, which allowed evaluation of the maturity of processes in order to identify best practices and to understand common perceptions.

1.5 KEY FINDINGS

The findings clearly demonstrated that SMEs targeting new customer segments recognise DCI as a driving force for radical innovation. DCI was found to support the refinement of innovation ideas, decision making, the generation of innovation funds, and the creation of internal and external commitment.

The processes for DCI generation were included in 13 different DCI practices, forming part of five overarching practice groups. These groups are dedicated to: (1) the identification and activation of input sources such as customers, termed *mobilisation* of sources; (2) research activities such as data collection and analysis; (3) synthesis of findings into new forms of understanding; (4) utilisation of insights in NPD tasks; and (5) management DCI actions. The manner in which the practices are combined revealed that SMEs only start exploring customer problems when they have conceived a first innovation idea. The close interaction between open-ended, *explorative*, research and confirmatory, *exploitative*, research confirms that DCI generation within SMEs is restricted. Additionally, this study determined that planned research alternates with unplanned research. Such a hybrid approach is illustrative of the improvisational nature of the processes, enabling SMEs to deal with unexpected events during DCI operations.

The level of insight was measured by using *requirement statements* specified by the case project teams. A requirement statement expresses a customer need, and informs and guides decision making during NPD (Ulwick and Bettencourt, 2008). The level of insight was determined by evaluating the requirement statements against a final set of five quality criteria, including comprehensiveness, novelty, acceptability, cost efficiency, and timeliness. The multi-component measure based on these criteria demonstrated that SMEs, on average, generated 24 insights, of which five were highly novel insights and the remainder current needs insights. These insights were generated without excessive cost, but were not always timely, comprehensive, and acceptable. The average of 24 insights is far less than the potential of 50–150 insights suggested in the literature (Griffin and Hauser, 1993; Ulwick, 2005). Considering the missed insights reported on, SMEs knowledge is not as comprehensive as possible, which reduces the chances for novel insights as well.

Looking at the variety of professionals involved in the practices, DCI is clearly a shared responsibility. The actors involved in the processes included sales, R&D, external experts, marketing, the owner, and customers, together playing nine distinct roles. Cases that managed to involve different actors in the key roles of data collection and synthesis displayed a higher

level of insight than cases concentrating all of these key roles with the owner or the customer. Overall, the number of customers involved in DCI generation is low, which explains why some of the innovations were not able to attract the interest of a wide group of customers.

The actors performed the practices by drawing on four distinct groups of resources: skills and techniques; firm-level assets; carriers of information; and dedicated people and money. A large concentration of readily available skills and techniques proved to be the most effective resource for reaching a higher level of insight. These skills and techniques were not only found with innovation specialists, but also with sales professionals, who generally worked outside the innovation project in routine sales operations.

SMEs proved to have awareness of the practices for DCI generation and were found capable of identifying issues and possible improvements. Nevertheless, 'technical' understanding of DCI generation (for example, data collection techniques and sampling logic) proved to be largely missing. Most actors' awareness is related to conversational techniques. The analysis of improvements suggests that strong research skills is a first, necessary condition before SMEs consider to improve the level of customer involvement and internal collaboration.

1.6 CONTRIBUTION

This study makes several contributions to the currently available academic theory. Most importantly, this research offers a new and challenging view of how SMEs generate DCI without being hindered by scarce resources. By demonstrating how research skills, and not 'just' the prior experience of the entrepreneur, enable effective improvisation, this study offers a major contribution to Entrepreneurial Marketing theory. Additionally, the findings present new understanding to MBL theory by demonstrating the unique value of DCI. This study sets DCI apart from other forms of knowing which are deemed relevant in radical innovation, including the concept of *intuition* — a feeling of rightness which does not include *knowing why* (see e.g. Eling, Griffin and Langerak, 2014; Roberts and Palmer, 2012). This, simultaneously, offers a challenging new perspective to Customer Involvement theory, which generally assumes learning within SMEs is unintentional. Moreover, the more precise understanding facilitated by the new concepts of *quality of insights* and *customer involvement* contributes to long-standing debates on SMEs' learning capability. These contributions open up interesting avenues for future research which will augment MBL and Customer Involvement theory.

The practical value of this study is the rich set of guidelines for effective involvement of both customers and internal actors, which is of interest to SMEs, policy makers, and education. In particular, the findings of this study demonstrate how research skills expedite the collection of valuable customer insights, and encourage SME managers to prioritise 'skills' when allocating resources to radical innovation projects. By firmly incorporating customer-focused research in human resource policies, SMEs may take full advantage of the available resources within their routine operation, and render them suitable for both short- and long-term firm objectives.

1.7 STRUCTURE OF THE THESIS

This thesis is structured as follows:

Chapter 1: Introduction. This chapter discusses the background to the study and gives an overview of the methodology, key findings, and contributions.

Chapter 2: Deep Customer Insight Within Large Firms. This chapter discusses the results of a Systematic Literature Review of the large firm literature. It will present the key concepts and review current understanding.

Chapter 3: Deep Customer Insight Within SMEs. This chapter undertakes a Systematic Literature Review of the small firm literature. It will present the key concepts and review current understanding. It also summarises how DCI generation within small firms is different from the methods employed by large firms.

Chapter 4: Conceptual Development. This chapter synthesises the findings of both Systematic Literature Reviews and discusses the critical knowledge gaps. It presents the conceptual model and research questions to address the knowledge gaps.

Chapter 5: Research Strategy. This chapter defines the philosophical assumptions and research strategy for this study.

Chapter 6: Research Methods. This chapter provides an overview of the research process, sampling procedure, and methods used for data collection and analysis.

Chapter 7: Example Case Study of SEMO. This chapter presents the within-case results and conclusions of the SEMO case study.

Chapter 8: Overview of the Case Studies. This chapter summarises the background information of all case studies together with the main results and findings.

Chapter 9: Cross-case Analysis. This chapter compares the case study results for each research question.

Chapter 10: Discussion and Conclusions. This chapter discusses how the study has addressed the knowledge gaps in the literature. It will also develop broader findings and present the methodological and managerial implications of this thesis.

1.8 SUMMARY

Chapter 1 has discussed the background of and rationale for researching DCI within the radical innovation projects of SMEs. It has considered relevant extant research on DCI, presenting the most important concepts and the critical knowledge gaps in current thinking. This has illustrated the following:

DCI, defined here as an intimate and shared understanding of the latent needs of the customer, is a key resource for firms developing highly unique and valuable, *radical* new products. DCI emerges from a distinctive set of processes, techniques, sources of knowledge, and actors drawing on specific resources.

These components are tied together into what are called ‘practices’. DCI practices take place within wider NPD processes, but the details of how these mechanisms operate in SMEs are currently unknown.

This study aims to identify DCI practices and measure their outcomes in terms of the resulting level of insight. Further, the perceptions of the actors, with regard to importance and implementation of the practices, are captured.

The results demonstrate how research skills drive effective improvisation of the managerial, mobilisation, and research activities needed to generate DCI in an NPD project. This thesis contributes to Market-Based Learning theory and Customer Involvement theory, and it offers a challenging new perspective to Entrepreneurial Marketing theory.

CHAPTER 2 DEEP CUSTOMER INSIGHT WITHIN LARGE FIRMS

2.0 INTRODUCTION

The extant academic knowledge relevant to this thesis was summarised by means of a Systematic Literature Review (SLR), the results of which are presented in this chapter and in Chapter 3. The methodology used in the SLR is summarised in Appendix A. Although the focus of this study is on Small and Medium-sized Enterprises (SMEs), it is clearly essential to also review the substantial literature available on large firms. This literature allowed a deeper understanding of the theoretical concepts already developed and helped to explain how SMEs' approach to Deep Customer Insight (DCI) can differ from that of large firms. This chapter discusses DCI in large firms; a discussion of DCI in SMEs will follow in Chapter 3.

Research on how DCI is generated in large firms was found in Marketing and Innovation literature. These domains of literature share theoretical concepts and have overlapping research interests, such as tools and methods for generating DCI. The review identified ten research themes, each describing unique aspects of DCI. Research within each theme is grounded within one of three theoretical foundations: Market-Based Learning (MBL), Customer Involvement, and Innovation Management and Design.

This chapter will show that *none* of the three foundations offers a complete and consistent view of DCI. Each of them has only begun to adapt concepts to the specific nature of DCI. Most of the available research tends to focus on the organisational level and is highly general by nature. More detailed research shows, above all, that the implementation of DCI practices is difficult, often not following theoretical prescriptions. However, research offering a detailed view of the processes for DCI generation is sparse.

Chapter 2 is organised into six mains sections:

1. The first section starts with a synopsis of the Systematic Literature Review
2. The second section discusses Market-Based Learning literature
3. The third section discusses Customer Involvement literature
4. The fourth section discusses Innovation Management and Design literature
5. The fifth section concludes on the literatures and presents six gaps of knowledge
6. The sixth section summarises Chapter 2

2.1 OVERVIEW OF THE SYSTEMATIC LITERATURE REVIEW

The SLR identified a total of 240 papers of potential interest when examining DCI in large firms. After a full text review, 82 papers were retained, all of which discussed one or more aspects of DCI. Papers that have not made a clear distinction in either the type of insight that was sought — current needs or latent needs — or the product development ambitions — incremental or radical innovation — were excluded. Such exclusions were made because this thesis concentrates on the insights that can lead to breakthrough and radical innovation rather than the superficial type of insights that give rise to incremental innovation.

Content analysis allowed the reviewed literature to be clustered in three different ways, according to: a *research theme*, the *theoretical foundation*, and the *overarching domain* of literature. The content analysis revealed ten themes in the research on DCI: the value of a Market Orientation (MO) culture; organisation-wide Market Information Processing (MIP); MIP within projects; sources of information; customer involvement processes; quality of knowledge; tools and techniques; implementation; practices of teams; and practices of individuals. Individual papers often provided understanding of more than one theme; for example, Moorman (1995) researched not only how firms process market information, but also provided information about how an organisational culture impacts these processes. As a result, the total number of references across the themes exceeds the total amount of papers.

The themes are summarised in Table 2.1, together with the references in the last column. An explanation of each theme is included to demonstrate the type of understanding that it represents. In addition, Table 2.1 shows how themes relate to different levels of perspective: the organisational-level perspective, describing collective capabilities, such as an MO culture; the project-level perspective, describing conditions needed within teams or functional units, such as information processing activities; and the individual-level perspective, describing behaviour and skills of individuals.

Furthermore, papers were grouped on the basis of their theoretical foundation. Three groups of theories informing DCI research were identified: Market-Based Learning (MBL), with 34 papers describing the capabilities and cultures for generating market knowledge; Customer Involvement, with 22 papers describing the role of the customer in radical innovation; and Innovation Management and Design, with 26 papers describing the management aspects of radical projects.

Lastly, papers were grouped into an overarching domain of literature. Based on journal titles, papers titles, and keywords, 27 papers were classified as Marketing papers, whereas 55 papers were classified as Innovation papers. The existence of separate journals for the Marketing and Innovation communities demonstrates the tradition to view Marketing and Innovation as distinct disciplines, each needing separate research attention. Therefore, the next two sections explain the distinct positions of DCI within the Marketing and Innovation disciplines.

Table 2.1: Overview of Themes of Research

Level	Theme	# of papers	References
Organisational	**(1) Value of an MO culture:** The influence of organisation-wide norms and beliefs about being market-oriented on new products' or new programs' success	9	Atuahene-Gima, Slater and Olson (2005); Baker and Sinkula (2005); Jaworski, Kohli and Sahay (2000); Lamore, Berkowitz and Farrington (2013); Moorman (1995); Narver, Slater and Maclachlan (2004); Reid and De Brentani (2010); Weigel and Goffin (2015); Yannopoulos, Auh and Menguc (2012)
	(2) Organisation-Wide MIP: The influence of organisation-wide processing of market information on new products' or new programs' success	11	Cillo, De Luca and Troilo (2010); Day (2011); Hao and Feng (2016); Kandemir and Acur (2012); Kyriakopoulos, Hughes and Hughes (2016); De Luca and Atuahene-Gima (2007); Moorman (1995); Smits and Kok (2012); Stanko and Bonner (2013); Tandrup, Schultz and Salomo (2014); Verganti (2008)
	Total references to themes at organisation-level	*20 (19%)*	
Project	**(3) MIP Within Projects:** How information processing takes place within distinct NPD phases	6	Berchicci and Tucci (2010); Hultink et al. (2011); Markham and Lee (2013); O`Connor (1998); Schweitzer and Gabriel (2012); Veldhuizen, Hultink and Griffin (2006)
	(4) Sources of Information: The background characteristics of the input sources of DCI, as well as the processes and methods for selecting sources of information	11	Bohlmann et al. (2013); Bonner (2012); Brem, Bilgram and Gutstein (2018); Chang and Taylor (2016); Gruner and Homburg (2000); Mahr, Lievens and Blazevic (2014); Menguc, Auh and Yannopoulos (2014); De Moor et al. (2014); Poetz and Schreier (2012); Tinoco and Ambrose (2017); Urban and Von Hippel (1988)
	(5) Customer Involvement Processes: The processes for engaging with customers	12	Bonner (2010); Chang and Taylor (2016); Cui and Wu (2016, 2017); Gruner and Homburg, (2000); Gustafsson, Kristensson and Witell (2012); Mahr, Lievens and Blazevic (2014); Menguc, Auh and Yannopoulos (2014); De Moor et al. (2014); Poetz and Schreier (2012); Roberts and Darler (2017)**;** Roberts and Palmer (2012)
	(6) Quality of Knowledge: The dimensions, determinants and consequences of knowledge quality	6	Bonner (2010); De Luca and Atuahene-Gima (2007); Galunic and Rodan (1998); Hultink et al. (2011); Mahr, Lievens and Blazevic (2014); Reid and De Brentani (2010)
	(7) Tools and Techniques: The applicability of tools and methods for DCI	31	Baxter, Goffin and Szwejczewski (2014); Brown (2008); Carlgren (2013); Carlgren et al. (2016); Cayla and Arnould (2013); Cooper and Dreher (2010); Deszca (1999); Durgee, O'Connor and Veryzer (1998); Goffin et al. (2012); Goffin, Lemke and Koners (2010); Griffin and Hauser (1993); Gruner and Power (2017); Janssen and Dankbaar (2008); Van Kleef, Van Trijp and Luning (2005); Kumar and Whitney (2003); Liedtka, (2015); Lynn, Morone and Paulson (1996); Madsbjerg and Rasmussen (2014); Markham and Lee (2013); McDermott and O'Connor (2002); Meyer, Crane and Lee (2016); Price and Wrigley (2016); Price, Wrigley and Straker (2015); Roberts and Darler (2017); Rosenthal and Capper (2006); Sakellariou, Karantinou and Goffin (2017); Saldanha, Mithas and Krishan (2017); Slater and Mohr (2006); Trott (2001); Weigel and Goffin (2015); Yang (2013)
	(8) Implementation: Guidelines or barriers for the implementation of DCI capabilities	3	Carlgren et al. (2016); Schirr (2012); Van der Hoven et al. (2013)
	(9) Practices of Teams: Roles, tasks, and interaction of team members during the generation of DCI	14	Atuahene-Gima, Slater and Olson (2005); Beverland, Micheli and Farrelly (2016); Brettel et al. (2011); Markham (2013); McDermott and O'Connor (2002); Moenaert et al. (1994)(1995); O'Connor (1998); Schweitzer and Gabriel (2012); Stigliani et al. (2012); Veldhuizen, Hultink and Griffin (2006); Veryzer (2005); Veryzer and Borja de Mozota (2005); Weigel and Goffin (2015)
	Total references to themes at project-level	*82 (77%)*	
Individual	**(10) Practices of Individuals:** The roles and tasks of specific individuals in the generation of DCI	5	Carlgren (2013); Kandemir and Acur (2012); McDermott and O'Connor (2002); Reid and De Brentani (2004, 2015)
	Total references to themes at individual-level	*5 (5%)*	
	Total references to themes	*107(100%)*	
	Total amount of unique papers	82 (100%)	

Source: Author

2.1.1 Deep Customer Insight Within Marketing

The main aim of the marketing function is to deliver products and services that fit as closely as possible with customer needs. DCI is, therefore, a key concept within marketing. Although Peter Drucker explored the interrelations between Marketing and Innovation in 1954, a widespread interest of Marketing scholars in Innovation only emerged in the 1990s. At that time, the focus shifted from internal marketing capabilities to marketing's potential contribution to value creation and radical innovation (Gruner and Homburg, 2000). Radical innovation is defined as the main source of sustained competitive advantage and superior value, and clearly set apart from incremental innovation as it "can fulfil key customer needs better than existing products" (Chandy and Tellis, 1998, p. 475). With the recognition of the customer as a major source of input for product development, marketing became increasingly involved in the product development process (e.g. Baker and Sinkula, 1999; Griffin and Hauser, 1993a; Kohli and Jaworski, 1990).

Marketing papers relevant to this thesis are grounded in either Market-Based Learning (MBL) theory or Customer Involvement theory. Each theoretical perspective emphasises distinct, yet complementary, processes. MBL emphasises the values and learning processes enabling firms to make sense of and connect to their marketplaces (Sinkula, Baker and Noordewier, 1997). Customer Involvement defines the relationships between buyers and sellers and puts forward communication as a key process to achieve customer involvement (Mohr and Nevin, 1990).

2.1.2 Deep Customer Insight Within Innovation

An interest in marketing concepts within Innovation literature arose in the 1970s. At that time, Rothwell (1974) concluded that user needs are major determinants of technical innovation success and prescribed how needs insights should be generated:

> User needs must be precisely determined and met, and it is important that these needs are monitored throughout the course of the innovation since they very rarely remain completely static. Many successful firms achieve this deep and imaginative understanding of user needs through interaction with a representative sample of potential customers throughout the development. (Rothwell et al., 1974, p. 289).

Later, Cooper and Kleinschmidt (1987) confirmed the importance of needs insights and pressed that they should be generated prior to formal product development activities. Today, the generation of needs insights is typically portrayed as part of the *front-end*, the first, difficult-to-manage step in the innovation process (Van der Hoven et al., 2013). The front-end is focused on problem definition, idea generation, and concept development, and ends after the new product business case has been approved and formal product development begins (Eling, Griffin and Langerak, 2014).

In the 1980s, Innovation scholars started to define different types of innovation. They defined radical innovations as those that embody new technology and fulfil needs not recognised before, thereby disrupting the current ways of doing business (c.f. Garcia and Calantone, 2002). The high levels of newness — of both technology and demand — make the New Product Development (NPD) process for radical innovations much more uncertain and complex than for incremental innovations (Slater, Mohr and Sengupta, 2014). Consequently, common innovation practices were deemed inappropriate for radical innovation and scholars became interested in how radical innovation changed the conditions for learning about customers, the role of the customer, and process management (c.f. McDermott and O'Connor, 2002). Advancements in MBL and Customer Involvement theory reflected these interests: the concepts of MBL were refined and adapted to learning about customers' latent needs

(Atuahene-Gima, Slater and Olson, 2005; Narver, Slater and Maclachlan, 2004), and Customer Involvement research focused on lead users (Roberts and Darler, 2017) and became inspired by Open Innovation (Chesbrough, 2006). A third theoretical foundation guiding Innovation Management and Design research is more practical by nature, and focused on the tools, techniques, and actors involved in radical innovation projects.

2.1.3 The Landscape of Deep Customer Insight Literature

Section 2.1.2 established the shared interest of Marketing and Innovation; now, this section will provide more detail on how the two domains overlap. Table 2.2 summarises the literature that was inspected for the SLR. The three theoretical perspectives are mentioned in the first column, and the two domains of literature are displayed in the first row. For each theoretical perspective, the upper half of the table gives examples of studies that were not included in the final selection of papers considered for this thesis because they do not focus on either DCI or radical innovation. Seminal studies, which are essential to gaining a fundamental understanding of DCI, but too general to be included with the papers selected for consideration in this study, are also placed in the upper half of Table 2.2. The lower half of Table 2.2 lists the number of papers that were considered, together with the themes of research[1] covered by those studies, and examples of some key work. The distinction between the shared themes and unique themes describes the particular interests of each domain of literature.

Table 2.2 illustrates that 12 MBL papers were found in the Marketing domain, and 22 within the Innovation domain. This clearly shows the importance of market-based concepts for innovation. Papers rely on concepts of seminal work, such as the works of Kohli and Jaworski (1990) or Cohen and Levinthal (1990). An example of an MBL paper excluded from the SLR is the study by Said et al. (2015), who researched how insight in general — regardless of the type, either needs, market, or perceptions — develops across large firms. The lower half of Table 2.2 lists the overview of themes and shows that Marketing and Innovation share an interest in the value of an MO culture, organisation-wide MIP, the quality of knowledge, and the tools and techniques used. Research of MIP within projects and practices of teams was only found within the Innovation domain.

The Customer Involvement perspective is more often present in the Marketing domain, with a total of 15 papers, compared to seven papers found in the Innovation domain. Marketing's interest is also visible in its unique focus on tools and techniques. Three research themes are shared between marketing and innovation: the sources of information; customer involvement processes, and the quality of knowledge. Research within the themes relies on concepts such as the co-creation of value (Vargo and Lusch; 2004), or the lead-user concept (Von Hippel; 1977). Again, papers discussing related Customer Involvement themes, but not focusing on DCI and radical innovation, were excluded. For example, the paper identifying the co-creating practices in service management of Russo-Spena and Mele (2012) is mentioned as a paper not included.

[1] It should be noted that the numbers exceed the total amount of papers within each domain of literature, because some papers discuss more than one theme.

Papers discussing DCI from an Innovation Management and Design perspective were exclusively found within the Innovation literature. A total of 26 papers were grounded within this perspective, focusing especially on tools and techniques, implementation, practices of teams, and practices of individuals. Again, papers discussing related themes, such as the formality of the front-end of Holahan, Sullivan and Markham (2014), were excluded from the review because of their general nature.

Table 2.2: DCI Within the Three Theoretical Foundations

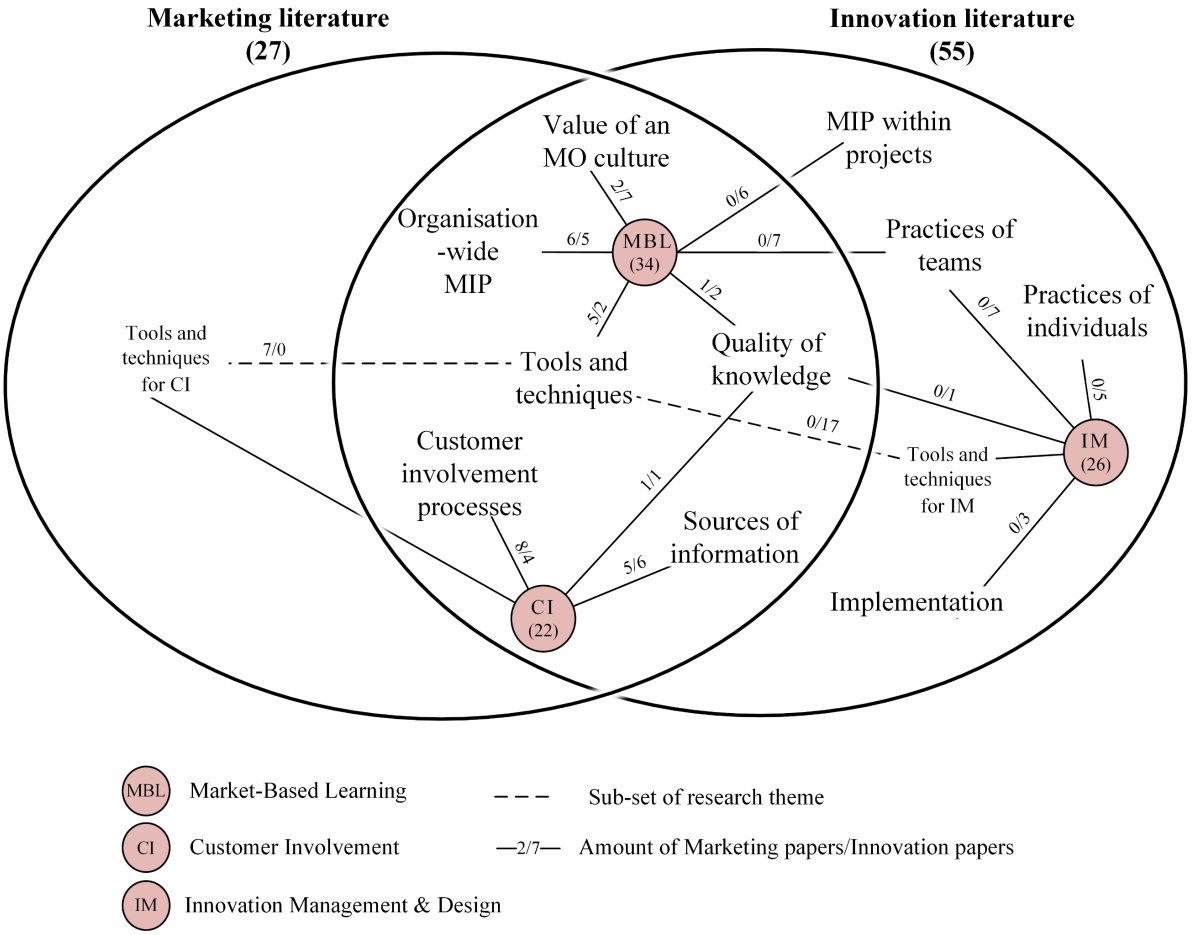
	Wider Marketing literature		Wider Innovation literature	
Market-Based Leaning	Rejected from review	Seminal papers	Rejected from review	Seminal papers
	Said et al. (2015); Zahay, Griffin and Fredericks (2004)	Kohli and Jaworksi (1990); Narver and Slater (1990); Narver, Slater and MacLachlan (2004); Morgan (2004)	Berghman et al. (2013)	Cohen and Levinthal (1990)
	Marketing literature included in review (12)		**Innovation literature included in review (22)**	
	Shared themes (# of papers)			
	The value of an MO culture (2); Organisation-wide MIP (6); Quality of knowledge (2); Tools and techniques (5).		The value of an MO culture (7); Organisation-wide MIP (5); Quality of knowledge (2); Tools and techniques (2)	
	Unique themes (# of papers)			
	n/a		MIP within projects (6); Practices of team (7)	
	Some key papers			
	Moorman (1995); Day (2011)		Atuahene-Gima, Slater and Olson (2005)	
Customer Involvement	**Wider Marketing literature**		**Wider Innovation literature**	
	Rejected from review	Seminal papers	Rejected from review	Seminal papers
	Russo-Spena and Mele (2012)	Mohr and Nevin (1990); Nambisan (2002); Vargo and Lusch (2004)	Kuusisto and Riepula (2011)	Von Hippel (1977)
	Marketing literature included in review (15)		**Innovation literature included in review (7)**	
	Shared themes (# of papers)			
	The sources of information (5); Customer involvement processes (8); Quality of knowledge (1).		The sources of information (6); Customer involvement processes (4); Quality of knowledge (1).	
	Unique themes (# of papers)			
	Tools and techniques for DCI (7)		n/a	
	Some key papers			
	Cui and Wu (2016); Gruner and Homburg (2000).		Bonner (2010); Mahr, Lievens and Blazevic (2014)	
Innovation Management and Design	**Wider Marketing literature**		**Wider Innovation literature**	
	Rejected from review	Seminal papers	Rejected from review	Seminal papers
	n/a	n/a	Holahan, Sullivan and Markham (2014)	Garcia and Calantone (2002); Cooper and Kleinschmidt (1987)
	Marketing literature included in review (0)		**Innovation literature included in review (26)**	
	Shared themes (# of papers)			
	n/a		n/a	
	Unique themes (# of papers)			
	n/a		Tools and techniques (17); Implementation (3); Quality of knowledge (1); Practices of teams (7); Practices of individuals (5)	
	Some key papers			
	n/a		McDermott and O Connor (2002); Reid and Brentani (2010)	

Source: Author

The complete theoretical landscape is depicted in Figure 2.1. The numbers provided in Figure 2.1 refer to numbers listed in Table 2.2. The diagram visualises how Innovation papers are more interested in operational aspects, with most research concentrating on project-level and individual-level themes. Marketing papers, on the other hand, focus more intensely on

customer involvement, with some unique understanding of the related tools and techniques. Figure 2.1 demonstrates that Innovation and Marketing literature share concepts and that both domains are highly intertwined. This close relationship is also visible in the authors publishing within both Marketing and Innovation journals, and in their cross-references (e.g. Atuahene-Gima, Slater and Olson, 2005; Cui and Wu, 2016, 2017; Griffin and Hauser, 1993b; De Luca and Atuahene-Gima, 2007; Veldhuizen, Hultink and Griffin, 2006).

Figure 2.1: Themes of Research Within Marketing and Innovation Literature



Source: Author

Due to the overlap, a presentation of the findings according to separate literature domain was not deemed useful. Therefore, the presentation of concepts and findings will be organised according to the theoretical foundations.

2.2 MARKET-BASED LEARNING

2.2.1 Key Concepts of Market-Based Learning Theory

It is crucial to note that Market-Based Learning (MBL) has been inspired by the work of Kohli and Jaworksi (1990). These scholars gave a central role to market knowledge and defined Market Information Processing (MIP) as the set of processes for generating such knowledge. Later work adapted the key concepts of MBL to the context of radical innovation and customers' latent needs. Before discussing the findings, Section 2.2.1 will introduce the key concepts of MBL.

2.2.1.1 The Role of Market Knowledge

Kohli and Jaworksi (1990), viewed market intelligence as the key driver of a firms' *Market Orientation* (MO): "Market orientation, is the organizationwide *generation* of market intelligence pertaining to current and future customer needs, *dissemination* of the intelligence across departments, and organizationwide *responsiveness* to it" (Kohli and Jaworski 1990, p.6). Today, Marketing literature generally uses the term knowledge instead of intelligence (Bonner, 2010; Cui and Wu, 2016; De Luca and Atuahene-Gima, 2007).

The centrality of knowledge regarding current and future needs highlights the importance of research based around this concept of Market Orientation. However, MO researchers are not unanimous on the definition and role of market knowledge. Some authors emphasise the idea that MO is not a set of knowledge-generating activities, but rather a business philosophy (Narver and Slater, 1990) or a set of beliefs (Deshpandé and Farley, 1998). It, therefore, consists of not only methods and Market Information Processing, but also includes values and norms for marketing execution. Further, there are different perspectives on the components of market knowledge, with authors mentioning: customer needs information (Baker and Sinkula, 1999; Kohli and Jaworski, 1990); general customer information (including, for example, information about customers' satisfaction)(Deshpandé, Farley and Webster, 1993; Zahay, Griffin and Fredericks, 2004); information about competitors (De Luca and Atuahene-Gima, 2007; Narver and Slater, 1990); and information regarding all external stakeholders (Moorman, 1995). This diffused perspective of MO makes it difficult to clearly isolate findings that are relevant to DCI.

2.2.1.2 Market Information Processing

Market-Based Learning literature displays a variety of perspectives for the processes that generate market knowledge. Kohli and Jaworksi (1990) defined three interrelated Market Information Processing (MIP) steps: generation, dissemination, and utilization of market knowledge. These processes are defined as *capabilities*, the set of routines through which inputs (market data) are converted into valuable outcomes (market knowledge) and become a source of competitive advantage (Day, 1994; Grant, 1996).

Various MBL scholars have added and revised the typical MIP sequence, each emphasising different sub-processes. For example, Moorman (1995) defined separate data collection processes for distinct data sources: experts, customers, and internal sources. Moorman further focused on the utilization step and defined separate processes for distinct contexts of use. The first is *instrumental use*, in which insights are used directly, such as decision making and problem solving; the second is *conceptual use*, in which insights are used as a source of inspiration, such as strategy development. When and how analysis of the collected data takes place is not discussed in Moorman's study. The conceptual work of Day (1994; 2011) is one of the few that emphasised analysis and also included separate steps for interpretation and evaluation. Empirical papers based on Day's MIP sequence are, however, sparse. Lastly, Grant (1996) emphasised knowledge integration, the way in which knowledge held by different organisational members is combined into a more encompassing form of understanding. This implies that knowledge requires further processing before it becomes valuable, and that some higher, more valuable form of understanding exists. This signals the relevance to consider each progressive step that enables the conversion of data into insights.

Morgan (2004) shows the various interconnected input-output relations of MIP. He defines *data* as a collection of objective recorded facts. Data becomes *information* when it is further organised to describe past and present situations. Subsequent interpretation of information results in *knowledge* and holds the capacity to predict future events.

Understanding, then, is a more deeply embedded and holistic form of knowing. *Insight* is similar to understanding and is placed at the top of the hierarchy (Said et al., 2015). In spite of this clear understanding of input-out relations, current MBL literature does not consistently use the terminology and often interchanges the terms data, information, and knowledge (e.g. Kohli and Jaworski, 1990; De Luca and Atuahene-Gima, 2007; Moorman, 1995). Moreover, Innovation scholars use the term insight(s) differently than Marketing scholars, highlighting not so much the embeddedness or inclusiveness of understanding, but rather its unique and novel character enabling radical innovation (e.g. Cayla and Arnould, 2013; Cui and Wu, 2016; Gruner and Homburg, 2000b; Madsbjerg and Rasmussen, 2014). Such an emphasis blurs the view on which series of processes is needed to generate DCI.

2.2.1.3 The Adaptation of Market Orientation to Radical Innovation

Increasing criticism of MO concepts resulted in a more detailed perspective on customer needs. It was found that, although MO helped achieve innovation success, it hampered long-term profitability, market share, and industry leadership (e.g. Baker and Sinkula, 2005; Christensen and Bower, 1996; Slater and Narver, 1998). Narver, Slater and MacLachlan (2004) argued that this results from too narrow an interpretation of MO, leading firms to listen too literally to customers' expressed, hence current, needs. This would foster only incremental innovation and explain the subsequent poor results of MO. The authors posited that MO, within the context of radical innovation, should take a different approach and focus on challenging existing assumptions within the marketplace. They ultimately proposed two separate MO concepts: one for insights into current needs, called *responsive MO*, and one for insights into customers' latent needs, called *proactive MO* (Narver, Slater and Maclachlan, 2004). Like the original MO construct (Narver and Slater, 1990), the two new MO constructs describe norms for marketing behaviour at a high level of abstraction such as "innovate even at the risk of making our own products obsolete" (Narver, Slater and Maclachlan, 2004, p. 346).

2.2.2 Findings of Market-Based Literature

A total of 34 papers describing DCI within large firms are grounded in MBL Despite the origin of MBL in Marketing, a majority of 22 papers are published in Innovation journals.

Table 2.3 shows the research methods of MBL papers. The large amount of 19 survey-based papers illustrate the positivistic nature of MBL research and its focus on understanding the relation between the often abstract concepts (c.f. Langley et al., 2013).

Table 2.3: Methods Used Within MBL Papers

Methods	References	Total
Case study	Berchicci and Tucci (2010); O`Connor (1998); Smits and Kok (2012)	3
Conceptual	Day (2011); Durgee, O'Connor and Veryzer (1998); Galunic and Rodan (1998); Jaworski, Kohli and Sahay (2000); Reid and De Brentani (2004); Schirr (2012); Trott (2001)	7
Literature review	Hao and Feng (2016); Van Kleef, Van Trijp and Luning (2005)	2
Mixed	Griffin and Hauser (1993)	1
Qualitative	Beverland, Micheli and Farrelly (2016); Cayla and Arnould (2013)	2
Survey	Baker and Sinkula (2005); Cillo, De Luca and Troilo (2010); Cooper and Dreher (2010); De Luca and Atuahene-Gima (2007); Hultink et al. (2011); Kandemir and Acur (2012); Kyriakopoulos, Hughes and Hughes (2016); Lamore, Berkowitz and Farrington (2013); Markham (2013); Markham and Lee (2013); Moorman (1995); Moenaert et al. (1994)(1995); Narver, Slater and Maclachlan (2004); Stanko and Bonner (2013); Tandrup, Schultz and Salomo (2014); Schweitzer and Gabriel (2012); Veldhuizen, Hultink and Griffin (2006); Yannopoulos, Auh and Menguc (2012)	19

Source: Author

Within MBL, DCI is only researched at the organisational and project level. The research themes are: the value of a Market Orientation (MO) culture, discussed in nine papers; organisation-wide Market Information Processing (MIP), discussed in 11 papers; MIP within projects, discussed in six papers; quality of knowledge, discussed in four papers; tools and techniques, discussed in seven papers; and practices of teams, discussed in seven papers. Perspectives on how DCI is generated at the individual level are not available. Despite the recognition that the customer is a prime source of input data for MIP (Griffin and Hauser, 1993), MBL scholars hardly research the background characteristics of informing customers. Nor are other sources of input explored.

Sections 2.2.2.1–2.2.2.6 discuss the findings and demonstrate that MBL research, above all, reinforces that 'just' being a market-oriented firm — regularly processing market data — does not automatically lead to DCI. The findings suggest that both culture and MIP activities result in DCI, while also facilitating current needs insights at the same time.

2.2.2.1 The Value of a Market Orientation Culture

When concentrating on the two distinct types of market-oriented cultures, available research confirms that a pro-active MO culture is beneficial for radical innovation (e.g. Lamore, Berkowitz and Farrington, 2013; Narver, Slater and Maclachlan, 2004). Aspects of a pro-active MO culture are: cross-functional collaboration, and an atmosphere in which team members feel free to challenge existing assumptions and learn new skills and knowledge (Atuahene-Gima, Slater and Olson, 2005; Baker and Sinkula, 2005; Lamore, Berkowitz and Farrington, 2013; Yannopoulos, Auh and Menguc, 2012). Pro-active MO advocates learning from many different perspectives. Therefore, Atuahene-Gima, Slater and Olson (2005) equate it with the concept of *explorative learning* of March (1991). They similarly equate responsive MO with the concept of *exploitative* learning of March, due to its reliance on market information that confirms and refines already existent knowledge within the firm. Research of Atuahene-Gima, Slater and Olson (2005) further show that there is a limit to being pro-active. Excessive pro-active MO prevents firms from developing experience and leads to disproportionately high costs induced by the processing of new market information. A combination of proactive MO and responsive MO yields better new product results than pro-active MO alone (Atuahene-Gima, Slater and Olson, 2005).

2.2.2.2 Organisation-Wide Market Information Processing

Research on the value of organisation-wide MIP provides some general guidelines for learning about latent needs. Studies agree that customers' input should *not* be acquired with traditional survey-based market research. Rather, such acquisition requires qualitative market research and an objective view on the customer (Kyriakopoulos, Hughes and Hughes, 2016; Smits and Kok, 2012; Tandrup, Schultz and Salomo, 2014). Other findings indicate that the internally focused processes of MIP — sharing, interpretation, and utilization processes — are of special importance and should be adapted to the unique nature of DCI (De Luca and Atuahene-Gima, 2007). How these processes are different from those used for current needs insights is only described generally. Processes should incorporate the viewpoints of multiple actors (De Luca and Atuahene-Gima, 2007; Moorman, 1995) and include reflection processes (Smits and Kok, 2012). These processes should facilitate conceptual use of DCI to preserve the innovativeness of the new product, and instrumental use of DCI to maintain the efficiency of the NPD process (Cillo, De Luca and Troilo, 2010; Moorman, 1995). Decision making should be flexible and adapt to the uncertainties involved in the NPD process (Kandemir and Acur, 2012). To what extent the MIP processes themselves need to be flexible is unclear. De Luca and Atuahene-

Gima (2007) focused on formal processes, whereas Moorman (1995) observed a mixture of formal and informal processes contributing to DCI.

Understanding related to other processes supporting MIP is scarce. Two conceptual MBL papers argued that MIP capabilities are not sufficient for DCI, and highlighted networking and relationship management capabilities to gain access to valuable information sources and partners (Day, 2011; Hao and Feng, 2016). However, strong evidence is not provided.

2.2.2.3 Market Information Processing Within Projects

Innovation papers provide details of the separate MIP steps and their timing across NPD. These studies show that MIP has a major role in the front-end of innovation, supporting the reduction of market uncertainty (Schweitzer and Gabriel, 2012; Veldhuizen, Hultink and Griffin, 2006). Once information is made available in the front-end, it positively impacts activities in other phases as well. It stimulates further processing (dissemination and utilization) in the later development and commercialization phases, and this, in turn, positively influences product advantage (Veldhuizen, Hultink and Griffin, 2006).

Dissemination — the organisation-wide sharing of information — includes both the way it is distributed and the way it is interpreted (e.g. Kohli, Jaworski and Kumar, 1993; Hultink et al., 2011; Veldhuizen, Hultink and Griffin, 2006). Higher levels of DCI are the result of joint interpretation processes taking place between actors with different functional backgrounds (Beverland, Micheli and Farrelly, 2016; Cillo, De Luca and Troilo, 2010). Sometimes, dissemination does not take place at all, implying that information is not subjected to joint interpretation, but rather used directly by the same people who have gathered it (Veldhuizen, Hultink and Griffin, 2006). Such direct use of collected information mostly concerns broad market knowledge, covering many aspects of markets. More complex and specific forms of knowledge do require sharing and interpretation to become valuable for NPD (De Luca and Atuahene-Gima, 2007).

Utilization is generally seen as the last MIP step, and its positive effect within all NPD phases clearly illustrates the three application areas of DCI: in ideation, in decision making regarding product attributes, and in marketing planning (Veldhuizen, Hultink and Griffin, 2006). DCI utilization in the front-end is crucial; insights are only used in the development and commercialisation phases, when the idea developed in the front-end was based on insights as well. Also, information that does not match with the NPD team's values and perspectives is unlikely to be accepted (Berchicci and Tucci, 2010). This is especially the case for conceptual information, which is more 'value-laden' than instrumental information.

2.2.2.4 Quality of Knowledge

Knowledge of suitable quality is an important driver of NPD success (Hultink et al. 2011). However, surprisingly few studies explicitly define such quality of knowledge and use this definition to measure the performance of MIP. Studies that do define the quality of knowledge limit this to the *extrinsic* qualities — qualities that belong to knowledge in general, regardless of the type of knowledge (c.f. Reid and De Brentani, 2010). Examples of extrinsic qualities are: accuracy, timeliness, clarity, specificity, breadth, depth, and tacitness (Galunic and Rodan, 1998; Hultink et al., 2011; De Luca and Atuahene-Gima, 2007). Conversely, *intrinsic* qualities describe the essence, the unique nature, of knowledge and may include the content-type or form, such as the type of needs insights (current or latent). A complete performance metric for DCI — including both intrinsic and extrinsic qualities — is not available.

Focusing on extrinsic qualities, Hultink et al. (2012) proved that market information that is not accurate, objective, clear, and timely is not further shared, interpreted, and used. De Luca and Atuahene-Gima (2007) add that further processing should be designed according to the breadth, depth, specificity, and tacitness of knowledge. The findings of both studies refer to any type of market knowledge. They highlight the priority that should be given to research skills and prove the value of adapting MIP to the quality of knowledge sought.

2.2.2.5 Tools and Techniques

When considering Market-Based Learning theory, the tools and techniques for generating DCI are found in the wider group of market research methods. Overall, the findings within the theme of research on tools and techniques confirm that not all methods are suitable to generate DCI and highlight qualitative research methods. These methods include laddering (asking customers why they like specific product features), or mini-concepts (asking customers' to evaluate new concepts)(Durgee, O'Connor and Veryzer, 1998; Van Kleef, Van Trijp and Luning, 2005). Due to the absence of a well-defined performance metric for methods' effective contribution to DCI an analysis of the effectiveness of research methods is not presented in the reviewed literature.

The work of Cooper and Dreher (2010) provides an understanding of the perceived effectiveness of methods used in the front-end. Focus groups and customer visits were evaluated as both popular and effective, whereas ethnography — generally believed to be the most effective method — was found less popular because of its high costs. Cayla and Arnould (2015) concentrated on the value of ethnography and compared this with the value of traditional market research. Traditional market research is defined as survey-based, relying on technical and analytical procedures, and summarising human experiences at a high level of abstraction. Ethnography, on the other hand, is defined as a human-centred approach. It does not only include techniques for data collection and analysis, but also for collaborative interpretation of findings and sharing of insights (for example, narratives and storytelling). In the earliest phases of NPD, firms perceive ethnography to be of particular value, allowing the exploration of many factors that influence customers' needs, and thus enabling the identification of latent needs. Traditional market research is perceived to have value after ideation. It captures customers' feedback to new product concepts and is vital in confirming latent needs. Such a dual approach across the NPD project corresponds with conclusions drawn regarding the necessity of maintaining both proactive and responsive market orientations in parallel (Atuahene-Gima, Slater and Olson, 2005). The exact contribution of each technique to DCI is, however, unclear because an objective measurement instrument for this type of insight is not available.

2.2.2.6 Practices of Teams

Eight MBL papers provide an understanding of how teams collaborate during MIP. Their findings argue that cross-functional collaboration as an end in itself is not sufficient to promote DCI. Consideration should be given to whom to involve, the timing of collaboration, the tools and methods used, and the cultural setting (De Luca and Atuahene-Gima, 2007; Schweitzer and Gabriel, 2012). Beverland, Micheli and Farrelly (2016) demonstrated that effective cross-functional collaboration between design and marketing is not a single process, but builds upon sub-processes of joint reflection, sharing and interpretation, and renewed information acquisition. This collection of joint processes proves to lead to deeper insights and more creative ideas.

In contrast to the added value of cross-functional collaborations, other studies suggest that DCI can be generated without cross-functional perspectives (Atuahene-Gima, Slater and Olson, 2005; Moenaert et al., 1994). In this case, MIP is the sole responsibility of a single

discipline, which may either be marketing, R&D or design. The findings do not agree upon which of these is best suited to undertake this responsibility and raises the question how this affects quality dimensions such as the depth and specificity of knowledge. Quality control mechanisms, such as *gatekeeping*, are offered as a solution to ensure the quality of knowledge, but further research is needed to draw conclusions regarding the presence and usefulness of quality control (Hultink et al., 2011).

2.2.3 Conclusions on Market-Based Learning Theory

Section 2.2 has discussed the concepts and findings of research grounded in MBL theory, giving rise to five sets of conclusions:

First, Market-Based Learning theory emphasises Market Information Processing (MIP) as the core process for generating market knowledge about current and future needs of customers. However, MBL scholars do not agree on the types of knowledge underpinning market knowledge, or on the key information processing steps of MIP.

Second, MBL is dominated by survey-based research and is highly generic by nature. It lacks detail on how MIP is laid out across New Product Development (Hultink et al., 2011; Veldhuizen, Hultink and Griffin, 2006). Furthermore, details on input sources and other resources supporting MIP steps are lacking.

Third, findings show that this stream of research has only just begun to recognise Deep Customer Insight. It has defined a concept for the cultural setting within which DCI is generated (Narver, Slater and Maclachlan, 2004), but there is no well-accepted definition and construct for DCI. As a consequence, it is difficult to draw firm conclusions on how large firms generate DCI.

Fourth, DCI thrives in a culture that is collaborative, people-oriented, and open-minded. MIP within this setting builds on both formal and informal activities, but to what extend the processes are formal (or informal) is not known (Moorman, 1995). Analysis and interpretation are key processes to achieve deep-level insights, but dedicated research into those key processes is sparse, with only one paper focusing on joint interpretation processes. Other research looking into the value of cross-functional coordination is contradictory. As a consequence, it remains unclear what actors should be involved and whether cross-functional coordination is always a necessary condition for DCI.

Fifth, papers studying tools and techniques argue that DCI embraces distinct NPD phases. Their findings suggest that DCI is not the result of a single MIP project, but of a series of interconnected MIP projects, each building on different processes, resources and tools (Cayla and Arnould, 2013). The scarce research that explores the interrelations between the two types of MIP — explorative and exploitative learning — confirm the added value to have, combined, interdependent learning processes (Atuahene-Gima, Slater and Olson, 2005). This stream of research does not make clear, however, how exactly latent needs insights and current needs insights should be combined.

2.3 CUSTOMER INVOLVEMENT

2.3.1 Key Concepts of Customer Involvement Theory

Customer Involvement theory gives a centrale role to the customer. It studies the customer's background characteristics and the modes for involving the customer. Customer Involvement theory is founded on three different perspectives of which two are found in the Marketing literature and one in the Innovation literature. Firstly, within Marketing literature, customer

involvement is defined within the context of *marketing channel* theory. This theory concentrates on the relationships between buyers and sellers and puts forward communication as a key process to achieve customer involvement (Mohr and Nevin, 1990). Authors building on this theory stress different aspects. Some focus on the frequency and direction of communication (Gustafsson, Kristensson and Witell, 2012), whereas others concentrate on the type of interaction, such as joint problem solving or idea generation (Bonner, 2010; Gruner and Homburg, 2000).

Secondly, Marketing literature refers to *Service-Dominant logic*, which recognises an active and wide role for the customer in the creation of value (Vargo and Lusch, 2004). Typical roles for customers are informants, co-creators, and testers (Nambisan, 2002), but inconsistent definitions make it difficult to understand what is and what is not included in these roles. Some studies define co-creation as customers working closely with a team during development (c.f. Cui and Wu, 2016; Gustafsson, Kristensson and Witell, 2012), whereas others include less active modes of cooperation, such as information exchange (c.f. Bonner, 2010). As a consequence of ambivalent definitions of processes and roles, findings are difficult to compare and interpret.

Thirdly, Innovation literature is focused on *lead users* (Roberts and Darler, 2017). The lead user concept of Von Hippel (1977) describes how firms gather views and ideas from extreme users — those who are inclined to develop their own solutions for the particularly demanding situations with which they are faced. The lead user method includes process steps to identify and engage lead users during concept development and testing (Urban and Von Hippel, 1988). This method fits within the wider concept of open innovation (Chesbrough, 2006), used as an umbrella encompassing Customer Involvement approaches (Huizingh, 2011).

2.3.2 Findings of Customer Involvement Literature

A total of 22 papers are grounded in Customer Involvement theory. A relatively large number of 15 papers were found in Marketing literature. Table 2.4 shows the research methods of Customer Involvement papers. Notably, despite the constructivist perspective that is related to working 'with' customers (instead of working 'on' them) (Maklan, Knox and Ryals, 2008) positivistic, survey-based approaches still account for 50% of papers.

Table 2.4: Methods Used Within Customer Involvement Papers

Methods	References	Total
Case study	Lynn, Morone and Paulson (1996); Price and Wrigley (2016); Roberts and Darler (2017)	3
Conceptual	Madsbjerg and Rasmussen (2014); Meyer, Crane and Lee (2016); Roberts and Palmer (2012)	3
Literature review	Brem, Bilgram and Gutstein (2018)	1
Mixed	De Moor et al. (2014)	1
Qualitative	Bohlmann et al. (2013); Gruner and Power (2017); Price, Wrigley and Straker (2015)	3
Survey	Bonner (2010); Chang and Taylor (2016); Cui and Wu (2016, 2017); Gruner and Homburg (2000); Gustafsson, Kristensson and Witell (2012); Mahr, Lievens and Blazevic (2014); Menguc, Auh and Yannopoulos (2014); Poetz and Schreier (2012); Tinoco and Ambrose (2017); Urban and Von Hippel (1988)	11

Source: Author

The overview of research themes makes clear that Customer Involvement research concentrates on the project level and emphasises the customer. The research themes are: sources of information, discussed in 11 papers; customer involvement processes, discussed in

12 papers; quality of knowledge, discussed in two papers; and tools and techniques, discussed in seven papers. Fine-grained perspectives on roles and skills of the internal team are not available.

Sections 2.3.2.1–2.3.2.4 discuss the findings, showing that conclusions in this stream of literature are parallel with those of MBL; merely involving the customer in a radical NPD project is not enough to generate DCI. The findings highlight the importance of involving the right type of customers, and to use the right techniques to prevent the generation of current needs insights only.

2.3.2.1 The Sources of Information

Papers researching the sources of information for DCI reveal strong interest in understanding which type of customers yield the most value when involved. In turbulent markets, business customers are of particular interest as they often possess knowledge of emerging technologies (Chang and Taylor, 2016). Furthermore, business customers that are closely related to the firm are sufficiently knowledgeable in general to contribute positively to radical innovation (Bonner, 2010; Gruner and Homburg, 2000). Some business customers may, however, not be motivated to contribute to radical innovations due to investments made in current solutions (Bohlmann et al., 2013).

Lead users have proven valuable for both business and consumer markets (Chang and Taylor, 2016; Menguc, Auh and Yannopoulos, 2014; De Moor et al., 2014; Urban and Von Hippel, 1988). However, Tinoco and Ambrose (2017) warn against too much lead user involvement; their needs may be out of touch with the needs of the marketplace. Additionally, lead users may, in some markets, be too small a group to be relied upon (Brem, Bilgram and Gutstein, 2018; Mahr, Lievens and Blazevic, 2014; Poetz and Schreier, 2012). Potential alternative sources of information are not addressed.

2.3.2.2 Customer Involvement Processes

Most authors within this stream of research concentrate on modes of communication with customers (e.g. Chang and Taylor, 2016; Gruner and Homburg, 2000a; Gustafsson, Kristensson and Witell, 2012). In order to develop new insights, lead users should be involved by means of rich communication channels — personal and face-to-face contact (Mahr, Lievens and Blazevic, 2014). Distant forms of communication (e.g. e-mail) hinder effective interpretation of new market information and are, therefore, of limited value for radical innovation. To avoid working with customers that lack skills or motivation, selection processes and training programmes are proposed (Roberts and Darler, 2017; Urban and Von Hippel, 1988). Evidence of the added value of such complementary processes is not available.

Generally, customer involvement processes are defined at a high level of abstraction. The processes are not adapted to the tasks of the distinct NPD phases, and how these processes interact with the information processes (data collection, analysis, or interpretation) has not been researched. Exceptions are found in work of Cui and Wu (2016; 2017) who integrated MBL and Innovation Management theory. Cui and Wu (2016) defined three levels of customer involvement. At the lowest level, customers act as a source of information and provide feedback. At the mid-level, customers are more active and take part in a firm's development team. At the highest level, customers make use of a firms' resources, but innovate on their own, without further interaction with the company's development team. Low levels of involvement were found to support the generation of needs insights in the front-end, whereas closer forms of involvement support the generation of both needs- and solution-based insights during development (Cui and Wu, 2017). The positive effects found when the two levels of

involvement are balanced prove again that DCI requires two distinct, carefully integrated, processes, instead of just one.

2.3.2.3 Quality of Knowledge

As with Market-Based Learning, the studies pay little attention to the immediate outcome of customer involvement, i.e. customer knowledge (or insights). Only two papers provide more detail regarding the quality of knowledge and confirm that high-quality knowledge is key to achieving positive radical innovation results (Bonner, 2010). Moreover, the findings add to MBL research by showing how novel knowledge is not only beneficial for the immediate project underway, but also for possible future projects (Mahr, Lievens and Blazevic, 2014). Again, there is a focus on extrinsic qualities, such as novelty, accuracy, consistency, actionability, relevancy, and cost-efficiency (Bonner, 2010; Mahr, Lievens and Blazevic, 2014). Whether or not the knowledge was of the desired kind (latent needs) is not addressed.

2.3.2.4 Tools and Techniques

Tools and techniques for close customer involvement are all found in the Marketing literature. Like in MBL, the findings consistently put forward the idea that the generation of needs insights requires a subjective, qualitative stance and collaborative approaches (termed *new methods).* This is clearly different from the objective, quantitative stance and survey-based approaches of traditional market research (Gruner and Power, 2017; De Moor et al., 2014; Price and Wrigley, 2016; Roberts and Darler, 2017).

Ample attention is paid to ethnographic market research with several conceptual papers prescribing how ethnography generates DCI (Madsbjerg and Rasmussen, 2014; Meyer, Crane and Lee, 2016). Four empirical papers focus on the pros and cons of ethnography and other approaches. Like Cayla and Arnauld (2015) in MBL, they conclude that new and traditional methods both have value, each playing their distinct roles before and after ideation (Price, Wrigley and Straker, 2015). However, Customer Involvement theory offers another perspective on the type and timing of methods. Lynn, Morone and Paulson (1996) observed that radical innovators do not explore needs before ideation, but rather rely on customers' feedback throughout the entire NPD process. They termed this a *probe-and-learn* approach. Due to the absence of an accepted performance metric for DCI, it is not possible to draw conclusions regarding the effectiveness of observed approaches.

2.3.3 Conclusions on Customer Involvement Theory

Section 2.3 discussed the concepts and findings of research grounded in Customer Involvement theory, giving rise to four sets of conclusions:

First, Customer Involvement literature defines the roles that customers perform during NPD and associates these with distinct processes, tools, and techniques. The customer is often considered an active innovation team member, not merely providing information. As in MBL, the results of this stream of literature are difficult to interpret due to the inconsistent use of terminology for roles, processes, and tools.

Second, Customer Involvement research is dominated by survey-based research and is, therefore, fairly generic by nature. The roles of the internal team working with customers remain largely undiscussed.

Third, Customer Involvement research has just started to integrate MBL and Innovation Management theory and is less clear regarding how distinct New Product Development phases define customer involvement approaches. The findings show that this stream of research has not yet fully adapted to Deep Customer Insight. Although research into tools and techniques

make explicit references to DCI, there is no well-accepted definition or construct with which to measure DCI.

Fourth, Customer Involvement literature concentrates on lead users and proves their value in generating novel knowledge (Mahr, Lievens and Blazevic, 2014). Notably, the selection processes of lead users are not explicitly addressed, despite the clear challenges such processes may pose within certain small markets. Compared to MBL, Customer Involvement literature is less compelling on the type and timing of approaches across NPD. It recognises distinct modes and tools for the front-end and development, but contradictory evidence — showing just a single, feedback-driven approach — is available as well (Cui and Wu, 2017; Lynn, Morone and Paulson, 1996; Price, Wrigley and Straker, 2015).

2.4 INNOVATION MANAGEMENT AND DESIGN

2.4.1 Key Concepts of Innovation Management and Design Theory

Studies within Innovation Management and Design focus on the management aspects of radical innovation projects. A radical innovation approach should be disciplined, yet sufficiently lean and flexible, responsive to mistakes and accommodating the ability to act upon surprising results (McDermott and O'Connor, 2002; Nagji and Tuff, 2012). Within this process, it is crucial to have the right skills and tools, and to connect and coordinate carefully across the project.

Design thinking offers a set of principles, tools, and methods enabling the development of radical innovations. Design thinking maximises learning and gives a central role to understanding what people need and want (Liedtka, 2015). The design thinking process overlaps with the front-end of innovation, but also includes proto-typing and a delivery phase in which launch is prepared (c.f. British Design Council London, 2005; Carlgren et al., 2016; Liedtka, 2015). Design thinking emphasises the different nature of learning within distinct process phases. Explorative learning is linked to divergent thinking skills and takes place before ideation and concept development. Exploitation of learning is linked to convergent thinking skills and takes place after ideas and concepts have been identified (British Design Council London, 2005).

Design thinking explicitly refers to DCI, but uses the plural form (DCIs) to denote the collection of new and deep-level understandings (Bucolo and Matthews, 2011; Price and Wrigley, 2016; Veryzer and Borja de Mozota, 2005). In parallel with the Customer Involvement literature, design thinking views the customer as an active participant, contributing to DCIs and helping with solution-finding (Price and Wrigley, 2016; Roberts and Darler, 2017).

2.4.2 Findings of Innovation Management and Design Literature

A total of 26 papers are grounded in Innovation Management and Design theory, all of which were found in Innovation papers. Table 2.5 shows the research methods and illustrates the fact that research within the Innovation domain is more conceptual and qualitative by nature than in the other two foundations. Studies utilising qualitative and case study approaches highlight a growing interest in answering the 'how' questions with regards to DCI.

Table 2.5: Methods Used Within Innovation Management and Design Papers

Methods	References	Total
Case study	Baxter, Goffin and Szwejczewski (2014); Janssen and Dankbaar (2008); McDermott and O'Connor (2002); Rosenthal and Capper (2006); Weigel and Goffin (2015)	5
Conceptual	Brown (2008); Goffin et al. (2012); Goffin, Lemke and Koners (2010); Van der Hoven et al. (2013); Liedtka (2015); Kumar and Whitney (2003); Verganti (2008)	6
Literature review	Carlgren (2013); Deszca (1999); Deszca (1999); Veryzer and Borja de Mozota (2005); Yang, (2013)	5
Mixed	Veryzer (2005)	1
Qualitative	Carlgren et al. (2016); Veryzer (2005); Reid and De Brentani (2010); Stigliani et al. (2012); Van der Hoven et al. (2013)	5
Survey	Atuahene-Gima, Slater and Olson (2005); Brettel et al. (2011); Reid and De Brentani (2015); Saldanha, Mithas and Krishan (2017)	4

Source: Author

Although Innovation Management and Design theory may be viewed as a collection of generic management concepts (e.g. Carlgren et al., 2016; Liedtka, 2015; Slater, Mohr and Sengupta, 2014), the SLR identified that studies within this stream of research concentrate, above all, on operational aspects. The papers provide greater understanding of the following research themes: tools and techniques, discussed in 17 papers; implementation, discussed in three papers; quality of knowledge, discussed in two papers; the practices of teams, discussed in seven papers; and the practices of individuals, discussed in five papers.

Sections 2.4.2.1–2.4.2.5 discuss the findings, and reveal special attention paid to the high level of skill and experience needed to generate DCI. At the same time, the findings show that firms do not always follow the theoretical guidelines for managing innovation (and DCI within it). Other than in incremental projects, DCI generation in radical projects is dictated by individuals.

2.4.2.1 Tools and Techniques

Papers researching tools and techniques concentrate on providing prescriptions, guiding firms in the selection of tools and techniques. Their prescriptions are similar to those found in Marketing papers, adding that tools should be capable to generate accurate and reliable information.

In the first NPD phase, tools and techniques should support divergent activities and be capable of exploring needs and problems. In later phases, they should support convergent activities and be capable of confirming the best ideas and concepts (e.g. Carlgren, 2013; Goffin, Lemke and Koners, 2010; Janssen and Dankbaar, 2008; Liedtka, 2011). This stream of research adds that tools and techniques should be applied systematically to capture reliable insights (Goffin, Lemke and Koners, 2010; Rosenthal and Capper, 2006; Weigel and Goffin, 2015). Liedtka (2015) focuses on this and defined the tools' capability to reduce biases. Bias may be the result of the inaccuracy of customers in describing their needs. To prevent this, customers should not be asked directly what they would want in the future, but rather be subjected to sophisticated, qualitative, techniques (e.g. observation) allowing inference of their needs. Bias may also be the result of decision makers becoming trapped in their own world view, causing them to favour solutions closely resembling familiar situations or matching their personal values. This kind of bias may be prevented by using techniques such as stories and narratives, allowing decision makers to experience customers' needs first-hand.

Evidence of firms' actual use of tools and techniques shows that, although they do increasingly use research tools (Markham and Lee, 2013), firms do not always follow the

theoretical prescriptions. Some choose to rely on tools that solely provide confirmatory information (c.f. Janssen and Dankbaar, 2008). Moreover, some practitioners consider surveys to be the norm for market research (Price, Wrigley and Straker, 2015), despite their dislike of traditional market research (Veryzer, 2005). Strong evidence showing how such choices impact DCI is not available.

2.4.2.2 Implementation

Findings revealing the actual use of tools and techniques indicate that firms have other, more practical, considerations than those described in the literature. Sparse research focussing on such considerations shows that firms favour tools and techniques that are easy to use and cost-efficient (Carlgren et al., 2016; Van der Hoven et al., 2013; Schirr, 2012). This is explained further by Carlgren et al. (2016), who researched the bottlenecks encountered by five large incremental innovators, finding that managers perceive DCI methods to be difficult to implement. The required processes fall outside the normal (incremental) innovation processes, and decision making based on DCI requires a logic that is counterintuitive to regular (rational) routines. Against this backdrop, the relatively high costs incurred by time spent on problem definition and needs identification are difficult to justify. Moreover, the competences that are needed for problem definition and needs identification are not commonly available and require some level of experience. Given that firms aiming for radical innovations may well have different expectations and budgets for DCI generation, the findings of Carlgren et al. require careful interpretation in light of this thesis.

2.4.2.3 Quality of Knowledge

Despite the attention paid to accurate and reliable insights, none of the papers offers a metric for measuring the quality performance of prescribed approaches. Only one paper has made a start with the definition of *market vision*, an encompassing form of understanding about the attractiveness of advanced technology (Reid and De Brentani, 2010). This includes technological understanding and is, therefore, much broader than DCI. Reid and De Brentani's findings are noteworthy because they prove the value in distinguishing between processes and their outcomes, leading to more in-depth understanding of the effectiveness of the processes. In contrast to the quality constructs found in MBL and Customer Involvement, market vision is defined by both intrinsic qualities (form and scope) and extrinsic qualities (clarity and support).

2.4.2.4 Practices of Teams

Studies focussing on the practices of teams enriches understanding of MBL by undertaking a detailed analysis of the different functional groups and their collaborations within the distinct NPD phases. The findings show that, in the first NPD phase, it are predominantly R&D team members who generate the first insights (McDermott and O'Connor, 2002; Veryzer, 2005). For products targeting familiar markets, marketing team members are informally consulted (McDermott and O'Connor, 2002). What these informal consultations exactly entail, and how this affects DCI or the further DCI generation process, is not addressed.

Marketing is generally not found to be an actor of importance in the front-end of radical innovation. It is perceived to rely too heavily upon conservative market research techniques and customers' current needs (c.f. Veryzer, 2005). Coordination between R&D and marketing is found to be valuable in later NPD phases, as soon as a physical representation of the product concept(s) is available and preparations for launch begin (Brettel et al., 2011; McDermott and O'Connor, 2002; Veryzer, 2005). At this later NPD phase, R&D and marketing are mutually dependent upon each other: R&D requires input from marketing to finetune the product

attributes and to get access to customers piloting the new product; marketing requires input from R&D to prepare the content for the marketing and communication programmes. As this stream of research is principally based on samples of the largest and most successful firms, it is unclear how firms with less functional divisions build on cross-functional perspectives.

2.4.2.5 Practices of Individuals

Research into individuals and their roles in DCI generation offers a new understanding of the interplay between R&D and business-oriented individuals. Reid and De Brentani (2004; 2010) argued that radical innovation projects do not start from a clear-cut scope, as in incremental projects, but instead, start from unstructured, messy problem situations. *Boundary-spanning individuals* — those who are acting in this diffuse problem context on a daily basis and often have a technical background — are the first to recognise unaddressed needs and opportunities. They are, therefore, the key individuals collecting and analysing DCI. Insights and ideas deemed important are then shared with small groups, or teams. Within these teams, *gatekeepers* — who are mostly business-oriented — decide how and when information is further transmitted to the organisational-level. They are, therefore, the key individuals interpreting DCI. Once the project is defined, further decision-making rests with senior managers. More generally, the actors involved in the information processing tasks have both a broad experience and in-depth expertise in their respective disciplines (McDermott and O'Connor, 2002). Moreover, they have access to networking, creative, and analytical skills (Carlgren, 2013; Reid and De Brentani, 2015). This stream of research does not explain the learning mechanisms underscoring insights generation, with only general references made to intuition and pattern recognition (Reid and De Brentani, 2010). Furthermore, this line of research does not discriminate between the types of information that are processed by boundary spanners; technical or market; needs- or solution-based. R&D professionals are known to seek hands-on, solution-based information (Veryzer, 2005); it is, therefore, unclear to what extent they do, indeed, identify latent needs.

Essential users of DCI are champions and sponsors. *Champions* are most effective in gaining management support. They develop internal commitment to the project and affect strategic decision making (Kandemir and Acur, 2012). *Sponsors* act within the management team and provide encouragement and financial backing for a radical project. The sponsors' faith in the project is strongly related to his confidence in the champion (McDermott and O'Connor, 2002). Again, these findings are based on large-firm samples; how they apply to smaller-sized firms, with less functional resources at hand, is not addressed.

2.4.3 Conclusions Innovation on Management and Design Theory

Section 2.4 discussed the concepts and findings of research grounded in Innovation Management and Design theory, giving rise to five sets of conclusions:

First, Innovation Management and Design literature is the most detailed stream of research and offers an understanding of the operational aspects of Deep Customer Insight. It gives a unique view on the implementation of tools and techniques, as well as on the roles of teams and individuals.

Second, studies in this tradition use much more qualitative research than in Market-Based Learning or Customer Involvement traditions, thus supporting the detailed level of understanding sought.

Third, despite a more detailed form of understanding, this stream of research has not yet fully adapted to DCI. Similar to the other theoretical foundations, Innovation and Design

Management does not offer a construct with which to measure the performance of the tools and efforts put into DCI.

Fourth, findings emphasise a high level of skill required to generate DCI. Furthermore, studies within this tradition uniquely identify the individuals performing key information processing roles and reveal a limited role for marketing. It remains unclear how technical individuals acting as boundary spanners in the front-end distinguish between solution-based and needs-based information, and whether these individuals do, indeed, identify DCI.

Fifth, the findings within this stream of research were principally collected from samples of large and experienced innovators. Therefore, this stream of research does not sufficiently show how less resourceful firms generate DCI within their radical innovation projects. Contradictory evidence found in the use of tools proves that there is not a single, unified approach. The bottlenecks evident in any approach implementing DCI suggest that not every firm possesses the necessary experience, money, or skills to engage in sophisticated procedures.

2.5 DISCUSSION AND CONCLUSIONS

The overview of the large firm literature has demonstrated that currently there is not a consistent and dedicated view of the set of processes and factors leading to DCI. Findings are difficult to interpret due to the presence of differing concepts and the fact that a separate performance metric for DCI is not available. These difficulties result in a confusing and contradictory set of findings. Further, the SLR has established that current understanding is insufficient to comprehend that which is needed to effectively generate DCI.

The overview presented in Table 2.6 summarises the scope, key concepts, conceptual issues, methodological considerations, key findings, and key gaps in the current understanding of each theoretical foundation. It shows that MBL and Customer Involvement theory discuss DCI only at a general and abstract level. Their analysis does not permit a deeper understanding of how and when in the NPD phase DCI activities and processes should take place, or which actors and resources should be involved. Moreover, their narrow focus on single processes (either MIP or customer involvement) does not facilitate an understanding of how learning and supporting processes for communication and relationship management interact. Inconsistent findings — for example with regards to the use of tools or the actors involved in the process — indicate that there may be several options for generating DCI.

The most detailed studies from the Innovation Management and Design literature describe how large and successful firms generate DCI. However, evidence of firms that struggle with the extraordinary processes required for DCI proves that not every firm possesses the necessary competences and coordination mechanisms. How firms with fewer resources generate DCI, or may build their capabilities to do so, remains unclear. Chapter 3 will explore more in-depth findings available from the SME literature.

Table 2.6: Overview of the Literature

	MBL	Customer Involvement	Innovation Management and Design
Key Concepts	Market knowledge; pro-active market orientation; market information processing	Communication; lead users; customers' roles	The NPD phases; focus on tools and techniques; cross-functional coordination
Scope	Learning processes and values; largely assumes customer is main source of input; limited understanding of how DCI is laid out across NPD	Focus is on the customer; no interest in other sources of market knowledge; only limited attention for internal processes; limited understanding of how DCI is laid out across NPD	Focus on operational aspects; mostly large firm focus
Methodological Considerations	Mostly survey-based research resulting in general level of understanding; understanding of individuals is largely missing	Mostly survey-based research resulting in general level of understanding; understanding of teams and individuals is largely missing	Mostly qualitative and focus on large firms; the findings are difficult to generalise to less-resourceful types of firms
Conceptual Issues	No consensus on the types of knowledge underscoring MBL; processing steps are not consistently defined; DCI is not defined	Roles and processes for customer involvement are not consistently defined; DCI is not defined	DCI is not defined
Key Findings	Just being market-oriented is not sufficient; firms should develop capabilities for both current and latent needs and combine thoughtfully during the distinct NPD phases. This would imply that radical projects require more than a single MIP sequence	Just involving the customer in a radical NPD project is not enough to generate DCI; it is important to involve the right type of customers and to use the right techniques that are adapted to the different NPD phases	DCI generation is often the work of individuals; it requires a high level of skills; firms do not always follow the theoretical prescriptions and have difficulty implementation tools and methods for DCI
Key Gaps in Understanding	Formality of the processes; role of analytical processes; connection of MIP sequences across NPD phases; role of cross-functional coordination; effectiveness of tools and techniques	Connection of MIP sequences across NPD phases; processes for selection and motivation of customers; effectiveness of tools and techniques	How technical people generate DCI; the actual implementation of tools and techniques; effectiveness of tools and techniques; the approaches of less resource-ful firms
Conclusions	No consistent and dedicated view on the factors leading to DCI; findings are difficult to interpret and it is unclear to what extent prescribed approaches result in DCI		

Source: Author

2.6 SUMMARY

Chapter 2 has provided an overview of the literatures discussing Deep Customer Insight from Market-Based Learning, Customer Involvement, and Innovation Management and Design perspectives. MBL and Customer Involvement perspectives are found within both the Marketing literature and Innovation literature. Innovation Management and Design perspectives were found only within the Innovation literature. Findings relevant to an understanding of DCI relate to ten research themes: the value of a Market-Orientation culture; organisation-wide Market Information Processing; MIP within projects; sources of information; customer involvement processes; quality of knowledge; tools and techniques; implementation; practices of teams; and practices of individuals.

Each stream of literature has a particular scope: MBL focuses on learning; Customer Involvement focuses on the roles that customers may have in the innovation process; and Innovation Management and Design focuses on the operational management aspects of radical innovation.

Understanding within MBL and Customer Involvement was found to be largely based on surveys. Their perspective on DCI is, therefore, general and often limited to the organisational level. Conversely, understanding within Innovation Management and Design is fine-grained and qualitative by nature, and often concentrates on large, resourceful firms.

It is, therefore, clear that none of the streams of literature unanimously defines DCI, nor do any offer a comprehensive view of the many aspects of DCI generation.

CHAPTER 3 DEEP CUSTOMER INSIGHT WITHIN SMEs

3.0 INTRODUCTION

Chapter 2 discussed Market-Based Learning (MBL), Customer Involvement, and Innovation Management and Design perspectives on Deep Customer Insight (DCI) within large firms. MBL theory provides an understanding of how organisations process market-based information in order to learn about customers' needs. Customer Involvement papers link such processes to the different levels of involvement that customers may have in the DCI generating process. Lastly, Innovation Management and Design perspectives provide a greater understanding of innovating teams and individual actors, and how they coordinate their efforts within distinct New Product Development (NPD) phases. However, it became clear during the Systematic Literature Review (SLR) that DCI is not clearly and consistently defined, and that many open questions regarding the type, timing, and scope of DCI activities remain.

The literature does reveal a consensus that DCI generation is significantly different from insight generation for more common innovation and emphasise that, even for large firms, DCI generation is a demanding process. This raises the question how Small and Medium-sized Enterprises (SMEs) — generally much less well-equipped with experience and resources than large firms — engage in this process. To understand how the practices found in the large firm literature apply to SMEs, a second systematic literature review (SLR) was conducted, the results of which are presented in this chapter. The methodology for this SLR is explained in Appendix A.

Research on how DCI is generated in SMEs was not only found in Marketing and Innovation literatures, but also in Entrepreneurship literature. These domains of literature share theoretical concepts and have overlapping research interests — for example, the value of a market-oriented culture. The review identified ten research themes which are identical to the large firm research themes identified in Chapter 2, each describing unique aspects of DCI. Research within each theme is grounded within one of four theoretical foundations: the research foundations found in the large firm literature, including Market-Based Learning, Customer Involvement, and Innovation Management and Design, supplemented with the typical SME theory of Entrepreneurial Marketing.

This chapter presents the main findings and gaps across the reviewed streams of literature. The discussion will show that, although DCI is recognised as an important driver of radical innovation in SMEs, it is not yet well understood. Despite the unique perspective on SMEs offered by Entrepreneurial Marketing theory, current understanding is highly generic by nature and, as a result, does not help to clarifying the debate surrounding SMEs' approach to DCI.

Chapter 3 is organised into seven mains sections:

1. The first section starts with a synopsis of the Systematic Literature Review
2. The second section discusses Market-Based Learning literature
3. The third section discusses Customer Involvement literature
4. The fourth section discusses Innovation Management and Design literature
5. The fifth section presents the results of Entrepreneurial Marketing literature
6. The sixth section concludes on the literatures and presents six gaps of knowledge
7. The seventh section summarises Chapter 3

3.1 OVERVIEW OF THE SYSTEMATIC LITERATURE REVIEW

The SLR identified 868 papers of potential interest when considering DCI within SMEs. This number was reduced by title and abstract inspection of 200 papers, and, after full text review of the rest, 39 papers remained. In parallel with the large firm SLR in Chapter 2, only papers describing details of either latent needs insights or radical innovation were retained. The content analysis followed the procedure applied to the large firm literature, categorising papers on the basis of *research theme*, *theoretical foundation*, and *overarching domain* of literature. Firstly, the content analysis started from the ten themes found in large firm research: the value of a Market Orientation (MO) culture; organisation-wide Market Information Processing (MIP); MIP within projects; sources of information; customer involvement processes; quality of knowledge; tools and techniques; implementation; practices of teams; and practices of individuals. These themes are included in Table 3.1, together with the references in the last column. An explanation of each theme is also included in order to demonstrate the type of understanding that is represented by it. Additionally, the Table 3.1 shows how each theme relates to different levels of perspective: the organisational-level perspective, describing collective capabilities, such as an MO culture; the project-level perspective, describing conditions needed within teams or functional units, such as information processing activities; and the individual-level perspective, describing the behaviour and skills of individuals.

The studies reviewed in the SLR were classified based on their connection to relevant research themes. However, Table 3.1 shows that SME researchers do not address the project-level themes of MIP, the quality of knowledge, and the practices of teams. The table further highlights the fact that papers regarding SMEs are much more focused on single themes than large firm studies. Therefore, only two papers (Coviello and Joseph, 2012; Nijssen et al., 2012) are categorised in more than one research theme.

Furthermore, papers were grouped on the basis of their theoretical foundation. These were found to partly overlap with those of large firms. Again, MBL theory is well represented, with 18 papers. Innovation Management and Design theory follows with seven papers, and Customer Involvement with six. Entrepreneurial Marketing theory offers a new perspective, and eight papers describe how DCI fits within the creative type of marketing adopted by SMEs. Section 3.1.1 will explore the relations between Entrepreneurial Marketing and Customer Involvement theory and how DCI is researched within Entrepreneurship literature.

Lastly, grouping of the reviewed papers into overarching domains of literature took place on the basis of journal titles, paper titles, and keywords. Crucially, this showed that DCI within SMEs is studied in Entrepreneurship literature (17 papers), such as the *Journal of Small Business Management*. This is followed by Innovation literature (15 papers), and a relatively small amount of seven papers were found in Marketing literature.

To introduce the DCI concept, Chapter 2 discussed the position of DCI within the Marketing and Innovation disciplines. The following section will complement the introduction and discuss the position of DCI within the discipline of Entrepreneurship.

Table 3.1: Overview of Themes of Research

Level	Theme	# of Papers	References
Organisational	**(1) Value of an MO culture:** The influence of organisation-wide norms and beliefs about being market-oriented on new products' or new programs' success	16	Baker and Sinkula (2009); Eggers et al. (2013); Gruber (2003); Jahanshahi et al. (2015); Lewrick, Omar and Williams (2011); Low, Chapman and Sloan (2007); Massa and Testa (2011); Micheels and Gow (2012); Renko, Carsrud and Brännback (2009); Salavou (2005); Salavou and Lioukas (2003); Schindehutte, Morris and Kocak (2008); Siegel and Renko (2012); Thomas, Painbéni and Barton (2013); Webb et al. (2010); Zortea-Johnston, Darroch and Matear (2011)
	(2) Organisation-Wide MIP: The influence of organisation-wide processing of market information on new products' or new programs' success	5	Bucolo and Matthews (2011); De Luca, Verona and Vicari (2010); Maes and Sels (2014); Mosey, Clare and Woodcock (2002); Parry et al. (2012)
	Total references to themes at organisation-level	*21 (51%)*	
Project	**(3) MIP Within Projects:** How information processing takes place within distinct NPD phases	n/a	n/a
	(4) Sources of Information: The background characteristics of the input sources of DCI as well as about the processes and methods for selecting sources of information	4	Coviello and Joseph (2012); Jones, Suoranta and Rowley (2013); Nijssen et al. (2012); Yli-renko, Autio and Sapienza (2001)
	(5) Customer Involvement Processes: The processes for engaging with customers	5	Berends et al. (2014); Chang and Taylor (2016); Coviello and Joseph (2012); Meyers and Athaide (1991); Nijssen et al. (2012)
	(6) Quality of Knowledge: The quality dimensions of DCI, and the determinants and consequences of knowledge quality	n/a	n/a
	(7) Tools and Techniques: The applicability of tools and methods for DCI	1	Baxter, Goffin and Szwejczewski (2014)
	(8) Implementation: Guidelines or barriers for the implementation of DCI capabilities	5	Frishammer and Ylinenpää (2007); Marion, Friar and Simpson (2012); Mosey, Clare and Woodcock (2002); Millward and Lewis (2005); Moultrie, Clarkson and Probert (2007)
	(9) Practices of Teams	n/a	n/a
	Total references to themes at project-level	*15 (37%)*	
Individual	**(10) Practices of Individuals:** The roles and tasks of specific individuals in the generation of DCI	5	Bettiol, Di Maria and Finotto (2011); Gruber, MacMillan and Thompson (2008; 2012); Hulbert, Gilmore and Carson (2015); Read et al. (2009)
	Total references to themes at individual-level	*5 (12%)*	
	Total references to themes	*41 (100%)*	
	Total amount of unique papers	39 (100%)	

Source: Author

3.1.1 Deep Customer Insight Within Entrepreneurship

Within Entrepreneurship, DCI generation comprises part of the opportunity formation process. Schumpeter (1934) defined *opportunities* as new combinations of products, processes, organisation, and markets. *Entrepreneurship* describes the opportunistic, pro-active, and innovative activities through which these opportunities are formed, thus linking entrepreneurship intrinsically to radical innovations (Eggers et al., 2013). The entrepreneurial process is similar to the New Product Development process and includes the phases of recognition, evaluation, and exploitation (Shane and Venkataraman, 2000). The entrepreneur plays a central role in these activities; although, in many studies, the individuals pursuing opportunities are not explicitly defined and may also be groups of individuals, or teams (Wakkee and Van der Veen, 2014). Schumpeter's definition of opportunities is not restricted to an idea, but may also include a new project or a new businesses (Hulbert, Gilmore and Carson, 2015; Siegel and Renko, 2012). This explains why Entrepreneurship research is not limited to start-ups, but also involves young firms and mature SMEs (e.g. Coviello and Joseph, 2012; Massa and Testa, 2011; Millward and Lewis, 2005).

SMEs are generally defined as firms that have fewer than 250 employees (Frishammer and Ylinenpää, 2007; Salavou, 2005; Siegel and Renko, 2012). It is important to note that the business practices of SMEs are determined by their small size and young age, due to which they have fewer available resources, skills, experience, and process maturity than large firms (Gruber, 2004). Considering the many successful radical innovations of SMEs (Acs, 2006), some small firms evidently overcome their limited resources and manage to connect well to customers' latent needs. The literature discussing SME approaches in more detail assumes two different philosophical positions. Firstly, opportunity recognition can be seen as a *discovery* process, in which opportunities exist independently and 'just' need to be recognised before they can be exploited. This aligns with the realist assumption that opportunities are real and objectively exist (Alvarez, Barney and Anderson, 2012). From this perspective, uncertainty can be reduced by undertaking both a systematic search for relevant information and subsequent information processing. Successful entrepreneurs are those who have superior information processing skills, justifying the application of MBL and Innovation Management and Design theory to gain a deeper understanding of their approach (c.f. Alvarez, Barney and Anderson, 2012).

The two other theoretical domains — Customer Involvement and Entrepreneurial Marketing — view opportunities as the result of a *creational* process. This means that the opportunity gradually emerges by means of an entrepreneur's action, reaction, and enactment, and without elaborate up-front planning (Alvarez and Barney, 2007). Opportunities cannot be predicted because they do not exist until they are created. Market research conducted with the intent to predict future needs is, therefore, of little use. Firms collecting market information do this mainly for instrumental reasons, confirming that ideas and concepts meet customers' needs (c.f. Alvarez, Barney and Anderson, 2012; Berends et al., 2014).

3.1.2 The Landscape of Deep Customer Insight Literature

Table 3.2 summarises the literature examined during the SLR. The four theoretical perspectives are mentioned in the first column, and the three domains of literature are displayed in the first row. For each theoretical perspective, the upper half of the table gives examples of papers that were *not* included in the final set of papers considered for this thesis because they did not offer specific details regarding DCI or radical innovation. Seminal studies, which are essential to gaining a fundamental understanding of DCI, but too general to be included with the papers selected for consideration in this study, are also placed in the upper half of Table 3.2.

The lower half of the Table 3.2 lists the number of papers that were considered, together with the themes of research[1] that are covered by those studies, and some examples of some key work. The distinction between the shared themes of research and unique themes of research facilitates a greater understand of the particular interests of each domain of literature.

The first part of Table 3.2 shows the results for MBL literature, including two Marketing papers, four Innovation papers, and 11 Entrepreneurship papers. The overview of themes shows that Marketing, Innovation, and Entrepreneurship share an interest in the value of an MO culture. Innovation and Entrepreneurship share an interest in organisation-wide MIP. Small firm literature draws upon the large firm concepts for MO and MIP (Kohli and Jaworski, 1990; Narver and Slater, 1990). The studies examining the more general aspects of marketing capabilities in SMEs were rejected because of their unspecific nature (Pelham, 2000; Reijonen and Komppula, 2010).

Only a small number of papers looked at DCI from a Customer Involvement perspective, with the sources of information and customer involvement processes emerging as the key research themes. Understanding of these research themes is found in two Marketing papers, three Innovation papers and one Entrepreneurship paper. Seminal work listed within Marketing and Innovation categories is identical to those listed in the large firm SLR in Chapter 2. A new perspective on Customer Involvement within the Entrepreneurship literature is offered by Sarasvathy (2008). She defined *effectuation,* which describes small firms' resource-driven, flexible, and stepwise approach for developing opportunities. An example from a paper excluded from the review is the work of Lagrosen (2005) from the Innovation literature. This paper researched the role of the customer within small firms but did not discriminate between current and latent needs.

Papers discussing DCI from an Innovation Management and Design perspective were found within Innovation literature, discussed in six papers, and Entrepreneurship literature, discussed in one paper. These studies draw upon the innovation management concepts developed within the large firm literature, with one key concept being the innovation management principles of Cooper and Kleinschmidt (1987). The Innovation and Entrepreneurship literature share an interest in the research theme of Implementation, whereas the Innovation literature also focuses on organisation-wide MIP and Tools and techniques. An example of rejected paper is the work of McAdam et al. (2007), because it was found too generic to explain DCI within the context of radical innovation.

Eight papers analysed DCI from an Entrepreneurial Marketing perspective. Of these, three were found in the Marketing literature, one in the Innovation literature, and four in the Entrepreneurship literature. The focus of these papers is on the practices of individuals and the value of MO. They moreover add understanding of the sources of information. Seminal papers were exclusively found in Entrepreneurship literature and provided the concepts of Entrepreneurial Marketing.

[1] It should be noted that the numbers exceed the total amount of papers within each domain of literature, because some papers discuss more than one theme.

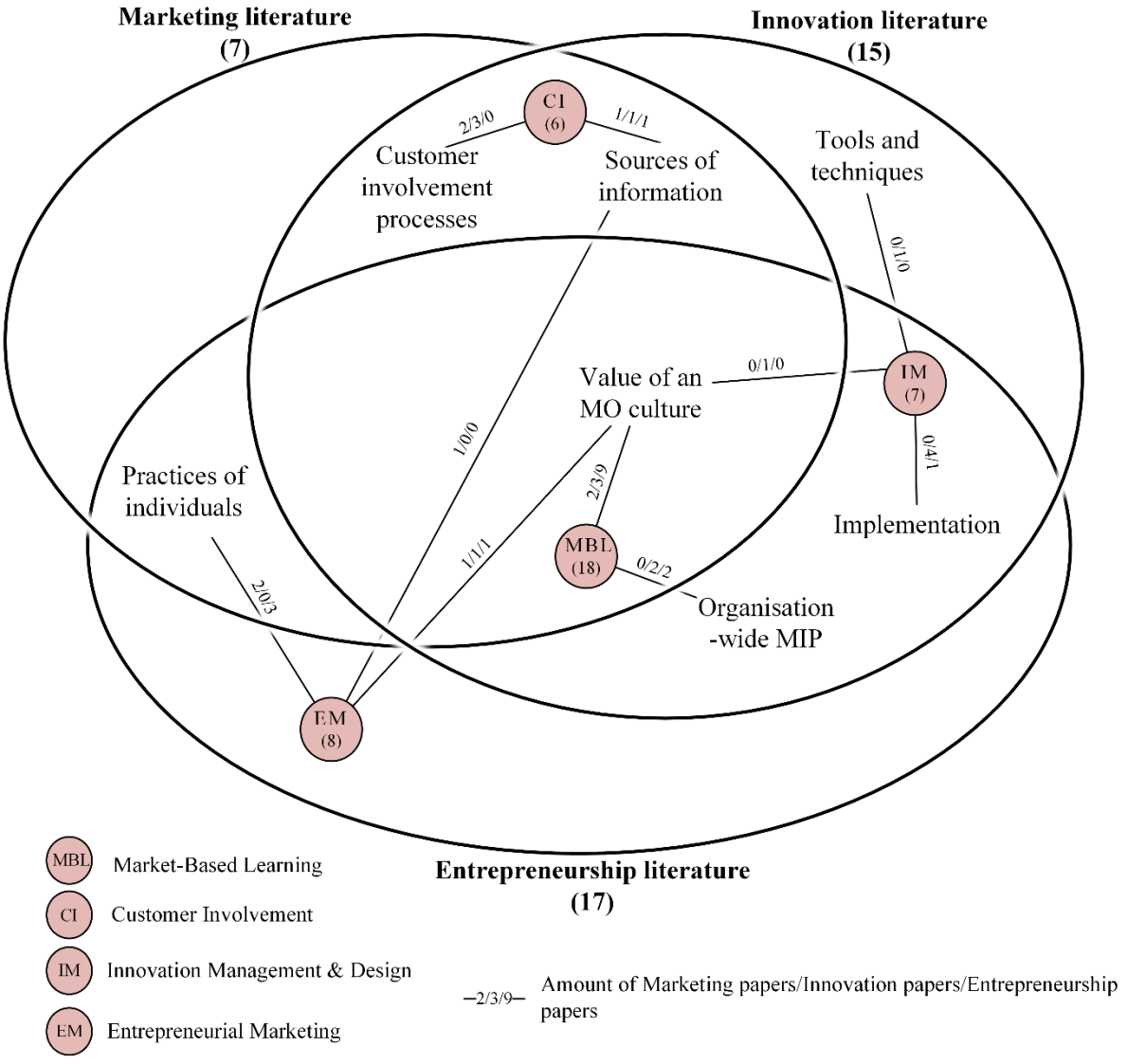
Table 3.2: DCI Within the Four Theoretical Foundations

	Wider marketing literature		Wider Innovation literature		Wider Entrepreneurship literature	
Market-Based Learning	Rejected from review	Seminal papers	Rejected from review	Seminal papers	Rejected from review	Seminal papers
	Reijonen and Komppula (2010)	Kohli and Jaworksi (1990); Narver and Slater (1990)	Frishammer and Horte (2005)	Cohen and Levinthal (1990)	Pelham (2000)	n/a
	Marketing literature included in review (2)		**Innovation literature included in review (5)**		**Entrepreneurship literature included in review (11)**	
			Shared themes (# of papers)			
	The value of an MO culture (2).		The value of an MO culture (3); Organisation-wide MIP (2)		The value of an MO culture (9); Organisation-wide MIP (2)	
			Unique themes (# of papers)			
	n/a		n/a		n/a	
			Some key papers			
	Salavou (2005)		De Luca, Verona and Vicari (2010)		Maes and Sels (2014)	
	Wider Marketing literature		**Wider Innovation literature**		**Wider Entrepreneurship literature**	
Customer Involvement	Rejected from review	Seminal papers	Rejected from review	Seminal papers	Rejected from review	Seminal papers
	Santos-Vijande, González-Mieres and López-Sánchez (2013)	Vargo and Lusch (2004)	Lagrosen (2005)	Von Hippel (1977)	Mainela, Pernu and Puhakka (2011)	Sarasvathy (2008)
	Marketing literature included in review (2)		**Innovation literature included in review (3)**		**Entrepreneurship literature included in review (1)**	
			Shared themes (# of papers)			
	The sources of information (1); Customer involvement processes (2)		The sources of information (1); Customer involvement processes (3)		The sources of information (1)	
			Unique themes (# of papers)			
	n/a		n/a		n/a	
			Some key papers			
	Coviello and Joseph (2012)		Nijssen et al. (2012)		Yli-Renko, Autio and Sapienza (2001)	
	Wider Marketing literature		**Wider Innovation literature**		**Wider Entrepreneurship literature**	
Innovation Management and Design	Rejected from review	Seminal papers	Rejected from review	Seminal papers	Rejected from review	Seminal papers
	n/a	n/a	Laughlin, Bessant and Smart (2008)	Cooper and Kleinschmidt (1987)	McAdam et al. (2007)	
	Marketing literature included in review (0)		**Innovation literature included in review (6)**		**Entrepreneurship literature included in review (1)**	
			Shared themes (# of papers)			
			Implementation (4)		Implementation (1).	
			Unique themes (# of papers)			
	n/a		Organisation-wide MIP (1); Tools and techniques (1)		n/a	
			Some key papers			
	n/a		Marin, Friar and Simpson (2012)		Millward and Lewis (2005)	
	Wider Marketing literature		**Wider Innovation literature**		**Wider Entrepreneurship literature**	
Entreprencurial Marketing	Rejected from review	Seminal papers	Rejected from review	Seminal papers	Rejected from review	Seminal papers
	Mar (2013)	n/a	Price, Stoica and Boncella (2013)	n/a	Franco et al. (2014)	Carson, Cromie and McGowan (1995)
	Marketing literature included in review (3)		**Innovation literature included in review (1)**		**Entrepreneurship literature included in review (4)**	
			Shared themes (# of papers)			
	Practices of individuals (2); Value of an MO culture (1)		Value of an MO culture (1)		Practices of individuals (3); Value of an MO culture (1)	
			Unique themes (# of papers)			
	The sources of information (1)		n/a		n/a	
			Some key papers			
	Hulbert, Gilmore and Carson (2015)		Gruber (2003)		Bettiol, Di Maria and Finotto (2011)	

Source: Author

Figure 3.1. sketches the complete theoretical landscape of research into DCI within SMEs. The numbers provided in Figure 3.1 refer to numbers listed in Table 3.2. The figure illustrates a fragmentation of the small firm literature; the key concepts of each theoretical domain are not fully exploited and are adopted in only a limited set of 2–3 themes. Papers grounded in Customer Involvement theory feature only in the Marketing and Innovation literature. The three domains of literature share an interest in understanding how a market orientation (MO) culture can be of value to SMEs' innovation projects. Organisation-wide MIP is only researched within the Entrepreneurship and Marketing literature.

Figure 3.1: Themes of Research Within the Small Firm Literature



Source: Author

3.2 MARKET-BASED LEARNING

3.2.1 Key Concepts of Market-Based Learning Theory

In parallel with large firm literature, MBL researchers focusing on SMEs consider market knowledge to be a vital resource for successful innovation. However, there is little consensus on the content underpinning marketing knowledge and the progressive state (data, information, knowledge, or insights) of market knowledge. This disparity leads to a confusing set of terms, including customer knowledge (Maes and Sels, 2014), customer-oriented market intelligence (Baker and Sinkula, 2009b), market knowledge (Siegel and Renko, 2012), and customer and competitor information (De Luca, Verona and Vicari, 2010). Although the papers frequently mention latent needs, and therefore we can infer that DCI is a part of MO, it remains unclear to what extent the results directly concern DCI.

Small firm researchers are particularly interested in the cultural conditions for DCI. Notably, they do not build on the pro-active MO concept of Narver, Slater and MacLachlan (2004), but rely on the traditional MO concept of Narver and Slater (1990). This latter MO concept represents a firm's adoption of market-driven behaviour, but was criticised for its over-emphasis on current needs (e.g. Narver, Slater and Maclachlan, 2004). In addition, small firm literature adds concerns about the MO measurement scale and reveals its poor validity for understanding marketing behaviour within SMEs. SMEs that rated themselves to be high-performing MO firms did not always understand the related concepts, nor did they perform the associated activities in daily practice. This is seen as a sign of SMEs being unconsciously incapable (Roersen, Kraaijenbrink and Groen, 2013).

3.2.2 Findings of Market Based Learning Literature

Eighteen papers were found to be inspired by MBL theory. Table 3.3 gives an overview of the methods. As is the case in the large firm literature, MBL researchers of SMEs predominantly seek to advance understanding by means of a survey-based approach.

Table 3.3: Methods Used Within MBL Papers

Methods	References	Total
Case study	Massa and Testa (2011); Mosey, Clare and Woodcock (2002); Parry et al. (2012); Schindehutte, Morris and Kocak (2008)	4
Literature review	Jahanshahi et al. (2015); Webb et al. (2010)	2
Survey	Baker and Sinkula (2009); De Luca, Verona and Vicari (2010); Eggers et al. (2013); Lewrick, Omar and Williams (2011); Low, Chapman and Sloan (2007); Maes and Sels (2014); Micheels and Gow (2012); Renko, Carsrud and Brännback (2009); Salavou (2005); Salavou and Lioukas (2003); Siegel and Renko (2012); Zortea-Johnston, Darroch and Matear (2011)	12

Source: Author

Market-Based Learning research of SMEs concentrates, above all, on the organisational-level aspects. The research themes include: the value of an MO culture, discussed in 14 papers; and organisation-wide MIP, discussed in four papers. More detailed perspectives of MIP within projects, or on individual-level themes such as the sources of information, is not available within this stream of research. Sections 3.2.2.1–3.2.2.2 discuss the findings, acknowledging the need to adapt culture and skills to the DCI context and introduce the owner as an influencing factor.

3.2.2.1 The value of a Market Orientation Culture

This stream of research explores how an MO culture stimulates DCI generation within SMEs. The findings repeat conclusions of the literature on large firms and emphasise that being market-oriented is not sufficient to generate DCI. DCI requires a culture that pairs MO with a culture that values learning (Massa and Testa, 2011; Salavou, 2005) and entrepreneurship (Baker and Sinkula, 2009; Eggers et al., 2013; Low, Chapman and Sloan, 2007; Salavou and Lioukas, 2003).

3.2.2.2 Organisation-Wide Market Information Processing

Only four papers address organisation-wide MIP and reveal the nascent interest of small firm researchers in understanding how market information is processed. The findings show that data acquisition is a key step, and of particular importance when targeting new customer segments (Mosey, Clare and Woodcock, 2002). Regardless of this importance, it is not clear to what extent SMEs undertake this first step. Some scholars noted extensive and formal data acquisition efforts (De Luca, Verona and Vicari, 2010), whereas others observed limited and informal efforts (Parry et al., 2012), or even a complete absence of any data acquisition (Maes and Sels, 2014). Studies that did observe data acquisition highlight that formal analysis and discussion is vital to ultimately generate new insights. This should be further complimented by cross-functional coordination between R&D, business, and marketing (De Luca, Verona and Vicari, 2010).

The findings of Maes and Sels (2014) emphasise the fact that SMEs need a certain level of skill and that this should be supported with measures such as data repositories, information meetings, training, and job rotation. Whether or not such measures result in DCI is highly influenced by the owner. Positive effects accrued through support systems are reduced when the resulting insights do not match the views of the owner(s) (in which case the generated insights are rejected). Although this research highlights the important roles of employees and owners, it is not very detailed. Future research should clarify the tasks, interactions, and power relations between actors at the different MIP steps and include the customer (Maes and Sels, 2014).

3.2.3 Conclusions on Market-Based Learning Theory

Section 3.2 discussed the concepts and findings of research grounded in Market-Based Learning theory, giving rise to three sets of conclusions:

First, small firm researchers crucially rely on the traditional (large firm) Market-Based Learning concepts and do not consider the specific nature of latent needs. Moreover, such measures suffer from a limited validity for small firms. Considering the large number of survey-based studies using such measures, it is unclear if the findings are a good indicator of the actual marketing and learning activities of Small and Medium-sized Enterprises.

Second, this stream of research suggests that, like large firms, many SMEs deliberately generate Deep Customer Insight and undertake the required measures to develop the necessary skills. However, MBL research of small firms raises new questions regarding the influence of owners on DCI. Like in large firms, MBL research of small firms does not offer detailed understanding of the characteristics and role of the sources of input.

Third, overall findings describe cultures and learning activities in a highly general way. Further, the contradictory evidence — for example, the importance and the level of formality of data acquisition — shows a lack of precise understanding regarding the conditions surrounding DCI. Clearly missing are detailed perspectives showing the actual capabilities of SMEs, including their use of tools within distinct New Product Development phases.

3.3 CUSTOMER INVOLVEMENT

3.3.1 Key Concepts of Customer Involvement Theory

Customer Involvement papers researching SMEs refer to creation theory and link customer involvement to the concept of effectuation (Sarasvathy, 2008). Within this approach, customers are considered a key resource, and, by actively involving customers in a variety of innovation tasks, SMEs ensure that opportunities match closely with customers' needs (Berends et al., 2014; Coviello and Joseph, 2012). Simultaneously, it saves them the costs of processing market data. Again, although frequent references are made to latent needs (De Luca, Verona and Vicari, 2010; Nijssen et al., 2012), none of the papers defines DCI explicitly.

3.3.2 Key Findings of Customer Involvement Literature

A total of six papers are grounded in Customer Involvement theory. Table 3.4 shows their research methods and reveals a preference for either case study or survey-based research.

Table 3.4: Methods Used Within Customer Involvement Papers

Methods	References	Total
Case study	Coviello and Joseph (2012); Berends et al. (2014); Meyers and Athaide (1991)	3
Literature review	Chang and taylor (2016)	1
Survey	Nijssen et al. (2012); Yli-renko, Autio and Sapienza (2001)	2

Source: Author

Research within this stream of literature is concentrated on the NPD project-level. It focuses on the customer's background characteristics, discussed in three papers, as well as on the processes for interacting with the customer, discussed in five papers. Sections 3.3.2.1–3.3.2.2 discuss the findings and demonstrate that SMEs easily involve *existing* customer relationships but lack understanding of how they involve *new* customers.

3.3.2.1 The Sources of Information

Findings regarding the sources of information for DCI highlight the importance of considering the *social capital* of customers from whom input for DCI is gathered. Social capital includes relationship quality and network ties. Repeated interaction with customers with strong network ties positively influences the in-flow of new information. In contrast, collaboration with close customers limits the in-flow of new information, because such customers often wish to maintain the current conditions of the relationship (Yli-renko, Autio and Sapienza, 2001). For a similar reason, Nijssen et al. (2012) found that close cooperation with large and important customers is harmful for DCI generation. In parallel with what was found in large firms, collaboration with lead users is beneficial for DCI (Nijssen et al., 2012).

To ensure that firms select the right sources of information, they should define selection criteria and develop a vision of the value of a potential source of information before the start of the project (Nijssen et al., 2012). Coviello and Joseph (2012) add that a mixture of close and more distant customer relations prevents the generation of current needs insights only. Specific details on the number of customers that need to be consulted, the processes for selecting and motivating them, or their effective contribution to DCI, are not available.

3.3.2.2 Customer Involvement Processes

Chang and Taylor (2016) investigated a broad range of customer involvement mechanisms, including distinct modes of communication and the lead user method. The meta-analysis causally linked these mechanisms to the financial performance of radical innovations. They concluded that small firms involve customers more effectively than large firms and offer SMEs' high motivation to use the generated insights as an explanation of the disparity. A more direct performance measure, such as the quality or type of knowledge, was not included. It is, therefore, difficult to clearly understand how customer involvement contributes to the generation of DCI.

Three case study papers explored SMEs' customer involvement mechanisms and found that they are different from the mechanisms utilised by large firms. Both Berends et al. (2014) and Coviello and Joseph (2012) observed customer involvement to be *effectual,* stepwise, and flexible, largely relying on existing resources and existing customer relations. Within these processes, customers share their insights while acting as funder, information source, tester, and promotor.

The young software firms studied by Coviello and Joseph (2012) were found to draw on three major processes, not only embracing customer interaction, but also learning. Firstly, they relied on *customer mobilisation*, ensuring that customers are identified and involved throughout the process (Coviello and Joseph, 2012). Secondly, the cases built on *mindful trial and error,* which reflects the planned and unplanned forms of gathering customers' feedback. Thirdly, they drew upon their *learning agility*, defined as "a nimble approach to learning, easily generating and transferring knowledge within the firm and across partners in a way that encouraged knowledge spill-over" (Coviello and Joseph, 2012, p. 99). The literature on learning agility generally uses the term to express a person's willingness and ability to learn from experiences (Lombardo and Eichinger, 2000). Learning agility may, however, hinder the generation of new insights when experiences are overly complex and challenging. A more precise definition and greater focus on the underlying (cognitive) information processing capabilities is, therefore, needed in order to understand learning agility's value to DCI (c.f. Derue, Ashford and Myers, 2012). Coviello and Joseph set the approaches observed in their work apart from the regular large firm information processing concepts of MBL theory. Furthermore, they determine SMEs' processes to be informal, short-term focused, and experience-based. However, detailed understanding — for example, on how actors analyse and reflect upon these experiences, or how they create meaningful experiences — is not given. Nor is it made clear to what extent these processes result in DCI. Greater understanding of these knowledge outcomes is vital given that experienced-based learning is known to be limiting new insights (Danneels, 2003).

Studying more mature SMEs, Meyers and Athaide (1991) observed similar processes as Coviello and Joseph (2012). However, unlike the young innovators, these older SMEs did not solely rely on experiences and feedback, but also used open-ended, explorative, research to identify needs early in projects. This suggests that effectuation is supplemented by other approaches as firms mature. Considering the small and very specific samples, and the availability of contradictory evidence showing that SMEs are reluctant to involve customers (e.g. Moultrie, Clarkson and Probert, 2007), more research is needed to confirm these findings.

3.3.3 Conclusions on Customer Involvement Theory

Section 3.3 discussed the concepts and findings of research grounded in Customer Involvement theory, giving rise to four sets of conclusions:

First, despite their project-level focus, the conditions and processes presented in this stream of research are explored only at a high level of abstraction and are not clearly defined. Such conditions and processes are roughly situated in the distinct New Product Development phases and do not focus on concrete data collection or analytical activities. Although frequent references are made to Deep Customer Insight, none of the contributions offers a separate definition.

Second, the findings largely emphasise learning from existing customer relations, despite the fact that such relations are known to be counterproductive for radical innovations aimed at unfamiliar markets (Danneels, 2003; O`Connor, 1998).

Third, the high attention paid to short-term experience-based learning (Coviello and Joseph, 2012) suggests that learning is not the primary goal, but rather an unintended by-product of the innovation tasks (c.f. Miner, Bassoff and Moorman, 2001). A lack of any in-depth discussion regarding how teams prevent the generation of current insights only is, therefore, a clear omission.

Fourth, none of the reviewed studies proved convincingly that observed measures and processes resulted in DCI and, therefore, it is difficult to draw any conclusions regarding their utility.

3.4 INNOVATION MANAGEMENT AND DESIGN

3.4.1 Key Concepts of Innovation Management and Design Theory

The papers identified within Innovation Management and Design adopt large firm concepts to understand how the same ideas apply to SMEs. They do not seek to explain the unique SME approach, and do not add to new theory for SMEs in the form of concepts like effectuation.

3.4.2 Key Findings of Innovation Management and Design Literature

A total of seven papers are grounded in Innovation Management and Design theory. Table 3.5 shows their research methods and reveals a preference for case study research.

Table 3.5: Methods Used Within Innovation Management and Design

Methods	References	Total
Case study	Marion, Friar and Simpson (2012); Mosey (2005); Millward and Lewis (2005)	3
Action research	Moultrie, Clarkson and Probert (2007)	1
Conceptual	Bucolo and Matthews (2011)	1
Literature review	Frishammer and Ylinenpää (2007)	1
Qualitative	Baxter, Goffin and Szwejczewski (2014)	1

Source: Author

Similar to large firm literature, Innovation Management and Design research in SMEs focuses on operational understanding. The key research themes are: tools and techniques, discussed in one paper; and implementation, discussed in five papers. Bucolo and Matthews's (2011) conceptual paper discusses MIP within SMEs. Due to the lack of empirical results, this paper is not further discussed.

Sections 3.4.2.1–3.4.2.4 present the findings, establishing that SMEs do not always follow large firm guidelines. Small firms' approach to cross-functional cooperation, formal management, market research, and customer involvement is found to be different. SMEs also have difficulty growing such capabilities from one project to the next.

3.4.2.1 Tools and Techniques

Empirical research of SMEs' use of tools and techniques is virtually non-existent, with only one paper describing how a single SME uses tools for the generation of DCI. The study discusses the value of *repertory grid* — a structured interview process identifying customers' hidden thoughts about products (Baxter, Goffin and Szwejczewski, 2014). Given that the insights generated were mainly used to re-design a current product, this paper if of little relevance to a radical innovation project.

3.4.2.2 Implementation and Capability Development

This stream of literature discusses a variety of barriers to the implementation of large firms' best practices in SMEs for the generation of DCI. Most of these concern obstacles arising during a single project, but there is also some attention paid to how capabilities mature across different projects. Papers within both sub-themes are based on case studies, and their evidence is often contradictory. This may be related to their poor quality of research; an assessment of the quality based on the ten quality items of the CASET scale developed by Goffin et al. (2019) revealed an overall poor rating. The assessment is included in Appendix B. None of the papers met more than five of the criteria, with critical issues identified in the transparency of data collection and the validation of evidence. As a consequence, the findings in this stream of research should be interpreted carefully.

Implementation in a Single Project

Four papers noted that SMEs' limited resources and experience hamper the implementation of cross-functional teams, process formality, and market research. When considering cross-functional teams, the findings describe how SMEs innovate in relatively small core project teams. Within these core teams, the owner performs most of the tasks, including sales, marketing, financial, and engineering duties. The other team members are, above all, engineers. Within this setting, cross-functional perspectives are scarce, with dominant owners oftentimes discarding pieces of market information found by others (Marion, Friar and Simpson, 2012b; Millward and Lewis, 2005; Mosey, Clare and Woodcock, 2002; Moultrie, Clarkson and Probert, 2007).

Large firm literature prescribes a certain level of formality during MIP to ensure that sufficiently new insights are generated (e.g. Goffin, Lemke and Koners, 2010; Hultink et al., 2011; Rosenthal and Capper, 2006; Weigel and Goffin, 2015). Formal processes are defined as processes that: (1) are written down; (2) take place in a planned, sequential approach; (3) are controlled (Marion, Friar and Simpson, 2012). Within small firms, these processes do not meet the same formal criteria (Marion, Friar and Simpson, 2012a). SMEs that attempt to implement procedures tend to find them too complex, ultimately leading to excessive bureaucracy (Moultrie, Clarkson and Probert, 2007). However, contradictory evidence shows that some processes follow a formal routine, such as the processes for customer selection or

MIP (De Luca, Verona and Vicari, 2010; Nijssen et al., 2012). This shows that formality within SMEs requires a careful definition.

Debate abounds in the small firm literature regarding SMEs' use of market research. Some authors do not observe any form of market research (Marion, Friar and Simpson, 2012c) and argue that SMEs do not have the necessary skills to conduct it (Moultrie, Clarkson and Probert, 2007). Others report that SMEs do, indeed, engage in market research activities, yet do this in a less systematic way (Mosey, Clare and Woodcock, 2002). Final conclusions are hindered by poor definition of the term market research, which is clear in the work of Mosey, Clare and Woodcock (2002). Their findings reveal that SMEs (and researchers) equate formal market research with survey-based, quantitative, market research and preclude qualitative techniques, like interviews and site visits. Considering this lack of quantitative market research, such research is generally reported missing, rendering accounts of the use of qualitative techniques in SMEs undiscussed. Measuring the use of formal market research[2] is, therefore, not sufficient to accurately gauge the extent of research activities that take place within SMEs.

Development of Capabilities Across Projects

Capabilities are dynamic by nature and change across a firm's evolution (Eisenhardt and Martin, 2000; Teece, Pisano and Shuen, 1997). Radical innovation processes, including those for DCI, are, therefore, expected to be different within start-up, young, and more mature small firms. Comparing the findings of SMEs at distinct phases of lifecycle within different studies suggests that DCI generation does, indeed, become a more mature capability as firms age (Hulbert, Gilmore and Carson, 2015; Lewrick, Omar and Williams, 2011). Other findings, however, contradict this, showing that the learning processes of an SMEs' first radical project are often not repeated in a second radical project (Mosey, 2005). Such lack of repetition is explained by the relatively simple and flexible nature of the first-time processes, making them easily forgotten. An alternative explanation is offered by Moultrie, Clarkson, and Probert (2007), who observed that actors within SMEs frequently disagreed on what constitutes a good practice. Moreover, these actors were found to have differing opinions regarding the extent to which they performed certain practices. Such process understanding, or *deutero* learning, is, however, essential to the improvement of capabilities in a second project (Sinkula, 1994).

Market-Based Learning theory offers a second viewpoint on how DCI capabilities grow more mature. Kohli and Jaworski (1990) argue that each MIP process step forms a pre-condition to a next step. Thus, implementation progresses through basic skillsets for the gathering of information, to dissemination skillsets at the intermediate level, and usage skillsets at the top level. Similar lines of reasoning are found in absorptive capacity literature (Lane and Lubatkin, 1998). Anecdotal evidence refers to SMEs' less sophisticated MIP processes, especially within the dissemination and usage procedures (Maes and Sels, 2014). However, dedicated research into how SMEs develop their DCI capabilities across projects is not available.

[2] See, for example, the work of Coviello and Joseph (2012) or of Mosey, Clare of Woodcock (2002). Similarly, the survey-based papers on Market Information Processing speak of market research in their constructs, without specifying the type of market research (e.g. of Maes and Sels (2014))

3.4.3 Conclusions on Innovation Management and Design Theory

Section 3.4 discussed the concepts and findings of building on Innovation Management and Design theory, giving rise to three sets of conclusions:

First, the quality of evidence within the streams of small firm literature is generally poor. It is, therefore, difficult to draw final conclusions on the extent to which small firms intent to generate Deep Customer Insight.

Second, the Innovation Management and Design studies are foremost interested in understanding the utility of large firm innovation practices for Small and Medium-sized Enterprises. Their results are contradictory and have led to major debates on the level of formality and the applicability of market research.

Third, following perspectives within the Capability and Market-Based Learning literature, it can be expected that SMEs at different lifecycle phases display different levels of mastery over DCI processes. However, research confirming this and showing clearly the conditions enabling SMEs to develop their capabilities, is not available.

3.5 ENTREPRENEURIAL MARKETING

3.5.1 Key Concepts of Entrepreneurial Marketing Theory

Entrepreneurial Marketing describes the unique, flexible, and operationally focused way of creating new primary demand (Hills, Hultman and Miles, 2008). This type of marketing emerged in the 1980s after recognition arose that mainstream marketing principles did not fit well with the practices of SMEs. Instead, a more creative and flexible way of marketing was observed, which did not draw on excessive resources and was better suited to the characteristics of the entrepreneur/owner (Carson and Gilmore, 2000; Smart and Conant, 1994). This type of marketing includes social networking and customer involvement, and supports SMEs in developing superior customer knowledge (c.f. Hills, Hultman and Miles, 2008).

The driving force within Entrepreneurial Marketing is the entrepreneur. He or she is personally engaged, and crucially relies on prior knowledge and expertise during the opportunity recognition process (Bettiol, Di Maria and Finotto, 2011; Read et al., 2009; Schindehutte, Morris and Kocak, 2008).

3.5.2 Key Findings of Entrepreneurial Marketing Literature

A total of eight papers are grounded in Entrepreneurial Marketing theory. Table 3.6 displays their research methods and reveals a preference for qualitative work, either case study research or other qualitative methods. The case studies within Entrepreneurial Marketing were evaluated using the CASET scale developed by Goffin et al. (2019). None of them met more than five of the criteria, with significant flaws evident in transparent data collection and validation of evidence.

Table 3.6: Methods Used Within Entrepreneurial Marketing Papers

Methods	References	Total
Case study	Bettiol, Di Maria and Finotto (2011); Jones, Suoranta and Rowley (2013); Thomas, Painbéni and Barton (2013)	3
Conceptual	Gruber (2003)	1
Qualitative	Hulbert, Gilmore and Carson (2015); Read et al. (2009)	2
Survey	Gruber, MacMillan and Thompson (2008; 2012)	2

Source: Author

Five papers within this stream of literature focus on the role of entrepreneur in the formation of market opportunities. The others contribute to the value of an MO culture, discussed in three papers, and the sources of information, discussed in one paper. Their findings have already discussed in the Sections 3.2 and 3.3, covering MBL and Customer Involvement papers.

Section 3.5.2.1 concentrates on the role of the entrepreneur and discusses how prior knowledge and experience influences the generation of DCI.

3.5.2.1 The Role of the Entrepreneur

Gruber, MacMillan, and Thompson's (2012) study argues that experienced entrepreneurs — those who have previously discovered market opportunities — actively consult a variety of external sources and engage in information search behaviour. This contrasts with the observations of Read et al. (2009), who concluded that experienced entrepreneurs principally rely on prior knowledge and do not perform market analysis. Considering that prior knowledge is not new knowledge and therefore refers to current needs insights, this raises the question: how do experienced entrepreneurs address customers' latent needs? Hulbert, Gilmore, and Carson (2015) give a more nuanced perspective, finding that successful entrepreneurs start from prior knowledge, but then combine this with new, externally available knowledge. Such complementary knowledge comes either from *entrepreneurial alertness* — noticing without deliberate search — or from more planned, analytical market research activities. Hulbert, Gilmore, and Carson further argued that entrepreneurs targeting unfamiliar markets, as opposed to current customers, find their prior knowledge of little relevance and chose to fully rely on market analysis. This suggests that the relevance, depth, and breadth of the entrepreneurs' prior knowledge drives further information processing. More specific details on how externally acquired knowledge is processed and combined with prior knowledge are not available.

Building on the sensemaking theory of Weick (1975), the exploratory case study of Bettiol, Di Maria, and Finotto (2011) explains how entrepreneurs interpret new information. The paper discusses four case studies of Italian design firms and found that entrepreneurs gather knowledge through alertness. New concepts and interpretative frameworks are the result of pattern recognition. Stories and narratives are essential instruments in this process and are used to inform and engage outside stakeholders as well as the teams internal to the organisation. This case study research, however, suffered from various quality issues — notably little transparency in data collection and a small, very specific sample. The results may, therefore, be difficult to generalise to SMEs in other industries or other countries.

3.5.3 Conclusions on Entrepreneurial Marketing Theory

Section 3.5.3 discussed the concepts and findings of research grounded in Entrepreneurial Marketing theory, giving rise to two sets of conclusions:

First, Entrepreneurial Marketing literature is relatively young, and the quality of the case studies does not allow for strong conclusions to be drawn.

Second, this stream of research is especially focused on the role of the entrepreneur and his or her prior knowledge. The results are not specific regarding how the entrepreneur collects, analyses, shares, and interprets market data. It is unclear to what extent the activities are systematic and controlled (as in Market-Based Literature). Nor is it made clear under what conditions prior knowledge is of value and how such knowledge can drive further information processing.

3.6 DISCUSSION AND CONCLUSIONS

As is the case within large firm literature, small firm literature does not offer a consistent and dedicated view on the set of processes and factors leading to Deep Customer Insight. Findings are difficult to interpret due to different concepts for market-based learning and customer involvement and the lack of a separate performance metric for DCI. As a result, the findings are confusing and contradictory, leaving many unanswered questions with regards to what is needed to effectively generate DCI.

The overview given in Table 3.7 summarises the scope, key concepts, conceptual issues, methodological considerations, key findings, and key gaps in current understanding of each theoretical foundation. This summary demonstrates that small firm researchers, drawing on Market-Based Learning and Innovation Management and Design theory, use the same concepts as large firm researchers. As a consequence, the concepts suffer from the same limitations and, above all, a lack clarity regarding what type of activities (for the processes) are included, or what type of knowledge upon which they are focused. Their findings are highly general and emphasise that DCI generation is performed differently in SMEs than in large firms, with an important role for the entrepreneur. Notably, neither of the MBL, Innovation Management and Design, or Entrepreneurial Marketing theoretical domains offer a detailed understanding of the role of the customer.

Theory focusing on the unique competences of SMEs is found within Customer Involvement and Entrepreneurial Marketing perspectives. It is important to note that the available studies concentrate solely on existing customer relationships. None of them looks at how DCI is generated for unfamiliar markets, in which knowledge of existing relationships is of little use.

Looking across the different perspectives, the many contradictory findings and debates become readily apparent regarding: the role of data acquisition and market research; the formality of the processes utilised; or the value of prior knowledge. Only one paper by Hulbert, Gilmore, and Carson (2015) has begun to clarify the concept of prior knowledge, enabling future research an opportunity to more precisely understand when and how prior knowledge interacts with new knowledge.

Overall, the poor quality of many case studies makes it difficult to interpret the findings. Furthermore, the fact that findings are dispersed across different age and industry groups complicates any comparative analysis. None of the available studies convincingly demonstrates how DCI capabilities change when SMEs gain more experience and move to a different phase of their lifecycle.

Finally, the different definitions and assumptions of each stream of literature prevent any definitive conclusions from being drawn. Only one study by Coviello and Joseph (2012) has begun to integrate perspectives from MBL and Customer Involvement. However, like many other studies, the findings are highly general and fail to accurately describe what exactly actors do at different New Product Development phases. Detailed understanding is further hindered by the absence of a more direct performance metric and impedes the establishment of a causal link between the processes and the direct knowledge result (such as DCI).

3.7 SUMMARY

Chapter 3 has given an overview of the literatures discussing Deep Customer Insight within Small and Medium-sized Enterprises. The perspectives offered by available streams of literature overlap with the large firm perspective — Market-Based Learning, Customer Involvement, Innovation Management and Design. A new perspective is offered by Entrepreneurial Marketing, which focuses on the marketing capabilities of entrepreneurial firms.

The perspectives were found in the Marketing, Innovation, and Entrepreneurship domains of literature. Findings of interest for understanding DCI related to seven research themes: the value of a Market-Oriented culture; organisation-wide Market Information Processing; sources of information; customer involvement processes; tools and techniques; implementation; and the practices of individuals.

In parallel with the large firm literature, understanding within MBL and Customer Involvement is predominantly based on surveys and is, therefore, general by nature. Understanding within Innovation Management and Design and Entrepreneurial Marketing is based on case-study research, which is often found to be of poor quality.

It is clear that none of the streams of literature unanimously defines Deep Customer Insight, and that none of them offers a full view on the many aspects of DCI generation.

Table 3.7: Overview of the Literature

	MBL	Customer Involvement	Innovation Management and Design	Entrepreneurial Marketing
Key Concepts	Market orientation; market information processing	Communication; lead users; customers' roles; effectuation	The NPD phases	Entrepreneurial marketing
Scope	Learning processes and values; largely assumes customer is main source of input; limited understanding of how DCI is laid out across NPD	Focus is on the customer; some interest in other sources of market knowledge; only limited attention for internal processes; limited understanding of how DCI is laid out across NPD	Focus on operational aspects; assumes the customer is a main source of input	Focus on marketing, connection with customer involvement, but no integration with MBL; does not extensively discuss the role of the customer
Methodological Considerations	Mostly survey-based research resulting in general level of understanding; understanding of teams and individuals is lacking	Mostly survey-based research and case study research; understanding of teams and individuals is largely missing; understanding is mostly generic and abstract not zooming into concrete activities and resources	Mostly case study research of poor quality	Mostly case study research of poor quality
Conceptual Issues	No consensus on what types of knowledge are part of market-based learning; processing steps are not consistently defined; DCI is not defined	Roles and processes for customer involvement are not consistently defined; DCI is not defined	DCI is not defined	DCI is not defined
Key Findings	Just being market-oriented is not sufficient; employees should have sufficient skills; the owner determines what insights are used	Young firms do not intentionally seek insights, Rather, they create radical projects in close cooperation with customers; Learning is, therefore, short-term focused, based on experience and feedback; the customers involved in the process are mostly existing relations	DCI generation is the work of the owner; SMEs do not easily adopt large firm practices; issues are found in the role of the entrepreneur and the level of formality of the processes; the nature of the processes also complicates capability development	DCI generation is often the work of the entrepreneur
Key Gaps in Understanding	Formality of the processes; actual activities (as opposed to perceptions of activities); tools and techniques and their effectiveness; roles and interaction between actors	Connection of MIP sequences across NPD phases; strategies to prevent that only current need insights results; tools and techniques and their effectiveness	Roles and interaction between actors; the role of market research; the level of formality of the processes; the conditions enabling SMEs to develop their capabilities; tools and techniques and their effectiveness	Roles and interaction between actors; the interaction between prior and new, externally acquired knowledge
Conclusions	No consistent and dedicated view on the factors leading to DCI; findings are difficult to interpret and it is unclear to what extent prescribed approaches result in DCI			

Source: Author

CHAPTER 4 CONCEPTUAL DEVELOPMENT

4.0 INTRODUCTION

Chapter 4 will integrate the findings drawn from the review of current large and small firm literature undertaken in Chapter 2 and Chapter 3. It will uncover six gaps in the current literature which are a consequence of issues with the scope and concepts of the theoretical foundations, as well as the dominant methodological approaches to research into Deep Customer Insight (DCI). To resolve these gaps, this study will adopt the principles of Practice Theory (Schatzki, 2002), leading to three research questions. Such an approach will enable the development of a tentative conceptualisation of DCI generation within radical projects of small firms and, ultimately, will define the scope of this study.

Chapter 4 is organised into five mains sections:

1. The first section synthesises the literature and identified gaps in understanding
2. The second section discusses the available theoretical perspectives to address the gaps
3. The third section presents the research questions
4. The fourth section gives an overview of the scope of this thesis
5. The fifth section summarises Chapter 4

4.1 SYNTHESIS OF THE LITERATURE

4.1.1 Issues with the Scope of the Theoretical Foundations

None of the four theoretical foundations reviewed in Chapter 2 or Chapter 3 was found to offer a complete view on the key aspects of DCI generation in Small and Medium-Sized Enterprises (SMEs). Although Market-Based Learning (MBL) theory provides an elaborate explanation of the processes and cultures required to generate DCI, this school of thought largely leaves undiscussed which resources are needed to conduct such processes. MBL is, therefore, unclear regarding both the sources of the data underlying DCI and the set of skills and techniques required to generate DCI.

Theory offered in the Customer Involvement literature focuses entirely on the customer as the source of input (data) and does not address other sources of data. This stream of literature emphasises processes for communication and interaction, but similar to MBL, does not make clear which resources are necessary in order to perform these processes. Academic interest in integrating the different theoretical concepts offered by MBL and Customer Involvement literature has grown recently with papers from Cui and Wu (2016; 2017) for large firms and Coviello and Joseph (2012) for small firms.

Theory from the Innovation Management and Design literature offers an operational perspective and highlights the conditions for DCI at the project level. Such emphasis includes cross-functional collaboration and individual-level skills and resources. However, the findings of this literature domain predominantly concern the practices of large and successful firms and are, therefore, difficult to apply to SMEs which generally have fewer resources available.

Lastly, Entrepreneurial Marketing Theory emphasises the unique and creative way in which SMEs conduct their innovation and marketing. It is a new field of research and offers highly generic findings. Thus far, other than one conceptual paper from Webb et al. (2010), ideas from MBL have not been integrated with Entrepreneurial Marketing Theory. Such a lack of integration clearly demonstrates that research into DCI has yet to flourish.

4.1.2 Conceptual Issues

In keeping with its relative scope, each stream of literature offers a unique set of concepts describing how DCI is generated. Even though many of these concepts originated in large firm research, they are, nevertheless, applied to small firm research into DCI. Conceptual shortcomings concern DCI itself, as exemplified by the concepts of *market knowledge* and *customers' needs* which do not illustrate a clear relationship with DCI. Overall, such knowledge concepts fail to consistently describe their inherent characteristics. Furthermore, each concept lacks a breakdown of embraced content (for example customers, competitors, or market forces). As a consequence, it is unclear what DCI actually is and how it can be measured.

Conceptual issues are compounded by the lack of a clear and unified view regarding the different processes leading up to DCI. Each theoretical perspective emphasises different processes: MBL focuses on *learning*, which is the result of Market Information Processing (MIP) and comparable to market research, whereas Customer Involvement focuses on interaction and communication. Scholars within each of these theoretical perspectives emphasise different sub-processes. Moreover, concepts are predominantly used to describe general, organisational-level behaviours. Such description does not reflect the distinct New Product Development (NPD) phases within which DCI emerges, and fails to make clear how distinct market research projects within NPD phases are connected and contribute to DCI.

With general conceptual shortcomings aside, it was found that not all concepts are valid to explore DCI within small firms. MBL constructs used within small firms do not necessarily give an accurate view of what actually happens within small firms (Roersen, Kraaijenbrink and Groen, 2013). As a consequence of this serious limitation of current small firm research, the importance and role of DCI within SMEs is not well understood.

4.1.3 Methodological Issues

Current academic understanding of DCI flows from three methodological approaches: surveys, qualitative interviews, and case study research, which together offer qualitative and quantitative types of understanding. The majority of studies are survey-based and provide generic types of understanding, limited to exploring a few key relationships, leaving other aspects undiscussed. For example, Salavou (2005) surveyed SMEs in Greece to explore the impact of an organisation-wide customer-oriented culture on innovativeness. However, she did not address the crucial issue of how such a culture affects market-based knowledge within an innovation project. A second drawback of survey-based studies stems from the many different concepts and models tested, complicating comparison of results. As a consequence of what appears to be generic and fragmented survey-based research, a complete overview of what DCI entails is missing from current academic thinking.

Innovation Management and Design papers rely importantly on qualitative interviews. They focus on specific events, such as the collaboration between design and marketing, or specific methods for DCI, such as ethnography. Although a much more fine-grained approach than survey-based studies, qualitative studies fail to offer a complete view regarding what is needed to generate DCI within SMEs. For example, Rosenthal and Capper (2006) studied how ethnography supports learning about markets. However, they left undiscussed the unique attributes of the knowledge generated by ethnography and how such knowledge complements other types of knowledge. Moreover, considering the vast disparity in available resources between small and large firms, the results of many of these studies were difficult to apply to

SMEs. As a consequence of the highly specialised nature of qualitative studies, a complete overview of DCI within SMEs is not forthcoming.

A large portion of small firm studies are based on case study research and an evaluation of their quality revealed significant issues. Such deficiencies include a lack of theoretical sampling, transparency of data collection, and/or reflection of validity and reliability. As a consequence of what appears to be largely flawed case study approach, reliable conclusions regarding DCI within SMEs are not available using this methodology.

4.1.4 Gaps in the Literature

The issues of scope, concepts, and methodologies lead to six inter-related gaps in current academic understanding. These gaps concern the intentionality of DCI generation; the nature and modes of DCI processes; the actors and their roles; the skills and resource; capability building; and the levels of insight. Table 4.1 shows these gaps in the columns, starting with the label '1. The intention to generate DCI' and ending in the last column with the label '6'. The Level of Insight'. The streams of literature in which these gaps were identified are displayed in the rows of Table 4.1, starting with 'MBL Large firms' and ending in the last row with 'Entrepreneurial Marketing'.

4.1.4.1 Knowledge Gap 1: The Intention to Generate DCI

Findings within all streams of literature confirm that large firms recognise the value of DCI, which is also demonstrated in their adoption of the appropriate tools and techniques (c.f. Cooper and Dreher, 2010; Markham and Lee, 2013). MBL literature emphasises the added value of DCI for radical innovation (Moorman, 1995). The Customer Involvement literature further argues that DCI is used for future innovation projects and, therefore, has a long-term effect (c.f. Mahr, Lievens and Blazevic, 2014).

There is no consensus within small firm literature regarding DCI as an important factor for radical innovation within SMEs. Signs that SMEs recognise DCI as important are found in MBL literature describing the deliberate attempts of small firms to understand the future needs of customers (see e.g. De Luca, Verona and Vicari, 2010). Furthermore, the large number of studies confirming the proactive, market-oriented (learning) culture of SMEs suggest that DCI is viewed as important. Conversely, indications that small firms pay limited attention to DCI can be found in the numerous implementation issues evident and low process awareness described in the Innovation Management and Design literature. Moreover, observations from the Customer Involvement and Entrepreneurial Marketing literatures, that market-based learning is not a goal in and of itself, suggest that DCI is no more than an unintentional by-product of NPD activities (c.f. Coviello and Joseph, 2012; Hulbert, Gilmore and Carson, 2015). Considering, however, that none of these studies distinguishes DCI from information on customers' current needs, strong conclusions cannot be drawn (see e.g. Baker and Sinkula, 2009; Eggers et al., 2013; Low, Chapman and Sloan, 2007; Salavou and Lioukas, 2003).

As a consequence of this lack of understanding, it is unclear whether SMEs have the intention to generate DCI. Addressing this gap is vital. Intentions are known to play a key role in organisational learning and change (c.f. Argyris and Schon, 1978; Feldman and Pentland, 2003; Zollo and Winter, 2002). Therefore, clarifying the intentions of SMEs regarding DCI is a necessary first step towards understanding how small firms adapt to the demanding context of radical innovation. Considering the significance of radical innovation for the long-term success of SMEs, the potential gains of such understanding are significant (c.f. Eggers et al., 2013; Rosenbusch, Brinckmann and Bausch, 2011; Schindehutte, Morris and Kocak, 2008).

4.1.4.2 Knowledge Gap 2: The Modes and Nature of DCI Processes

Current literature is contradictory regarding the type of processes needed to generate DCI; it does not provide a clear description of the timing of distinct modes of learning and interaction, or the level of formality. Large firm MBL literature prescribes two distinct modes of learning. The first is *explorative learning* — which may either be discovery, play, or experimentation (March, 1991). The second mode proposed by MBL is *exploitative learning* — helping to refine ideas in a later phase of NPD based on experience and feedback (Kim and Atuahene-Gima, 2010; March, 1991). These prescribed modes suggest the importance of carefully defining the focus of information processing and studying the interaction between distinct information processing (research) projects. The findings of Beverland, Micheli and Farrelly (2016) reinforce the idea that more than one research project takes place during NPD. These authors showed that joint interpretation of data collected in a first exploratory phase may give rise to another round of information collection and that this leads to deeper insights.

The majority of small firm studies focus on just a single set of information processing activities. This emphasis on a single mode of learning may explain the contradictory findings evident within all streams of literature. Some schools of thought argue that SMEs build upon exploratory learning (e.g. Meyers and Athaide, 1991), whereas other theoretical domains stress exploitative learning from the beginning to the end of NPD (e.g. Coviello and Joseph, 2012). Compounding the confusion, is the frequent use of large firm concepts to study the processes of SMEs. These concepts emphasise formal processes, but lack validity for small firm contexts (c.f. Roersen, Kraaijenbrink and Groen, 2013). The questions arising from such uncertainty are various, including questions with regard to: the planning and order of processes (e.g. Berends et al., 2014; Marion, Friar and Simpson, 2012); the extent to which processes are documented and remembered (e.g. Mosey, 2005); and the extent to which the processes are improvised (e.g. Miner, Bassoff and Moorman, 2001).

Consequently, the modes and nature of the DCI processes within SMEs remain unclear. Addressing this gap is essential. A specific understanding of how SMEs learn and innovate will generate best-practices that are better suited to their small firm context, thus supporting successful innovation and economic growth (c.f Berends et al., 2014; Coviello and Joseph, 2012; Marion, Friar and Simpson, 2012a; Read et al., 2009).

4.1.4.3 Knowledge Gap 3: Actors and their Roles in DCI Generation

Current academic thinking does not offer a sufficient understanding of who is involved in DCI generation, or which tasks and roles are performed. The MBL and Innovation Management and Design literatures have begun to identify different information processing roles, such as boundary spanning or gatekeepers (e.g. Hultink et al., 2011; Reid and De Brentani, 2010). Further, these streams of literature describe the functional background that actors should have — e.g. marketing or design — but do not draw final conclusions regarding who is doing what (e.g. Atuahene-Gima, Slater and Olson, 2005; Moenaert et al., 1994; Veldhuizen, Hultink and Griffin, 2006). Recently, the Customer Involvement literature has begun to describe the role of the customer. The resulting understanding is, however, highly generic and suffers from the inconsistent definitions of concepts, such as ‘co-creation’ (e.g. Mahr, Lievens and Blazevic, 2014; Menguc, Auh and Yannopoulos, 2014).

Whether or not gatekeeping and boundary spanning roles are present within the smaller SMEs is unknown. Within all streams of literature, customers and owners are put forward as the key players within the radical innovation of SMEs. However, their roles and influences are only described at a high-level and do not include information processing (e.g. Coviello and Joseph, 2012; Maes and Sels, 2014; Marion, Friar and Simpson, 2012a). Moreover, current

understanding does not include how customers and owners interact with others across MIP and NPD.

As a result of a lack of focus of current literature on who is doing what, it is currently not known how DCI defines the tasks of innovation actors within SMEs. Considering the significant impact that individuals within SMEs have on radical innovation success, addressing this gap is vital (c.f. Gruber 2008).

4.1.4.4 Knowledge Gap 4: The Skills and Resources for Generating DCI

The current literature does not offer a consistent and detailed view on what types of skills and resources SMEs use for the generation of DCI. The MBL and Innovation Management and Design literatures on large firms argue that the generation of DCI requires sufficient levels of skill (e.g. Hultink et al., 2011). Various people, each having broad experience and in-depth expertise, should be involved in information processing (McDermott and O'Connor, 2002). These people should attend to networking with customers and engage in creative and analytical tasks (Carlgren, 2013; Reid and De Brentani, 2015). Firms gain access to such skills and knowledge through their employees. Alternatively, firms may acquire the skills from externally located actors, such as the customer (Chesbrough, Vanhaverbeke and West, 2006; Griffin and Hauser, 1993; Vargo and Lusch, 2004).

Extant work in the field of Entrepreneurship suggests that SMEs pursue new opportunities with limited resources and, therefore, seek creative ways in which to work with resources close at hand (e.g. Baker, Miner and Eesley, 2003; Hills, Hultman and Miles, 2008). Such accessible resources are largely found internally and include prior knowledge and experience — of the entrepreneur or employees — but may also be found externally within existing customer relationships. However, complete reliance on close at hand resources creates tension for DCI. Firstly, small firms' prior knowledge concerns current needs and experiences which are insufficient to generate a high quality of new insights (Maes and Sels, 2014). Secondly, existing customer relations often seek to reinforce current, short-term needs and are not motivated to contribute to radical innovation (Nijssen et al., 2012).

Contradictory findings with regard to skills and resources for DCI were found across all four streams of literature. Some findings provide proof of SMEs deliberately developing their research skills, whereas others observed a general absence of such skills, as well as little resource creation activity (e.g. Maes and Sels, 2014; Marion, Friar and Simpson, 2012b; Moultrie, Clarkson and Probert, 2007). Additionally, none of the available studies addressed the particular skills and data sources needed for learning about 'unfamiliar' markets, despite the significant impact that such a market context has on the applicability of resources (c.f. Danneels, 2003; Hulbert, Gilmore and Carson, 2015).

As a consequence of the omissions and contradictions present in current literature, it is unclear what skills and resources are needed for generating DCI. Addressing this gap is crucial. Resources, and resource combinations, may have different trade-offs and impact radical innovation success in different ways (Kyriakopoulos, Hughes and Hughes, 2016). Developing an understanding of resources and their strengths will, therefore, contribute significantly to radical innovation success.

4.1.4.5 Knowledge Gap 5: Capability Building

Current research fails to provide a satisfactory view of the different levels of mastery of a DCI capability. Within studies focusing on both large and small firms, attention paid to capability development is limited. Within large firm literature, Innovation Management and Design papers focus on the implementation of methods and describe the barriers for implementation (e.g. Carlgren et al. 2016; Van der Hoven et al., 2013). How capabilities evolve from one project to a next is not known.

The studies based on SMEs largely neglect the heterogeneity of small firms and the variations caused by the different phases of the business life cycle. Capabilities are dynamic; SMEs may learn from first attempts to generate DCI and do it differently in a second project. However, considering the fact that first experiences also set the path for future courses of action, the options for doing things differently are not unlimited (Teece, 2012). The scarcely available studies suggest that capability building within SMEs is, above all, difficult and suffers from a lack of process awareness, preventing small firms from pinpointing success and failure factors (e.g. Mosey, 2005; Moultrie, Clarkson and Probert, 2007).

As a consequence of this lack of understanding and awareness, it is unclear how SMEs develop their DCI capability over time. Addressing this gap is important. A small firm's current DCI capabilities determine the path to future radical innovation success and may sustain competitive advantage (Schindehutte, Morris and Kocak, 2008). Understanding how SMEs effectively transition from one phase to a next, therefore, significantly supports SMEs growth.

4.1.4.6 Knowledge Gap 6: The Level of Insights

A clear gap identified within all streams of literature is the lack of understanding of the value of DCI. Despite frequent references made to latent needs, current thinking does not define DCI explicitly. Instead, DCI is largely assumed to be present when certain market research activities are conducted, but none of the available studies explicitly proves that new insights resulted from such efforts.

Only a few contributions across the large firm streams of research define the extrinsic qualities of market knowledge — for example accurate, relevant, actionable, and timely (e.g. Bonner, 2010; Hultink et al., 2011; De Luca and Atuahene-Gima, 2007; Mahr and Lievens, 2012). Some of these characteristics may also be qualities of DCI; however, the essence, the intrinsic elements explaining the unique content and form of DCI, are left undiscussed. Within the small firm literature, the characteristics of market knowledge are not explored at all.

As a consequence of this lack of discussion and understanding within current literature, it is impossible to finally conclude whether SMEs generate DCI or not. Addressing this gap is important because having the right type of information is a vital driver of radical innovation (Hultink et al., 2011; Reid and de Brentani, 2010).

Table 4.1: Gaps in the Literature

	Six Gaps in the Literature					
Streams of Literature	**1. The intention to generate DCI**	**2. The modes and nature of DCI processes**	**3. The skills and resources for generating DCI**	**4. Actors and their roles in DCI generation**	**5. Capability building**	**6. The level of insight**
MBL Large firms	DCI is a key activity within radical innovation projects; DCI is used instrumentally and conceptually. **Key references:** Cooper and Dreher (2010); Markham and Lee (2013); Moorman (1995)	Focus is on MIP in the front-end. First research on ambidexterity. No understanding of interaction between different MIPs in one project. Debates about the level of formality. **Key references:** Beverland, Micheli and Farrelly (2016); Cayla and Arnould (2013); Kim and Atuahene-Gima (2010); Moorman (1995); Smits and Kok (2012)	DCI requires high level of research skills. Little attention for the sources of input. **Key references:** Hultink et al. (2011)	Focus is on functional background of actors. Observes roles for R&D, design, and marketing. But evidence of who is doing what is contradictory. **Key references:** Atuahene-Gima (2007); Moenaert et al. (1994) (1995); Veldhuizen, Hultink and Griffin (2006)	Only addressed in conceptual papers. **Key references:** Day (1994); Day (2011)	Defines some extrinsic qualities of market-based knowledge. Does not define DCI. **Key references:** De Luca and Atuahene-Gima (2007); Hultink et al. (2011)
MBL Small firms	Like large firms, SMEs intentionally seek market information. Unclear if this also includes DCI. **Key references:** De Luca, Verona and Vicari (2010); Maes and Sels (2014)	Like large firms, SMEs engage in formal market-oriented learning activities. Unclear if this also includes DCI. **Key references:** De Luca, Verona and Vicari (2010); Maes and Sels (2014)	SMEs develop new skills for MIP. **Key references:** Maes and Sels (2014)	Emphasises important role of entrepreneur, does not define roles of others. **Key references**: Maes and Sels (2014)	No attention for capability development.	Does not define knowledge quality of DCI concept.
Customer Involvement Large firms	DCI stimulates development of concepts and solutions as well as future learning. **Key references:** Cui and Wu (2017); Mahr, Lievens and Blazevic (2014)	Focus is on communication and interaction. Generally ignores learning. **Key references:** Bonner (2010); Cui and Wu (2016, 2017); Gruner and Homburg (2000)	Little attention for resources, other than existing customers. Not all customers are good participants. Lead users are important. **Key references:** Mahr, Lievens and Blazevic (2014); Menguc, Auh and Yannopoulos (2014); Urban and Von Hippel (1988)	Emphasises important role of customer but is inconsistent on what co-creation is. Does not zoom into internal roles. **Key references:** Mahr, Lievens and Blazevic (2014); Menguc, Auh and Yannopoulos (2014)	No attention for capability development.	Defines some extrinsic qualities of market-based knowledge. Does not define DCI. **Key references:** Bonner (2010); Mahr, Lievens and Blazevic (2014)

Table 4.1: Continued

	Six Gaps in the Literature					
Streams of Literature	**1. The intention to generate DCI**	**2. The modes and nature of DCI processes**	**4. Actors and their roles in DCI generation**	**3. The skills and resources for generating DCI**	**5. Capability building**	**6. The level of insight**
Customer Involvement Small firms	DCI emerges while collaborating with customers. It is not the result of intentional action. **Key references:** Berends et al. (2014); Coviello and Joseph (2012)	Learning is experienced-based, informal, and short-term focused. It is a by-product of a trial-and-error approach. Others observe formal research is the front-end. **Key references:** Berends et al. (2014); Coviello and Joseph (2012); Meyers and Athaide (1991)	Describes innovation tasks of the customer. Understanding of information processing roles is limited. **Key references:** Berends et al. (2014); Coviello and Joseph (2012); Meyers and Athaide (1991)	Little attention for resources, other than existing customers. SMEs use mix of distant and close relations. **Key references:** Coviello and Joseph (2012)	No attention for capability development.	Does not define knowledge quality of DCI concept.
Innovation Management and Design Large firms	The tools and techniques for DCI signal that DCI is an important front-end activity. **Key references:** McDermott and O'Connor (2002); Reid and De Brentani (2004)	Prescribes a varied set of tools and techniques for generating DCI in the front-end. It is unclear if firms actually implement these prescriptions. **Key references:** Carlgren et al. (2016); Janssen and Dankbaar (2008); Liedtka (2015)	Defines boundary spanning and gatekeeping roles. Explains on high-level interaction between marketing and R&D. **Key references:** McDermott and O'Connor (2002); Veryzer (2005); Reid and De Brentani (2010)	DCI requires high level of research skills, as well as creative and networking skills. Not all firms have these skills. **Key references:** Carlgren (2013); Carlgren et al. (2016); McDermott and O'Connor (2002); Reid and De Brentani (2010)	Only attention for bottlenecks in using DCI methods. **Key references:** Carlgren et al. (2016)	Defines broader concept of Market Vision. **Key references:** Reid and De Brentani (2010)
Innovation Management and Design Small firms	Low process awareness and debate on use of tools and techniques imply little attention paid to DCI by SMEs. **Key references:** Marion, Friar and Simpson (2012); Mosey (2005); Moultrie, Clarkson and Probert (2007)	Identified important barriers for formal market research and cross-functional approaches. **Key references**: Marion, Friar and Simpson (2012); Mosey (2005); Moultrie, Clarkson and Probert (2007)	MIP is done by entrepreneur. Demonstrates negative impact of entrepreneur. **Key references:** Marion, Friar and Simpson (2012); Mosey (2005); Moultrie, Clarkson and Probert (2007)	SMEs lack skills and do not involve customers. **Key references:** Marion, Friar and Simpson (2012); Moultrie, Clarkson and Probert (2007)	Capability building within SMEs is difficult and suffers from a lack of process awareness. **Key references:** Mosey (2005); Moultrie, Clarkson and Probert (2007)	Does not define knowledge quality of DCI concept.
Entrepreneurial Marketing	Market-based learning is part of the tasks of entrepreneur. Sometimes, this is done intentionally, sometimes not. **Key references:** Gruber, MacMillan and Thompson, (2012); Hulbert, Gilmore and Carson (2015); Read et al. (2009)	SMEs rely on some form of MIP to develop opportunities. The formality of MIP is debated. **Key references:** Gruber, MacMillan and Thompson, (2012); Hulbert, Gilmore and Carson (2015); Read et al. (2009)	MIP is done by entrepreneur. Demonstrates positive impact of entrepreneur. **Key references:** Bettiol, Di Maria and Finotto (2011); Gruber, MacMillan and Thompson, (2012); Hulbert, Gilmore and Carson (2015); Read et al. (2009)	SMEs rely on MIP competence and prior knowledge of entrepreneur. They creatively make use of existing resources, like networks. **Key references:** Bettiol, Di Maria and Finotto (2011); Gruber, MacMillan and Thompson (2012); Jones, Suoranta and Rowley (2013)	No attention for capability development.	Does not define knowledge quality of DCI concept.

Source: Author's own table based on the results of the SLR

4.2 THEORETICAL PERSPECTIVE

Before presenting the research questions, the theoretical perspective of this study is introduced. This perspective informs the empirical approach, but also, more fundamentally, alludes to the ontological stance of this study. It, therefore, inspires the research questions and the scope of research (c.f. Easterby-Smith, Thorpe and Jackson, 2012). Section 4.2 will present arguments in support of the choice of Practice Theory. Therefore, it will first list this study's objectives and argue why current perspectives are rejected, before introducing the principles of Practice Theory.

4.2.1 Research Objectives

This study aims to generate a complete understanding of Small and Medium-sized Enterprises' approach to DCI and will, therefore, address the six gaps identified in Section 4.1 holistically. This study is *exploratory* by nature implying an inductive approach of data collection and analysis. By exploring processes, actors and resources and adding an analysis of the consequences (i.e. the level of insight) new theoretical understanding will be generated. Moreover, by observing how observed practices produce a change in the level of insight, this study will aim to provide explanatory understanding. Lastly, by focusing on the opportunities for improving DCI capabilities, the dynamism of SME's DCI capabilities will become clear. This will, in turn, strengthen conclusions drawn and support the development of practical prescriptions guiding SMEs that wish to build and improve their DCI capability.

The SLR clearly demonstrated that, in order to achieve the stated research objectives, this study's approach should provide a complete and reliable view of the daily activities of individual actors and connect these to skills, input sources, and other resources. Moreover, it should include some form of measurement of DCI. Lastly, the research approach should distinguish clearly between actual activities and perceptions, in order to understand how actual behaviour differs from norms and values.

4.2.2 Suitability of Capability and Creational Theory

The theoretical foundations of current understanding were found to either emphasise rational and intentional processes, or less intentional, creational processes. Neither stance offers a suitable theoretical lens for use by this study. MBL and Innovation Management and Design theory define processes as capabilities, and views on capabilities originated in the school of Evolutionary Economics (e.g. Nelson and Winter, 1982). Scholars from this theoretical credo tend to describe rational and intentional processes in fairly abstract categories, like Market Information Processing (MIP). As a result of this high-level of abstraction, there is less room to study the individual actors and specific aspects driving such processes (Parmigiani and Howard-Grenville, 2011). Such a lack of detail was clearly observed in the SLR of MBL and Innovation Management and Design theory.

A second group of theories adopt a Social Constructivist philosophy and posit that knowledge resides in individuals. In this perspective, NPD and DCI are the result of a creational process, examples of which include Service-Dominant Logic and Effectuation Theory. These theories offer comprehensive analyses of the interaction between individuals, but are less clear on the role of intentional and information-driven processes (c.f. Danneels, 2003). Such a lack of integration was observed in the review of MBL, Customer Involvement literature and Entrepreneurial Marketing Theory.

4.2.3 Introducing Practice Theory

Practice Theory (Schatzki, 1996) looks at capabilities from Organisation Theory perspectives, with a greater focus on addressing the 'how' questions rather than what is commonly found in capability perspectives (Parmigiani and Howard-Grenville, 2011). The term 'practices' is often used in the Innovation and Marketing literature to describe what people do in 'best-practices', illustrating a successful approach (Eisenhardt and Martin, 2000; Hoholm and Araujo, 2011; Russo-Spena and Mele, 2012).

Practice Theory defines practices as a system of sub-components — such as tools and other resources, activities, and underlying beliefs — taking place within wider, socially embedded systems (Korkman, Storbacka and Harald, 2010). Practice-based scholars recognise that the daily "doings and sayings ('practices')" of actors are key to understanding organisational phenomena (Nicolini and Monteiro, 2009, p 110). Practices are similar to capabilities but are generally researched on the level of sub-components. Sub-components, like resources, are theorised to form an inherent part of processes. Thus, through analysing sub-components, scholars can find new ways to understand the outcomes of those processes (c.f. Feldman and Orlikowski, 2011). Such understanding would remain 'black-boxed' within capability research. The detail-orientated approach of Practice Theory allows greater scope to understand both regular and irregular processes, and it places a strong focus on the activities and resources of individual actors (Parmigiani and Howard-Grenville, 2011).

Practice Theory aligns well with the requirements of this study, and takes into consideration the idea that SMEs' processes are not likely to be as formal and stable as those in large organisations (c.f. Parmigiani and Howard-Grenville, 2011). Practice Theory is a suitable tool for use by entrepreneurial scholars in order to advance current understanding of the entrepreneurial process (Steyaert, 2007) and is widely adopted in research into knowledge production (e.g. Feldman and Orlikowski, 2011). Several papers within the SLR were found to adopt a practice perspective. These papers include: Liedtka (2015), examining the role of design thinking for bias reduction; and Stigliani et al. (2012), studying sense-making processes in order to understand organisational planning and change.

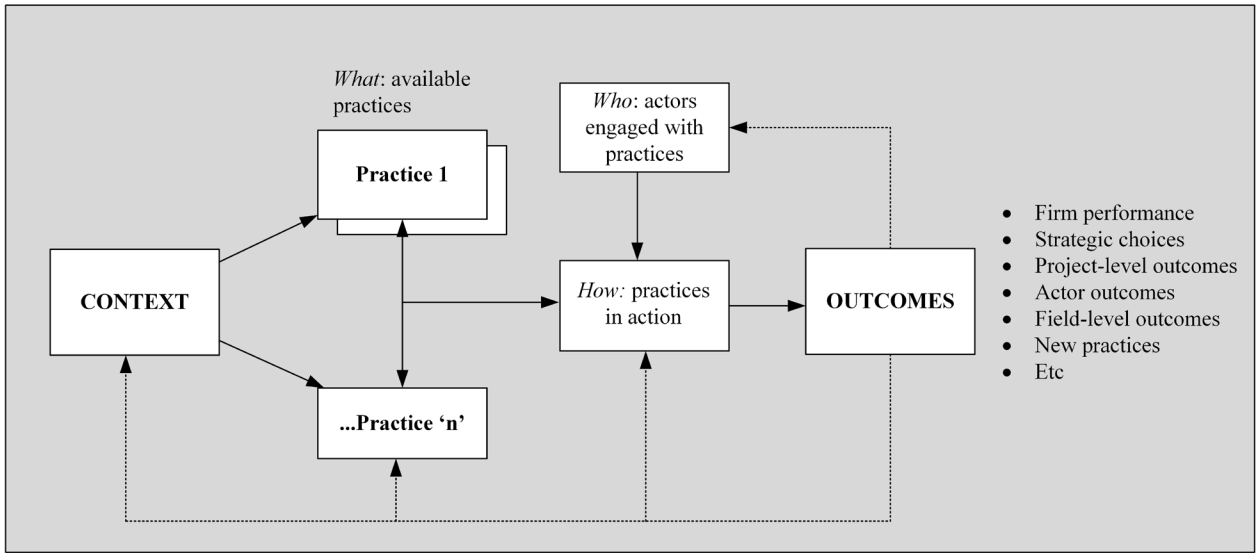
The schematic model of strategy practice, developed by Jarzabkowski et al. (2016a), is included in Figure 4.1; it illustrates the strong focus of Practice Theory on actors and the consequences of their practices. This model will be elaborated on in Section 4.4.

4.3 RESEARCH QUESTIONS

This study adopts a Practice Theory perspective and defines a practice as a bundle of activities, resources, and meanings, that forms part of a bigger constellation of practices, joined together to accomplish higher-order goals (c.f. Jarzabkowski et al., 2016; Nicolini and Monteiro, 2017; Vaara and Whittington, 2012; Whittington, 2006). This thesis will address the six knowledge gaps identified in Section 4.1 by means of the following research questions (RQs):

- RQ1: *How do small firms' practices enable them to generate DCI for radical innovation projects?*
- RQ2: *What is the level of insight resulting from DCI practices?*
- RQ3: *What are the perceptions of small-firm actors of DCI practices?*

Figure 4.1: Schematic Model of Strategy Practice



Source: Jarzabkoswki et al. 2016, p. 251.

Table 4.2 illustrates the connection between the RQs with the six gaps in current literature. RQ1 aims to conceptualise customer insight practices by taking an integrative look at practices and their subcomponents. RQ2 aims to define and conceptualise the outcome of the practices — the insights — and to understand the relationship between insights and practices. RQ3 aims to separate the actual performance of the practices from actors' perceptions and show the opportunities for improvement at different life cycle phases of business.

Table 4.2: Research Questions

Research Questions	Gap 1	Gap 2	Gap 3	Gap 4	Gap 5	Gap 6
RQ1: *How do small firms' practices enable them to generate DCI for radical innovation projects?*	x	x	x	x		
RQ2: *What is the level of insight resulting from DCI practices?*						x
RQ3: *What are the perceptions of small-firm actors of DCI practices?*	x		x	x	x	

Source: Author

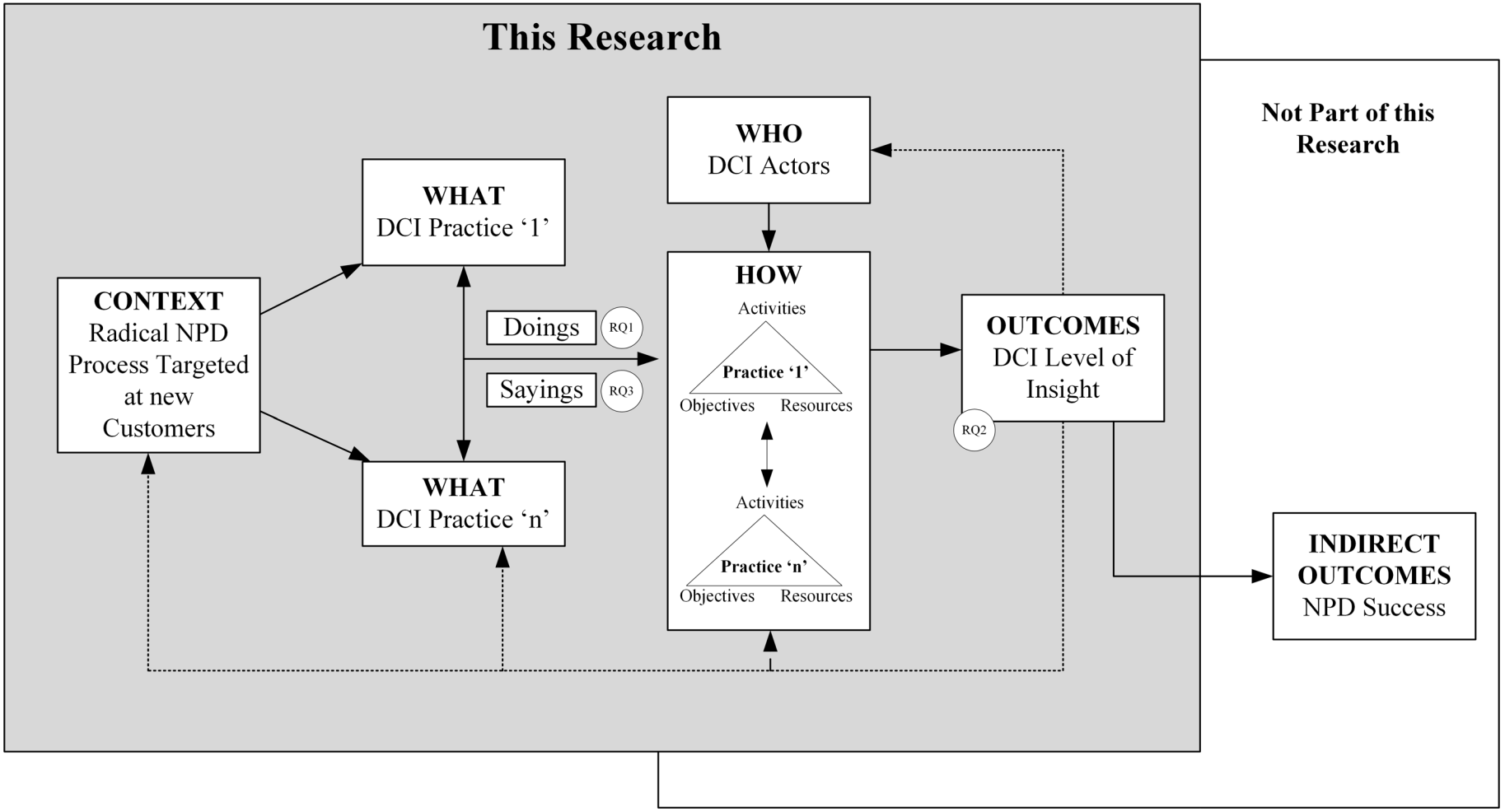
4.4 SCOPE OF THIS STUDY

Adapted from the general practice model of Jarzabkowski et al. (2016), a tentative conceptual model guiding this study is described in Figure 4.1. The model demonstrates this study's context of radical innovations targeted at new customers. Furthermore, Figure 4.2 shows how this study not only investigates the practices related to DCI, but also disentangles these practices into their sub-components, linking this to the level of insight that is achieved. This study does not include indirect outcomes, such as NPD success.

4.5 SUMMARY

Chapter 4 has shown that current academic understanding suffers from major limitations in terms of scope, concepts, and methodological approaches; this resulted in six gaps in the literature. This study intends to address these gaps holistically and, therefore, three research questions (RQs) were defined. The RQs were inspired by Practice Theory and the approach undertaken in order to answer these questions will build upon the elements constituting a practice. Such a method will provide a detailed perspective of the activities, resources, objectives, and actors involved in Deep Customer Insight generation, as well as how these components affect the level of insight.

Figure 4.2: Scope of this Study



Source: Adapted from Jarzabkowski et al. (2016)

CHAPTER 5 RESEARCH STRATEGY

5.0 INTRODUCTION

Chapter 5 explains the main strategic choices underpinning the research design of this thesis. Strategic choices have been identified as an important first step in developing a research design (Blaikie, 2007). There are four aspects that need to be considered: the *type* of *research questions*; the *philosophical stance* adopted; the *logic of enquiry*; and the *methodological fit.*

Table 5.1 gives an overview of the strategic aspects discussed in this chapter. The table includes the main points from Chapter 4, in which the relevant literatures were synthesised, revealing six significant gaps in the extant knowledge. Identification of these gaps led to the definition of the research objective and three research questions. Practice theory was identified as an appropriate theoretical perspective and it informed the research questions. Both the type of research questions and philosophical stance will argue for the selection of an abductive, intensive case study design in this thesis, making use of four theorising approaches. A benchmark of how this approach fits with the maturity of theory within the fields of research, will confirm its suitability.

Table 5.1: Summary of the Research Strategy

	Topic	Approach
Chapter 4	Research gaps	(1) Unclear if SMEs have the intention to generate DCI (2) A lack of integrated perspectives on the processes for the generation of DCI (3) Unclear what skills and resources are applied in the DCI generation process (4) A lack of understanding of the actors and their roles in the DCI process (5) A lack of understanding on how SMEs implement and develop DCI capabilities (6) Unclear how DCI can be measured and what the level of insights are
	Research objective	To explore the DCI processes and explain performance differences in terms of actors, their roles, and resources. To develop practical prescriptions.
	Theoretical stance	Practice Theory
	Research questions	*RQ1. How do small firms' practices enable them to generate DCI for radical innovation projects?* *RQ2. What is the level of insight resulting from DCI practices?* *RQ3. What are the perceptions of small-firm actors of DCI practices?*
Chapter 5	Type of research questions	'How' and 'what' questions, generating exploratory understanding and working towards explanatory understanding and prescriptions
	Philosophical stance	Pragmatic-Realism
	The logic of enquiry	Reasoning logic: Abductive Research design: Intensive multiple case-study research Theorizing approach: Narrative; quantification; temporal bracketing; visualisation
	Methodological fit	Young field of Entrepreneurship; intermediate maturity of MBL and Customer Involvement literature

Source: Author

Chapter 5 is organised into five main sections:

1. The first section begins with a summary of the type of research questions
2. The second section discusses the philosophical stance of Pragmatic-Realism
3. The third section explains the components of the logic of enquiry
4. The fourth section considers the methodological fit with literatures discussing DCI
5. The fifth section concludes this chapter and summarises methodological considerations

5.1 TYPE OF RESEARCH QUESTIONS

This thesis will provide a comprehensive understanding of the practices that lead Small and Medium-sized Enterprises (SMEs) to Deep Customer Insight (DCI). It does not only aim to generate theoretical knowledge, but also knowledge that can facilitate implementation programs. This requires answers to the 'how' and 'what' of DCI (c.f. Blaikie, 2007).

RQ1: *How do small firms' practices enable them to generate DCI for radical innovation projects?* addresses the 'how'. It explores and describes actors' activities, objectives, and the resources employed to generate DCI in radical innovation projects. RQ1 also lays the foundations to gain a deeper understanding of the 'what' in RQ2. This may help to explain the variations observed in the level of DCI.

RQ2: *What is the level of insight resulting from DCI practices?* addresses the 'what' question. It will describe the outcomes of the practices employed by SMEs in terms of the level of DCI.

RQ3: *What are the perceptions of small-firm actors of DCI practices?* adds to the 'what' question by describing the DCI practices from the perception of their actors.

A comparison of the results of RQ1, RQ2, and RQ3 will support answers to the overall 'how' question of this thesis and provide an understanding of how SMEs generate DCI for radical innovation.

According to Blaikie (2007) 'how' and 'what' questions require an exploratory, qualitative research approach, in which theory describing and explaining social events is iteratively developed and tested.

5.2 PHILOSOPHICAL STANCE

Philosophical assumptions about the nature of reality — *ontological aspects* — and how knowledge about this reality can be developed — *epistemological aspects* — determine the choice of research approach (Blaikie, 1993). These assumptions may fall on a continuum which has *objectivist* or *subjectivist* ends. An objectivist ontology follows the natural sciences and considers the social world to exist objectively. At the other end of the continuum, in subjectivist ontology, it is believed that reality does not objectively exist, but, in contrast, is defined by human actors and social forces. An objectivist epistemology follows an objective process of reasoning to develop knowledge about reality. Conversely, the subjective epistemology relies on interpretations of reality.

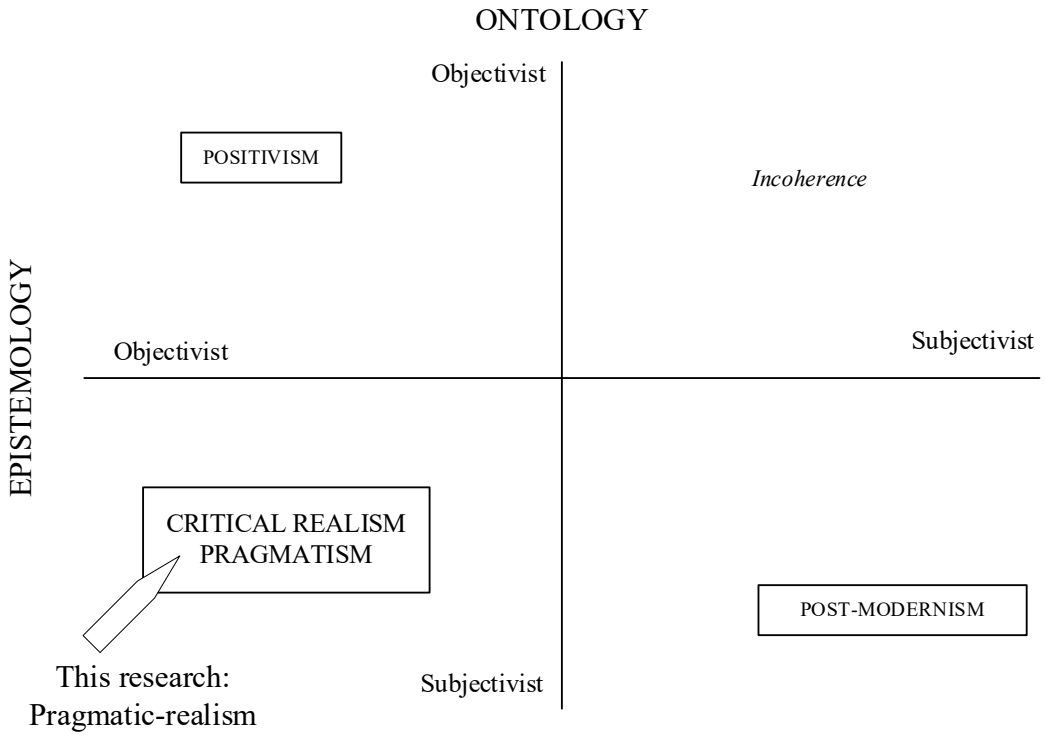
Based on the work of Johnson and Duberley (2000), Figure 5.1 positions different philosophical stances on objectivist and subjectivist extremes, with ontological aspects displayed on the y-axis and epistemological aspects on the x-axis. This results in a diagram with the upper-left quadrant in a position called *Positivism*. Positivism assumes that the social world can be understood through quantifiable, universal laws, and emphasises generalisability. Within management research, such a stance is believed to be less suitable for the exploration

of processes and meaning (Easterby-Smith, Thorpe and Jackson, 2012). It was, therefore, rejected as an unsuitable stance for this study.

Subjectivist researchers, placed in the lower-right quadrant of the diagram, are called *Post-modern* researchers. They are actively involved in data collection and rely on reflexivity to generate theory. Truth claims of Post-modern researchers are difficult to generalise beyond the sample (Easterby-Smith, Thorpe and Jackson, 2012). Considering that the aim of this thesis is to contribute to theory, a Post-modern position was rejected as well.

The lower-left quadrant displays *Pragmatism* and *Critical Realism*. Both positions combine a subjectivist ontology with a positivist epistemology and assume that complexity within the social world can best be understood with a scientific approach. Sections 5.2.1–5.2.2 will briefly explain these different positions and argue why this thesis adopts a middle-ground position between the two, termed *Pragmatic-Realism.*

Figure 5.1: Philosophical Positioning



Source: Adapted from Johnson and Duberley (2000)

5.2.1 Overview Pragmatism, Critical Realism and Pragmatic-Realism

Pragmatism originated in the United States of America at the end of the nineteenth century and seeks to develop understanding within highly specific contexts of use (Easton, 2010). It regards the world as complex and constantly changing and considers theory an instrument for problem solving. Pragmatic researchers engage in an ongoing, cyclical process of problem framing, articulation, hypothesis generation, and practical evaluation (Dalsgaard, 2014). As a consequence of this constantly changing world, less attention is paid to structural explanations.

Critical Realist assumptions are often found in prescriptive research (Van Aken, 2004; Pawson and Tilley, 1997). From a Critical Realist perspective, reality is believed to exist independent of the observer. It asserts that, beneath the surface of observed events, less transparent structures and mechanisms operate. It also recognises that these structures and mechanism are highly context dependent and need a clear view on different organisational levels of a system (Sayer, 2000). This contextual view sometimes renders Critical Realist approaches overly complex.

Critical Realists and Pragmatists define social structures differently. Pragmatism concentrates on people's everyday lives, social practices, and troubles; Critical Realism defines structures and categorisations on a high level of conceptual abstraction, often neglecting the role of actors. An intermediate position between the two is offered by Pragmatic-Realism, as defined by Rom Harré and Hilary Putnam (Kivinen and Piiroinen, 2004). These authors offer a more Constructivist, people-oriented Realism, claiming that structural powers exist as long as people believe in them. Actors and their perceptions are, therefore, an important gateway to understanding people's practices. Further, research in this tradition offers a medium-level granularity of understanding.

The central role given to actors and their practices by Pragmatic-Realism compliments the objectives of this study. Pragmatic-Realism was, therefore, chosen to provide the general principles of theoretical thinking for this thesis.

5.2.2 Implications of Pragmatic-Realism

Table 5.2 summarises the characteristics of Pragmatism, Critical Realism, and Pragmatic-Realism. The last column lists the implications of each philosophy for research designs and shows the conditions under which Pragmatic-Realism may resolve the limitations of both Pragmatism and Critical Realism.

This thesis considers the conditions listed in Table 5.2 in six ways. First, the research outcomes should be useful for practitioners and support actors involved in the DCI generation process, allowing them to improve their practice. The research approach should, therefore, incorporate sufficient room for interaction between the researcher and the stakeholders. At the same time, reflexivity should ensure academic rigour. Second, the approach should recognise the fact that daily activities are not static but *processual* and relational, and are situated within open social systems that are subject to change. Therefore, the claim to knowledge should remain modest and focus on the most immediate DCI relationships within the radical New Product Development (NPD) setting. Third, the approach should include a full range of methods to support an analysis of how DCI emerges across the various NPD phases. Fourth, the research outcomes should encompass both practitioner and academic understanding, and relate to the concepts within Market-Based Learning (MBL), Customer Involvement, Innovation Management and Design, and Entrepreneurship theories. This will support the applicability of the results — *external validity* — in settings other than those studied in this thesis. Fifth, the research strategy should encompass the different contextual layers within NPD projects, and include both individual-level, group-level, and organisational-level effects. Sixth, to understand how both human interaction and less clear, structural powers affect DCI, both the sayings and doings of actors should be captured. These six conditions confirm the suitability of an exploratory qualitive approach to this thesis.

Table 5.2: Summary of Philosophical Assumptions

Philosophical perspective	Adopted in this study	Characteristic	Implications for research design
Pragmatism	No	Predominant focus on everyday live and social practices	Neglect of long-term benefits and structural explanations
Critical Realism	No	Predominant focus on structures to explain behaviour. This goes beyond interpretation of actors	Complex research designs; unclear role of actors; lack of reflexivity
Pragmatic-Realism	Yes	The world is real and constantly changing	(1) Allow for sufficient interaction between the researcher, and the actors (2) Focus on most immediate relationships (3) Allow to use a range of methods and processual approach
		Theory supports development of solutions and should be evaluated in practice	(4) Compare results with relevant theory, thus adding to external validity
		Truth exists within contexts of use	(5) Offer a clear view on different layers of the context and actors involved
		Causal relations follow from human interaction and structural powers	(6) Capture both sayings and doings of actors

Source: Author

5.3 THE LOGIC OF ENQUIRY

Section 5.2 considered the impact of philosophical stance on the research design of this thesis, and determined that an exploratory, qualitative approach is appropriate. Such an approach compliments the type ('how' and 'what') of research questions posed. The following sections will explore how the logic of enquiry (i.e. the reasoning logic, research design, and theorising approach) will be integrated into the strategic approach (c.f. Blaikie 2007).

5.3.1 Reasoning Logic

Reasoning logic describes the general procedure for creating new knowledge. Four types of logic may be considered, including inductive, deductive, retroductive, and abductive logic. Their aims, ontological and epistemological assumptions, and procedures from start to finish are summarised in Table 5.3. This table shows how an *inductive* logic, which starts from data collection, is suitable for finding patterns of observations, but stops as soon as theory is produced. Considering the aim of this thesis is to develop theory with high practical value, an inductive approach was deemed unsuitable. Equally, *deduction* was rejected due to the absence of a well-developed theory from which to deduce. Considering the focus of this thesis centres on a limited number of contexts, a full *retroductive* strategy, which generalises findings to broad socio-economic contexts (Ackroyd, 2009), was also deemed unsuitable.

Table 5.3: Different Reasoning Logics

Element	Inductive	Deductive	Retroductive	Abductive
Aim	To establish descriptions of characteristics and patterns	To test theories, to eliminate false ones, and corroborate the survivor	To discover underlying mechanisms to explain observed regularities	To describe and understand social life in terms of social actors' motives and understanding
Ontology	Cautious, depth or subtle realist	Cautious or subtle realist	Depth or subtle realist	Idealist or subtle realist
Epistemology	Conventionalism	Conventionalism, Falsificationism	Modified Neo-realism	Constructionism
Start	Collect data on characteristics and patterns	Identify a regularity to be explained	Document and model a regularity	Discover everyday lay concepts, meanings
	Produce descriptions	Construct a theory and deduce hypotheses	Describe the context and possible mechanisms	Produce a technical account from lay accounts
Finish	Relate these to the research questions	Test the hypotheses by matching them with data	Establish which mechanism(s) provide(s) the best explanation in that context	Develop a theory and elaborate it iteratively

Source: Blaikie (2007)

Considering choices taken with regards to the nature of research questions and the philosophical stance of this thesis, an *abductive* style of reasoning is most appropriate. Abduction is suitable to both describe and explain social life and therefore is suitable for 'how' and 'what' questions. Thus, it enables the development of theory on "actors' language, meanings, and accounts" (Blaikie, 2007, p. 89).

5.3.2 Research Design

The philosophical stance of this thesis was determined to be Pragmatic-Realism, which forms part of a broader philosophical position called *Realism*. Ackroyd (2009) summarises research designs for realist stances, which rest on one of two extremes: *intensive* — relying on methods such as interviews, ethnography, and qualitative analysis; or *extensive* — using surveys and statistical analysis.

Realist research design options are summarised in Table 5.4 The first column specifies the defining characteristics of research design, including the main research focus which may be comprised of underlying mechanisms, contexts, or the interaction between the two. The first column of Table 5.4 also mentions the type of procedure, including passive approaches — in which the activities and events are explained as they are — and active approaches — in which some form of change is induced. Lastly, Table 5.4's first column includes the logic of discovery: abductive, inductive, or deductive. The title row indicates the type of approach, intensive or extensive.

This thesis adopts a middle-ground position in terms of intensive or extensive characteristics, which allows the development of an understanding regarding how the mechanism — DCI generation — varies within different contexts — different SMEs or levels of DCI. Therefore, this thesis combines an intensive comparative case study design with an

abductive logic. It will use passive procedures and not seek to induce change by means of active procedures.

Further arguments supporting this selection can be found in the work of Yin (2014), who emphasises the high levels of depth, richness, and the natural setting of case-study designs, all of which is needed to holistically understand the complexity of real-life events. Despite the high degree of relevance and abstraction, case studies may lack rigour and generalisability, and may become too complex. However, such flaws can be accounted for (Yin, 2014), and the specific quality control measures undertaken by this thesis are discussed in Chapter 6.

Table 5.4: Research Designs

Characteristics	Intensive	This study	Extensive
Research focus	Mechanism (context as given)	**Interaction between context and mechanism**	Context (mechanism inferred)
Passive research procedures	Case study	**Comparative case study**	Survey and census data
Active research procedures	Action Research	Comparative policy evaluation	n/a
Logic of discovery	Abduction	**Abduction**	Abduction/retroduction

Source: adapted from Ackroyd, (2009)

5.3.3 Theorising Approach

The theorising approach defines how data is processed and will add to theory (Langley, 1999). Langley (1999) considered a total of seven approaches, and from these, the current research adopted four. Each of Langley's approaches offers a different *granularity*. For example, a quantification strategy results in a coarse level of detail, while the finest level of detail is provided by a narrative strategy. Each strategy has a different focus (e.g. patterns, meanings, or underlying mechanisms) and performs differently on Weick's (1975) dimensions for good theory: *accuracy* (close data fitting), *generality* (the range of applicable situations), and *simplicity* (the range of elements included).

A variety of approaches is needed to provide a good theory across all dimensions (Langley, 1999) and, therefore, this thesis combines theorising concepts into a narrative, temporal bracketing, quantification, and visual mapping approach. First, participants' *narratives,* in the form of verbal accounts of the DCI processes, provided an entry point for the composition of the practices. *Temporal bracketing,* or decomposing the processes, further allowed comprehension of the relationship between the components and between different practices. A *quantification* approach, coding and counting, was helpful in setting priorities for further qualitative analysis of perceptions, and for summarising findings in the cross-case analysis. Lastly, *visual mapping,* using diagrams and tables, aided in the development of frameworks for categorising different DCI approaches. These theorising approaches are listed in Table 5.5 and illustrate how each approach provides sufficient levels of accuracy, generalisability, and simplicity.

Table 5.5: Theorising Approach

Strategy	Description	'Good theory' dimensions	Conceptual products	Application in this study
Narrative Strategy	Reconstruction of events into an extended verbal account or 'thick' description	High on accuracy; lower on simplicity and generality	Meaning and mechanisms	To determine the type of needs; to identify DCI activities, and resources; to suggest causal relations
Temporal Bracketing	Decomposing of temporal processes in phases because of the continuity of certain events within each period and discontinuities between the phases	Moderate level of simplicity, generality and accuracy	Mechanism	To identify content and dynamics between different sets of practices
Quantification Strategy	Coding of events into quantitative categories that are analysed using statistical methods	High simplicity, high generality and modest accuracy	Patterns and mechanisms	To identify the relations between typical sequences of DCI activities and effects
Visual Mapping	Representation of processes using diagrams, tables, and other visual displays	Moderate level of simplicity, generality and accuracy	Patterns	To identify causal logic between DCI activities

Source: adapted from Langley (2009), (1999)

The research questions, philosophical stance, and the logic of enquiry presented in this thesis have all indicated a qualitative, exploratory approach, specifically using case studies and abductive logic. Additionally, four theorising strategies were selected, which means that the final aspect to be considered is the methodological fit.

5.4 METHODOLOGICAL FIT

Strategic choices should be consistent with the advancement of prior knowledge in a literature domain. The methodological fit is, therefore, an overarching criterion that ensures the quality of research (Edmondson and McManus, 2007). This thesis offers contributions to all reviewed streams of literature, including Market-Based Learning, Customer Involvement, Innovation Management and Design, and Entrepreneurial Marketing literature.

Table 5.6 summarises some of the key findings of the Systematic Literature Review (SLR) in demonstrating the maturity of each stream of literature (c.f. Edmondson and McMagnus, 2007). The table lists how theory has adapted to DCI and the available DCI concepts. Additionally, it summarises the typical data collection approach and the type of understanding that is generated, together with some example papers. MBL is the only literature domain to offer a new construct that includes some of the specificities of DCI. Customer Involvement and Innovation Management and Design literature have also begun to define new concepts, but these are broader than DCI and are, therefore, of limited applicability. However, the large sections on tools and techniques demonstrates forthcoming interest of both streams of literature in DCI. Entrepreneurial Marketing literature largely builds upon existing concepts for learning and involvement to understand the differences between radical and incremental innovation. To advance understanding, MBL and Customer Involvement papers typically build on survey-based approaches and are focused on exploring relations, which results in highly general findings. Innovation Management and Design relies more often on qualitative approaches and case studies to generate explorative and open-ended understanding. However, due to the high level of detail and the poor quality of case studies, this type of comprehension cannot be easily generalized.

Table 5.6: Maturity of the Literature

Prior work	Market-Based Learning	Customer Involvement	Innovation Management and Design	Entrepreneurial Marketing
Adaptation to DCI	Start with development of concept for DCI culture; radical innovation is defined as a separate context, allowing comparison with incremental innovation	Start with defining customer involvement capabilities for radical innovation of SMEs; radical innovation is defined as a separate context, allowing comparison with incremental innovation	Start with development of constructs for Market Vision; overview of tools and techniques to develop DCI	Radical innovation is defined as a separate context, allowing comparison with incremental innovation
DCI concepts	Pro-active market orientation; high-level concept showing the cultural setting needed to generate DCI.	n/a	n/a	n/a
Typical Methods for data collection	Surveys	Surveys	Qualitative and case studies	Qualitative and case studies
Type of understanding	Exploring relations; general level of understanding	Exploring relations; general level of understanding	Open-ended; highly specific and difficult to generalise	Open-ended highly specific and difficult to generalise
Exemplars papers	Narver, Slater and MacLachlan (2004); Moorman (1995)	Coviello and Joseph (2012); Cui and Wu (2017); Nijssen et al. (2012)	Janssen and Dankbaar (2008); Reid and Brentani (2010)	Hulbert, Gilmore and Carson (2015)

Source: Author

The state of prior knowledge of DCI points to an intermediate maturity level of all four streams of literature. At this level of maturity, new research should focus upon specific contexts and develop new propositions for the exploration of middle-range theory (Blundel, 2007; Davidsson and Wiklund, 2001). Such research should utilise hybrid data collection methods, and triangulation of qualitative and quantitative evidence (c.f. Edmondson and McManus, 2007). The selection of an abductive, intensive case study research approach is highly consistent with these recommendations. Together with the specific context of this thesis — radical innovations targeted at new customers — such a research approach will facilitate the development of middle-range theory offering an alternative view on DCI.

5.5 SUMMARY OF THE RESEARCH STRATEGY

Chapter 5 has discussed the strategic choices underpinning this study, focusing on four aspects: the research objectives and research questions; the philosophical stance; the logic of enquiry; and the methodological fit. An exploratory qualitative approach was selected, which compliments the 'how' and 'what' research questions of this thesis.

This choice was further warranted by the philosophical stance of Pragmatic-Realism. Such a philosophy recognises that reality is defined by human actors and social forces, and that actors and their perceptions are an important entry-point in the exploration of organisational events. Furthermore, this stance permits the devleopment of theory from a practical, people-oriented viewpoint, with sufficient attention for long-term benefits and structural explanations.

Considering the requirements of Pragmatic-Realism, an abductive, intensive, case study design was deemed most appropriate for this thesis. Given that case study research is suitable for the study of events as they unfold within their real-life context, such a choice is justified. Case studies also allow the use of multiple sources of evidence, thus serving the explorative nature of this study, and providing sufficient levels of depth and richness to fully scrutinise the complexity of Deep Customer Insight generation.

The research approach of this study is consistent with the intermediate maturity of Market-Based Learning, Customer Involvement, Innovation Managmenet and Design, and Entrepeneurship literature. The intensive case study research design will allow this thesis to challenge prior work, and to offer an alternative view on how Small and Medium-sized Enterprises learn about customer needs. By researching DCI within SMEs targeting unfamiliar markets, this study will develop new theories regarding customer-focused learning in highly constrained and demanding situations.

CHAPTER 6 RESEARCH METHODS

6.0 INTRODUCTION

Chapter 5 demonstrated the suitability of an intensive case study research design for this thesis. Such a selection was based upon the proposed research questions, the philosophical stance of Pragmatic-Realism, the logic of enquiry, and the methodological fit. Considering the methodological fit, case study research complements the intermediate level of maturity of the Market-Based Learning, Customer Involvement, Innovation Management and Design, and Entrepreneurship literature.

Based on the decisions made in Chapter 5, this chapter delivers an overview of seven tactical aspects of the research, which are summarised in Table 6.1. These aspects involve the choice of Deep Customer Insight (DCI) practices as the unit of analysis and the procedures for sampling six cases. Furthermore, they include a research process of two main phases and a set of dedicated quality criteria which govern this study. Other aspects include the data-collection methods, and the approaches for within-case and cross-case analysis, resulting in four main contributions.

Table 6.1: Overview of Tactics for Case Study Research

Topic	Approach
Unit of analysis	The practice and its component parts (activities, actors, and resources) within the context of a radical innovation process
Sampling	Six award-nominated SMEs in the Netherlands. They are all system integrators and were selected on the basis of their market and technological experience
Research process	Two phases: one phase to identify the practices; one phase to capture perceptions and identify the consequences of the practices
Quality criteria	Preserving construct validity, internal validity, and external validity as well as reliability, e.g. by means of member-checks, data-sources, and methodological triangulation.
Data collection methods	Interviews, documents, surveys (screening, needs assessment, and practice-maturity), and a workshop.
Analytical approach	Analytical frameworks for coding and tabulation of individual cases.
Cross-case analysis	Three distinct approaches for each RQ, including coding and temporal bracketing procedures for the narratives, and a quantification and visualisation strategy.
Main contributions	Demonstrating how research skills and improvisation enable SMEs to effectively tap into customers' knowledge and to generate DCI, despite of their scarce resources.

Source: Author

Chapter 6 is organised in nine main sections:

1. The first section describes the unit of analysis and the underlying theoretical base
2. The second section explains the selection of case study projects and participants
3. The third section gives an overview of the research
4. The fourth section discusses the quality measures to preserve validity and reliability
5. The fifth section gives an overview of the full set of data collection methods
6. The sixth section describes the analytical approach for each research question
7. The seventh section describes the procedures for the cross-case analysis
8. The eighth section gives an overview of the empirical approach
9. The ninth section summarises Chapter 6

6.1 UNIT OF ANALYSIS

A unit of analysis distinguishes the research setting from the context and should align with the research questions. Moreover, it should facilitate comparison with existing literature (Yin, 2014). According to the guidelines of Practice theory, the central unit of analysis of a practice consists of its component parts and its outcomes (Nicolini and Monteiro, 2017). The central outcome explored in this study is DCI. To define the component parts of a practice, several definitions in the Practice literature were examined. Table 6.2 displays the definitions of four practice scholars, illustrating the broad family of theories available. Each theory defines its own component parts, although a closer inspection establishes that parts are often very similar.

Some definitions offered by Practice theory are difficult to operationalise. For example, Reickwitz (2002; 2012) mentioned a wide set of components including "bodily activities" or "states of emotions". Whittington (2006) and Shove, Pantzar and Watson (2012) build on the definitions of both Reckwitz and Schatzki to define three clearly distinct components. The components of Whittington (2006) are activities, resources, and actors, and are well-applied in previous research (e.g. the overview of Vaara and Whittington, 2012). The components of Shove, Pantzar and Watson overlap with these, except for the component called "meaning". This represents the *purpose*, or driving force, of a practice. Practice theory generally assumes that practices are organised towards an end, and are, therefore, purposeful (Nicolini and Monteiro, 2017). Integrating meaning as an integral component of a practice facilitates a better understanding of how motivation shapes practices (Shove, Pantzar and Watson, 2012).

Table 6.2: Practice Definitions

Authors	Definitions (constructs underlined)
Reckwitz (2002, p. 249)	"A 'practice' (Praktik) is a routinized type of behaviour which consists of several elements, interconnected to one other: forms of bodily activities, forms of mental activities, 'things' and their use, a background knowledge in the form of understanding, know-how, states of emotion, and motivational knowledge."
Schatzki (2002, p. 87)	"A practice is a temporally evolving, open-ended set of doings and sayings linked by practical understandings, rules, teleoaffective structures, and general understandings. […] the organisation of a practice describes the practice's frontiers: A doing or saying belongs to a given practice if it expresses components of that practice's organisation"
Shove, Pantzar and Watson (2012, p. 24)	"[…] practices are defined by interdependent relations between materials, competences, and meanings."
Whittington (2006, p. 615, 619):	Practice tradition includes three concepts of strategy praxis, practices, and practitioners. Practices are: "rules and resources"; Praxis are: "actual activity, what people do in practice"; Practitioners are: "those who do the work".

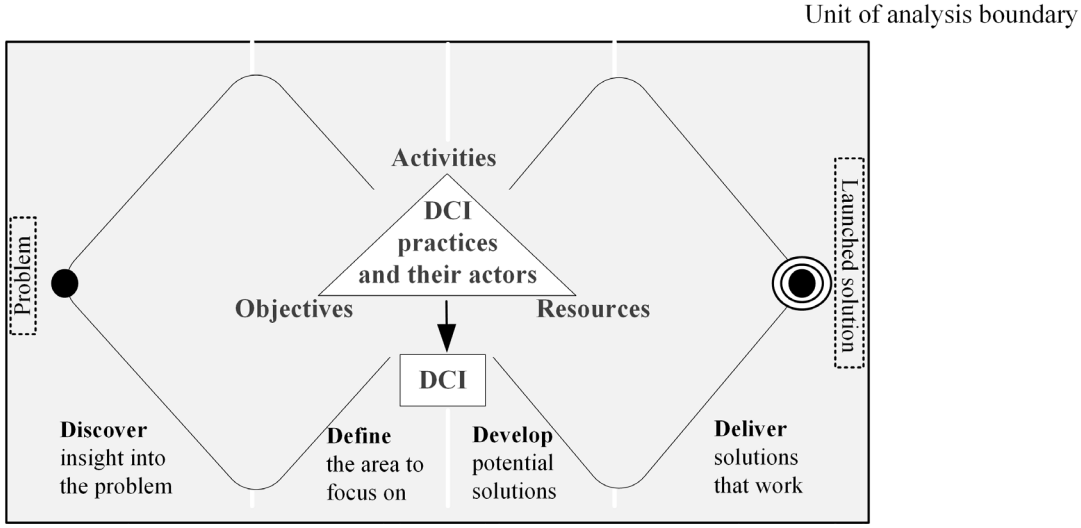
Source: Author

This study, therefore, defines the practice elements of actors; activities; the meaning given to these activities; and resources. A similar operationalisation has been adopted in other innovation studies, such as the work of Russo-Spena and Mele (2012). Moreover, the resulting unit of analysis can be easily compared with the capabilities from Market-Based Learning (MBL) and Customer Involvement literature (c.f. Berends et al., 2014; Coviello and Joseph, 2012).

The DCI practices are situated within the context of a radical innovation project which is targeted at new customers. The processes of radical projects can be described by the Double Diamond process of the British Design Council London (2005). This model has four phases: the Discover phase, in which insights into the problem are generated; the Define phase, in which the area upon which to focus ideas is defined; the Develop phase, in which potential

solutions are generated; and the Deliver phase, in which solutions are developed and launched (British Design Council London, 2005). Based on this model, the unit of analysis is graphically displayed in Figure 6.1. It comprises all activities related to DCI during the radical project, starting in the very earliest phase to define the problem and ending after launch of the solution. This unit of analysis does not include DCI activities taking place within regular business processes, such as the sales of current products.

Figure 6.1: Unit of Analysis



Source: Adapted from British Design Council London (2005)

Pettigrew (1997) stressed that the unit of analysis should be studied from multiple perspectives. This thesis will, therefore, study the DCI practices of individuals, as well as those taking place within (functional) groups, and within the wider project- and firm-level.

6.2 SAMPLING

With a clear unit of analysis, it is possible to select an appropriate sample. This study incorporated two levels of sampling: sampling of the case study projects, and sampling of individual informants for each case study project.

6.2.1 Case Study Selection

Innovation cases were selected from a population of 700 projects. These projects were gathered from the MKB[1] top 100, the most innovative SMEs in The Netherlands. Since 2007, these SMEs have been nominated annually in a competition run by the Dutch Chamber of Commerce. By using this sampling frame, it can be argued that all projects were sufficiently radical by nature.

[1] MKB is the Dutch equivalent acronym for SME and stands for Midden and Klein Bedrijf.

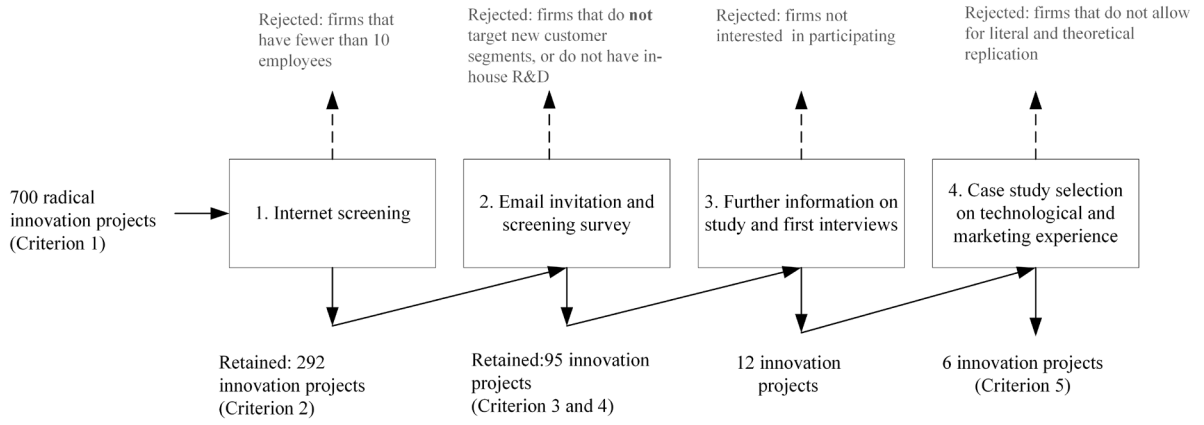
The screening procedure used to select cases is illustrated in Figure 6.2 and consisted of four steps. In the first step, the projects' firm details were identified. To this aim, all 700 innovation projects featured in the MKB lists from 2010 to 2016 were screened using publicly available details. 292 projects, all developed within firms employing more than ten people, were retained.

In the second step, projects were screened by means of a brief telephone survey. Projects that did not target new customer segments were excluded. Additionally, firms not having an in-house R&D position were excluded. The remaining firms were then screened on their perceived technological and marketing experience, thus confirming that their projects were sufficiently radical by nature. Perceived experience was rated on a five-point Likert scale ranging from 'very poor' (1) to 'excellent' (5), adapted from Olson, Walker and Ruekert (1995). The operationalisation for the screening survey is included in Appendix C. A total of 95 responses were captured.

In the third step, 39 firms that expressed an interest in participating in this study were given information on its purpose and timing. Initial interviews were held with 12 interested firms.

Following the guideline of Eisenhardt (1989), that 4–10 cases suffice to establish replication, in the fourth step, six case projects were selected. To provide for *literal replication* — yielding similar results — and *theoretical replication* — yielding different results, cases were selected at both high, medium, and low levels of technological and marketing experience.

Figure 6.2: Case Study Selection Procedure



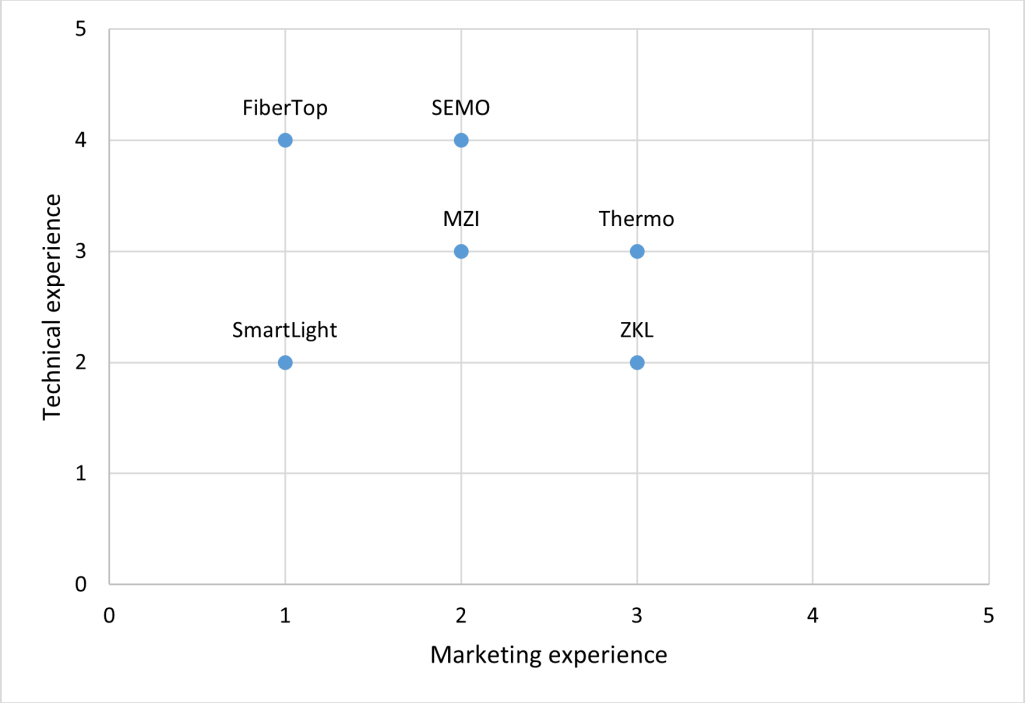
Source: Author

This four-step procedure thus ensured that the selected cases met five selection criteria, which are displayed in Figure 6.2. The criteria are:

1. Featured in the MKB top 100 and are, thereby, sufficiently innovative
2. Developed in a firm employing at least ten employees
3. Targeting an unfamiliar customer segment
4. Developed in a firm employing at least one R&D professional at the time of the project
5. Representing a project for which the team developed substantial new technological and marketing skills, thereby confirming the projects' radicalness

Figure 6.3 displays the six selected projects and the levels of marketing and technological experience of the teams working on the projects. In order to maintain confidentiality, the six projects and their companies funding them are referred to with disguised names (e.g. SEMO and FiberTop).

Figure 6.3: The Six Cases Selected



Source: Author

None of the selected cases scored higher than 3 in their marketing experience for the new project. This score is consistent with the new needs that their projects were aiming to address, and, therefore, confirms the radical nature of the projects.

6.2.2 Actor Selection

Planned data collection methods included interviews with the key actors involved with DCI and were selected on the basis of their involvement with DCI activities. For each case, multiple actors, holding positions at multiple levels of the organisation, were interviewed. Interviewing such a variety of actors leads to richer and more reliable theory (Eisenhardt, 1989). The screening interviews of the case study selection procedure were held with one of the main innovation actors; this person became the entry point for a further purposive sampling procedure. Such a procedure is appropriate when a limited number of primary data sources possesses knowledge of the phenomenon of interest (Patton, 2002). In this thesis, the knowledgeable actors varied for each case, and, other than the owner-entrepreneur, included R&D employees, marketing experts, outside consultants, market research experts, and the customer. To ensure that all relevant actors were identified, the involvement of the interviewee with the innovation project was verified at the beginning of each interview. When new actors were mentioned during an interview, the actual level of involvement with the project of that newly introduced actor was validated with the contact person.

6.3 OVERVIEW OF THE RESEARCH PROCESS

Two distinct research phases were necessary in order to address the research questions posed by this study. This is illustrated in Figure 6.4, which shows how a first phase *of interviews and document* inspection provided the input for a second, *workshop*, phase. Sections 6.3.1 and 6.3.2 summarises the activities and output of each phase, as well as the role of the researcher.

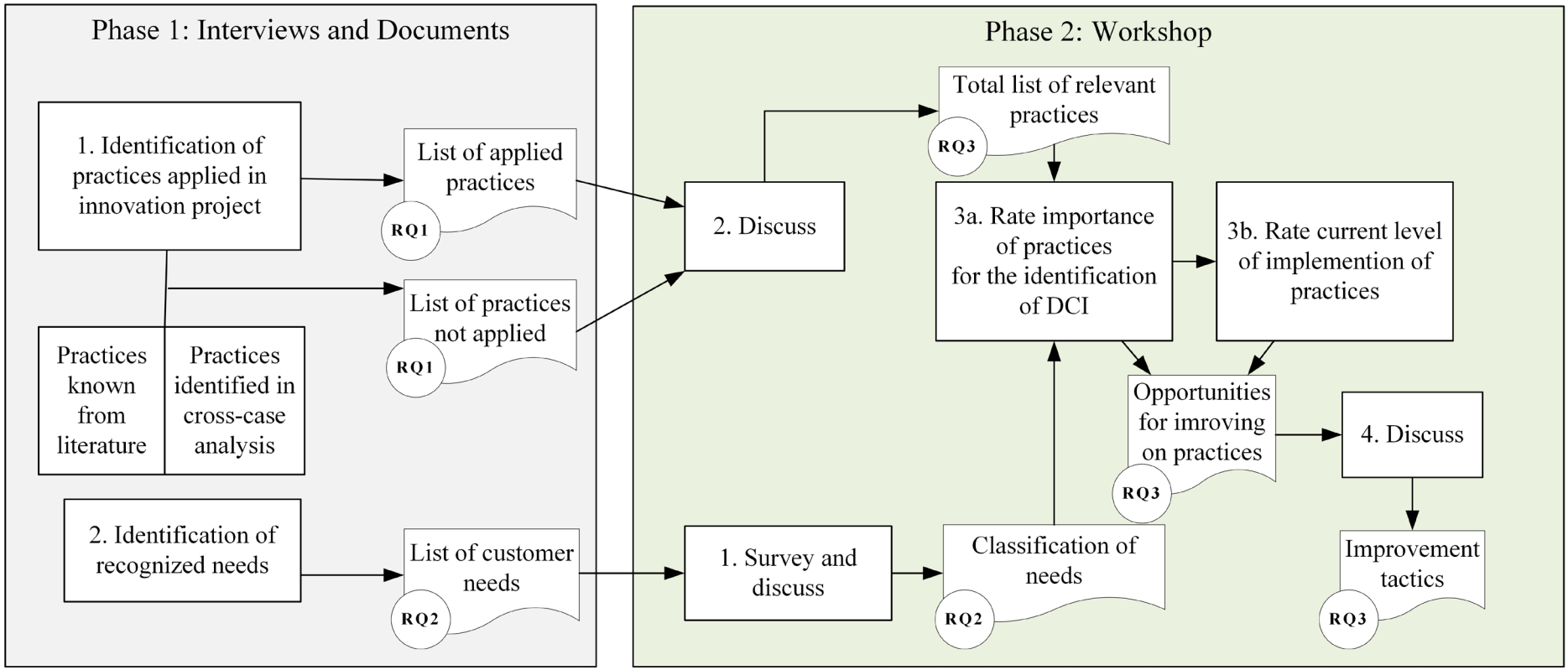
6.3.1 Activities in Phase 1

In Phase 1, two main sets of activities took place, both of which are based on interviews and company documents. Firstly, interviews with the main innovation actors probed for activities in relation to DCI and traced evidence in company documents. This resulted in an overview of the applied practices within each case project, thus addressing RQ1. Moreover, the cross-case analysis provided a list of practices that were not applied, and both lists furnished input for Phase 2. Secondly, interviews probed for needs that the innovation project aimed to address and asked for supporting documentary evidence. This resulted in a list of customer needs, which was evaluated in Phase 2. The researcher's participation in Phase 1 was confined to a *complete observer role* (Lee, 1999), in which the researcher observes and listens, remaining as unobtrusive as possible.

6.3.2 Activities in Phase 2

In Phase 2, a collaborative research process validated and refined the findings of RQ1, and generated results for RQ2 and RQ3. Data was collected by means of a workshop format, including four distinct steps. In the first step, the participants were asked to appraise the type of needs addressed by the innovation project, which provided conclusions for RQ2. The second step consisted of an evaluation of the importance and level of implementation of the practices utilised by the innovation project, generating findings for RQ3. In the third step, a qualitative probing into participants' perceptions of the most relevant practices generated additional data for RQ3. This was combined with the results of the fourth step, in which opportunities for improvement, as well as barriers and factors of success, were discussed. In Phase 2 the researcher assumed a more active, but still modest, role, closely resembling the *peripheral-member-researcher* role as defined by Adler and Adler (1987, p. 35). The researcher did not participate in the core business processes of the firm, and took into account requirements with regards to socialisation and the level of knowledge, thus ensuring acceptance and a non-threatening climate (Fielding, 2001).

Figure 6.4: Overview of the Research Process



Source: Author

6.4 QUALITY CONSIDERATIONS

Case study research requires consideration of quality risks (Goffin et al., 2019). Such risks may include *construct validity* — incorrect concepts and measures —, *internal validity* — incorrect conclusions about causation —, but also *external validity* — a lack of generalisability, or inability to reproduce the same results. Moreover, a lack of transparent procedures for data collection and analysis may compromise *reliability*, which is defined as a difficulty to replicate the study (Yin, 2014).

6.4.1 Overview of Quality Measures

Several available measures can be used to mitigate these quality risks. For example, construct validity can be improved by creating measures for concepts, while reliability can be improved by adding triangulation opportunities (Eisenhardt and Graebner, 2007). Moreover, external validity can be improved by tying findings back to theory (Tsoukas, 2009). Internal validity may be preserved by identifying a non-conforming case and set-up pattern matching in the within-case or cross-case analysis (Harrison, 2002). This study adopted all of these strategies, and a summary of the measures is included in Table 6.3.

Table 6.3: Actions to Mitigate Quality Risks

Criterion	Description	Measures taken
Construct Validity	The quality of conceptualisation (Gibbert et al. 2008). Correct operationalisation for the concepts studied (Yin, 2014)	Methodological and data triangulation
		Multiple sources of evidence and theorising approaches
		Use of informants with different perspectives to enhance accuracy and compensate for individual biases
		Multiple methods, such interviews and surveys
		Traceability and replicability by using database containing source material, coded material, and findings
		The presentation of protocols to experts and peers
		Development of analysis instruments and a DCI measurement instrument
		Explicit and comprehensive account of the findings
		Peer reviews of findings
		Respondents proof-reading case study materials
		Joint coding and debriefing
Internal Validity	Check if causal relations between variables and results are valid	Correct for common method bias by applying multiple methods and temporal separation
		The use of multiple cases
		Coding of relations between activities, the objectives, and associated resources of each activity
External Validity	Check if the findings are generalisable beyond the six cases	Literal and theoretical replication
		Cross-case analysis
		Suggest settings for further research
Reliability	Check if the study is free of errors and biases	Detailed case protocols and analysis instruments
		Transcripts
		Member checks of case descriptions

Source: Author

Table 6.3 demonstrates how this thesis triangulated findings by combining interviews, document inspection, workshop methods, and by interviewing different actors. Furthermore, this study corrected for common methods bias by separating data collection of practices and their outcomes, both in terms of method and timing (Podsakoff et al., 2003). The associated procedures will be discussed in more detail in Sections 6.4.2 – 6.7.

6.4.2 Pilot Study

A pilot study supports the refinement of the procedures used in this thesis and, therefore, strengthens the validity of the findings (Goffin et al., 2019). Criteria for selecting a pilot study include its proximity or its complexity (Yin, 2014); the SEMO case was chosen as the pilot study because it met both selection criteria. First, the researcher held a close, professional, relationship with several members of the research team. High levels of trust enabled the researcher access to all of the actors involved in the innovation process and all documents related to the project. Moreover, such trust also helped actors to speak openly about the difficulties encountered. The SEMO case was highly complex, involving a significant number of actors located in different countries, all of whom had extensive interactions. Findings generated by the pilot study helped in two ways. Firstly, it supported data-collection and identified the documents of potential interest. Additionally, the wide range of practices identified in this project improved probing for specific activities and resources in subsequent cases. Secondly, as a result of the high number of data sources, the strategy of this thesis for data analysis was strengthened.

6.5 DATA COLLECTION METHODS

This study included multiple methods of data collection, and execution of such methods took place according to pre-defined protocols. By using a hybrid set of data collection methods, the inherent weaknesses of each method is mitigated by the strengths of others (Brewer and Hunter, 2006). Four categories of methods were applied: interviews, documents, a survey, and a workshop. Table 6.4 gives an overview of data collection methods' objectives and planning in the two research phases.

Table 6.4: Objectives and Planning of the Research Methods

Phase	Data collected	Methods	Data objective	Quality objective
1	Interviews	Interviews about practices and needs	To identify DCI activities, meanings, resources, and actors	To triangulate with findings from documents
			To capture needs insights and assess the quality of insights	To triangulate with findings from documents and survey
			To understand actors' perceptions of DCI practices	To triangulate with findings from workshop
	Documents	Document inspection	To understand context and perceptions of DCI practices	To triangulate with findings of practice interviews
			To capture needs insights and use as input for needs insights assessment survey	To triangulate with findings from interviews
2	Surveys	Needs insights assessment survey	To identify the level of insight produced by the practices by using the Kano procedure (Kano et al., 1984); to compare this across cases.	To strengthen construct validity
		Needs insights assessment interviews		To correct for common-method bias provoked by self-assessment of outcomes of practices
		Practice maturity survey	To identify perceptions with regard to importance and level of implementation of the practices (Reijonen and Komppula, 2010)	To strengthen construct validity
	Workshop	Focus group discussion	To understand DCI practices implementation	To triangulate with findings of the practice maturity survey and the practice interviews

Source: Author

6.5.1 Data Collection at Phase 1

6.5.1.1 Interviews About Practices and Needs

Interviews are a primary source of data in case studies (Yin, 2014) and are considered essential to understanding the background, activities, and perceptions of practitioners in practice-based studies (Bond, Pilbeam and Turner, 2017). Interviews at Phase 1 aimed to identify both the actual activities and resources employed in the practices, as well as the perceptions of the actors about such practices. Additionally, Phase 1 interviews pinpointed actors' definitions of DCI, the quality criteria perceived to be important for DCI, and the most important needs insights generated during the project. This enabled triangulation of the findings of the document inspection, needs insights assessment survey, and workshop discussion held in Phase 2.

To ensure consistency and completeness across the interviews, an interview protocol was used (see Appendix D for the translated topic list), beginning with the identification of important DCI-related events, their timing, and their linkages across the NPD project. The narrative was elicited in a naturally flowing discussion and focused on actual activities. For each activity, participants were asked to explain associated objectives and resources. This focus on specific events facilitated the accuracy of the narrative (Huber and Power, 1985). After the identification of main events, actors were probed for needs insights gained during the DCI process, and asked to score their level of insight on a scale ranging from 'very poor' (1) to 'excellent' (5). Lastly, the actors were asked for the most important events leading to insights.

After the first round of interviews, follow-up interviews took place in order to clarify or complete findings (Johnson et al., 2007).

6.5.1.2 Documents

As recommended by Yin (2014), company documentation was collected to enhance and support the findings generated by the interviews. Some of the documents, such as brochures, referred to the organisation's rules and procedures, and reflected the organisation's vision of the ideal way of acting with regards to DCI and NPD. Other documents included meeting notes and e-mails referring to the actual doings of the actors (Feldman and Pentland, 2003); for example: requirements lists, market research reports, business cases, and marketing planning documents.

6.5.2 Data Collection at Phase 2

6.5.2.1 The Needs Insights Assessment Survey

Although practice-based studies predominantly rely upon qualitative methods, there is room for quantitative data, especially for validation and cross-case analysis (Johnson et al., 2007). The needs insights assessment survey of Phase 2 aimed to measure the type of needs insights (i.e. latent needs insights or current needs insights) resulting from the practices.

A key issue for addressing RQ2 was the lack of readily available measurement instruments to gauge the type of needs insight. Exploration of suitable measurement instruments took place both within the set of systematically reviewed papers and in an additional, more specialised, set of papers. The latter included measurement instruments from C-K theory (Hatchuel and Weil, 2003; Le Masson, Hatchuel and Weil, 2007), Means-end theory, and Total Quality Management. Table 6.5 provides an overview of these additional measurement instruments, most of which were deemed inappropriate because of their scope. Constructs from the work of Bonner (2010) were too narrow, focusing only on extrinsic quality attributes and not revealing the type of insights to which these attributes refer. Others, such as the concept of Market Vision (Reid and De Brentani, 2015), were too broad, including other types of insights, such as technical insights. The measurement instruments from C-K theory and Means-end theory were rejected due validity issues and the difficulty utilising them in cross-case analysis.

The most appropriate measurement instrument originates in the concept of attractive quality (Kano et al., 1984), which is commonly used in Total Quality Management to evaluate and select product concepts. Attractive quality theory was found to align well with available definitions of needs insights, and to offer an approach free of validity issues (e.g. Rejeb, Boly and Morel-Guimaraes, 2011; Witell and Löfgren, 2007).

Attractive quality theory equates customers' needs with customers' *requirements* to products and services. This comes close to the conceptualisation of needs by Ulwick and Bettencourt (2008), and overlaps with the definition of customer needs offered in other papers included with the Systematic Literature Review (SLR) (e.g. Carlgren, 2013; Goffin, Lemke and Koners, 2010; Griffin and Hauser, 1993). Customer requirements were, therefore, considered an expression of needs insights and coded as such in interviews and documents. The resulting list of insights was then subjected to the scoring procedure.

This procedure entails scoring insights in any of the following categories: 'attractive', 'one-dimensional', 'must-be', or 'indifferent' (e.g. Berger et al., 1993; Rejeb, Boly and Morel-Guimaraes, 2011; Witell and Löfgren, 2007). Attractive insights address latent needs, and are generally *novel* needs, whereas the others refer to current needs (Goffin, Lemke and Koners, 2010). The amount of needs insights in the 'attractive' category were, therefore, used as a proxy

indicator for novelty. A drawback of direct scoring is that it requires respondents to have a sufficient understanding of attractive quality theory (Witell and Löfgren, 2007). Therefore, a brief explanation and accompanying exercise was given to the respondents prior to the scoring activity. Moreover, during scoring, individual assistance was offered, thus preserving construct validity. The example and operationalisation for the needs insights assessment survey is included in Appendix E.

Table 6.5: Available Approaches for Measuring the Level of Customer Insight

Option	Measures available	Findings	Studies of importance	Final conclusions
Measures available within the SLR	Quantity of needs Quality of customer information Value of customer knowledge Market Vision	The few studies that focus on immediate outcomes of DCI processes use measurement instruments that are either too narrow, or too broad. They focus on different information quality aspects, such as relevance, novelty, or cost without including the content of the insights. When they do, they include other content types such as technical insights.	Bonner (2010); Mahr, Lievens and Blazevic, (2014); Griffin and Hauser (1991); Reid and De Brentani (2010).	The available measures do not match the aims of this this to distinguish latent and current needs
C-K Theory	Mapping of the content of knowledge domains and interaction with creativity	The approach is mostly applied to technical knowledge and has no proven value within the customer knowledge domain. The qualitative output is difficult to use for cross-case analysis.	Agogué et al. (2014); Agogué, Le Masson and Robinson (2012); Cassotti et al. (2016); Hatchuel and Weil, (2003, 2009); Le Masson, Hatchuel and Weil (2009, 2007).	The available output does not allow for valid cross-case comparison
Means-end Theory	Cognitive mapping measures, such as complexity and centrality, of the knowledge domain	Widely applied in various domains, but still debated with regards to its validity and applicability.	Vanden Abeele and Zaman (2009); Gutman (1982); Bourne and Jenkins (2005); Henneberg et al. (2009); Botschen and Hemetsberger (1998); Jenkins (1997).	The available measures suffer from validity issues
Total Quality Management	Classification of customer needs on quality dimensions of Kano	Widely applied in various domains, no issues with regard to its validity.	Berger et al. (1993); Rejeb, Boly and Morel-Guimaraes (2011); Tontini (2003); Witell, Löfgren and Dahlgaard, (2013); Witell and Löfgren (2007); Yang, (2013).	Suitable to classify the insight in current and latent needs

Source: Author

6.5.2.2 The Practice Maturity Survey

A second survey probed for the perceived importance and level of implementation of the innovation practices, providing part of the data of RQ3. Importance was measured on a five-point Likert scale ranging from ‘not at all important’ (1) to ‘very important’ (5). The scale for measuring the implementation of practices was adapted from Reijonen and Komppula (2010), and ranged from ‘managed very poorly’ (1) to ‘managed very well’ (5).

6.5.2.3 The Workshop and Focus Group Discussion

The workshop provided the setting for survey procedures and interviews, and further allowed for a focus group discussion on the innovation practices. Focus groups are useful in practice-based studies to capture perceptions, reach consensus between participants at different organisational levels, and to understand how practices evolve over time (Johnson et al., 2007), which matches the objectives of Phase 2. The drawbacks of workshops include the potential contamination due to the proximity with the participants, and enforced reflexivity within focus group discussions. By using multiple methods and defining a distant role for the researcher, such a risk was mitigated.

Participants in the workshops consisted of the actors interviewed in Phase 1 of the study. The workshop began with a brief presentation of the practices identified in Phase 1. This was followed by the needs insights assessment survey procedure, including an immediate display of results followed by a discussion on the procedures undertaken. This discussion produced insights into the validity of the survey procedure. After this, individual rating of the importance and level of implementation of the practices took place online. An immediate display of results followed, with a final plenary discussion of how the practices supported the generation of DCI and the opportunities for improvement. The entire session was audio-recorded and transcribed. An example of the workshop script is enclosed in Appendix F.

6.6 WITHIN-IN CASE ANALYSIS

The analytical procedures utilised in this study were developed for each research question separately. Sections 6.6.1– 6.6.3 provide the relevant details.

6.6.1 Analytical Approach for RQ1

The approach with regards to RQ1: *How do small firms' practices enable them to generate DCI for radical innovation projects?* involved five steps, which are summarised in Table 6.6. Following the work of Schatzki (2012), *activities* — defined as happenings, or work-related tasks — were used as a starting point for the identification of practices. Therefore, in a first analytical step, all activities related to DCI generation and use were identified. Codes were assigned according to the guidelines of Corbin and Strauss (2008) for open coding and retained in NVIVO11.

In the second analytical step, activities were grouped into higher-order practices based on their adjacency and similarity (Miles, Huberman and Saldana, 2014). This step aligns, again, with Practice theory, positing that activities within one practice are interconnected (Bond, Pilbeam and Turner, 2017; Schatzki, 2005). At this step, a comparison with the Market-Based Learning, Customer Involvement, Innovation Management and Design and Entrepreneurship literature allowed for categorisation consistent with relevant themes. Alongside the researcher, two junior researchers coded the activities individually and any discussion of both open codes and higher-order practices was withheld until consensus on coding was reached.

In the third step, the associated objectives of each practice were identified. This followed the premise that practices are always organised towards an end, while, simultaneously, validated the results of Step 2. In the fourth step, the relationship between activities and resources was established, which was done by coding all means — i.e. resources — that proved to support actors in their execution of the activities. The fifth analytical step refined findings by identifying the relationships between the practices, following the procedure of axial coding set down in the work of Strauss and Corbin (1998).

Table 6.6: Analytical process RQ1

#	Steps in the analysis	Main activity
1	Identifying the DCI activities by means of first-order coding	Open coding, first-level coding
2	Grouping into higher-order practices	Higher-order coding
3	Identification of objectives of each practice	Coding of objectives – activity relations
4	Identification of resources and actors drawing upon these resources	Coding of resource – activity relations Coding of actors – activity relations
5	Identification of relationships	Axial coding of relationships between activities

Source: Author

6.6.2 Analytical Approach for RQ2

The analytical procedure to address RQ2: *What is the level of insight resulting from DCI practices?* focused on assessing the quality of the insights resulting from the practices. To grasp the different qualities of insights, a multi-factor measure for six quality criteria was composed. Seven indicators were used to measure the six quality criteria. Aside from the indicator for the type of needs insights, it included six other indicators found in the Systematic Literature Review (SLR). The data was generated by means of two main procedures: the analysis of customer requirements of each case project and the needs insights assessment survey. The quantitative findings were triangulated with qualitative data stating actors' perceptions of the defining quality characteristics of DCI as well as their perceptions of their performance on these criteria.

The distinct aims, procedures, and indicators are summarised in Table 6.7. On the left-hand side, the table includes the six papers from the SLR addressing the quality of knowledge (from Bonner (2012) to Ulwick (2005)), which considers 13 quality criteria. The right-hand side of the table demonstrates this study's dual procedure allowing the adoption of six of these criteria, namely: 'timely', 'comprehensive', 'novel', 'consistent', 'inspiring', and 'format'. This set includes criteria mentioned in more than one paper. Although 'timely' and 'comprehensive' were less frequently mentioned, they were, nevertheless, included because of numerous anecdotal references (e.g. Veryzer, 2005; Veryzer and Borja de Mozota, 2005). 'Accurate' and 'relevant' were not included because of the absence of a suitable measurement instrument. By focusing on a specific type of knowledge — namely latent needs insights (represented by the criterion of 'novel' insights) — this thesis indirectly incorporates the criterion of 'specific insights'.

Table 6.7: Aims, Procedures, and Indicators RQ2

	Authors						This study		
							Multi-factor measure for level of insight		
Quality criteria	**Bonner (2010)**	**Mahr, Lievens and Blazevic (2014)**	**Hultink et al. (2012)**	**Reid and De Brentani (2010)**	**De Luca and Atuahene-Gima (2007)**	**Ulwick (2005)**	**Procedure**	**Indicator**	**Validation of quality criteria**
1 Timely	-	-	✓	-	-	-	Coding of customer requirements found in interviews and documents	Yes/no availability of a document listing insights	Coding of criteria for DCI and perceptions of performance as found in interviews, documents, and workshop
2 Comprehensive	-	-	-	-	✓	-		Verification missed needs insights	
								total # of needs insights	
3 Novel	-	✓	-	-	✓	-	Needs assessment survey	# attractive needs	
4 Consistent	✓	-	-	-	-	✓	Coding of customer requirements found in interviews and documents	% of consistently formatted insights	
5 Inspiring	✓	-	✓	✓	-	✓		% of insights free of solution aspects	
6 Format	-	-		✓		✓		# of formats	
7 Accurate	✓	-	✓	-	-	-	-	-	
8 Specific	✓	-	-	✓	✓	✓			
9 Relevant	✓	✓	-	-	-	-	-	-	
10 Magnetism	-	-	-	✓	-	-	-	-	
11 Cost-efficient	-	✓	-	-	-	-	-	-	
12 Objective	-	-	✓	-	-	-	-	-	
13 Depth	-	-	-	-	✓	-	-	-	

Source: Author

Six indicators were calculated on the basis of the customer requirements specified in each case project. The indicator for 'timely' insights considered the availability of a document listing insights during the project. For 'comprehensive' insights two indicators were included: a count of missed needs, and the total amount of needs insights. For 'consistent' insights, the percentage of consistently formatted insights was calculated. The indicator for 'inspiring' insights followed the prescriptions of the reviewed literature stating that customer insights should be fit for purpose and induce the appropriate action. More specifically, they should not refer to specific product characteristics because of their limiting effect on creativity (Bettencourt and Ulwick, 2004; Van Kleef, Van Trijp and Luning, 2005; Le Masson, Hatchuel and Weil, 2009). The percentage of insights that were free of solution aspects incorporates this notion. The indicator for 'format' displayed the number of different formats used for the requirement statements. This aligns with directions of Ulwick (2005) that needs insights should be captured in a single, dedicated format. One indicator, namely 'novel' insights, was based on the needs assessment survey and counted the number of novel needs.

Validation of the quality criteria taken from the literatures, took place by coding participants' criteria for DCI. Additionally, actors' perceptions of their performance on each of those criteria were coded. The list of criteria from the reviewed literature formed the initial set of codes, which were then supplemented with emerging codes.

6.6.3 Analytical Approach for RQ3

Several instruments were applied for RQ3: *What are the perceptions of small-firm actors of DCI practices?,* including quantitative and qualitative procedures. Quantitative procedures facilitated the recognition of the perceived importance and level of implementation of the practices. This in turn enabled to understand what practices were perceived most relevant to improve. The quantitative analysis was done in real-time, and graphically displayed during the workshop to facilitate discussion, which was then subjected to further coding and qualitative analysis.

Practices deemed most relevant to improve included those upon which the team agreed they were important, but not yet implemented sufficiently. An opportunity score was calculated to easily identify the practices that should receive priority for improvement. Following Ulwick (2005) the score is based on the proportion of respondents giving a specific practice a score of 4 or more for importance and implementation. It is the result of the following calculation:

> % of respondents giving a score of 4 or more for importance + (% of respondents giving a score of 4 or more for importance − % of respondents giving a score of 4 or more for implementation)/10.

High opportunities have opportunity scores above 15, moderate opportunities have scores above 12, and low opportunities have scores score above 10 (Ulwick, 2005). Practices with opportunity scores of 10 or more were presented to the group for validation, and reactions were coded on the basis of the practice codes generated for RQ1. For each of the identified practices, separate open codes captured participants' perceptions of importance and implementation and specific improvements. The codes for the improvements were further reduced into a selected number of higher-order themes, representing improvement tactics. Triangulation with perceptions expressed during the interviews of Phase 1 further enhanced construct validity.

6.7 CROSS-CASE ANALYSIS

The cross-case analysis aimed to support the generalisation and explanation of findings. According to Miles and Huberman (1994) this can be achieved by further data reduction and inspecting the cases on patterns and themes that cut across the cases. It may also include an examination of typologies, case families. With regards to RQ1: *How do small firms' practices enable them to generate DCI for radical innovation projects?* the cross-case analysis is based on five distinct approaches. Firstly, data was reduced by applying a higher order categorisation of the practices in four distinct practice-groups. This facilitated an understanding of the key practices. Secondly, the number of efforts put into a practice was used as a measure for practice performance and defined by the sum of elements (activities and resources) constituting a practice. This enabled to compare the case projects, as well the importance of a given practice within a scheme of other practices. Thirdly, a summary of the incoming and outgoing relationships of the practices revealed common timing and order aspects of the practices. Fourthly, an overview of team roles elucidated how cases varied in terms of actors involved. Fifthly, an additional count and comparison of the resources enabled the identification of the main resource groups. Overall, the results show typical strategies for developing DCI within separate SMEs.

With regards to RQ2: *What is the level of insight resulting from DCI practices?,* the results on three pre-defined criteria including timely, comprehensive, and novel were compared. Together with two additional criteria of acceptance and cost-efficient, both identified from the perceptions of DCI quality, overall results were scored. This enabled the classification of the cases in terms of high, medium, and low DCI performance.

With regards to RQ3: *What are the perceptions of small-firm actors of DCI practices?,* the procedure for cross-case analysis followed the within-case procedure on the aggregate importance and implementation scores. The practices commonly perceived most relevant to improve were identified and for each supporting qualitative material was listed. Further data-reduction of improvement tactics into higher order themes, facilitated conclusions and revealed typical differences.

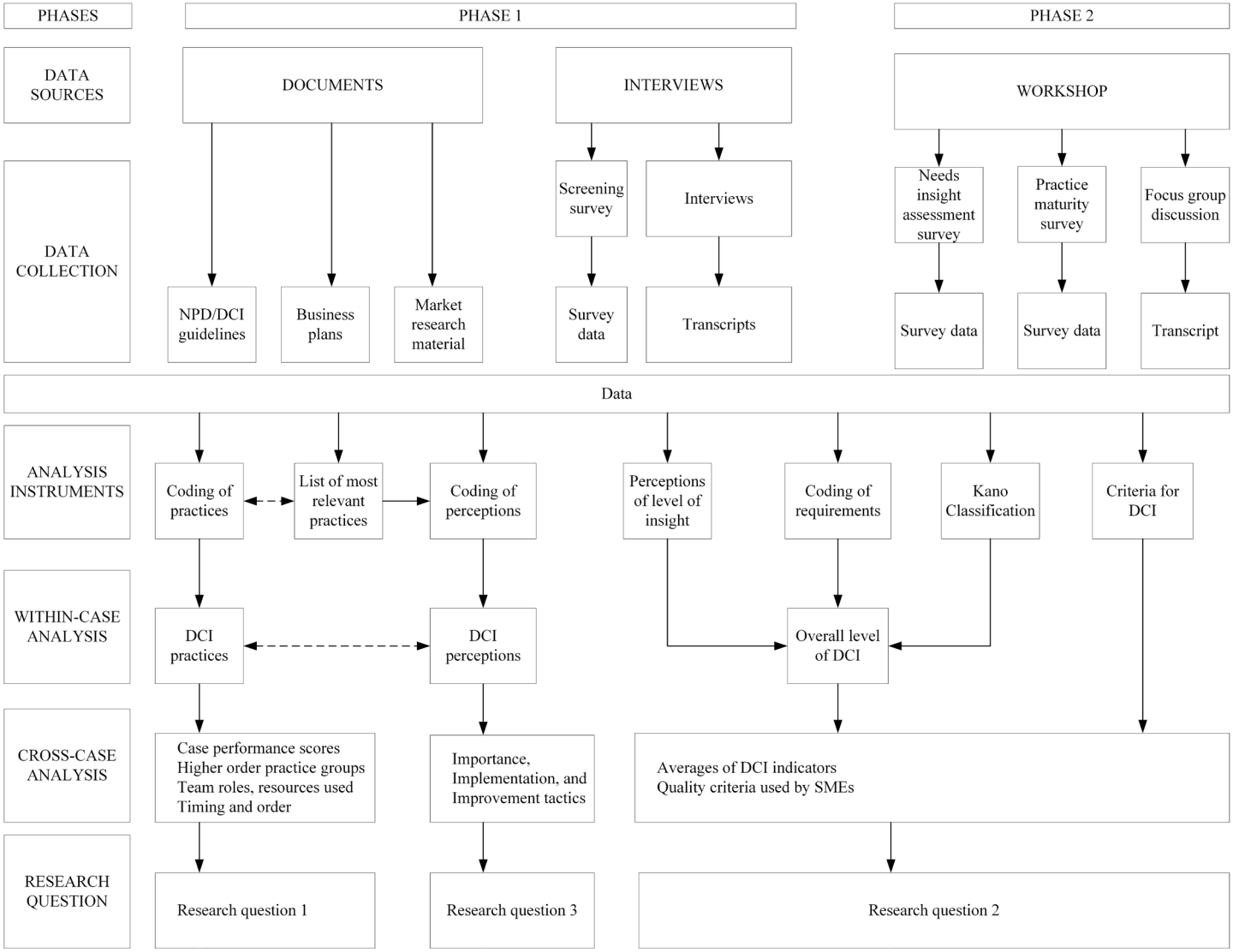
6.8 OVERVIEW OF THE RESEARCH APPROACH

The empirical approach of this study is summarised in Figure 6.6. The top half of the figure displays the data-sources in the two research phases.

In Phase 1, documents and interviews offered an initial understanding of the DCI practices and the needs insights resulting from it. These were further validated in Phase 2, in which a workshop was held. During this workshop, the DCI practices were scored based on their importance and implementation in the practice maturity survey. Moreover, the type of needs insights was scored by using the Kano Methodology (Kano, 1984) in the needs insights assessments survey, with the results explored during focus group discussion.

The bottom half of Figure 6.6 displays the within-in case and cross-case analysis for each research question. RQ1 was based on a coding procedure which evolved from a combination of open coding, higher-order grouping, and axial coding. This resulted in an overview of DCI practices per case. The case performances of each practice were identified by comparing their individual performance on activities and resources against the average group performance. Moreover, the individual practices were clustered into practice groups. Summaries of team roles, resources, and timing and order aspects completed the cross-case analysis for addressing RQ1. RQ2 was investigated by using six measures representing the timeliness, completeness, type of needs insights, consistency, degrees of freedom, and number of formats. Aggregates of these measures were used in the cross-case analysis for addressing this research question. RQ3 was examined by aggregating the scores of importance and implementation and summarising the barriers and critical success factors.

Figure 6.6: Overview of the Empirical Approach



Source: Author

6.9 SUMMARY

Chapter 6 has discussed the choices taken regarding research methods when considering: the unit of analysis, sampling, the research process, quality considerations, data collection methods, within-case analysis, and cross-case analysis. This illustrated how the unit of analysis incorporated the components of a practice — activities, meanings, and resources. Morover, the unit of analysis included the actors performing the practice and the outcome of the practice (i.e. the level of insight). The practices were situated wihtin the New Product Development (NPD) processes taking place within radical innovation projects, thus excluding regular business process from the unit of analysis.

Sampling was performed at the level of the innovation cases, and at the level of actors within the cases. The sampling frame ensured that the innovation cases were sufficiently radical. Other criteria for selection ensured that the projects targeted unfamiliar customer segments, were developed by firms employing at least ten people, and that firms included an in-house R&D department. The theoretical and literal replication logic used for sampling was based on the different levels of technological and marketing experience of the firms being considered, resulting in the selection of six cases. Within these cases, the actors that were closely involved in the NPD process were selected by means of purposive sampling.

The research process consisted of two main phases. The first phase was dedicated to the identification of practices and needs insights by means of conducting interviews and document inspection. The second phase consisted of a workshop, which validated the practices and provided the data for an analysis of the level of insight and the perception of the practices.

To preserve the quality of this study, the approach incorporated a wide set of measures to protect construct validity, internal validity, external validity, and reliabilty. These included methodological and data triangulation, member checks, and a pilot study.

By using a hybrid set of data collection methods, the inherent weaknesses of each method are mitigated by the strengths of others. Four method categories were applied: interviews, documents, a survey, and a workshop.

For each research question, a separate analytical approach was designed, thus supporting the within-case analysis. The approach for RQ1 incorporated the guidelines of Practice theory, which led to the identification of DCI practices in five analytical steps. The approach for RQ2 was based on both the quantitative and qualitative data of six indicators, together representing the level of insight. The approach for RQ3 was similarly based on both quantitative and qualitative data showing importance, implementation, and improvement opportunities for these practices.

The cross-case analysis was designed to highlight the similarities and differences between the selected cases, which was achieved by aggregating the results of the within-case analysis.

CHAPTER 7 EXAMPLE CASE STUDY OF SEMO

7.0 INTRODUCTION

Chapter 7 presents the results of the case study of SEMO, a newly developed Information System (IS) solution from InfoCo.[1] InfoCo produces solutions to help academic researchers capture and analyse empirical data. SEMO featured in the MKB[2] top 100 in 2015, and built on substantially different technology than previous solutions. It was targeted at new customer groups in the health care, legal, and educational markets. Thus, SEMO was a radical innovation for InfoCo, involving new products, with new technology, aimed at new markets. Data capturing was undertaken from May 2016 through to September 2017.

SEMO was chosen as an ideal example because it was a rich case, illustrating the many factors and interactions involved in DCI generation. The SEMO case thoroughly demonstrates the data collection and theorising approaches adopted for this thesis.

Chapter 7 is organised into six main sections:

1. The first section gives the background to the case
2. The second section presents the findings with regard to RQ1, the practices
3. The third section discusses the findings with regard to RQ2, the level of insight
4. The fourth section considers the results of RQ3, the perceptions of the practices
5. The fifth section draws conclusions regarding the research questions
6. The sixth section summarises Chapter 7

7.1 BACKGROUND TO THE CASE

7.1.1 Overview of the Company and Case

Founded in 1989, InfoCo is headquartered in the Netherlands and currently employs 160 people across Europe, Asia, and North America. InfoCo's mission is to develop innovative research applications and, over the course of its existence, the firm has successfully launched 5–6 new system solutions, including SEMO. The idea for SEMO arose in 2010 and formal development started in 2013. The core team consisted of five members occupying positions in management, sales, marketing, and R&D. InfoCo's Owner initiated the project and was involved in decision making but was not a member of the core team. SEMO was launched in 2014 and significantly broadened InfoCo's customer base. Sales today exceed the estimates made in the draft business case. SEMO is, therefore, from InfoCo's perspective, a real success.

In the screening survey,[3] InfoCo's market researcher rated their technological experience with a score of 4 on a scale ranging from 'none' (1) to 'extensive' (5). Experience in marketing of SEMO was considered to be lower, given a score of 2 on the same scale. Maturity with regard to the DCI processes was given an average scale of 3 on a scale 'not managed at all' (1) to 'managed very well' (5).[4]

[1] The names of both firm and project were disguised to maintain confidentiality.

[2] MKB stands for Small and Medium-Sized Enterprises (SME) in Dutch.

[3] The screening survey was held to identify potential case study projects out of 292 radical innovation projects featured in the MKB top 100 from 2010 to 2016.

[4] The scales measuring technological and marketing experience give an indication of the product's newness and was adapted from Olson, Walker and Ruekert (1995) and Bonner (2012). The scale measuring maturity of the DCI processes was adopted from Reijonen and Komppula (2010).

7.1.2 Data Collection of SEMO

The sources of data collection at SEMO consisted of interviews, company documents, two short surveys, and a workshop.

7.1.2.1 Interviews

A total of eight interviews were held with five members of the core innovation team. These actors held positions in management, sales, marketing, and R&D, and all had been involved in previous innovation projects. Total interview length was 498 minutes (8 hours and 18 minutes). The interview details are summarised in Table 7.1 and include the notations used to label and refer to the interviewees in the case study analysis.

Table 7.1: Interview Details of SEMO

Interviewees	No of Interviews	Interview Length (min)	Interviewee Reference	Role	Innovation Experience[5]
Product Owner	2	70 76	INT-PO1s[6] INT-PO2s	Responsible for CI	Low
Market Researcher	2	30 101	INT-Mkt1s INT-Mkt2s	Execution market research	Medium
Interaction Designer	2	61 64	INT-RD1s INT-RD2s	Development	Medium
User Centred Design (UCD) Manager	1	46	INT-MANs	Process manager UCD	High
Sales Director USA	1	50	INT-SLSs	Involved in early phases	High
Total	8	498			

Source: Author

7.1.2.2 Documents

Six relevant documents were collected during the interviews; Table 7.2 illustrates how a total of 92 pages were inspected and include the notations used to reference the documents in the analysis.

[5] Actors who, at the time of the innovation project, had been involved in more than five innovation projects were classified as high level of experience. Actors involved in less than three projects were classified as low level of experience. Actors participating in 3-5 projects were rated as having a medium level of experience.

[6] Note on terminology: The first three initials denote the data source; for example, INT stands for interviews. This is followed by two initials denoting the actors' role; for example, PO stands for the Project Owner. The number signals the number of interviews held with an actor fulfilling the role. The last initial denotes the case project; for example, 's' denotes SEMO. This will enable easy identification of the different sources of data in the cross-case analysis.

Table 7.2: Documents of SEMO

Document No	No of Pages	Title	Document Content	Document Reference	Date	Author
1	3	Software requirements for [SEMO]	Customer problem description; main functional requirements for different use groups; list of potential customers.	Roadmap	Nov 2010	Sales Manager and CEO/Founder
2	14	Draft Business Case	Brief problem analysis; summary of competitor analysis; definition of solution, attributes and requirements; user stories; estimates of turnover and margin; a list of customers that might be questioned in a next phase of development.	PBC	Final version for MT Nov 2012	PO
3	11	UCD plan (Plan from the User-Centred Design team)	Describing set up of user panel and evaluates some methods on their applicability to generate user insights.	UCDPLAN	Jan 2013	Interaction Designer
4	29	User Requirements Document	Process description; results of general market characteristic and competitive analysis; results of research into customer activities and objectives; recommendations on product strategy. Listing of requirements that take the form of user stories and accompanying priorities for development.	URD	April 2013	Interaction Designer
5	21	[SEMO] Internal sales	Internal note on customer problem and idea to solve this; argues for a starting up an innovation project.	Launchdoc	Dec 2017	PO
6	14	Market Research [SEMO]	Findings of user interviews and contains conclusions and recommendations for SEMO.	MR	Oct 2017	Market Researcher
Total	92					

Source: Author

7.1.2.3 Workshop

The workshop was held at headquarters of InfoCo. Participants included the Product Owner, Market Researcher, the current Usability Tester, a Project Manager, and the R&D Director. The notations used to refer to them are included in Table 7.3. The workshop lasted 2 hours and 3 minutes and was fully transcribed.

Table 7.3: Workshop Details of SEMO

Participants	Participant Reference	Role
Product Owner	WS-POs[7]	Responsible for CI
Market Researcher	WS-Mkts	Execution market research
R&D Director	WS-RDs	Final responsible for SEMO
Project Manager	WS-PMs	Assisting the PO at the time of SEMO
Usability Tester	WS-UTs	Assisting the Market Researcher at the time of SMO

Source: Author

7.2 THE DEEP CUSTOMER INSIGHT PRACTICES OF SEMO

Section 7.2 presents the results of Research Question 1 (RQ1): *How do small firms' practices enable them to generate DCI for radical innovation projects?* The analysis is based on the findings of the interviews, documents, and workshop and demonstrates that, in order to generate DCI, SEMO engaged in 13 sophisticated and interrelated practices.

The results are presented in six sections:

1. The first section gives an overview of the procedure for identifying the practices
2. The second section illustrates the trail of evidence of Practice A
3. The third section discusses each practice, as well as their interrelationships
4. The fourth section describes the actors and their roles
5. The fifth section considers the resources
6. The sixth section draws conclusions regarding RQ1

7.2.1 Analytical Procedure for Identifying the Practices

According to Practice Theory, the best way to identify a practice is by analysing the *activities*, which are defined as happenings, or work-related tasks (Schatzki, 2012). Activities within a practice are interconnected, recognisable in different contexts and over time, organized towards an end, and connected to other practice elements such as associated resources and general understandings (Nicolini and Monteiro, 2017; Pilbeam and Turner, 2017; Schatzki, 2005, 2012). The analytical procedure was designed to respond to these requirements, as well as to understand the interconnections between the practices. The procedure thus consisted of five steps, each aiming to satisfy criteria of: (1) recognisable activities; (2) interconnected activities; (3) purposive activities; (4) connected practice elements; (5) constellation of practices.

In Table 7.4, the columns summarise details of each step, including: the criteria (in italics) and anchoring rules of the analysis instrument; the total results of the analysis; and a listing of the actual results for each practice. In the first analytical step, the transcripts and documents of the six case projects were carefully read and coded line-by-line to identify actor's activities related to the gathering and use of customer insight.

[7] Note on terminology: The first two initials denote the data source; for example, WS stands for workshop. This is followed by two initials denoting the actors' role; for example, PO stands for the Product Owner. The last initial denotes the case project; for example, 's' denotes SEMO. This will enable easy identification of the different sources of data in the cross-case analysis.

Table 7.4: The Identification of the Practices

Step 1: Identifying Activities	Step 2: Grouping into Practices	Step 3: Linking to Associated Objectives	Step 4: Identifying Resources	Step 5: Establishing Relationships
Analysis Instrument: Looking for *recognisable activities* -activities mentioned more than once -clear references to activities, exclude opinions	Analysis Instrument: Looking for *interconnected activities* -adjacent or similar activities	Analysis Instrument: Looking for *purposive activities* -coding phrases of purpose or effects (in order to, so that, therefore, consequently, etc.)	Analysis Instrument: Looking for *connected practice elements* -coding material, general understandings, skills & competences addressed in executing the activities	Analysis Instrument: Looking for *constellation of practices* -coding transition words indicating chronology or sequence (in the meantime, afterwards, etc.)
Total Results: 47 Activities	Total Results: 13 Practices	Total Results: 36 Objectives	Total Results: 70 Resources	Total Results: 108 Relationships
Actual Activities Identified	**Actual Practices Identified**	**Actual Objectives Identified**	**Actual Resources Identified**	**Actual Relationships**
Identifying a problem area Conducting conversations Analysing customer problems Documenting customer problems	**A:** Exploring the customer problem situation	To define product market segments To further develop first ideas To validate a first idea To build trust with potential customers	A sufficiently broad scope Readily available internal sources Readily available customer sources Readily available expert sources Readily available secondary sources Interview skills Analytical skills	11
Checking ideas of customers Consensus and decision making Generate new ideas	**B:** Generating ideas	To define a project fitting into the strategic agenda To define a solution for observed needs To define a project that can be funded	Vision of the future Overview of current products and capabilities Experience with creative techniques A sufficiently broad scope Market reputation	9
Finding funds for problem analysis Finding funds for needs analysis Finding funds for testing	**C:** Securing innovation funds	To get authorisation from management To create means for next development To create a customer base	Corporate decision-making criteria Strategic reflections Availability of grants Customers willing to pay	8
Desk research Visiting conferences Interviewing Analysing the opportunity Documenting the opportunity	**D:** Exploring the market & opportunity	To make a business model To estimate market potential	Research method expertise Interview skills Analytical skills Student support Internal sources of market knowledge Readily available customer sources Readily available expert sources Readily available secondary material Company formats	8
Defining customer value Defining firm value	**E:** Defining the value	To justify investments in development, production, and marketing To establish a shared vision on the importance of the project	Individual integration skills Sensemaking with customer Collaborative sensemaking within team External legitimacy Company formats	8

Table 7.4: Continued

Step 1: Identifying Activities	Step 2: Grouping into Practices	Step 3: Linking to Associated Objectives	Step 4: Identifying Resources	Step 5: Establishing Relationships
Planning Developing methods Monitoring	**F:** Managing DCI action	To collect information in a conscious, efficient, and impartial manner To make sure uncertainty decreases across the process	Research method expertise Reflectiveness A manager Company formats Criteria for customer selection	3
Defining customer criteria Identification of customers Activation of customers Managing of expectations	**G:** Mobilising customer sources	To increase development capacity To find money for further development To prepare for sales & marketing To get customer information	Customer incentive Internal incentive Marketing channels Customer management skills	15
Preparing for efficient data collection Visiting customers Watching movies Conducting conversations Analysing needs Documenting needs Reflecting on assumptions	**H:** Elaborating customer needs	To support solution-finding To define customer requirements To validate the scope of the project	Research method expertise Interview skills Analytical skills Student support Readily available internal sources Readily available customer sources Awareness of uncertainties Company formats	4
Surveying customers Conducting conversations Watching movies of use Analysing feedback Documenting feedback Reflecting on assumptions	**I:** Collecting customer feedback	To validate and refine customer requirements To identify missing information To check performance of the solution	Minimum Viable Product Interview skills Analytical skills Documentation system Readily available customer sources	10
Listing user requirements Setting priorities Refining requirements	**J:** Defining customer requirements	To achieve a shared understanding of requirements and priorities To supervise the development process To manage expectations of customers	Individual integration skills Sensemaking with customer Collaborative sensemaking within team Company formats	15
Acquiring of sources holding relevant prior customer knowledge Sharing of information	**K:** Mobilising internal sources	To learn about new customers and markets To validate findings To get access to customer network	Readily available internal or partner sources Internal Incentive Communication channels	8
Generating ideas for solutions Consensus and decision making Developing the solution	**L:** Developing the product concept	To provide material for testing To prepare for sales & marketing	Experience with collective idea generation Customer empathy in R&D team Visual material supplied by the customer Co-creating customer Student support Project management tool	8
Re-using CI Communicating insight	**M:** Planning sales & marketing	To start up the commercial process	Individual integration skills Collaborative sensemaking within team Student support Documentation system Company formats	2

Source: Author

The practices analysed in Table 7.4 were based on an actors' actual activity, which may be different than perceptions of how an ideal activity should appear.[8] Therefore, coding distinguished between the actual and ideal perceptions by considering the use of verbs and past tenses for activities, and affective words and opinions for perceptions. For example, the following sentence in the transcript of the interview with the PO was phrased in the past tense and clearly explains events of the SEMO case. It was, therefore, coded as an *activity*: "We talked to one particular customer in [city][…]" (INT-PO1s). On the other hand, the following sentence contains a clear opinion on how things should be done and was, therefore, coded as a *perception*: "The most important thing is talking to customers." (INT-SLSs). To satisfy the criterion of recognisable activities, an anchoring rule was applied and only those activities mentioned more than once, either by one actor or across data sources, were retained. Additionally, information disconfirming the presence of an activity was coded and confirmed the absence of activities within case studies. This step resulted in 47 distinct activities.

The second step involved the grouping of adjacent or similar activities and satisfied the criterion of interconnected activities. For example, the adjacent and interconnected learning activities 'identifying a problem area', 'conducting conversations', 'analysing customer problems', and 'documenting customer problems' were grouped together in Practice A. Exploring Customer Problem Situations. Grouping of activities into an overarching practice followed, as much as possible, current understanding of Market-Based Learning (MBL), Customer Involvement, Innovation Management and Design, and Entrepreneurship literatures. In this way, the resulting practices are closely connected to the commonly used concepts of *research*, *synthesis*, *utilisation,* and *mobilisation of sources.*[9] In some instances, a new practice not defined in these current literatures, was formed. An example of such an emerging practice is Practice F, which consists of the adjacent activities of preparatory planning, methodological design, and monitoring. Practice F is undertaken in order to collect information in a conscious, efficient, and impartial manner, and to make sure that uncertainty decreases across the process. In executing the activities, actors draw upon their methodological expertise, reflectiveness, a manager guiding the process, company formats specifying options and procedures, and criteria for customer selection. Although, the reviewed literature does discuss the importance of having a planned approach in order to prevent biased insights (Berghman et al., 2013; Deszca, 1999; Liedtka, 2015), it has not defined underlying activities and resources in a single *management* practice. Step 2 resulted in 13 distinct practices. The codebook for the activities is included in Appendix G.

In the third step, the associated objectives of each practice were identified, satisfying the criterion of purposive activities and simultaneously validated the results of step two. Coding was undertaken by paying attention to purposeful words such as 'because', 'in order to', 'so that'. A total of 36 objectives was identified. The codebook for objectives is included in Appendix H.

In the fourth step, the relationship between activities and resources was established, satisfying the criterion of connected practice elements. This was done by coding all input factors supporting actors in the execution of activities. Following the tenets of the *Resource-Based View* (RBV) (c.f. Barney, 1991; Eisenhardt and Martin, 2000; Winter, 2003), a broad definition of resources was used.

[8] See, for example, Feldman and Pentland (2003).

[9] Research, synthesis, and utilisation form part of the concepts of information processing (e.g Day, 1994; Kohli and Jaworski, 1990; Moorman, 1995) and absorptive capacity (Cohen and Levinthal, 1990). Customer mobilisation is a concept of the Customer Involvement literature and refers to accessing, selecting, and motivation of customers that will be involved in NPD (Coviello and Joseph, 2012).

Resources were defined as the full range of assets that are used in organisational processes. They include *physical resources (e.g. plants, equipment), human capital resources* (e.g. prior knowledge, experience, and skills), and *organisational resources* (e.g. superior sales force, customers relations). This fourth analytical step resulted in a total of 70 resources. The codebook for resources is included in Appendix I.

The fifth step identified the relationships between practices. This showed how the 13 practices work together to create Customer Insights (CI). Relationships were identified by coding the sequences and linkages between the practices. A total of 109 relationship were identified. The codebook for relationships is included in Appendix J

7.2.2 Illustration of the Trail of Evidence

Section 7.2.1 presented an overview of the 5-step procedure for identifying practices; Section 7.2.2 will now illustrate how evidence was collected. It will demonstrate the trail of evidence of Practice A within SEMO. After an overview of the procedure in Section 7.2.2.1, Section 7.2.2.2 will summarise the justification of grouping the activities into Practice A.

7.2.2.1 Overview of the Procedure

Figure 7.1 shows Step 1 and Step 2 of the analytical procedure used to identify practices of SEMO. It displays the codes assigned to pieces of evidence regarding the activities that generate DCI. These activities were identified in transcripts of the interviews of the Product Owner (INT-PO1s) and Sales Director (INT-SLSs), and the PBC document (PBC). The coded activities in the transcript of the Sales Director captured three distinct activities: 'identifying a problem area', 'conducting conversations', and 'reporting of problems'. Evidence for the activity 'analysing customer problems' was found only in the transcript of the interview with the PO, who turned out to be the sole person performing this analytical activity. He mentioned doing this several times during the interview; this code was, therefore, retained. The other activities were mentioned both by the PO and the Sales Director and were also confirmed in the documents. Given that all of these activities relate to understanding customer problem situations, they were included with Practice A.

Figure 7.2 illustrates the coding of two objectives in relation to Practice A. This is Step 3 of the analytical procedure. Figure 7.2 shows the codes assigned to objectives in transcripts of the interviews of the Product Owner (INT-PO1s) and Sales Director (INT-SLSs), and the PBC document (PBC). For example, the following phrase in the transcript of the PO demonstrates how the findings of Practice A spurred idea generation: "We start, of course, from a use case (INT-PO1s). That sparked the idea". It was therefore coded as the objective 'to further develop ideas'. Each objective identified in these pieces of evidence was mentioned more than once and was, therefore, retained.

Figure 7.3 exhibits the codes assigned to the resources, again, evident in transcripts of the interviews of the Product Owner (INT-PO1s) and Sales Director (INT-SLSs), and the PBC document (PBC). This is Step 4 of the analytical procedure. In the example provided in Figure 7.3, four resources were identified: 'readily available internal sources', 'readily available customer sources', 'interview skills', and 'analytical skills'. For example, the following remark of the Sales Director was coded as 'readily available customer sources: "[…] to visit some customers who had our current system." For each resource more than four distinct pieces of evidence were available and, therefore, they were all retained.

Figure 7.1: Constructing Practice A - Analytical Steps 1 and 2

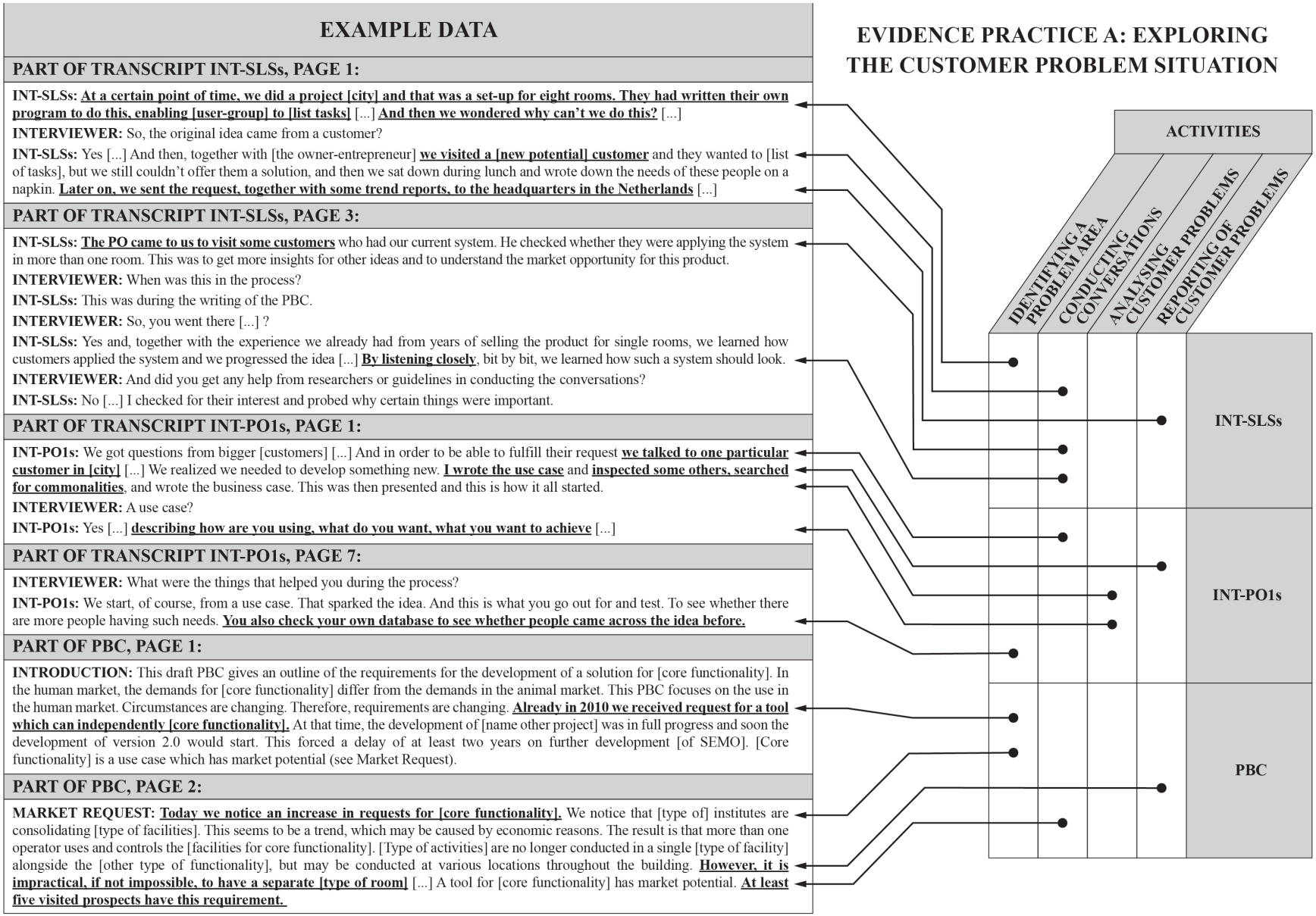


Figure 7.2: Constructing Practice A - Analytical Step 3

EXAMPLE DATA

PART OF TRANSCRIPT INT-SLSs, PAGE 1:

INT-SLSs: At a certain point of time, we did a project [city] and that was a set-up for eight rooms. They had written their own program to do this, enabling [user-group] to [list tasks] [...] And then we wondered why can't we do this? [...]

INTERVIEWER: So, the original idea came from a customer?

INT-SLSs: Yes [...] And then, together with [the owner-entrepreneur] we visited a [new potential] customer and they wanted to [list of tasks], but we still couldn't offer them a solution, and then we sat down during lunch and wrote down the needs of these people on a napkin. Later on, we sent the request, together with some trend reports, to the headquarters in the Netherlands [...]

PART OF TRANSCRIPT INT-SLSs, PAGE 3:

INT-SLSs: The PO came to us to visit some customers who had our current system. He checked whether they were applying the system in more than one room. **This was to get more insights for other ideas and to understand the market opportunity for this product.**

INTERVIEWER: When was this in the process?

INT-SLSs: This was during the writing of the PBC.

INTERVIEWER: So, you went there [...] ?

INT-SLSs: Yes and, together with the experience we already had from years of selling the product for single rooms, we learned how customers applied the system and we progressed the idea [...] By listening closely, bit by bit, we learned how such a system should look.

INTERVIEWER: And did you get any help from researchers or guidelines in conducting the conversations?

INT-SLSs: No [...] I checked for their interest and probed why certain things were important.

PART OF TRANSCRIPT INT-PO1s, PAGE 1:

INT-PO1s: We got questions from bigger [customers] [...] And in order to be able to fulfill their request we talked to one particular customer in [city] [...] We realized we needed to develop something new. I wrote the use case and inspected some others, searched for commonalities, and wrote the business case. This was then presented and this is how it all started.

INTERVIEWER: A use case?

INT-PO1s: Yes [...] describing how are you using, what do you want, what you want to achieve [...]

PART OF TRANSCRIPT INT-PO1s, PAGE 7:

INTERVIEWER: What were the things that helped you during the process?

INT-PO1s: **We start, of course, from a use case. That sparked the idea.** And this is what you go out for and test. **To see whether there are more people having such needs.** You also check your own database to see whether people came across the idea before.

PART OF PBC, PAGE 1:

INTRODUCTION: This draft PBC gives an outline of the requirements for the development of a solution for [core functionality]. In the human market, the demands for [core functionality] differ from the demands in the animal market. This PBC focuses on the use in the human market. Circumstances are changing. Therefore, requirements are changing. Already in 2010 we received request for a tool which can independently [core functionality]. At that time, the development of [name other project] was in full progress and soon the development of version 2.0 would start. This forced a delay of at least two years on further development [of SEMO]. [Core functionality] is a use case which has market potential (see Market Request).

PART OF PBC, PAGE 2:

MARKET REQUEST: Today we notice an increase in requests for [core functionality]. We notice that [type of] institutes are consolidating [type of facilities]. This seems to be a trend, which may be caused by economic reasons. The result is that more than one operator uses and controls the [facilities for core functionality]. [Type of activities] are no longer conducted in a single [type of facility] alongside the [other type of functionality], but may be conducted at various locations throughout the building. However, it is impractical, if not impossible, to have a separate [type of room] [...] **A tool for [core functionality] has market potential.** At least five visited prospects have this requirement.

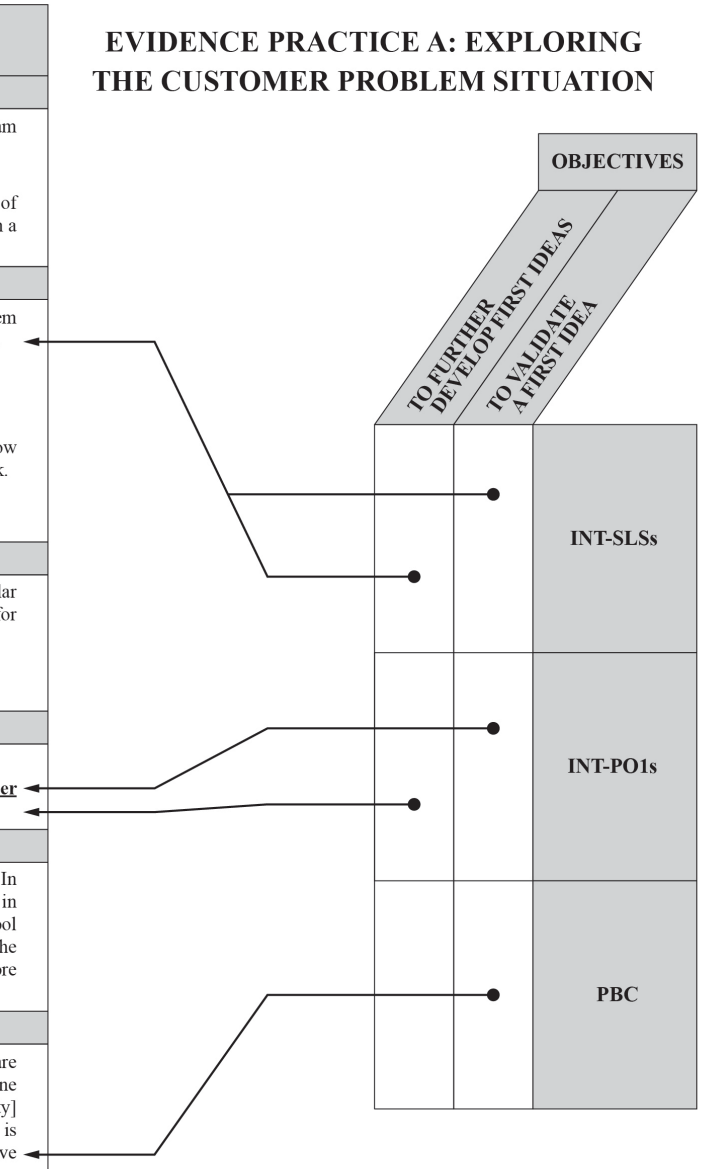


Figure 7.3: Constructing Practice A - Analytical Step 4

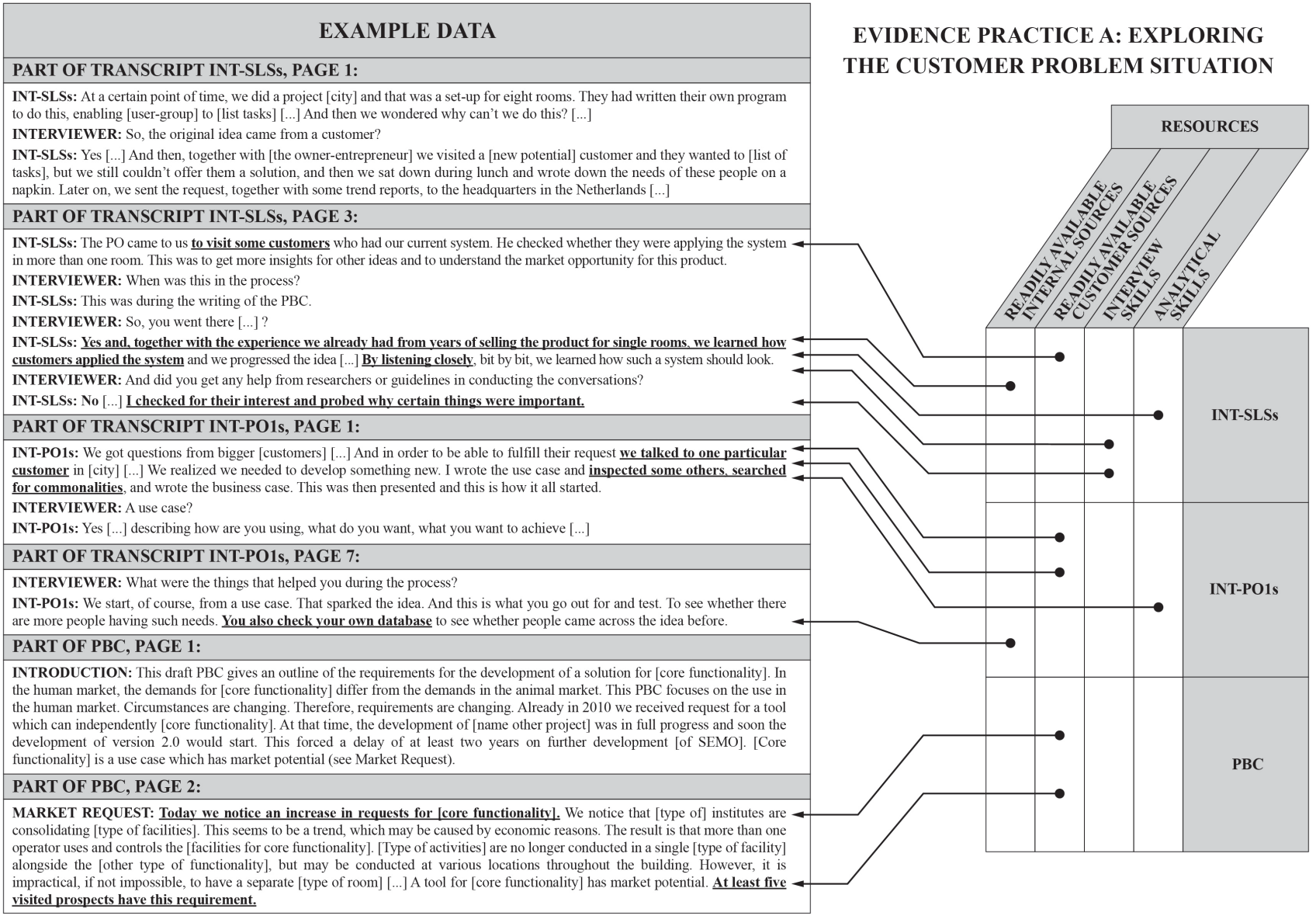


Figure 7.4: Constructing Practice A - Analytical Step 5

EXAMPLE DATA
PART OF TRANSCRIPT INT-SLSs, PAGE 1:
INT-SLSs: At a certain point of time, we did a project [city] and that was a set-up for eight rooms. They had written their own program to do this, enabling [user-group] to [list tasks] [...] And then we wondered why can't we do this? [...] **INTERVIEWER:** So, the original idea came from a customer? **INT-SLSs:** Yes [...] And then, together with [the owner-entrepreneur] we visited a [new potential] customer and they wanted to [list of tasks], but we still couldn't offer them a solution, and then we sat down during lunch and wrote down the needs of these people on a napkin. Later on, we sent the request, together with some trend reports, to the headquarters in the Netherlands [...]
PART OF TRANSCRIPT INT-SLSs , PAGE 3:
INT-SLSs: The PO came to us to visit some customers who had our current system. He checked whether they were applying the system in more than one room. **This was to get more insights for other ideas** and **to understand the market opportunity for this product.** **INTERVIEWER:** When was this in the process? **INT-SLSs: This was during the writing of the PBC.** **INTERVIEWER:** So, you went there [...] ? **INT-SLSs:** Yes and, together with the experience we already had from years of selling the product for single rooms, we learned how customers applied the system and we progressed the idea [...] By listening closely, bit by bit, we learned how such a system should look. **INTERVIEWER:** And did you get any help from researchers or guidelines in conducting the conversations? **INT-SLSs:** No [...] I checked for their interest and probed why certain things were important.
PART OF TRANSCRIPT INT-PO1s, PAGE 1:
INT-PO1s: We got questions from bigger [customers] [...] **And in order to be able to fulfill their request we talked to one particular customer** in [city] [...] We realized we needed to develop something new. I wrote the use case and inspected some others, searched for commonalities, and wrote the business case. This was then presented and this is how it all started. **INTERVIEWER:** A use case? **INT-PO1s:** Yes [...] describing how are you using, what do you want, what you want to achieve [...]
PART OF TRANSCRIPT INT-PO1s, PAGE 7:
INTERVIEWER: What were the things that helped you during the process? **INT-PO1s: We start, of course, from a use case. That sparked the idea.** And this is what you go out for and test. To see whether there are more people having such needs. You also check your own database to see whether people came across the idea before.
PART OF PBC, PAGE 1:
INTRODUCTION: This draft PBC gives an outline of the requirements for the development of a solution for [core functionality]. In the human market, the demands for [core functionality] differ from the demands in the animal market. This PBC focuses on the use in the human market. Circumstances are changing. Therefore, requirements are changing. Already in 2010 we received request for a tool which can independently [core functionality]. At that time, the development of [name other project] was in full progress and soon the development of version 2.0 would start. This forced a delay of at least two years on further development [of SEMO]. [Core functionality] is a use case which has market potential (see Market Request).
PART OF PBC, PAGE 2:
MARKET REQUEST: Today we notice an increase in requests for [core functionality]. We notice that [type of] institutes are consolidating [type of facilities]. This seems to be a trend, which may be caused by economic reasons. The result is that more than one operator uses and controls the [facilities for core functionality]. [Type of activities] are no longer conducted in a single [type of facility] alongside the [other type of functionality], but may be conducted at various locations throughout the building. However, it is impractical, if not impossible, to have a separate [type of room] [...] A tool for [core functionality] has market potential. At least five visited prospects have this requirement.

EVIDENCE RELATIONSHIPS BETWEEN PRACTICES

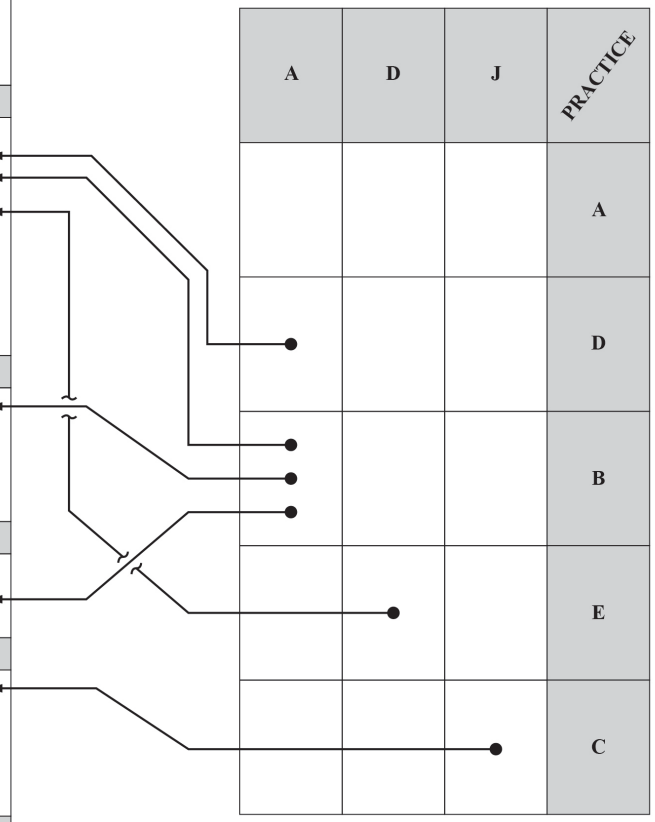


Figure 7.4 describes how the relationships were identified in Step 5 of the analytical procedure. It shows, again, a portion of transcripts of interviews with the Product Owner (INT-PO1s) and Sales Director (INT-SLSs), and parts of the PBC document (PBC). The layout of this figure is, however, different than Figures 7.1–7.3 in that it illustrates how two practices are connected. Moreover, Figure 7.4 does not only show the relationships between Practice A and other practices, but also between Practices J and C. This is because the draft PBC appeared to be used during the decision-making processes of Practice C and already mentioned some requirements which were explicated and listed in Practice J. The other transcripts and documents were coded following the same procedure.

7.2.2.2 Exemplar Evidence of Practice A and Relationships

An example of the output of the analytical steps is given in Tables 7.5 and 7.6. Table 7.5 summarises all evidence for the objectives, activities, and resources underscoring Practice A within SEMO (analytical Step 1–4). It contains exemplar quotes and indicates the total number of mentions from the various data sources. Objectives, activities, and resources observed in other cases, but not in the SEMO case, were cross-checked with *disconfirming information,* evidence confirming the absence of a practice element. Tables summarising evidence for the other practices are included in Appendix K which are based on the same analytical process illustrated by Practice A.

Table 7.5: Evidence of Practice A Within SEMO Case (Based on Figures 7.1–7.3)

Objectives	Data Source	# of Mentions	Exemplar Evidence	Disconfirming Information	Include y/n
To define product market segments	DOC	2	n/a	The PBC, p. 4, lists potential target groups, without defining these more carefully. The URC, p. 4, does discuss market segments in more detail, but this is at a much later stage of the project.	n
To further develop first ideas	SLSs	2	"We went to see a number of customers […] to get more insight for other ideas […]" (INT-SLSs)	n/a	y
To understand the opportunity of a customer idea	POs	3	"And that is what you go out for and test. To see whether there are more people having such needs" (INT-PO1s)	n/a	y
To build trust with potential customers	DOC	2	n/a	The PBC and Roadmap state that, at this stage of the project, both idea and target group are open for discussion. At later stages, customer management goals drive the activities.	n

Table 7.5: Continued

Activities	Data Source	# of Mentions	Exemplar Evidence	Disconfirming Information	Include y/n
Identifying a problem area	POs SLSs DOC	1 1 2	"Already in 2010, we received a request for a tool which can [functionality] (PBC, p.1). "They had written their own program to do [functionality], this enabled [user-group] to [lists tasks] [...] And then we wondered why can't we do this?" (INT-SLSs)	n/a	y
Conducting customer conversations	POs SLSs DOC	1 3 2	"We call them and get in touch (INT-PO1s). "At least 5 visited prospects have this requirement." (PBC, p.2)	n/a	y
Analysing customer problems	POs	2	"[…] and searched for commonalities […]" (INT-PO1s) "[…] describing how are you using, what do you want, what you want to achieve […]" (INT-PO1s)	n/a	y
Reporting of customer problems	POs SLSs DOC	1 1 1	"I wrote the use case." (INT-PO1s) "3. Market Request" PBC, page 2)	n/a	y

Resources	Data Source	# of Mentions	Exemplar Evidence	Disconfirming Information	Include y/n
A broad scope	DOC	2	n/a	The first rudimentary ideas, expressed in the Roadmap and PBC, centre around the addition of a new functionality. The underlying customer problems remain within the boundaries set by this functionality and do not take a broader perspective.	n
Readily available internal sources	POs SLSs	2 2	"You need salespeople with experience […] to understand customer needs" (INT-SLSs) "We started of course from a use case. That sparked the idea." (INT-PO1s)	n/a	y
Readily available customer sources	POs SLSs DOC	2 1 1	"[…] and in order to be able to fulfil their request we talked to one particular customer in [city] [...]" (INT-PO1s) "We went to see a number of customers […]" (INT-SLSs)	n/a	y
Readily available expert sources	PO	1	n/a	"I did do desk research and I went to talk to people at conferences, but that was later. Were there any other things, I should have done besides of talking to the customers? I don't know […]" (INT-PO1s)	n

Source: Author

Table 7.6 summarises the evidence of the relationships identified in analytical Step 5. The first column lists the outcomes of each practice. The arrows in each row indicate to which practice these outcomes formed an input. For example, the findings resulting from Practice A were used to refine the first idea developed by the Owner and Sales Director and is, therefore, related to Practice B. Customer problem understanding also inspired research into markets and is, therefore, related to Practice D.

Table 7.6: Relationships Between the Practices

Practice / Output of Practices	Exploring the problem situation (A)	Generating ideas (B)	Exploring the market & opportunity (D)	Defining the value (E)	Securing innovation funds (C)	Managing DCI action (F)	Mobilising customer sources (G)	Exploring the user experience (H)	Collecting user feedback (I)	Defining /refining requirements (J)	Mobilising internal sources (K)	Developing the product concept (L)	Planning sales and marketing (M)	Representative Quotes
Customer problem understanding (A)		→	→											"The initial use case [x] sparked the idea" (INT-PO1s); "We went to see a number of customers […]" (INT-SLSs); "[…] to get more insight for other ideas and to understand the potential" (INT-SLSs)
A first idea concept (B)	→									→				"We went to see a number of customers […](INT-SLSs); "During our visit today to the Child Development Centre at Los Angeles Southwest College (LASC) we discussed the requirements for their multi-room observation facility" (ROADMAP, p.1)
Market understanding (D)				→										"I took the original use case, explored others […] analysed the opportunity, and then I wrote a proposal, which is called business case" (INT-PO1s)
Defined value (E)					→	→								"In which [the business case] payback time and opportunities of growth are presented to the MT for approval." (INT-PO1s); "The business case defines further planning" (INT-Mkt2s); "One of the sections in the form was about prioritising solution aspects […] The initial solution aspects were defined on the PBC assumptions" (URD, p. 13)
Authorized means (C)			→			→				→				"During the Roadmap discussion in March 2012 MT indicated to prioritize the development of [SEMO]" (PBC, p. 1); "And then you get approval to start the project" (INT-PO1s); "The final priority set by the PM and approved by the steering committee. The Must priority determine which User Stories will be covered by the R1 release" (URD, p. 13)
A managed approach (F)							→	→						"Focus groups were specified and agreement was achieved on the size of the User Panel" (URD, p. 4); "The UCD plan (Ref. 2) has been carried out almost fully" (URD, p. 4)
Customer sources (G)								→						"We asked for similar cases and we visited them" (INT-PO1s)

Table 7.6: Continued

Practice / Output of Practices	Exploring the problem situation (A)	Generating ideas (B)	Exploring the market & opportunity (D)	Defining the value (E)	Securing innovation funds (C)	Managing DCI action (F)	Mobilising customer sources (G)	Exploring the user experience (H)	Collecting user feedback (I)	Defining /refining requirements (J)	Mobilising internal sources (K)	Developing the product concept (L)	Planning sales and marketing (M)	Representative Quotes
Understanding of needs (H)						→				→				"The UCD plan (Ref. 2) has been carried out almost fully with the following changes and conclusions" (URD, p. 4); "In the analysis we look what requirements can be achieved" (INT-PO1s)
Feedback of customers (I)	→				→			→						"I took the list and did my sales visits and asked them if they were interested and why" (INT-SLSs); "Well, there is still sufficient room [for exploration], only the direction is fixed: like this fits with our [segment names] […] We set priorities from the list of requirements" (INT-RD2s); "In the analysis we look what requirements can be achieved" (INT-PO1s)
Prioritized requirements (J)					→				→			→	→	"The final priority set by the PM and approved by the steering committee" (URD, p. 14); "A few requirements came up and they asked me to verify whether they applied to my customers as well" (INT-SLSs); "At the end of the UCD phase, we started development" (INT-MAN); "[in order to move the product from development to sales] we should not only have only shared product information, but also market information" (INT-RD1s)
Internal sources (K)	→							→						"Input was given by colleagues from Sales and R&D and customer feedback" (PBC, p. 1); "Sometimes we give an engineer the opportunity to join. We also did one conversation in which the sales engineer joined" (INT-RD2s)
A first product concept (L)									→					"Often, I make a release and then I make it better in a next release. We had our launching customers. We asked them from feedback and we still ask them for feedback" (INT-PO1s)

Source: Author

7.2.3 Overview of the SEMO Practices

By applying the full analytical procedure to SEMO, 43 out of 47 total customer insight-related activities were identified. These activities were grouped into 13 practices, covered 17 out of 36 total objectives, and drew upon 41 out of 70 total resources. The 13 practices were interconnected by means of 25 relationships. Table 7.7 lists all practices and their elements, illustrating how DCI within SEMO emerges across the entire NPD project. DCI is not the result of a single research practice, but rather of an interplay between several research and supporting practices. A rich collection of both existing and newly acquired resources supports the activities within each practice. Sections 7.2.3.1–7.2.3.14 present a more detailed breakdown of each practice as well the interrelationships between different practices.

7.2.3.1 Practice A. Exploring the Customer Problem Situation

DCI generation for SEMO began after the Owner and the Sales Director witnessed how a customer worked around specific issues with current systems. This observation spurred further idea generation for SEMO (described in Practice B) and demanded a greater understanding of customers' problems. Practice A addressed this demand. It is a *research* practice and includes the collection, analysis, and reporting of customer problem information. These activities were assigned to the PO and Sales officials. The Owner was not involved further.

Evidence found in both documents and interviews clearly demonstrates that problem-based information from customers was considered key for understanding customers' needs within InfoCo: "[key to understanding latent needs] is getting insights into the real problem, things that bother people when they are doing their daily tasks. Ideally, that starts up thinking in how you can solve this" (INT-Mkt2s). The main objective of Practice A was not only to explore customer issues and inspire further idea generation (demonstrating the *conceptual* value of insights), but also to validate the first idea with other customers (demonstrating the *instrumental* value of insights).[10]

The PO and Sales officials had loosely organised conversations with selected, easily accessible customers. They made use of their conversational skills to identify problems and issues of these customers. Apart from the customers and interview skills, internal sources comprised an important resource, and added prior knowledge and experience to the activities: "[…] and together with the experience we already had from years of selling the product for single rooms, we learned how customers applied the system" (INT-SLSs). (Note the evidence of Practice A was presented in Section 7.2.2.)

7.2.3.2 Practice B. Generating Ideas

The Owner and Sales Director started generating new ideas immediately upon observing how a user outside the regular business had solved problems using the current systems. "During lunch, on a napkin, we wrote down the needs of these people and then we started drawing how we could [solve the problem]" (INT-SLSs). They elaborated on the customers' idea, listed some high-level requirements, and passed it on to the organisation. Idea-generating activities form part of Practice B, which is labelled as a *utilisation* practice because of its reliance on the insights generated in Practice A. The main objective of the activities comprising Practice B was to develop a project that would solve the observed problems of customers while giving InfoCo a competitive edge over their competitors.

[10] The notions of conceptual and instrumental value are used in the Market-Based Learning literature to denote the distinct types of uses of market-based information (e.g. Moorman, 1995).

Resources for Practice B proved to be actors' vision of the future coupled with a thorough understanding of current products and capabilities. The Sales Director stressed the importance of having a strong market reputation paving the path for potential customers to put forth their ideas for specific problems. (Note the evidence of Practice B is in Appendix K).

7.2.3.3 Practice C. Securing Innovation Funds

Newly generated insights were used to make decisions regarding the continuation of funds for the SEMO project. Decision-making activities were grouped together in a second *utilisation* practice, Practice C, which involved the Management Team (MT), including the PO, the Owner, and Sales Director. The activities of Practice C consider the continuation of funds for three phases: the problem analysis phase; the needs analysis phase; and the testing phase. Decision making processes were aimed at securing management approval, thus enabling the PO to involve others in the project: "It [management approval] ensured that there was commitment to spend time on researching this new product" (INT-Mkt2s).

Insights generated on markets (Practice D) and on customer problems (Practice A) formed an important resource for Practice C. Moreover, later in the project, decision making drew on understanding of customer needs insights (Practice H). Decision criteria and strategic reflections supported the process. (Note the evidence of Practice C is in Appendix K)

7.2.3.4 Practice D. Exploring the Market and Opportunity

The PBC document shows that the PO not only collected customer problem information (generated in Practice A), but also engaged in the collection and analysis of general market information. This second set of *research* activities is the subject of Practice D. The interviews conducted confirm that market information was another important component of DCI: "You do all kind of things to understand needs and you do this at several points in time: you speak to customers; you go to conferences; and you also do general desk research to understand what goes on in relevant markets" (INT-PO1s). The PBC document illustrates how the gathering of general market information involved research on market segments, the competitive position, and the market size. The PO was supported in this research practice by market researchers from the marketing department, which also involved students. The main objective of Practice D was to understand the financial consequences of the innovation idea.

Practice A relied on field research; conversely, Practice D focused on desk research. An important resource for this practice was therefore secondary information. "Many of our customers publish their results and by analysing this, you might conclude on trends." (INT-Mkt2s) (Note the evidence of Practice D is in Appendix K)

7.2.3.5 Practice E. Defining the Value

Customer problem information and market information were synthesised into an overall value definition and articulated in the PBC document. These *synthesising* activities were grouped together in Practice E. Activities were twofold: the first concentrated on defining the value for the customer, while the second focused on calculating the value to the firm. Synthesis within SEMO was not a collaborative process performed by many, but rather a coordinated process, with the PO as the main actor.

This synthesis of information helped to develop a shared understanding and commitment to the project: "For new features, it is important to explain the idea very well. You need a good presentation, so that you can create a common ground." (INT-RD1s). Moreover, the value definition was used to get MT approval for further development and help the team to justify additional investment in SEMO (as in Practice C).

The PBC document contains prescriptions for the type of knowledge that should be included in the synthesis, thus steering the activities, and is, therefore, an important resource to Practice E. The PO drew upon his abilities to integrate information about problems and markets (generated in Practices A and D) with knowledge he received from others within InfoCo. (Note the evidence of Practice E is in Appendix K)

7.2.3.6 Practice F. Managing DCI Action

After the SEMO project was formally approved, DCI actions became more formal by nature and were planned and monitored. These *management* activities were grouped together in Practice F and illustrate deliberate efforts put into DCI within SEMO. The activities were performed by the UCD Manager, who engaged in planning, definition of customer selection criteria and methods, and monitored the results. Dedicated management of DCI guaranteed that knowledge was bias free and objective, as well as cost efficient: "The UP feedback sessions (Ref. 7) were carried out with increasing efficiency with each session." (URD, p.4).

The URD document explained how methods were chosen and demonstrates the skill that was put into Practice F. Monitoring activities relied on the UCD Managers' presence and reflectiveness. (Note the evidence of Practice E is in Appendix K)

7.2.3.7 Practice G. Mobilising Customer Sources

At several stages during SEMO, customers needed to be accessed, motivated, and prepared so that they could effectively inform the project. These activities were grouped together in Practice G, a *mobilising* practice, and included: the identification of customer selection criteria; the identification of suitable customers as sources of information; activation of those customers; and management of expectations. Main actors were the PO, the UCD team, and the Sales team. In addition to mobilising existing, easily accessible customers, new customers were mobilised. The main objective was to ensure that customers deemed suitable to inform the team were available at the right time. As such, Practice G formed input to the research practices.

Two main resources were used. First, a customer incentive was deployed in the form of a discount which motivated customers to participate. Secondly, customer relationship management skills were used in order to get a hold of the right customers and build a more lasting relationship. (Note the evidence of Practice G is in Appendix K)

7.2.3.8 Practice H. Elaborating Customer Understanding

In-depth information on customer needs was gathered by means of a third *research* practice, Practice H. Activities grouped together in Practice H included customer conversations and analysis of the resulting information, and were controlled by the management activities of Practice F. A survey preceded the conversations in order to save time. Activities took place under supervision of the UCD Manager and were executed collaboratively by the PO, Sales, and the Interaction Designer. The conversations were qualitative by nature, and actors actively probed for latent needs: "Sometimes people have a need, but don't realise they have it, and then they describe it […] and you really need to probe deeper to understand what they look for." (INT-SLSs). Furthermore, during these open conversations, the customer was asked for feedback on ideas and concepts. This was done to save time, but also to raise interest in SEMO:

> People don't have much time in [specific market] so we had this list of requirements and during the conversations we wanted to make sure that ideas got validated […] but, of course, you also want to show what you have, and then the conversations were more like disguised sales conversations. (INT-RD1s)

After customer conversations, the team reflected on assumptions and uncertainties as described in the URD document: "The analysis by the UCD team has led to recommendations that on some points differ substantially from the original assignment in the draft PBC. Before jumping to these recommendations, a brief reflection on the core element of the draft PBC [SEMO] is addressed." (URD, p 8). Main purpose of Practice H was to reduce uncertainty and to validate insights generated earlier about customer problems and markets.

Resources for this practice were similar to those of Practice A and consisted of interview and analytical skills. Prior knowledge and experience brought in by the Interaction Designer supported the activities: "I think, with my sales experience, you know better what type of customers they are" (INT-RD1s). (Note the evidence of Practice H is in Appendix K)

7.2.3.9 Practice I. Collecting Customer Feedback

More detailed feedback from customers regarding the SEMO solution was obtained by means of a fourth *research* practice, Practice I. The survey preceding the qualitative research activities of Practice H was one of the first activities aimed at collecting feedback. Otherwise, feedback was predominantly collected without thorough preparation and emerged naturally during training sessions and sales conversations. The data was captured and reported by Sales, while the PO and the R&D team worked on the analysis. The main objective of Practice I was to understand how product versions should be improved.

A vital resource specific to this practice is the document system which disseminated feedback to others within InfoCo. (Note the evidence of Practice I is in Appendix K)

7.2.3.10 Practice J. Defining Customer Requirements

Findings from research activities were not only synthesised into a value proposition (as in Practice E), but also into customer requirement statements. These statements were the result of Practice J, a second *synthesising* practice. Customer requirements were formatted in user stories and epics. The URC document holds a glossary describing to the reader what a user story is: "One or more sentences in the everyday or business language of the end user or user of a system that captures what a user does or needs to do as part of his or her job function." (URD, p. 1). Activities grouped together in Practice J involved the listing of requirements, the setting of priorities, and a redefinition of previous requirements. The main actor was the PO, who consulted the UCD team: "Setting the priorities is done by the PO. I advise, but final responsibility lies with him." (INT-RD1s).

The main aim of Practice J was to support development. Additionally, Practice J supported the creation of a shared view on requirements and priorities. Therefore, like Practice E, it had both *instrumental* value, advancing the solution, and *symbolic* value,[11] establishing relationships and creating commitment.

The PO's integrative skills were essential to his execution of Practice J. The company formats hold guidelines for drafting user stories and are, therefore, an important resource to Practice J. (Note the evidence of Practice J is in Appendix K)

[11] Like conceptual and instrumental use, the concept of symbolic use of market-based information originates in the Market-Based Learning literature. It is less abundantly studied despite findings on its important role, for example, in determining export success (Vyas and Souchon, 2003).

7.2.3.11 Practice K. Mobilising Internal Sources

In addition to collecting information from customers, the PO collected input from internal sources such as sales reports. These activities were grouped together in Practice K, a second *mobilising* practice, and included getting access to internal sources and sharing information with the owners of these sources (which were, above all, sales officials).

Internal sources supported several objectives including, for example, the identification of gaps in current understanding and the preparation of data collection activities in Practices A and H. Moreover, internal sources both supported the PO in locating customers that could inform these practices, and helped in making sense of the findings generated in Practice H.

Salespeople proved to be a valuable source of internal information: "If I am a salesperson, I know a lot about the customer. But I am not sales, I am sitting behind my desk." (INT-PO1s). However, not all salespeople were automatically willing to share their information, proving that strong internal incentives to contribute to innovation projects were lacking at InfoCo. (Note the evidence of Practice K is in Appendix K)

7.2.3.12 Practice L. Generating the Product Concept

Creative and development activities on behalf of SEMO were grouped together in Practice L. This practice was the responsibility of the R&D department in cooperation with the PO. This partnership of actors generated ideas, decided on the most appropriate ones, and developed the solution concepts. Practice L relied, most importantly, on previously generated insights and is, therefore, a *utilisation* practice. The concept versions formed input for Practice I and sales and marketing planning (as in Practice M).

At the time of the SEMO project, the R&D team had just finished training in creative techniques and started to experiment with implementation. Their newly acquired skills formed an important resource for Practice L. (Note the evidence of Practice L is in Appendix K)

7.2.3.13 Practice M. Planning Sales and Marketing

In a third *synthesising* practice, labelled Practice M, the PO synthesised information on customers captured earlier in the project, markets, and solutions into a plan for sales and marketing when launching the solution. Activities involved the re-use of earlier findings and communication of the resulting marketing-communication and market-release plan. The PO considered the information needs of the users of the launch plans when drafting them.

The main objectives of Practice M were to prepare all actors for product introduction and to ensure that the product was sold to the right market, at the right time. Despite these intentions, the launch was difficult: "It appeared that our sales organisation wasn't familiar with this product." (INT-PO2s). This difficulty was also demonstrated in the following extract: "It took a long time before [SEMO] was sold to the right market in Europe." (INT-RD2s).

The resources for Practice M include the integrative skills of the PO and the company formats prescribing what insights should be presented in the launch plans. (Note the evidence of Practice M is in Appendix K)

Table 7.7: Overview Table SEMO Practices

Practice	Characteristics/Exemplary Quotes	Activities	Objectives	Resources	Actors
A. Exploring customer problem situations (Research)	Due to the reliance on a single customer idea, narrow in scope. Dedicated interviewing activity, including analytical activity and documenting of findings. Actors draw upon interview and analytical skills. Sourcing from internal and customer sources: "We went to see a customer in the US and learned that they had difficulty using the system on a much wider scale. At that moment, nobody could help them, so we went to see how they had worked their way around. We then went visiting other clients to understand what they were missing." (INT-SLSs).	Identifying a problem area; Conducting conversations; Analysing customer problems; Documenting customer problems	To further develop first ideas; To validate a first idea	Readily available internal sources; Readily available customer sources; Interview skills; Analytical skills;	PO and Sales
B. Generating ideas (Utilisation)	Informal process, starting from a customer idea. Draws on vision for the future and awareness of strengths and weaknesses. Idea is put forward under influence of the market reputation of InfoCo. "There are always people who do things differently [...] who search for solutions and come to us." (INT-SLSs)	Checking ideas of customers; Consensus and decision making; Generate new ideas;	To define a project fitting the strategic agenda	Vision of the future; Overview of current products and capabilities; Market reputation	Owner and Sales
C. Securing innovation funds (Utilisation)	Done from the start of the project. Involves decision making with regard to fund finding in three distinct project phases. Strategic reflections and explicit decision criteria guide the activities. "When MT has the intention to develop a new pillar of growth, they are more open for that [approving the business case]." (INT-Mkt2s)	Finding funds for problem analysis; Finding funds for needs analysis; Finding funds for testing	To get authorisation from management	Corporate decision-making criteria; Strategic reflections	Owner, Sales Director and PO
D. Exploring the market & opportunity (Research)	Explicit activities. Done from the start of the project. Draws on research skills of students and secondary sources. Company formats specify the type of information that is needed to draw conclusions. "Ideally, initial research is done by students. I don't have the time for this." (INT-PO1s)	Desk research; Visiting conferences; Interviewing; Analysing the opportunity; Documenting the opportunity	To estimate market potential	Research method expertise; Analytical skills; Student support; Readily available secondary material; Company formats	Students/ market research
E. Defining the value (Synthesising)	Both customer and firm value are explored. This is an individual effort of the PO supported by the company formats. The PO uses his integration skills to combine all kinds of insights into one coherent value definition: "That is a lot of talking, and when the Sales Engineer says: 'This is not possible', you have to go back to your customer to check the alternative." (INT-PO1s).	Defining customer value; Defining firm value	To justify investments in development, production, and marketing; To establish a shared vision on the importance of the project	Individual integration skills; Company formats	PO
F. Managing DCI action (Organising)	Full set of preparatory and management activities for DCI. It draws on research expertise and critical thinking of the UCD Manager. Building upon criteria for selecting participating customers and accompanied by a company format. "Formerly, we once in a while collected some information. Now the goal was to do this in a more conscious manner." (INT-MANs)	Planning; Developing methods; Monitoring	To collect information in a conscious, efficient, and impartial manner	Research method expertise; Reflectiveness; A manager; Company formats; Criteria for customer selection	UCD Manager
G. Mobilising customer sources (Mobilising)	Full set of preparatory activities dedicated to customer information processing. It draws on criteria set by the UCD Manager, and the cooperation and management skills of sales in getting access to customers. "It is [the PO] who needs to ask sales for customer contacts and pass them on to us." (INT-RD2s)	Defining customer criteria; Identifying of customers; Activating of customers; Managing of expectations	To get customer information	Customer incentive; Customer management skills	UCD Manager and Sales

Table 7.7: Continued

Practice	Characteristics/Exemplary Quotes	Activities	Objectives	Resources	Actors
H. Elaborating customer needs (Research)	Seeking a deeper understanding of customer needs. Supports solution finding, requirements capturing, and validation of first insights. Resources are research skills and company formats. Methodological skills steer the activities. Preferred approach is interviewing: "These are open conversations. Not structured, but, of course, we have our ideas about the product, and we try to find out whether this matches." (INT-RD1s)	Preparing customers for efficient data collection; Visiting customers; Conducting conversations; Analysing needs; Documenting needs; Reflecting on assumptions	To validate the scope of the project	Research method expertise; Interview skills; Analytical skills; Readily available internal sources; Readily available customer sources; Awareness of uncertainties; Company formats	UCD team
I. Collecting customer feedback (Research)	Basic activities to test performance of developed product, findings are documented, small sample of customers. "I collected a lot of feedback on what works and what doesn't and this goes into the list for a next improvement on functionality." (INT-RD1s)	Surveying customers; Conducting conversations; Watching movies of use; Analysing feedback; Documenting feedback; Reflecting on assumptions	To check performance of the solution	Documentation system; Readily available customer sources	R&D and Sales team
J. Defining customer requirements (Synthesising)	This practice includes integrative activities largely building on integration skills of PO. Findings are captured in a company format. "Epics and User Stories were defined. Usage scenarios were analysed. Personas for each focus group were defined." (URD, p.4)	Listing user requirements; Setting priorities; Refining requirements	To achieve a shared understanding of requirements and priorities To supervise the development process	Individual integration skills; Company formats	PO
K. Mobilising internal sources (Mobilising)	Salespeople were consulted on a regular basis to validate learnings and to get access to relevant customer sources for testing. Knowledge was shared in several meetings and an internal documentation system was used to make relevant project information available to sales: "[…] we actively sat around the table with sales." (INT-PO1s).	Acquiring of sources holding relevant prior customer knowledge; Sharing of information	To validate findings; To get access to customer network	Readily available internal or partner sources; Communication channels	PO and Sales team
L. Developing the product concept (Utilisation)	Combines creative and development activities aiming for product concepts, and product versions. Builds on internally available skills. "We talk with customers about the value proposition, after which we generated concepts […] a creative session […] after which we selected an idea and start development of a proto-type." (INT-MANs)	Generating ideas for solutions; Consensus and decision making; Developing the solution	To provide material for testing; To prepare for sales and marketing	Experience with collective idea generation; Project management tool	R&D team and PO
M. Planning sales and marketing (Synthesising)	Done as a last step by the PO. Draws on individual integration skills, ease of access of insight-related material and formats.	Re-using CI; Communicating insight	To start up the commercial process	Individual integration skills; Documentation system; Company formats	PO

Source: Author

7.2.3.14 Relationships Between Practices

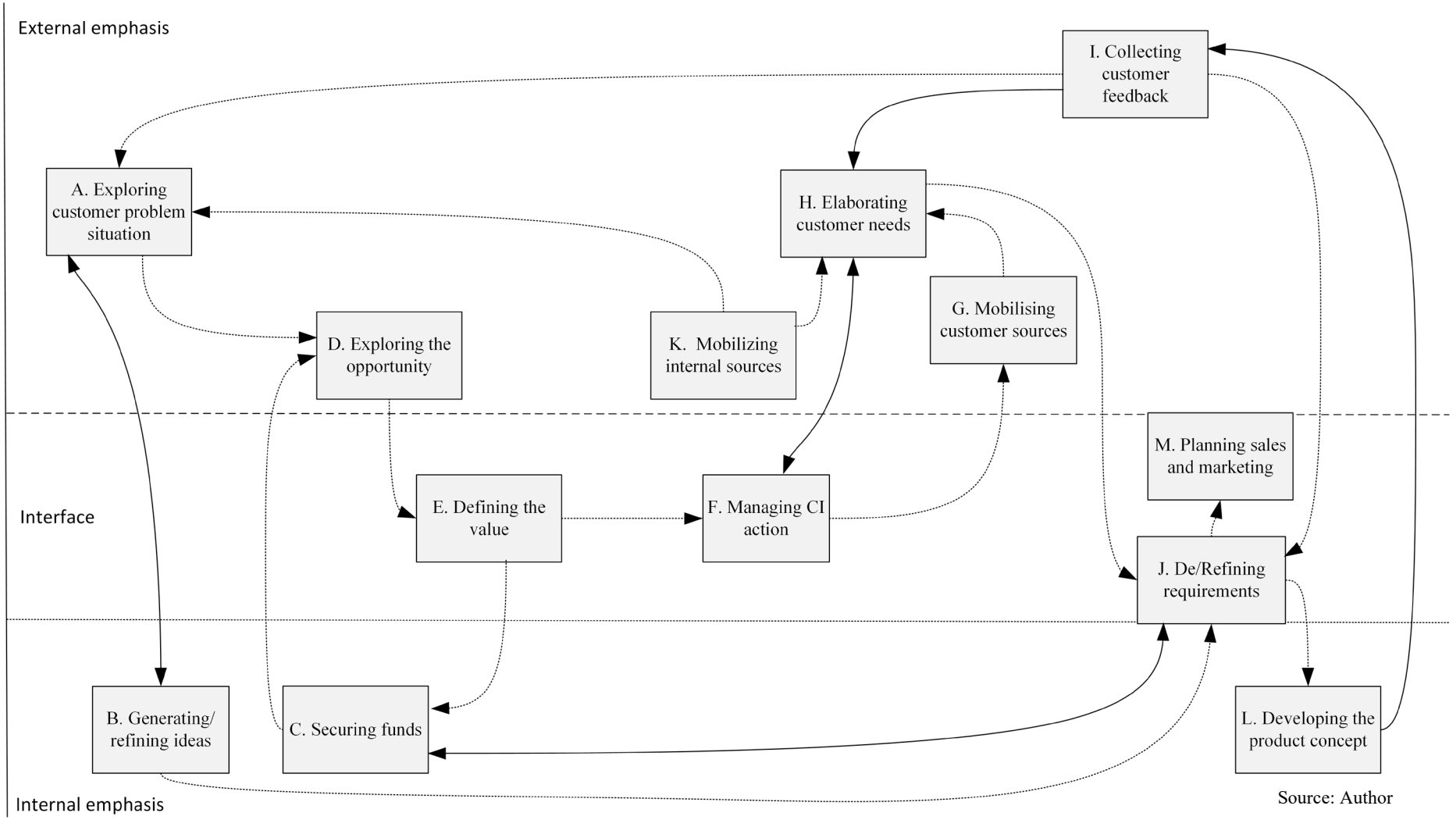
Following the evidence of analytical Step 5, Figure 7.5 visualises the relationships between each of the practices from A to M. The top row of the diagram depicts the practices with an external emphasis — the research and mobilising practices. The middle row displays the practices interfacing the external and internal environment — the synthesising and management practices. Lastly, the bottom row shows the practices that are internally focused — the utilisation and management practices. The single-headed arrows signal one-way relationships between two practices. For example, the PO, when being informed by the Owner and the Sales Director about a potential new idea, first sought contact with Sales to learn whether the problem was known and previously documented. In this way, prior knowledge of Sales (Practice K) became an engine for customer problem research (Practice A). Furthermore, prior knowledge of the Interaction Designer assisted the PO in having more meaningful conversations in Practice H, thus signalling an additional relationship between Practices K and H.

The relationship diagram in Figure 7.5 illustrates the interactions between the research practices and highlights the importance of Practice I. The survey used in Practice I was sent out to save time during conversations undertaken in Practice H and to speed up the process. The URD document explains that at the time of Practice H the technical analysis had already started and valuable time was lost in finding customers that could be interviewed in Practice H. An efficient approach was therefore deemed necessary: "[…] developed the questionnaire to maximise the amount of information we could get from a single respondent." (INT-MANs). The relationship between Practices I and A illustrates the fact that DCI requires several iterations. Additional analysis of the problem was not only performed during the first phase of the project, but also at a later stage, after testing: "When we have a proto-type, we take a next step of data collection in order to draw conclusions regarding the real potential of the solution, including the problems it actually solves" (INT-Mkt2s). Interaction between the research practices is also seen in the relationship between the Practices A and D, with Practice A giving direction to the gathering of a more in-depth understanding of the market forces within specific market segments.

Double headed arrows in Figure 7.5 show the two-way interplay between certain practices. For example, within Practice F, the criteria for monitoring the progress on Practice H were defined, one of which was the comprehensiveness of the generated understanding. Using this criterion, the UCD team decided that, after the first round of conversations, they did not need to go back for additional questioning and corrected their plan accordingly. In this way, Practice F clearly controlled research taking place on behalf of customer needs research. The double headed arrows between Practices I and J illustrate the many rounds of corrections needed to develop a final list of requirements.

Ultimately, the many interrelations shown in Figure 7.5 demonstrate how DCI is the result of various activities undertaken at various points in time. This is clearly evident in the documents describing how research findings resulted in customer requirements (Practice J). The findings from the research Practices H and I were integrated directly into requirements whereas earlier captured insights in the Practices A and D were integrated into requirements via the business case of Practice E.

Figure 7.5: Relationship Between the SEMO Practices



7.2.4 Actors and Roles

Practice Theory stresses the influence of actors on the actual happenings during execution of the practices (Jarzabkowski et al., 2016; Parmigiani and Howard-Grenville, 2011; Vaara and Whittington, 2012). To better understand how actors' influenced DCI generation, a closer examination of their roles complemented the analysis of the SEMO project for RQ1.

Table 7.8 summarises actors and their roles and confirms that DCI generation within SEMO is not the responsibility of a single person, but of many separate disciplines, closely working together. The Owner began the process, recognising important new, externally located information which was passed on to others. He thus fulfilled a *boundary spanning* role. Upon recognition of a first idea, business, sales, and R&D officials put continuous effort into information collection and analysis. It is worth noting that market research was only involved in collecting information on markets (Practice D) and did not participate in other research practices (Practices A, H, and I). In contrast, Sales performed a large variety of roles, stretching beyond their typical commercial duties. The Sales team acted together with the Owner in recognising the first idea, ensuring the commitment of customers, and also both provided input data and participated in data collection. Similarly, the PO performed many roles including the synthesis of findings. This gave him a decisive, *gatekeeping* role, setting the stage for insights use. Another gatekeeping role was performed by the UCD Manager, determining insights use by means of quality control task.[12] Notably, the customer's role was limited to being an informant. SEMO feared that putting their customers in close contact with an unfinished product would harm their market reputation.

Table 7.8: Actors and Roles in the SEMO Case

Practice	Roles	Description of Role	Practice
PO (Business)	Information processing	Collecting and analysing information	A, H
	Champion	Promoting the project internally, creating commitment	C, K
	Gatekeeper/synthesis	Synthesising all relevant knowledge into new models	E, J, M
Customer	Input source	Providing the raw data	A, H, I
Sales	Relationship manager	Promoting the project externally, creating commitment	A, G, H
	Information collection	Collecting information	H, I
	Boundary spanning	Recognising new externally located information	B
	Champion	Promoting the project internally, creating commitment	C
	Decision maker	Making go/no go decisions about the project	C
	Information source	Providing market ad/or customer data	K
Owner	Boundary spanning	Recognition and recommendation of externally located information	B
	Decision maker	Making go/no go decisions about the project	C
Students	Information processing	Collecting and analysing information	D
Market Research	Information processing	Collecting and analysing information	D
UCD (R&D) Manager	Gatekeeper/quality control	Mitigate biases	F, G

[12] The literature review of Barzilai-Nahon (2008) identified different gatekeeping mechanisms, including synthesis and quality control.

Table 7.8: Continued

Practice	Roles	Description of Role	Practice
R&D	Information processing	Collecting and analysing information	H, I
	Boundary spanning	Recognition and recommendation of externally located information	H
	Creativity and development	Develop ideas and concepts	L

Source: Author

7.2.5 Resources

Innovation success is determined most crucially by the resources allocated to the development process (Kyriakopoulos, Hughes and Hughes, 2016). Moreover, Innovation Management and Design literature stresses that radical innovation requires new resources which are different from those used for incremental innovation (McDermott and O'Connor, 2002). Despite this consideration, the literature is not clear on what these resources exactly are. Additional analysis was, therefore, required to explore the types of resources used for DCI within SEMO.

The 70 resource types identified in analytical Step 4 were categorised into four groups of resources. These groups were formed with a consideration for categorisations listed in the reviewed literature (Barney, 1991; Eisenhardt and Martin, 2000; Kyriakopoulos, Hughes and Hughes, 2016). The resource groups reflect the level at which each resource was made available (organisational, project, and individual level) and informational resources are set apart from skills and techniques. Additionally, the groups distinguish *inherited resources*, which are those already present, from newly acquired resources.

The first resource group consists of resources situated at the organisational level and was termed 'Firm-Level Assets' (FLA). Examples of FLA are, for instance, the market reputation within Practice B, or the formats used for the business case and requirement statements. The second resource group consists of information sources and systems, and was termed 'Carriers of Information' (CoI). Most of these resources were created during the project; examples include new customer contacts and secondary information found via internet search and databases. This group also included some of the firms' existing resources, such as the prior knowledge of the sales force. In contrast to the definitions of prior knowledge found in the reviewed literatures, such prior knowledge was not confined to knowledge of regular customers and current needs (e.g. Hulbert, Gilmore and Carson, 2015; Maes and Sels, 2014). Sales clearly also held information regarding prospects, new business opportunities, and new needs, which was included in the CRM system as unusual use-cases of unusual customers (like that which inspired SEMO). The third resource group consists of individual-level skills and was termed 'Skills & Techniques' (S&T). The fourth resource group consists of people and money and was termed 'People & Money' (P&M). This is a second set of project-level resources specifically attracted for the project. Examples include the students that were hired to collecting general market information, or the UCD Manager, trained in design techniques and assigned with the task to manage DCI.

A full overview of the distinct resources is given in Appendix L. Table 7.9 summarises the number of resources within each resource group, and shows that SEMO heavily relied on already existing individual-level skills and techniques, in particular research methods expertise and analytical skills. Company formats were an important FLA resource and steered DCI activities towards the different content components.

Table 7.9: Importance of Resource Groups Within SEMO

Resource Group	# of Resources	%	Dominant Resource Type (# of Appearances in Practices)
FLA	10	24%	Company formats (5)
CoI	11	27%	Customer sources (4)
S&T	18	44%	Research methods, analytical skills, integrative skills (11)
P&M	2	5%	Students, DCI Manager (2)
Total	41	100%	

Source: Author

7.2.6 Conclusions Research Question 1 Example Case Study SEMO

Section 7.2 has responded to RQ1 by describing the practices for InfoCo's radical innovation project SEMO. Five sets of conclusions follow from the within-case analysis.

First, SEMO generated DCI by means of the full set of 13 practices: four of these practices are dedicated to research; three to synthesis of the research findings; two to mobilisation of sources; three to utilisation of insights; and one to management of insights. The significant number of practices demonstrates that the generation of DCI was intentionally sought and formed an important part of SEMO's project approach. Insights were predominantly used instrumentally during decision making, and supported the refinement of the product concepts. Insights were also used symbolically to create internal commitment to the project. Although insights were gathered from the earliest phases of the project, their conceptual use — inspiring the new idea — was limited. The first idea was based on a solution seen at the premises of a customer and was not inspired by the findings of explorative research.

Second, DCI was generated at various instances during the project. It included four types of research: research about customers problems; research about markets; research about customers' needs; and research capturing customers' feedback on solutions. Research about customers' needs was closely managed, whereas the others were much more unscripted following the natural course of events. At later phases of the project, a large part of customers' feedback was the result of other activities, such as training and trouble shooting of pilot versions.

Third, time constraints led the team of SEMO to use an unconventional order of techniques by asking for feedback before engaging in 'open' conversations with customers. Regular feedback questions were included within these conversations in order to retain customers' interest. Both the order and blend of these approaches indicates that explorative research within SEMO was determined by the first idea; such research was not sought in order to maximise the inflow of different perspectives (as prescribed in the literature).

Fourth, the overview of actors and roles illustrates the fact that DCI within SEMO involved many actors. However, the most continuously crucial roles were within the Sales department. To effectively make use of the prior knowledge of Sales, SEMO ensured that salespeople were closely involved in key DCI tasks. In contrast, knowledge of the customer was primarily accesssed by subjecting customers to research, which is a more distant form of collaboration, limiting customers' role in providing input data. Contrary to what may be expected of the Market Research department, this discipline was not involved in primary customer research, only in desk research to generate market information.

Fifth, SEMO employed 40 of 71 total resources identified. Most abundantly used were individual-level research skills. Prior knowledge of sales officials clearly paved the way towards new knowledge, thereby proving a valuable access point to DCI. SEMO also created new resources, albeit to a limited extend, including a small group of new customers and dedicated people like the UCD Manager. Considering his decisive role on DCI quality, the UCD Manager had an especially important impact on the events.

7.3 THE LEVEL OF INSIGHT OF SEMO

The findings on RQ1 enabled to identify the set of practices that the SEMO team applied to generate DCI. Section 7.3 now discusses the findings with regard to RQ2: *What is the level of insight resulting from DCI practices?* The assessment of the level of insight is based on the unique qualities of DCI. Therefore, in a first step towards the assessment, these unique qualities are identified. This analysis is based on interviews, documents, and a workshop. It will show that the insights of SEMO are comprehensive and inspiring, consisting of both current and novel insights. The perceptions of the SEMO team confirm the findings and demonstrate the team's awareness of DCI quality.

The findings are presented in five sections:

1. The first section gives an overview of the procedure to identify the level of insight
2. The second section illustrates the trail of evidence
3. The third section presents the DCI quality criteria perceived to be important by the team
4. The fourth section evaluates the level of insight on a set of pre-defined quality criteria
5. The fifth section draws conclusions regarding RQ2

7.3.1 Analytical Procedure for Identifying the Level of Insight

The analytical procedure used to identify the level of insight in SEMO consisted of two steps. The first step determined the quality criteria for DCI held by the SEMO team. In the second step, quality criteria were used to perform both subjective and objective evaluations of the level of insight generated in SEMO.

In analytical Step 1, all pieces of evidence expressing actors' perceptions of quality criteria were coded. For example, during the interview, the Market Researcher suggested that insights should not be limited to the needs of a single type of user, thus putting forward the criterion of 'comprehensive' insights:

> But you should be aware of different stakeholders within an organisation. We create a canvas for different people. We are always very inclined to talk to the user. But, of course, you also have a head of department who has to approve the budget. You've got people in there, technical people, who may reject innovations. And I think that's very important that you take into account all these users. (INT-Mkt2s)

Six pre-defined quality criteria[13] were used as a starting point for coding. They include the criteria of 'timely', 'comprehensive', 'novel', 'consistent', 'inspiring', and 'format'. New codes were created for emerging criteria. Only criteria mentioned more than once were retained in the coding process. For each criterion, a second code was created, expressing actors' perception of how their insights performed on that specific criterion. This was used in the subjective evaluation of analytical Step 2. The following quote from the UCD manager about 'comprehensive' insights is one such evaluative perception: "These were qualitative sessions.

[13] The six pre-defined quality criteria for DCI were based on criteria found in the Market-Based Learning (MBL), Customer Involvement, and Innovation Management and Design literatures. They were used to objectively evaluate the level of DCI.

With a group of eight organisations and specific persons from within that organisation. That's where we got most extensive results." (INT-MANs).

The second analytical step centred around an objective, quantitative evaluation of the level of insight. This was based on seven indicators which together represent the six pre-defined quality criteria. Consistent with the reviewed literatures, needs insights were equated with customer requirements, which allowed measurement by means of the set of customer requirements defined for SEMO during the project. A full list of customer requirements was published in the URD document, and the contact person at InfoCo confirmed that this list represented all insights gained during SEMO.

During the project, the indicator for 'timely' insights considered the availability of a document listing insights. Two indicators measured whether the insights were 'comprehensive': the total number of needs insights and a count of missed needs. For 'consistency', the percentage of consistently formatted insights was calculated. The indicator for 'inspiring' insights presented the percentage of insights that were free of The indicator for 'format' displayed the number of different formats used to communicate insights.[15] The indicator for 'novel' insights followed from the workshop in which five team members scored the insights in any of the following Kano categories: 'attractive', 'one-dimensional', 'must-be', or 'indifferent'.[16] The number of needs classified in the 'attractive' category was then used as an indicator for 'novel' insights.

The objective evaluation was supplemented with a subjective evaluation. Actors' perceptions of the level of insight (captured in the first analytical step of coding) were used to validate the findings on the seven indicators for the pre-defined criteria as well as on the emerging quality criteria (identified in Step 1).

7.3.2 Illustration of the Trail of Evidence

Section 7.3.1 presented an overview of the two-step procedure for measuring the level of insight; Section 7.3.2 will illustrate how qualitative evidence was collected. It will demonstrate the procedure by focusing on the trail of evidence of the perceptions of the DCI quality criteria within SEMO (Step 1). Evidence of Step 2 is based, most importantly, on quantitative data and will be discussed further in Section 7.3.4.

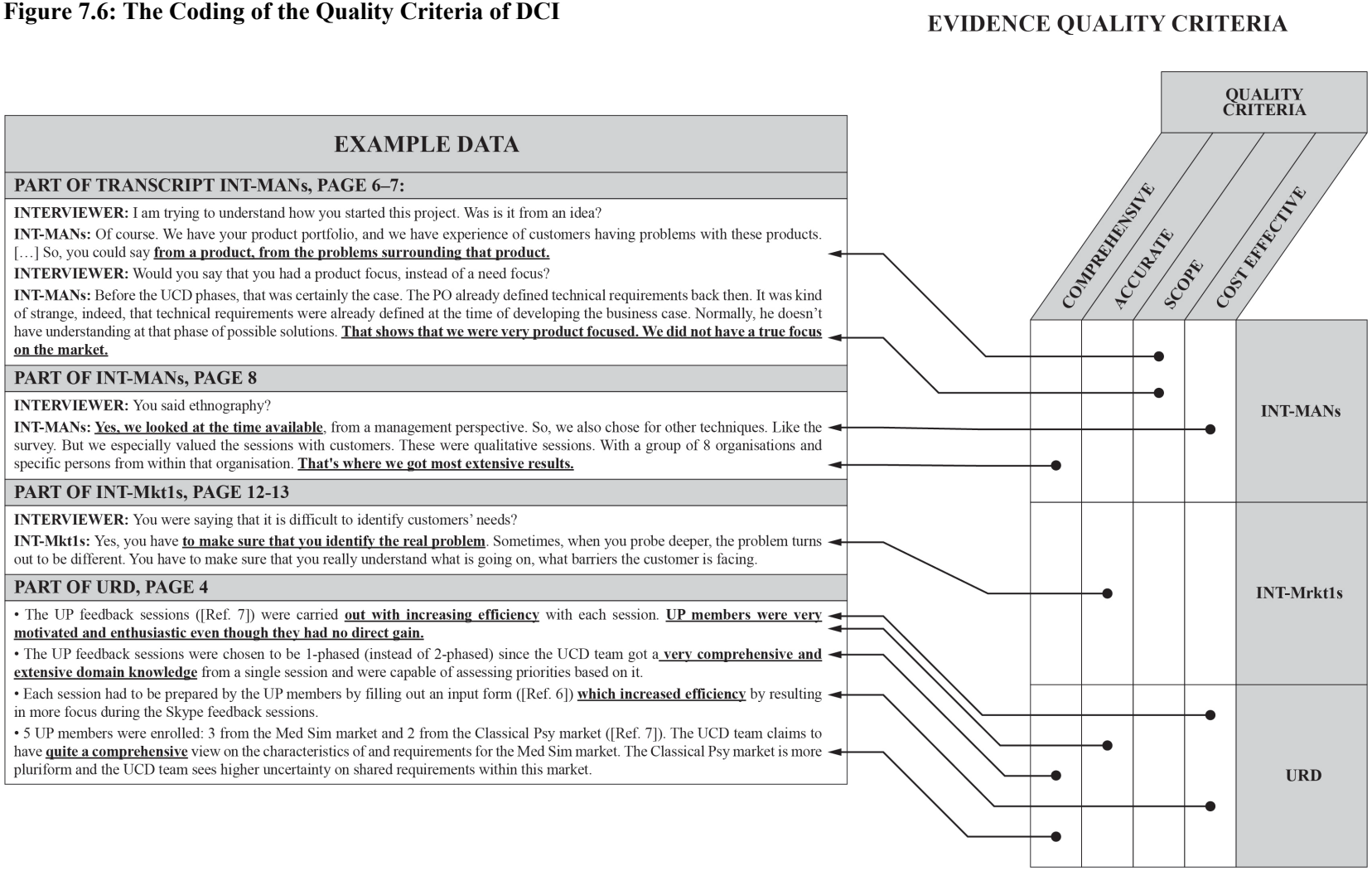
Figure 7.6 shows the codes assigned to pieces of evidence regarding the DCI quality criteria identified in transcripts of the interviews with the UCD Manager (INT-MANs) and Market Researcher (INT-Mkt2s), and found present in the URD document (URD). The coded criteria in the interview with the UCD Manager captured three distinct criteria: 'comprehensive', and the two emerging criteria of 'scope' and 'cost efficient'. Evidence for the criterion of 'accurate' was found in the interview with the Market Researcher. Evidence for 'comprehensive', 'accurate', and 'cost efficient' were also found in the URD document. The other transcripts and documents were coded following the same procedure.

[14] The Innovation Management and Design as well as Creativity literature specifies that customer 7.3.3 s should not include specific product characteristics as this limits creativity (Bettencourt and Ulwick, 2004; Van Kleef, Van Trijp and Luning, 2005; Le Masson, Hatchuel and Weil, 2009).

[15] This aligns with directions of Ulwick (2005) that needs insights should be captured in a single, dedicated format.

[16] This was referred to in Chapter 6 as the Kano procedure, based on the methodology of Kano (Kano, 1984).

Figure 7.6: The Coding of the Quality Criteria of DCI



Source: Author

7.3.3 The DCI Quality Criteria

Table 7.10 summarises the DCI quality criteria mentioned by the team of SEMO, together with exemplar evidence. The complete set of eight perceived criteria proves that actors at SEMO regard DCI as a concept with different dimensions, requiring a careful balance in order to achieve a satisfactory level of overall quality. Perceptions of quality criteria overlap with four of the six pre-defined quality criteria: 'comprehensive', 'novel', 'inspiring', and 'format'. The pre-defined criteria of 'timely' and 'consistent' insights were not mentioned. The number of mentions signifies the extent to which a specific criterion is present in the discussions on DCI quality within the team and is used as an indicator of importance. Comprehensive insights appeared to be of particular concern, with six mentions in interviews and three mentions in documents. The following quote of the Sales Manager explains how the team of SEMO was explicitly looking for novel insights. "Not all contacts are suitable. You need to target the labs where they do ground-breaking research, new stuff." (INT-MANs)

In addition to the pre-defined criteria, the SEMO team focused on collecting DCIs that were 'accurate', 'acceptable', of the right 'scope', and 'cost efficient'. Concerns over accuracy were expressed most especially by the Market Researcher. Furthermore, a total of ten mentions suggests the importance of 'acceptable' insights. Having insights capable of creating internal commitment was found to drive the synthesis of Practices E, J, and M, and underlines the importance of this criterion. Having insights of the right 'scope' was less frequently mentioned and was predominantly expressed by the UCD Manager. He perceived insights of the right 'scope' as critical for selling the product to the right market: "[…] this is about market focus, you have to keep this consistent throughout the project, otherwise you run the risk of focusing on functionalities that are of little importance for that market." (INT-MAN1). Evidence of the last criterion — 'cost-efficient' insights — illustrates the fact that insight quality has a cost limit. The need for 'cost-efficient' insights warranted the need for short-cuts when collecting customer needs information (in Practice H), and to accept lower levels of comprehensiveness.

Table 7.10: Mentions of Quality Criteria for DCI

Criteria	Mentions in Interviews	Mentions in Documents	Exemplar Quote
Comprehensive (pre-defined)	6	3	"The UP feedback sessions were chosen to be one-phased (instead of two-phased) since the UCD team got a very comprehensive and extensive domain knowledge from a single session and were capable of assessing priorities based on it." (URD, p. 4)
Novel (pre-defined)	3	-	"Not all contacts are suitable. You need to target the labs where they do ground-breaking research, new stuff." (INT-MANs)
Inspiring (pre-defined)	2	2	"The user stories in Chapters 8 and 9 lack detail for sake of simplicity." (URD, p. 14)
Format (pre-defined)	5	1	"We use this format to make very clear what we are talking about. We refer to what our customer needs to fulfil their objectives." (INT-RD2s)
Accurate (emergent)	4	1	"You have to make sure that you identify the real problem. Sometimes, when you probe deeper, the problem turns out to be different." (INT-Mkt2s)
Acceptable (emergent)	9	1	"People who will be working on the system all have a different mindsets and backgrounds than I […] you need to make sure that you know what you are talking about." (INT-RD1s)
Scope (emergent)	3	1	"Well, that is about focus […] I told him, this has nothing to do with the original […] If you continue doing this you make the lives of the sales engineer, of the customer […] difficult, you are mixing functionalities."(INT-RD2s)
Cost efficient (emergent)	4	2	"The UP feedback sessions (Ref. 7) were carried out with increasing efficiency with each session." (URD, p. 4)

Source: Author

7.3.4 The Evaluation of the Level of Insight

Table 7.11 shows the evaluation of the level of insight based on both pre-defined criteria and emergent criteria. The criteria are listed in the first row of the Table 7.11 and the second row lists the indicators used for each pre-defined criterion. The emergent criteria resulted from the interviews and documents and, therefore, lack an indicator for objective evaluation. The last row of Table 7.11 displays selected quotes showing the team's perceptions of their level of insight. Sections 7.3.4.1–7.3.4.10 discuss the findings for each criterion.

7.3.4.1 Timely

The insights generated during the SEMO project were well-timed and formed input into several key activities. In fact, an initial set of insights inspired the business case. Moreover, the URD document explicitly states that needs insights were used during design sprints.

7.3.4.2 Comprehensive

The URD document lists 22 needs insights. Content analysis revealed that there were no other needs items than those extracted from the URD document. This analysis has been confirmed by the Interaction Designer who is still working on improved versions of SEMO at the time of writing and has not discovered any new needs. Compared to the amount of 50–150 needs insights mentioned by Ulwick (2016), 22 is a relatively small amount of needs. The Usability Tester, similarly, evaluates this as a small amount and mentions a standard amount of 50 requirement statements for other projects. Due to this absence of agreed-upon standards, a firm conclusion regarding the amount of insights is not possible at this stage of the analysis. The cross-case comparison in Chapter 9 will provide more grounds for evaluating the quantity of insights. Pending this comparative analysis, and looking at the subjective evaluation of the team, it is clear that 22 needs insights were sufficient in providing the team with a level of understanding perceived to be sufficiently complete and rich.

7.3.4.3 Novel

SEMO was clearly based on novel insights. Five workshop participants scored the insights on one of the four Kano categories: 'indifferent'; 'one-dimensional'; 'must be'; and 'attractive'. The participants were familiar with the Kano methodology: "We used it once in a stakeholder meeting." (WS-PM). In spite of this, the low Krippendorff's alpha of 0.19% demonstrates that the team did not always agree[17] on their score. Discussion of the distinct scores reveals that the participants considered the insights in different time frames when evaluating the insights. Due to the dynamic nature of needs, this disparity resulted in different scores. For example, the PO explained how needs related to privacy were new at the time of development, but were much more manifest at the time of the workshop in 2017, thus exemplifying why this item was scored attractive by some participants and must-be by others. Furthermore, the actors appeared to adopt the perspective of distinct types of users. For example, the actual users of SEMO were often found to be indifferent towards data security, whereas the IT departments supporting SEMO considered this to be a 'must-be' requirement. Lastly, the low agreement score was a consequence of the phrasing of the insights, some of which were not clear, leading to discussions about their meaning. This issue regarding insight clarity is further discussed in Section 7.3.4.6. Overall, 16 insights were scored 'attractive' by at least one participant. Considering the degree of consensus and limiting novel insights to those agreed upon by three or more participants, seven insights remain. Discussions regarding the particulars of these

[17] Krippendorff's alpha is a well-accepted measure for agreement among multiple raters. Values >0.67 signal sufficient agreement.

seven insights confirm the teams' consensus. All seven of the novel insights are related to features concerning data-manipulation and analysis. At that time, data-analysis was not as well developed as it in 2020 and SEMO's features were still considered to be unique. Moreover, the team indicates the interrelation between 'attractive' and 'must-be' features: 'must-be' features were needed in order to deliver the 'attractive' needs: "[…] the 'attractives' are related to the analytical functionality that we offer. To do this we need to have 'must-bes'. The customers do not find this exciting but still we have to incorporate it." (WS-RDs).

7.3.4.4 Consistent

Ulwick (2016) argues that firms need to draft needs statements in a consistent and specific format (Ulwick, 2005, p. 29). The evaluation of the insights in terms of their the consistency shows that the 22 statements made by the SEMO team are all identically displayed and are, therefore, 100% consistent.

7.3.4.5 Inspiring

Ulwick (2005) argues that needs statements should be free from solution aspects needs insights within SEMO were drafted in a user story format, and that format specifies the user type, the activity performed, and an underlying motive. The format was outlined in the URD document as follows: "As a facilitator, I want to be able to [perform activity], so that [outcome specified]." (URD, p. 15). This outline did not allow for any reference to solutions, and, therefore, all SEMO insights were free from solution aspects, offering maximum freedom to generate new ideas.

7.3.4.6 Format

The insights were drafted exclusively in the form of user stories and were not mixed with other formats. As explained in Section 7.3.4.5, this user story format communicated the main tasks that users undertake, including preparational, usage, and supporting tasks. Despite the effort that has clearly been put into drafting the insights according to the format, some participants found it difficult to understand the insights. Discussions between the workshop participants regarding the meaning of certain insights suggest a lack of universal clarity.

7.3.4.7 Accurate

Although the Market Researcher emphasised the importance of accuracy and consideration for potential biases, evidence demonstrating the accuracy of SEMOs insights was not found. This suggests that the criterion of 'accuracy' was not actively used to follow up on the quality of insights.

7.3.4.8 Acceptable

Occasionally problematic interactions with Sales suggest that insights were not always easily accepted and did not create internal commitment to the planned course of action. The difficulties encountered in selling the product are put forward by several actors as an example of a lack of internal insights acceptance: "I underestimated this. I thought it was easier to motivate Sales to sell SEMO. I thought they would be more eager." (INT-PO1s).

7.3.4.9 Scope

At several stages during the SEMO project, the team lacked a clear and stable focus on customers' needs. The UCD Manager recalled that observations of new trends and developments frequently led to a redefinition of the intended market during development. But also, that it was not easy to define the market in terms of needs; instead, it was defined in terms of products. As a consequence of this lack of scope, the current product does not fully meet the needs of the main, originally defined, target market.

7.3.4.10 Cost Efficient

The accounts of the Interaction Designer demonstrate that the internal discussion were at time fierce and time-consuming, but nevertheless worthwhile to maximise results: *"*You can try to do it quickly and with just enough detail, or go for 100%, all the way and put more time in it. We had several discussions on it and this took a lot of time". (INT-RD2s). The URD document shows how the team compensated for the loss of time at a later phase of the project, thus managing to bring the project back on track in terms of timing and cost.

Table 7.11: Evaluation Level of Insight of SEMO

	Pre-defined						Emergent			
Criterion	**Timely**	**Comprehensive**		**Novel**	**Consistent**	**Inspiring**	**Format**	**Accurate**	**Acceptable**	**Scope**	**Cost Efficiency**
Indicator	Availability of document listing insights during the project	Amount of needs insights	Verification missed needs insights	Attractive needs (agreed upon by 50% or more of team)	% of consistently formatted insights	% of insights free of solution aspects	# of different formats	n/a	n/a	n/a	n/a
Objective evaluation	Yes	22	No	7	100%	100%	1	n/a	n/a	n/a	n/a
Subjective evaluation	Insights were available from the start of project and were captured in user stories before development started: "The user stories in Chapter 8 and 9 lack detail for sake of simplicity. More information will be provided during size estimation discussions and sprint planning. For background information, please refer to the UCD team." (URD, p. 14).	Insights were fairly comprehensive. Although, for some market segments, uncertainties remained, and the amount of needs is relatively small compared to those in InfoCo's regular in usability tests: "The UCD team states to have a quite comprehensive view on the characteristics of and requirements for the [market segment 1]. The [market segment 2] market is more pluriform and the UCD team sees higher uncertainty on shared requirements within this market." (URD, p. 4). "To be honest, until now, I haven't come across any new needs with regard to SEMO. Maybe others may have been surprised by certain customer reactions, but they were not as deeply involved as I was." (INT-RD1s) "Currently, I am doing a usability test including 50 requirements." (WS-UTs)		Confirmation of newness of certain attributes of SEMO: "Our uniqueness is related to the way in which we enable [specific task]. At that time, nobody was very explicit about that, but we knew that was key." (INT-RD1s). "That [feature] was completely new, and the way in which we developed [other feature] as well. It was a combination of new and old." (INT-Mkt2s)	Despite the uniform and solution-free format, the workshop discussions revealed that the insights were not always clear to all: "Sometimes it was difficult. I didn't quite understand what was meant with some of the requirements." (WS-RDs). "I just tried to interpret them myself." (WS-Mkts)			n/a	Although the PO tried to create consensus during the synthesising activities, it appeared that Sales did not fully accept the market and sales plan: "It appeared that our Sales organisation wasn't familiar with this product. That was very inconvenient." (INT-PO2s),	Too narrowly focused/shifting focus: "That shows that we were very product focused, We did not have a true focus on the market." (INT-MANs).	Explicit attempts to generate both accurate and cost-efficient knowledge: "The UP feedback sessions (Ref. 7) were carried out with increasing efficiency with each session." (UCD, p. 4).

Source: Author

7.3.5 Conclusions on Research Question 2 Example Case Study SEMO

Section 7.3 has addressed RQ2 by describing the level of insight generated during InfoCo's SEMO project. Five sets of conclusions follow from this within-case analysis.

First, the quality criteria expressed by the SEMO team demonstrate that the actors considered multiple criteria for good DCI. There is an overlap with the criteria identified in the literature and several less well-described criteria, including 'accurate', 'acceptable', 'scope', and 'cost-efficient' insights were detected.

Second, SEMO's level of insight consisted of 22 instances of needs insights, which was a level perceived to be sufficiently comprehensiveness and complete. By trading some of the comprehensiveness off against costs, the SEMO team endeavoured to generate cost-efficient DCI. Seven out of the 22 needs insights were related to latent, hence novel, needs. To establish the novelty of insights, it was essential to consider insights' stability over time and to carefully define the user group. Known features — related to current needs insights — were found indispensable in order to deliver new features — related to latent needs insights. This dependency between current needs and latent needs proves the interdependence between the two types of insights.

Third, overall, SEMO achieved positive results on seven of ten total DCI quality criteria. Difficulties were found in 'acceptance' and 'scope' of the insights; these criteria are related to internal activities and touch upon the role of Sales. Such difficulties show how DCI requires durable organisational internal commitment to prevent interests in current needs and current business conflicting with activities and decision making. Difficulties experienced with 'acceptance' and 'scope' may also be related to another quality issue, namely the perceived lack of clarity of insights. Although the insights were found 'inspiring' and 'consistent' — necessary qualities for creativity — participants' abstract wording clearly led to further discussion about their meaning, which suggests that insights may require different formats depending on the NPD phase and user of the insights.

7.4 PERCEPTIONS OF DEEP CUSTOMER INSIGHT PRACTICES

In response to RQ2, Section 7.3 concluded that DCI within SEMO was timely, comprehensive, consistent, and novel. Concurrently, however, DCI lacked clarity and broad acceptance. Section 7.4 discusses the results of RQ3: *What are the perceptions of small-firm actors of DCI practices?* It will highlight which practices are deemed important and how the SEMO team could improve their DCI capabilities. The analysis is based on the findings of the interviews, documents, and a workshop. Section 7.4 will argue that the SEMO team was critical of the processes leading up to DCI, and would aim for stronger DCI management and a more collaborative and considered approach in next projects.

The findings are presented in five sections:

1. The first section gives an overview of the procedure for identifying the perceptions
2. The second section illustrates the trail of evidence
3. The third section discusses perceived importance and implementation of the practices
4. The fourth section considers the details of potential improvements of the practices
5. The fifth section draws conclusions with regard to RQ3

7.4.1 Analytical Procedure for Identifying the Perceptions

7.4.1.1 Quantitative Procedure

The analysis is based on a combined quantitative and qualitative procedure. In the workshop, participants were asked to score the *importance* and the *level of implementation* of the practices identified by RQ1 in Section 7. 2. These perceptions were measured by using a five-point Likert scale. For importance, the scale ranged from 'not at all important' (1) to 'very important' (5). The scale for the level of implementation was adapted from Reijonen and Komppula (2010), and ranged from 'managed very poorly' (1) to 'managed very well' (5).

Both importance and implementation scores were used to identify improvement opportunities. The Ulwick (2005) procedure supported the analysis, and was chosen because, with the large number of practices used at SEMO, a clear method was essential to facilitate the identification of priorities for InfoCo. The Ulwick procedure takes the proportion of respondents for both scales of importance and implementation, scoring 4 or more. The opportunity score then results from the following equation:

> % of respondents giving a score of ≥4 for importance + (% of respondents giving a score of ≥4 for importance − % of respondents giving a score of ≥4 for implementation)/10

High opportunities have scores ≥15, moderate opportunities have scores ≥12, and low opportunities have scores score ≥10 (Ulwick, 2005). All practices with a score of ≥10 were presented to the workshop participants for further discussion.

7.4.1.2 Qualitative Procedure

The qualitative analysis concentrated on the practices that were given priority for improvement. Therefore, the qualitative analysis first sought to validate the quantitative analysis of the levels of importance and implementation of the practices. Perceptions of importance and implementation were coded separately. Perceptions of importance were recognised by paying attention to phrases such as "it is important that […]". Additionally, strong statements, such as "I always know that […]" or "every team has to have […]", were coded as perceptions of importance. Perceptions of implementation were recognised by paying attention to time aspects of phrases, like "we only recently started using […]" or "at that time we didn't work yet with […]".

The focal point of the analytical procedure was to explore the *improvement* tactics that were seen as key in order to develop the SEMO team's DCI capabilities. Therefore, accounts of potential, or recently applied, changes of action were used as an entry point for further analysis. In this way, improvements were detected in phrases like: "we have decided to train people, because […]" or "I would like to have […]". The findings were triangulated and enriched with opinions found in the interviews and documents. A total of 48 improvements resulted from the analysis and these were reduced into 15 higher order themes, each representing an improvement tactic. The improvement tactics include: analytical tools; collaborative approach; creative skills; culture; data collection techniques; format synthesis; management of learning; management of customer expectations; market definition; order of doing things; roles; sampling; timing; test material; and flexible processes. Appendix M gives a full overview of the perceptions and their higher-order themes. For example, the theme 'data collection techniques' holds perceptions of improvements in terms of advanced data collection techniques; the use of desk research; or control of the objectivity of findings

An additional analysis was aimed at gaining a deeper understanding of the implications of improvements for DCI. Therefore, perceived improvements were also categorised according their potential impacts on the level of DCI. The quality criteria for DCI (identified Section 7.3) were used to describe these impacts. For example, the following quote from the Interaction Designer was coded as an improvement tactic labelled 'flexible processes' because the previous corporate approach was deemed inefficient and inflexible: "We had the PBC as our corporate approach, but that is not a very efficient way of working, requiring too much discussion and decision making. We now work in an agile, lean way." (INT-RD2s). Considering the potential time and efficiency effects of this improvement, it was coded as 'timely' and 'cost efficient'. Appendix N gives an overview of the full results of this analysis.

Lastly, the qualitative data provided a deeper understanding of the practicality of the improvement tactics, and allowed an analysis of the barriers impeding their implementation. Barriers were recognised for each improvement separately by paying attention to phrases such as "it is very difficult […]", "the problem is that […]", or "we needed to […] but […]" in connection to specific improvements. The findings were triangulated and enriched with opinions found in the interviews and documents. A full overview of barriers is summarised in Appendix O.

7.4.2 Illustration of the Trail of Evidence

Section 7.4.1 has presented an overview of the procedure for measuring the perceptions of the DCI practices; Section 7.4.2 will illustrate how qualitative evidence was collected. It will demonstrate this by focusing on the trail of evidence of the perceptions of improvement tactics within SEMO.

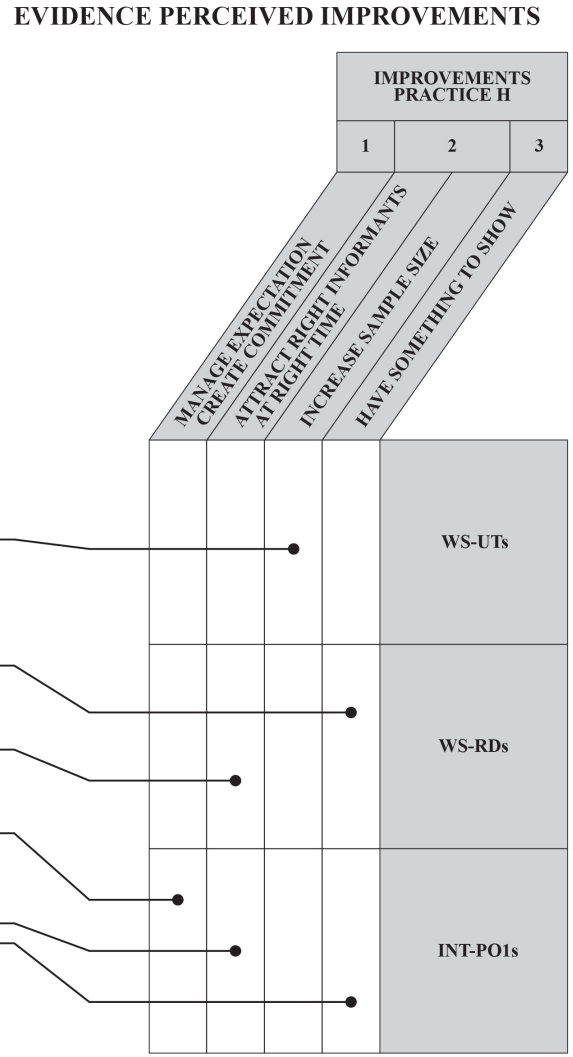
Figure 7.7 shows the codes assigned to pieces of evidence about perceptions of improvement for Practice H. The overview presented in Figure 7.7 shows the codes found in the workshop transcript and the transcript of the interview with the PO. These codes include: 'manage expectations, create commitment'; 'attract the right informants, at the right time'; 'increase sample size'; and 'have something to show'. The table legend of Figure 7.7 mentions the higher-order themes, i.e. the improvement tactics of these codes, including: 'management of expectations'; 'sampling'; and 'test material'.

The coding of the transcript of the workshop with the Usability Tester (WS-UTs) captured one code: 'increase sample size', which formed part of the theme of 'sampling'. Similarly, the code 'attract the right informants at the right time', which was found in the workshop transcript of the R&D Manager (WS-RDs) and the transcript of the interview with the PO (INT-POs), falls within the 'sampling' theme. Evidence for perceived improvement — in the form of code 'have something to show' — was found in the workshop transcript of the R&D Manager and in the transcript of the interview with the PO. Lastly, instances of the code 'manage expectations, create commitment' was found in the transcript of the interview with the PO. Other transcripts and documents were coded following the same procedure.

Figure 7.7: The Coding of the Perceptions of Improvement

TABLE LEGEND	
1	MANAGEMENT OF CUSTOMER EXPECTATIONS
2	SAMPLING
3	TEST MATERIAL

EXAMPLE DATA
PART OF TRANSCRIPT WORKSHOP, PAGE 20
WS-UTs: I often hear that somebody went to see a single customer with a specific need, and comes back stating that all customers have this need. **WS-RDs:** Then you do not develop for a group of customers. **WS-UTs:** Exactly, so I think that **validation in groups** will add a lot to our approach
PART OF TRANSCRIPT WORKSHOP, PAGE 26
WS-POs: At InfoCo, we are like, oh we start with the must-bes and present this to the customer. And they easily agree on their value […]. **WS-RDs:** Yes, that is because we want to stay on the safe side. We like to keep things internal, first design the floorplate, before we show something to the customer, but that is not exciting. The exciting part is what is on top of that, the body of the car […] But one way or another, when we start talking to customers, **we need something to show, to communicate with**. This should be more than plain text, it should be pictures […] anything that visualises what we want to improve.
PART OF TRANSCRIPT WORKSHOP, PAGE 28
WS-RDs: For [other innovation], we did this differently. **We took more time to think about the customer segment** […] We thought about the farmers […] or maybe the animal feed producers, they have more budget […]
PART OF INT-PO1s, PAGE 12-13
INT-PO1s: Ideally, you would like to involve customers early in the process. But that depends on the product. **I am now working on a product for which the proto-type isn't ready. So I can't do anything with customers.** **INTERVIEWER:** What other things are important to involve customers early in the process? **INT-PO1s:** The question is when are you talking to a customer. In an early phase, they have too many questions and than they lose interest. When you are too late, we lose time. So, you have to pick your time and **keep the customer on board. You have to have a good story.** And then, you also **have to find a customer who is willing to work with you.**



Source: Author

7.4.3 Perceptions of Importance and Implementation

Both quantitative and qualitative findings indicate that the SEMO team placed high value on the DCI practices, and the team was particularly critical of the level of DCI practice implementation. The average scores (means) of both importance and implementation are summarised in Table 7.12, together with the standard deviations (std). The standard deviation indicates the consensus within the team. Practices displaying a higher standard deviation than average were considered to have a low level of team agreement. Table 7.12 also includes illustrative quotes for the most important findings, which have been printed in bold type.

Table 7.12 demonstrates that most practices were perceived to be highly important, with only the mobilisation of internal sources (Practice K) scoring <4. The relatively low score of Practice K seems to contradict the findings of Section 7.2, which describes the efforts placed on utilising the prior knowledge of Sales. However, such perceptions may also be taken as confirmation that Sales is not a regular internal source, but rather a partner that supplements the DCI generation process with various additional resources. Furthermore, the team clearly agreed that customer problem exploration (Practice A) and the exploration of markets and opportunities (Practice D) were key practices. The importance of Practice D is explained by InfoCo's strong commercial culture. Lastly, participants agreed on the significance of the value proposition (Practice E). The PO stressed how the format of the business plan informed him what information was needed in order to develop a sound value proposition, and further, helped him in communicating the value of SEMO. The recent company-wide adoption of the business model canvas underlines the importance of a clear and communicative value proposition.

The level of implementation of the practices was generally perceived to be modest, with only two practices having scores >4. Only customer problem exploration (Practice A) and the sales and marketing plan (Practice M) were found to be well executed. The execution of the practices for mobilising customer sources (Practice G) and DCI management (Practice F) was found to be more problematic. Perceived difficulties included access to informing customers and the limited availability of the UCD Manager to oversee the DCI process. Similarly, the collection of customer feedback (Practice I) was not perceived to be well implemented, which is witnessed in the discretionary documentation of customers' feedback.

Table 7.12: Scores of Importance and Implementation of the SEMO Practices

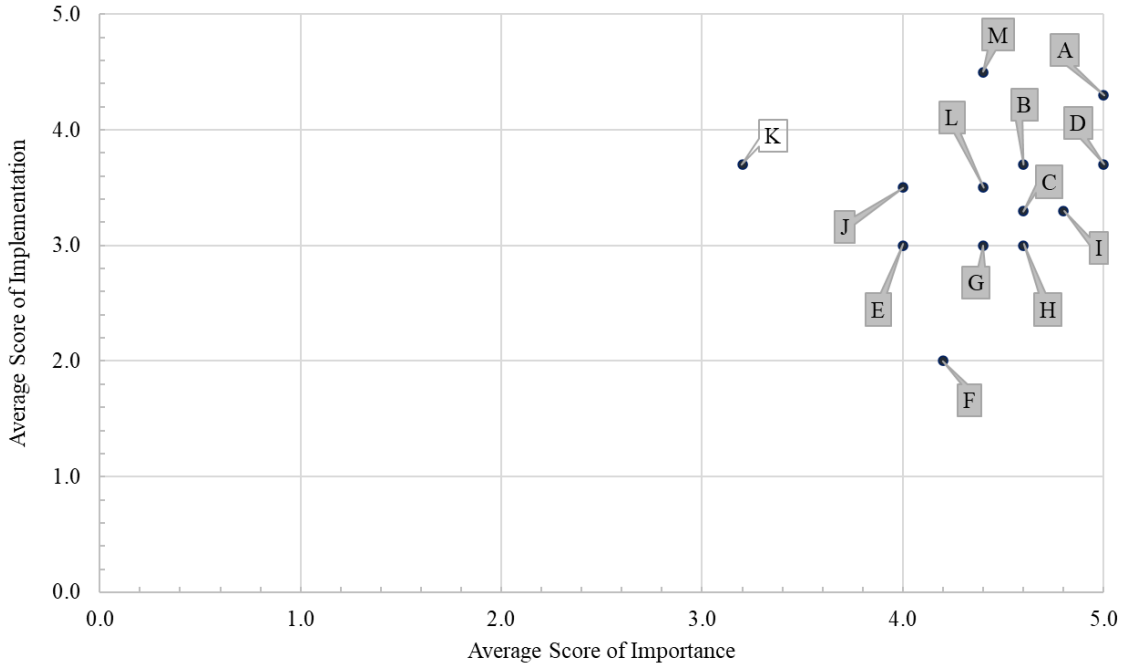
	Practice	Importance		Implementation		Exemplar Quotes (referring to bold printed results)
		Mean	Std	Mean	Std	
A.	**Customer problem exploration**	**5**	**0.00**	4.3	0.58	"You need to talk to the customer. That is the most important thing, probe deeper, to understand what exactly the problem is." (INT-SLSs)
B.	Generating ideas	4.6	0.55	3.7	0.58	
C.	Securing innovation funds	4.6	0.55	3.3	0.58	
D.	**Exploring the market & opportunity**	**5**	**0.00**	3.7	1.15	"We are a very commercially-driven firm." (INT-PO); "As far as I am concerned, the main questions are: 'What is our market?' and 'What are the most important opportunities?'" (WS RDs)
E.	**Defining the value**	**4**	**0.00**	3.0	1.41	"For me, this was very important. It gave me an overview of what I was doing, and why." (INT-PO2s)
F.	**Managing DCI action**	4.2	0.45	**2.0**	**0.00**	"It depends on the product if we do this […] in [SEMO] I was involved only from the UCD phase on." (INT-MANs)
G.	**Mobilising customer sources**	4.4	0.55	**3.0**	**0.00**	"At that time, we didn't pay sufficient attention to getting launching customers. It could have saved us a lot of problems when we would have looked more into that." (INT-PO1s)
H.	Elaborating customer understanding	4.6	0.55	3.0	1.00	
I.	**Collecting customer feedback**	4.8	0.45	**3.3**	**0.58**	"Not all feedback was documented." (INT-Mkt2s)
J.	Defining customer requirements	4	0.71	3.5	0.71	
K.	**Mobilising internal sources**	**3.2**	**0.84**	3.7	0.58	"Our internal sources know a lot of [customer segment x], but not about the market we were looking for." (WS-RDs)
L.	Generating the product concept	4.4	0.55	3.5	2.12	
M.	**Planning sales and marketing**	4.4	0.55	**4.5**	**0.71**	"I know by now how sales works. You cannot overwhelm them with all kind of technical information. You have to present it with pictures." (INT-PO2)
	Total	4.4	0.44	3.4	0.77	

Source: Author

7.4.4 Perceptions of Improvement

Combining the two scores of importance and implementation from Table 7.12 into a single diagram, Figure 7.8, clearly visualises which practices were deemed most in need of improvement. Generally, practices that have a relatively low score in importance (the left-hand side of the diagram) or a high score in implementation (the upper half of the table) should be given lower priority for improvement. Figure 7.8 demonstrates that, due to high levels of importance together with modest levels of implementation, most of the practices were seen as good candidates for improvement. This is confirmed by the Ulwick procedure which enabled the calculation of anchoring rules, and led to the exclusion of only Practice K, mobilising internal sources. All other practices were discussed in the workshop to identify improvements and barriers. Appendix P summarises the results of the Ulwick procedure for each practice.

Figure 7.8: Practices Offering an Opportunities to Improve



Legend:
Grey Labels: Priority for Improvement
White Labels: No Priority for Improvement

Source: Author

7.4.4.1 Improvement Tactics

Overall, the workshop, interview transcripts, and documents held references to 20 improvements. Table 7.13 summarises the amount of improvements for each practice (except Practice K) and shows which improvement tactics were mentioned most often. Consistent with the relatively low implementation score of Practice G, several improvements were mentioned for mobilising customers. The majority of mentions (13) concerned the sampling procedures; the actors pressed for involving a wider customer group and expressed the need to gather input from customers of Asian countries. The teams also proposed a relatively high number of four improvements for Practice H. Within this practice, data collection techniques were most often mentioned, and the team was particularly eager for sufficient time to establish an accurate view of customers' needs.

Table 7.13: Improvement Tactics of SEMO

Practice	# of Improvements	Dominant Tactic	# of Mentions	Exemplar Quotes
A	1	Market definition	2	"For me that would be an important improvement […] to define the market segment based on customers' needs." (WS-RDs)
B	1	Creative techniques	1	"Ideas are not the problem, we have plenty of ideas, we should not stimulate that, on the contrary, we should limit it." (WS-RDs)
C	1	Format synthesis	5	"[…] we now work with canvasses to show market and potential, but that is not a very extensive document anymore […] much more a poster format […] making it easier to show where we are and where we are heading." (INT-RD2s)
D	2	Collaborative approach	4	"I would have taken much more time in involving Sales. Not only in generating product-related information, but also in understanding the market. What is important there? How do you sell this? Why would customers pay for this? […] Connect to their questions and support them in selling the product." (INT-RD2s)
E	1	Flexible processes	1	"We had the PBC as our corporate approach, but that is not a very efficient way of working, requiring too much discussion and decision making. We now work in an agile, lean way." (INT-RD2s)
F	2	Management of learning	6	"This was the first project in which we gave a central role to DCI. I, therefore, created the template, but, in my opinion, this was not enough. Every project calls for a dedicated approach and we need to have one person assigned to the team who follows up on the process." (INT-MANs)
G	4	Sampling	13	"We do not only want to make products for Western Europe or the United States, but also for Asia and, increasingly, China. So, we should include other cultures in our analysis." (INT-Mkt2s)
H	3	Data collection techniques	6	"I think we should invest more time in sitting alongside the customer and observe what is going on […] I don't care who does this, as long as it is done in a way that doesn't influence the actual way of working of the customer." (INT-Mkt2s)
I	2	Management of learning	8	"[…] and this is where we should have validated more continuously, checking whether they, indeed, need what you have developed." (INT-PO1s)
J	1	Collaborative approach	3	"We need to spend much more time with Sales. Integrating their perspectives as well." (INT-RD1s)
L	1	Creative techniques	1	"We had a training and then we think that everybody that was present is able to implement the learning. But, not everybody had the same background in using creative techniques […] we easily say we do not have the time to use what we have learned, but we also need to make this part of our daily work flow." (INT-MANs)
M	1	Collaborative approach	3	"It is important that we come to one conclusion, otherwise everybody keeps thinking in his own interest. Therefore, we use formats like Personas. So that we all understand the motives of specific persons." (INTRD1s)
Total	20			

Source: Author

Improvement tactics related to more than one practice were identified as key tactics. The improvements found in the tactic 'management of learning' noted a total of 14 references across the Practices F and I. Suggested improvements included much closer involvement of a manager throughout the entire project instead of only in Practice H. Such increased managerial involvement would result in a more sophisticated approach, as explained by the UCD Manager: "Every team should have a person managing DCI, and thus takes informed decisions with regard to the activities that are needed to get information out of the market." (INT-MANs). Moreover, the team would choose to integrate a more continuous customer feedback process instead of the one-off survey that preceded the customer conversations of Practice H during the SEMO project.

The improvements identified in the tactic 'collaborative approach' noted a total of ten references across the Practices D, J, and M. These improvements principally advocate a more intensive collaboration with, and reinforce earlier arguments regarding the contributing role of, Sales. Improved collaboration would allow an increase in the human resources available for data collection, as well as the incorporation of Sales' requirements during synthesis. This would, in turn, avoid lengthy discussions regarding the priority setting, thus speeding up the process. Furthermore, such a collaboration is perceived to support Sales in selling SEMO to the targeted new customers instead of to current customers.

It is vital to note that none of the improvements suggested a change in order between Practices A and B, thus demonstrating how prescriptions from the literature (start with needs information before ideation) are not readily recognised in practice. In fact, the SEMO team is relatively silent on potential improvements of Practice A, other than the UCD Manager who proposed a more careful and consistent definition of the market.

7.4.4.2 The Implications of the Improvements

Table 7.14 summarises the implications of the improvements for SEMO, thus exhibiting their potential effect on insight quality. The last row of Table 7.14 summarises the amount of improvements for a specific quality criterion, and shows that perceived improvements for SEMO would have a particularly positive effect on timely, comprehensive, accurate, and acceptable insights. A total of eight improvements impact timeliness, of which, three are the result of improvements to the collaborative approach. Improved collaboration with Sales will also impact the acceptability of insights, a second major impact domain with a total of seven improvements contributing to it.

The other key tactics identified in Section 7.4.4.1 (data collection techniques, management of learning, and sampling) will impact various DCI qualities, including comprehensiveness, which is a third major impact domain with a total of seven improvements. Management of learning is a particularly impactful improvement, having a potential effect on all impact domains, including comprehensive insights.

Table 7.14: The Quality Implications of Improvements

Improvements per Improvement Tactic	Implications for the Level of DCI									
	Timely	**Comprehensive**	**Novel**	**Consistent**	**Inspiring**	**Format**	**Accurate**	**Acceptable**	**Scope**	**Cost efficient**
Collaborative approach	✓				✓			✓	✓	
Take into account informational needs sales	✓				✓			✓		
Take a collaborative approach to priority setting	✓							✓		
Involve sales in development sales and marketing	✓							✓	✓	
Creative skills			✓							
Have training in creative techniques (1 x B, 1 x L)			✓							
Data collection techniques		✓	✓				✓			
Take time to visit and observe customers		✓	✓							
Preserve objectivity							✓			
Flexible processes	✓									✓
Have a fast and flexible approach	✓									✓
Format synthesis					✓	✓		✓		
Present the project convincingly to others					✓	✓		✓		
Management of learning	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Have more intensive DCI management	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Have more continuous feedback from customers	✓	✓								
Market definition									✓	
Define the market in a meaningful way									✓	
Order of doing things										✓
Start validating early										✓
Roles	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Create a dedicated DCI management role	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Sampling	✓						✓			✓
Attract the right informants at the right time	✓						✓			
Make clever use of online channels for interviewing										✓
Timing		✓					✓			✓
Get most out of limited time		✓								✓
Plan more time for market research		✓					✓			
Test material			✓				✓			
Put the right things in the proto-type			✓				✓			
Management of customer expectations		✓					✓	✓		
Manage expectations, create commitment		✓					✓	✓		
Total impact (amount of improvements)	**8**	**7**	5	2	4	3	**7**	**7**	4	6

Source: Author

7.4.4.3 The Barriers to Implementation

Overall, 26 barriers to the implementation of improvements were identified, thus confirming that the SEMO team possesses a certain level of process awareness. The full set of barriers are included in Appendix Q. Table 7.15 focuses on the barriers for the most important improvement tactics identified in Section 7.4.4.2, including: the collaborative approach; data collection techniques; management of learning; and sampling. The barriers for these improvements represent 11 of the 26 total barriers, illustrating the fact that the implementation of improvement tactics would require substantial change management.

Barriers for achieving more collaboration with Sales were found in the organisation's current structure and processes. These barriers emphasise current business and customers' current needs, and do not support activities with less clear returns, such as radical innovation. Moreover, the physical distance and distinct thought worlds between Innovation and Sales officials was perceived to further complicate collaboration.

Obstacles to the improvement of data collection techniques were found in the lack of an organisational-wide awareness of biases. Biases, such as an overly optimistic view on new product features, are not incidental and occur with different actors — Sales as well as the Owner:

> Often, when the owner gets back, he has positive response about a new idea. But of course, these persons talk to the Owner of a middle-sized company and they will not say that they feel the idea is bad […] it is a large difference, when I probe, maybe in a more down-to-earth way, about new ideas than when the Owner does. (INT-Mkt2s)

The different views regarding what constitutes market research — "verifying ideas" (INT-SLSs) or "desk research, and checking with colleagues" (INT-PO1s) — demonstrate that not everybody within InfoCo recognises the sophisticated set of techniques needed for DCI generation. Similarly, this lack of a shared understanding was found to complicate the overall management of learning. During the SEMO project, this led to only a marginal involvement of the DCI manager and to frequent deviations from the plan.

A lack of recognition of what is needed in terms of sampling was indicated by different actors at different occasions. This clearly demonstrates the fact that, in general within InfoCo, teams easily accept needs of single customers and do not automatically validate such needs among a wider group of customers. Moreover, although some consideration was given to what type of customers to involve in the SEMO project, explicit criteria and procedures for selecting customers are not available within InfoCo, leading to frequent discussions within the teams. Sampling is further complicated by customers' motivation and background. Apparently, customers motivated to participate are not easily found. In addition, effective communication with distant, Asian customers is perceived difficult. As a result of these complications, teams easily settle for whatever customer is available and small-sized samples.

The majority of implementation barriers to DCI generation are related to cultural aspects or, in other words, the organisation-wide system of beliefs and values with regard to innovation. Clearly there is no shared language used to describe the types of information sustaining DCI (customer information, market information, needs information, and solution information) or the research practices used in generating this information. Moreover, there is no unified view on important aspects such as the involvement of Sales, customer selection, bias, and management of DCI. Execution of activities are left to the discretion of single actors, without the support of corporate guidelines affirming the values of certain practices.

Table 7.15: Barriers to Implementation of Improvement Tactics

Barriers to Improvement Tactics	Sum of # Mentions	Exemplar Quote
Collaborative approach	**6**	
Current structure and processes	3	"In the ideal situation, you sit together with Sales. But, in practice, this is problematic […] They should have the courage and align sales targets. And as long as there is not a product, Sales is reluctant to share information […] Sales is too busy achieving their targets." (INT-PO1s)
Distance to sales	3	"If I am a salesperson, I know a lot about the customer. But I am not sales, I am sitting behind my desk. I need to pull this out of our CRM system." (INT-POs1)
Data collection techniques	**6**	
No measures to correct for biases	4	"Salespeople are opportunistic, they want to sell. So, they easily say everybody wants that feature, but you have to validate that, of course." (INT-SLSs)
What is market research?	2	"Market research, that is simply verifying ideas that are on the table." (INT-SLSs); "Market needs, that is desk research, and checking with colleagues […] Product information is about giving customers a product and seeing how they react to it." (INT-PO1s)
Management of learning	**9**	
Lack of recognition of DCI management	2	"Overall, the organisation thinks that once we have a plan or template everything will run smoothly, but that is not the case." (INT-MANs)
Deviations of plan	3	"The User Panel (UP) formation was a slow process and formed a bottleneck in the UCD team analysis work. One of the reasons was that the project (technical) analysis work had already started before the first UP member was found. Whereas, in a normal UCD process, the UP is almost complete at start of analysis." (UCD, p4)
Sampling	**17**	
Lack of attention for sample size (2x, both in Practice H and I)	4	"I have noticed that customers easily ask for specific features and that this is put on the agenda of R&D. But when you then ask the Sales Engineer about other customers having this need, it remains silent." (INT-RD1s)
Lack of method for customer selection	4	"This is frequently part of internal discussions. Should we involve our closest relationships? But then we run the risk of self-fulfilling prophecies, or should we put effort in findings others?" (INT-Mkt2)
Motivation of customers	2	"You need to have customers that are willing to cooperate. It is not that such customers are not available, but they do not come in great numbers. Especially not if they need to sit with you regularly." (INT-Mkt2s)
Geographical location of customers	7	"It is very difficult to get useful feedback, for example, out of China. This culture is so different […] Sometimes when responses gets back, you find out that they didn't understand everything." (INT-Mkt2s)
Total of 11 barriers	**38**	

Source: Author

7.4.5 Conclusions on Research Question 3 Example Case Study SEMO

Section 7.4 has addressed RQ3 by describing the perceptions of the actors involved in the DCI practices of InfoCo's SEMO project. Five sets of conclusions follow from this within-case analysis.

First, the practices perceived to be particularly critical for the generation of DCI are the research practices for understanding customers problems (Practice A) and markets (Practice D), and the synthesis of this information into a value proposition (Practice E). Data collection skills and the format for capturing findings during synthesis are elements deemed especially important.

Second, the level of implementation of Practice A is considered above standard, which is reflected in the low number of suggested improvements for this practice. Issues with an early definition of the idea — as mentioned frequently in the literature — were not recognised. Less well implemented practices included DCI management (Practice F), mobilisation of customers (Practice G), and collecting customers' feedback (Practice I).

Third, overall, the SEMO team would prioritise improvements for seven of their practices, including Practices D, F, G, H, I, J, and M. Consistent with modest levels of implementation, the SEMO team would choose to improve both the quality and quantity of customers involved in the project, especially including customers from Asian countries. These improvements would, above all, contribute to comprehensive insights. Interestingly, the team would not seek to increase the level of involvement of customers, demonstrating the SEMO team's preference to learn *from* customers and not *with* customers.

Fourth, the SEMO team would seek to strengthen the involvement of *internal* actors, thereby showing the strong internal orientation of the suggested improvements. The team expressed the need to more permanently involve a DCI expert and pay more attention in order to avoid bias. Additionally, the SEMO team would seek greater involvement of the Sales team in the research and synthesis practices. Overall, these improvements would contribute to timely, accurate, acceptable, and comprehensive insights.

Fifth, the barriers to implementation reveal what needs to be changed in order to implement the suggested improvements. All barriers point in the direction of a cultural change. In order to have a concerted effort, instead of discretionary activities of single actors, a more shared and in-depth understanding of topics like sampling, bias, and management of DCI, is deemed necessary.

7.5 DISCUSSION AND CONCLUSIONS OF THE SEMO CASE

Chapter 7 has presented findings of the within-case analysis of InfoCo's SEMO project, which has led to the following seven sets of conclusions.

First, SEMO's encompassing set of practices can be organised into five practice groups: mobilisation practices, research practices, synthesis practices, utilisation practices, and a management practice. Practices within each group maintain highly similar activities and objectives, setting them apart from the practices assigned to other groups. The practice groups incorporate key aspects from market-based learning and customer involvement, and the interplay between the two fields demonstrates that a combination of aspects from both domains is required for DCI generation (see e.g. Cui and Wu 2016; 2017).

Second, the interplay between SEMO research practices shows that an early and close interaction between *exploratory*, open-ended, research and feedback gathering (i.e. *confirmatory* research) takes place. Market-Based Learning and Innovation Management and Design literature generally prescribes that these two types of research take place in separate NPD phases, with exploratory research preceding confirmatory research (e.g. Cayla and Arnould, 2013; Goffin, Lemke and Koners, 2010; Price and Wrigley, 2016). However, the SEMO case findings show that feedback gathering may start early in the project, and may even be intertwined with exploratory research.

Third, some practices, but not all, were found to be explicitly managed and controlled. This illustrates the fact that academic studies emphasising either formal or informal practices disregard hybrid approaches actually taking place in some SMEs. In a similar vein, the SEMO case findings argue that a forced distinction between either prior or new knowledge does not match the practices of some SMEs. In fact, the findings prove that prior knowledge may be related to new knowledge, interacting with it when seeking an understanding of problems and needs.

Fourth, SEMO's focus on skills and techniques shows that not all SMEs lack the expertise for generating DCI (e.g. Coviello and Joseph, 2012; Marion, Friar and Simpson, 2012; Moultrie, Clarkson and Probert, 2007). SEMO's team was composed of many actors, thus maximising available skills and knowledge. Sales professionals were actively contributing to many DCI practices, possibly at the expense of market research experts.

Fifth, within SEMO, DCI is recognised as a separate body of knowledge with different dimensions of quality. These dimensions go beyond those that are well-described in the, admittedly scarce, literature. Above all, acceptable insights proved vital; a dimension which, thus far, has received little serious academic attention (Schirr, 2012). The practices of SEMO led to a reasonable amount of both current and novel needs insights, and both types of insights were recognised as important for a radical innovation project like SEMO. The absence of established threshold levels for the amount of novel needs frustrates the drawing of any robust conclusions regarding the level of insight. What does become clear is that SEMO's insights were timely, consistent, inspiring, and uniformly formatted. However, the high level of wording needed to produce inspiring insights also led to misunderstanding, suggesting that insights should take different forms across NPD, and could even adapt to users. A comparison between the case projects in Chapter 8 will enable this study to draw firm conclusions regarding the level of insight achieved.

Sixth, SEMO's team would seek to improve their DCI capabilities by advancing their data collection skills and techniques, increasing overall DCI management, and boosting the quality and quantity of the sample of customers. Moreover, there is a strong interest in improving internal collaborations. Although SEMO would aspire to increase the amount and the quality of the customers involvement, they would not seek more close forms of interacting with customers. The fear of the team of SEMO for reputational damage may explain observed reluctance to closely involve customers in some academic studies (Marion, Friar and Simpson, 2012b; Moultrie, Clarkson and Probert, 2007). Improvements are aimed at achieving more timely, comprehensive, and accurate insights, and are consistent with the relatively low acceptance of SEMO's insights. However, the suggested improvements do not offer a solution for issues identified with the clarity and scope of insights.

Seventh, the observed barriers to the implementation of suggested improvements show that many of the DCI activities were the result of discretionary action of individuals and were not grounded in InfoCo's innovation culture. Therefore, successful implementation of the improvements would require a more uniform and company-wide understanding of DCI, thus enabling the actors to collaborate more effectively.

7.6 SUMMARY OF THE SEMO CASE

Chapter 7 has presented an analysis of the SEMO case in response to RQ1, RQ2, and RQ3. It has illustrated the following:

Section 7.2 has addressed RQ1: *How do small firms' practices enable them to generate DCI for radical innovation projects?* The findings argue that SEMO applied a complete and sophisticated set of 13 practices in order to generate new insights. The findings also facilitated an analysis of the types of resources applied in these practices, as well the actors and roles utilised. This revealed a strong reliance on the existing research skills and on some newly created resources, including new customers and a dedicated DCI Manager. Moreover, it established the important role of Sales in more than traditional sales-related duties.

Section 7.3 has addressed RQ2: *What is the level of insight resulting from DCI practices?* The findings of this section uncovered the different dimensions of quality forming part of DCI, and determined that the SEMO team is particularly susceptible to having acceptable insights. The practices of SEMO were evaluated using both an objective and subjective procedure, which established a fair amount of both current and novel needs characterising SEMO's level of insight.

Section 7.4 has addressed RQ3: *What are the perceptions of small-firm actors of DCI practices?* The identified perceptions confirmed the presence and importance of the practices outlined in RQ1 and highlighted improvements recognised by the SEMO team. In particular, these improvements concerned the prevention of bias, sampling, more continuous DCI management, and internal collaboration. The findings also revealed practical barriers for implementing the improvements.

CHAPTER 8 OVERVIEW OF CASE STUDIES

8.0 INTRODUCTION

Chapter 7 discussed the rich set of findings from the SEMO case study. Chapter 8 will give an overview of other case study projects: Thermo, ZKL, MZI, SmartLight, and Fibertop. This overview includes the background information for each case study, the data collected, and a summary of the findings. Chapter 8's discussion of the findings will not be as detailed as that which was undertaken for SEMO. Chapter 8 serves to only illuminate the key characteristics before presenting a detailed comparison of the case study projects in the cross-case analysis of Chapter 9.

Chapter 8 is organised into six main sections:

1. The first section presents the overview of the Thermo case study
2. The second section discusses the main details of the ZKL case study
3. The third section considers the main results of the MZI case study
4. The fourth section summarises the main findings of the SmartLight case study
5. The fifth section considers the main results of the FiberTop case study
6. The sixth section summarises Chapter 8

8.1 OVERVIEW OF THE THERMO CASE STUDY

Section 8.1 presents the results of the Thermo case study, which is a newly developed system solution from SystemCo.[1] SystemCo produces electronic safety systems with applications in medical and agricultural industries. Thermo featured in the MKB[2] top 100 in 2012. Both the technology underlying Thermo, and the customer segments being targeted were new to the company. Thus, Thermo was a radical innovation for SystemCo, involving new products, with new technology, aimed at new markets. Data capturing was undertaken from April 2018 through to December 2018.

Sections 8.1.1 and 8.1.2 will present background information on the Thermo case study. After which, the findings for each research question are presented; RQ1 on the practices, RQ2 on the level of insight, and RQ3 on the perceptions.

8.1.1 Overview of the Company and Case

SystemCo is a small-sized SME, whose headquarters is located in the Netherlands, and currently employs 10 people selling the solutions across Europe. SystemCo was founded in 2008 by the current Owner-Manager. Its mission incorporates the development of innovative solutions, and Thermo was one of the five SystemCo has developed thus far. The idea for Thermo arose in 2011, formal development began in 2014, and the product was launched in

[1] The names of both firm and project were disguised to maintain confidentiality.
[2] MKB stands for Small and Medium-Sized Enterprises (SME) in Dutch.

2016. In the screening survey,[3] Thermo's technological experience was rated with a score of 3 on a scale ranging from 'none' (1) to 'extensive' (5). For experience in marketing, Thermo was given a score of 3 on the same scale. Maturity with regard to the DCI processes was considered low, with a score of 1 on a scale ranging from 'not managed at all' (1) to 'managed very well' (5).[4]

8.1.2 Data Collection of Thermo

The sources of data collection at Thermo consisted of interviews, company documents, two short surveys, and a workshop.

8.1.2.1 Interviews

A total of three interviews were held with the three members of the core innovation team, the Owner, her partner who co-owns SystemCo and acts as the R&D Director, and an external marketer. The total interview length was 201 minutes (3 hours and 21 minutes). The interview details are summarised in Table 8.1 which includes the notations used to label and refer to the interviewees in the case study analysis.

Table 8.1: Interview Details of Thermo

Interviewees	No of Interviews	Interview Length (min)	Interviewee Reference	Role	Innovation Experience[5]
Owner	1	77	INT-OMt	Owner Manager	Medium
R&D Director	1	54	INT-RDt	R&D Director, Owner	High
External Marketer	1	70	INT-Mkt1t	Execution marketing research	Low
Total	3	201			

Source: Author

8.1.2.2 Documents

Two relevant documents were available for this case. Table 8.2 illustrates how a total of 49 pages were inspected, including the notations used to reference the documents in the analysis.

[3] The overall newness score was adapted from Olson, Walker and Ruekert (1995) and Bonner (2012). It was given by the Marketing Executive during the screening procedure and averaged scores on three items: newness to firm, newness to industry, and newness to customer.

[4] The scales measuring technological and marketing experience give an indication of the product's newness and were adapted from Olson, Walker and Ruekert (1995) and Bonner (2012). The scale measuring maturity of the DCI processes was adapted from Reijonen and Komppula (2010).

[5] Actors who, at the time of the innovation project, had been involved in more than five innovation projects were classified as having a high level of experienced. Actors involved in less than three projects were classified as having a low level of experienced. Actors participating in 3–5 projects were rated as having a medium level of experienced.

Table 8.2: Documents of Thermo

No	No of Pages	Title	Document Content	Reference Document	Date	Author
1	2	[Thermo] Brochure	Overview of the main requirements identified during the project	Brochure	Nov 2015	Owner
2	47	Developing a good market segmentation as a basis for successfully introducing [Thermo]	Research results of desk research and interviews of prospective customers, recommendations with regard to the marketing tactics and business case for the marketing approach	Marketing Research	March 20215	External Marketer
Total	49					

Source: Author

8.1.2.3 Workshop

The workshop was held at the headquarters of SystemCo. Participants included the R&D Director, the External Marketer, the Internal Marketer, and the Owner. The notations used to refer to them are included in Table 7.3. The workshop lasted 3 hours and 15 minutes and was fully transcribed.

Table 8.3 Workshop Details of Thermo

Participants	Participant Reference	Role
Owner	WS-OMt	Owner Manager
R&D Director	WS-RDt	R&D Director
Internal Marketer	WS-Mkt2t	Marketing support
External Marketer	WS-Mkt1t	Execution of market research

Source: Author

8.1.3 Summary Findings: Thermo

First-order coding revealed that the Thermo team performed 25 out of the 47 total customer insight-related activities. These activities are grouped into 10 different higher-order practices, covering 15 of the 36 total objectives, and drew upon 29 of the 70 total resources. The practices that were observed are connected through 17 relationships. Practices H, F, and K were not performed, and overall, this is case project is less research intensive and less deliberately managed than the SEMO case project.

The idea for Thermo came from the strategic agenda and vision of the two Owners (the persons referred to as Owner and R&D Director) regarding technological advantages that could be achieved. Insights generation within Thermo started after the basic idea was launched on the project's website. In this way, marketing and customer interaction (Practices M and G) started much earlier than in the other case projects. Once a specific customer group expressed their interest, and this group was judged sufficiently commercially attractive, the R&D Director immersed himself in that customer group's business in order to understand how Thermo could solve specific problems. The focus of his activities was on data-collection and developing what the R&D Director called "broad domain knowledge'. He drew extensively on his interview and

integrative skills and less on analysis and reporting skills. After development, the customers were involved more intensively in testing the product and, ultimately, became the ambassadors giving credibility to Thermo during launch. Aside from the early start in marketing and customer interaction, Thermo also differed in its timing and use of market research in Practice D. Shortly before investing in the development of Thermo, the Owners hired an external marketer, who was a masters student at that time, to perform market research. Their main aim was to validate their much more informal vision and findings with what they called a "scientific approach". Aside from this involvement of the external marketer, the Owners were not keen to involve their other employees and believed that they alone were best suited to generate DCI. Other employees were predominantly involved in execution or supporting tasks and, therefore, the majority of DCI generation roles were concentrated with the Owners. Tables containing evidence for these results are included in Appendix R – V.

The Thermo team defined DCI by means of six quality criteria: comprehensive, novel, accurate, acceptable, scope, and cost efficient. A total number of 26 insights were generated at the time of development, of which six were believed to be novel insights. Overall, the Thermo team perceived their insights to be limited at the time of development, and insights with regard to design and appearance were reported to be missing. Such gaps in understanding were retrospectively answered and, therefore, not all insights were available at the right time. The 'lean' approach led to highly cost-efficient insights. Moreover, the team felt that their insights were well-accepted by their customers despite the poor quality of the format and their lack of clarity. Tables containing evidence for these results are included in Appendix W and X.

The Thermo team recognised improvement opportunities for Practices A, G, I, L, and M. They listed eight improvements related to data collection techniques, sampling, and the skills and experience of their internal team. In subsequent projects, the Thermo team would address the comprehensiveness, novelty, and accuracy of their insights. They would take a more systematic approach and try to immerse themselves further in the field. Further, they would focus less on commercially attractive customers, but rather try to identify more useful customers; customers that are more innovative and more capable of expressing their needs. How exactly this could be achieved is not mentioned. A total of ten barriers remained for implementing these improvements and were related to thoroughly understanding what is needed for DCI. Moreover, the barriers address the roles played by the Owners, who did not trust others within the firm to be of value because of their lack of experience. As a consequence, perspectives and skills that could easily have been acquired or developed to enrich research findings were left unused. Tables containing evidence for these results are included in Appendix Y – AA.

8.2 OVERVIEW OF THE ZKL CASE STUDY

Section 8.2 presents the results of the ZKL case study, which is a newly developed system solution from RailCo, a company produces railway systems across Europe. ZKL was featured in the MKB top 100 in 2015. At that time, it was a start-up and the technology developed was completely new to the Owner. Although the Owner had some experience servicing subsegments within the railway industry, he did not have any knowledge or experience with the customer group he was targeting with his solution. Thus, ZKL was a radical innovation for RailCo, involving new products, with new technology, aimed at new markets. Data capturing was undertaken from April 2018 through to December 2018.

Sections 8.2.1. and 8.2.2. will present background information regarding the ZKL case study. After which, the findings for each research question are presented; RQ1 on the practices, RQ2 on the level of insight, and RQ3 on the perceptions.

8.2.1 Overview of the Company and Case

RailCo is a small-sized SME whose headquarters is located in the Netherlands and currently employs 25 people selling solutions across Europe. It was founded in 2014 by the current Owner-Manager. RailCo's mission incorporates the development of innovative solutions, and ZKL was the first of a series of two other innovations targeting the same railway industry. The idea for ZKL arose in 2009, formal development began in 2014, and the product was launched in 2016. In the screening survey, ZKL's technological experience was rated with a score of 2 on a scale ranging from 'none' (1) to 'extensive' (5). For experience in marketing, ZKL was given a score of 3 on the same scale. Maturity with regard to the DCI processes was considered high, with a score of 4 on a scale ranging from 'not managed at all' (1) to 'managed very well' (5).

8.2.2 Data Collection of ZKL

The sources of data collection at ZKL consisted of interviews, company documents, two short surveys, and a workshop.

8.2.2.1 Interviews

A total of two interviews were held with the two main actors, the Owner and a Product Owner in the ZKL development. Total interview length was 262 minutes (4 hours and 22 minutes). The interview details are summarised in Table 8.4, which includes the notations used to label and refer to the interviewees in the case study analysis.

Table 8.4: Interview Details of ZKL

Interviewees	No of Interviews	Interview Length (min)	Reference Interviewee	Role	Innovation Experience
Owner	1	87	INT-OMz	Owner Manager	Medium
Project Owner	1	68	INT-POz	Overall Project Manager	Low
Total	4	262			

Source: Author

8.2.2.2 Documents

One relevant document was available for reference in this case study. Table 8.5 illustrates how a total of two pages were inspected, and includes the notations used to reference the document in the analysis.

Table 8.5: Documents of ZKL

No	No of Pages	Title	Document Content	Reference Document	Date	Author
1	2	[ZKL] Brochure	Overview of the main requirements identified during the project	Brochure	April 2016	Owner1
Total	2					

Source: Author

8.2.2.3 Workshop

The workshop was held at the RailCo headquarter. Participants included the Marketing Director and the Owner. The notations used to refer to them are included in Table 8.6. The workshop lasted 2 hours and 6 minutes and was fully transcribed.

Table 8.6: Workshop Details of ZKL

Participants	Reference Participant	Role
Owner	WS-OMz	Owner Manager
Marketing Director	WS-Mktz	Execution of marketing activities

Source: Author

8.2.3 Summary Findings: ZKL

First-order coding revealed that ZKL performed 23 out of the 47 total customer insight-related activities. These activities are grouped into 10 different higher-order practices, covering 14 of the 36 total objectives, and drew upon 23 of the 70 total resources. The practices that were observed are connected through 19 relationships. Practices D, H, and F were not performed, and make this case less research-intensive and less deliberately managed than the SEMO case project.

Most of the knowledge within ZKL resulted from the immersion of the Owner in the railway industry (Practice A). The Owner emphasised how this gave him a broad domain of knowledge and a vision of the future, which drove idea generation. Once the idea was developed further, customers were involved in feedback gathering (Practice I), thus enabling the refinement of the insights generated in Practice A. The focus of activities within the research practices is primarily on data collection and less on analysis and reporting. The Owner frequently refers to his 'gut feeling' and is hesitant to perform projections and calculations on the basis of market data. Customers involved in Practice I were the result of extensive direct interactions in Practice G. Customers co-developed the requirements in Practice J and performed support tasks for product development in Practice L. An experienced partner was attracted to the project in order to supplement customer understanding and to gain access to the user group. Similar to the Thermo case, ZKL is characterised by the strong presence of the Owner. He performed all practices and made decisions often based on gut feelings and his strong vision of the future, which allowed him to apply simple rules for go/no go decisions without spending time on a business case. As the project unfolded, the Owner's insights became gradually more complete and were then used to motivate other people to participate in the project. Other team-members were largely involved in execution or supporting tasks. Tables containing evidence for these results are included in Appendix BB – FF.

The ZKL team defined DCI by means of five quality criteria: comprehensive, novel, format, acceptable, and cost efficient. A total number of 20 insights were generated at the time of development, of which five were believed to be novel insights. These were not documented at the time of development but listed afterwards. Insights from other markets were not included and, therefore, insights were not believed to be complete. ZKL team members did not perceive the preferred format of epics and user stories to be very clear. This may also explain the difficulties encountered in selling ZKL to customers. Tables containing evidence for these results are included in Appendix GG and HH.

The ZKL team identified nine potential improvements for Practices A, B, E, H, I, L, and M. Improvement of data collection and team collaboration were themes often mentioned and reveal a need to involve a wider group of team members in this activity. Furthermore, the ZKL team felt that they could improve structuring insights in the format. Inconsistent thoughts within the team about how and when this should be done suggest the presence of tensions and

disagreements and demonstrate how the strong role played by the Owner may form an important barrier to further improvement. Tables containing evidence for these results are included in Appendix II – KK.

8.3 OVERVIEW OF THE MZI CASE STUDY

Section 8.3 presents the results of the MZI case study, which is a newly developed machine solution from MachineCo. MachineCo produces customised machines for customers in a wide variety of industries, including chemical, agricultural, and fishing industries. MZI featured in the MKB top 100 in 2015. Both the technology underlying the application and the customer segments being targeted were new to the company. Thus, MZI was a radical innovation for MachineCo, involving new products, with new technology, aimed at new markets. Data capturing was undertaken from May 2016 through to September 2017 and involved interviews, documents, surveys, and a workshop.

Sections 8.3.1 and 8.3.2 will present background information regarding the MZI case study. After which, the findings for each research question are presented; RQ1 on the practices, RQ2 on the level of insight, and RQ3 on the perceptions.

8.3.1 Overview of the Company and Case

MachineCo is a family-owned machine manufacturer whose headquarters is located in the Netherlands. Currently, it employs 35 people selling solutions worldwide, and noted a turnover in 2016 of 5.5 million Euro. MachineCo believes innovation is vital in order to maintain its market position. Over the course of its 30-year existence, it has successfully developed between five and eight innovative solutions for new markets. The MZI project began in 2012 in joint effort with MusselCo. The aim of the project was to radically improve current systems for capturing mussel seed, referred to by 'MZI'. MusselCo's current system was too inefficient for upscaling. Both firms believed their solution would be relevant to other fishermen and aimed to commercialise it. The prospect of a larger target audience opened up substantial grant funds, which were used to buy in additional resources from the nearby University of Applied Sciences (UAS). These resources included a senior engineer, a senior market researcher, and student support. By the end of 2015, the project was terminated. At that time, a pilot version was developed, but resources for further development were not forthcoming.

In the screening survey, MZI's technological experience was rated with a score of 3 on a scale ranging from 'none' (1) to 'extensive' (5). For experience in marketing, MZI was given a score of 2 on the same scale. Maturity with regard to DCI processes was considered average, with a score of 3 on a scale ranging from 'not managed at all' (1) to 'managed very well' (5).

8.3.2 Data Collection of MZI

The sources of data collection at ZKL consisted of interviews, company documents, two short surveys, and a workshop.

8.3.2.1 Interviews

A total of six interviews were held with four different actors, all of whom were part of the MZI innovation team. The actors held positions in both management and R&D, and also included a co-creating customer. Total interview length was 498 minutes (8 hours and 18 minutes). The interview details are summarised in Table 8.7, which includes the notations used to label and refer to the interviewees in the case study analysis.

Table 8.7: Interview Details of MZI

Interviewees	No of Interviews	Interview Length (min)	Reference Interviewee	Role	Innovation Experience
Owner	2	34	INT-OM1m	Project leader - Owner	High
		94	INT-OM2m		
Customer	1	45	INT-Cst1m	Initiator	Low
Internal Engineer	2	43	INT-RD1m	Developer	Low
		91	INT-RD2m		
External Engineer	1	48	INT-RD3m	Development support	High
Total	6	355			

Source: Author

8.3.2.2 Documents

Documents were collected during the interviews. Table 8.8 illustrates that a total of 118 pages were inspected, and includes the notations used to reference the document in the analysis.

Table 8.8: Documents of MZI

No	No of Pages	Title	Document Content	Reference Document	Date	Author
1	9	Project Plan Innovation in the Fishing Industry	Description of the MZI usage situation and the planned way of working of the innovation team, including CI activities.	GrantDoc	Okt 2010	Customer
2	11	MZI Plan of Approach	Details on objectives and expected outcomes of the project, as well as on team and process-steps.	PPlan	Sept 2013	Student Engineer
3	16	MZI Analysis Report	Reports analysis results, including some customer needs findings.	Areport	Sept 2013	Student Engineer
4	4	Choice Matrix Total	Evaluates potential solutions against requirements.	CM1	Sept 2013	Student Engineer
5	6	Choice Matrix 2nd Phase	Evaluates potential solutions against requirements.	CM2	Sept 2013	Internal Engineer
6	3	Briefing Market Research	Puts forward research objectives and preferred analysis instruments.	BriefMR	Sept 2014	Owner
7	61	Market Research Report	Reports on objectives, methods, and results of market research project.	Mrreport	Dec 2014	Student MR

Table 8.9: Continued

No	No of Pages	Title	Document Content	Reference Document	Date	Author
8	2	Call Report Market Researcher	Discusses business model options.	CallReport	July 2015	Market Researcher
9	2	Meeting Report RD	Refers to test reports and summarises ideas for solving observed problems.	MeetReport	Dec 2014	Internal Engineer
10	4	Causal Storiesv0.1	Adds more details on a preferred business model.	Cstories	Sept 2015	Market Researcher
Total	116					

Source: Author

8.3.2.3 Workshop

The workshop was held at MachineCo's premises. Participants included the Owner, Market Researcher, the customer, Internal Engineer, and the External Engineer. The notations used to refer to them are included in Table 8.9. The workshop lasted 5 hours and 45 minutes and was fully transcribed.

Table 8.10 Workshop Details of MZI

Participants	Reference Participant	Role
Owner	WS-OMm	Project leader - Owner
Market Researcher	WS-Mktm	Execution market research
Internal Engineer	WS-RD1m	Developer
External Engineer	WS-RD3m	Development support
Customer	WS-Cstm	Initiator

Source: Author

8.3.3 Summary Findings: MZI

First-order coding revealed that MZI performed 30 out of 47 total customer insight-related activities. These activities are grouped into 10 different higher-order practices, covering 17 of the 36 total objectives, and drew upon 32 of the 70 total resources. The practices that were observed are connected through 15 relationships. Although Practices F, G, and M were not performed, this case study was, nevertheless, among the most research-intensive.

The MZI case is unique because the owner, who was actively involved in this project, depended on a single customer, MusselCo, for many of the DCI activities. The idea of MZI was presented to MachineCo by MusselCo and, because of the substantial grant money available, MZI was easily evaluated as an attractive new opportunity for MachineCo. The grant money made it possible to buy in research skills from the nearby university. These were, however, not used to the fullest potential, largely as a result of the strong role played by MusselCo. In the MZI project, MusselCo, as customer, served as an input source, but also participated in additional data collection, analysis, and synthesis. He undertook desk research and held conversations at conferences and with some colleague fisherman. Moreover, MusselCo facilitated research and testing on his boat and attended to fundraising. Lastly, he participated in decision making, problem solving, and idea generation. As a consequence of

MusselCo's commitment to the project, there was an expectation that he acted as an internal marketer for MachineCo, taking care of all customer-related tasks. Despite the strong focus on research and abundantly available research skills, the resulting information was actually narrowly focused on the specific problems and situation of MusselCo and, as was later discovered, did not fit with needs of other potential customers. Conversations with other potential customers were limited because MusselCo feared that his fellow fishermen would benefit from MZI and the idea's IP could not be protected. The only research with a broader perspective on the market was executed by students, under the supervision of an external marketer. However, this was undertaken after most of the investments in development had been made. Tables containing evidence for these results are included in Appendix LL – NN.

The MZI team defined DCI by means of seven quality criteria: timely, comprehensive, novel, accurate, acceptable, scope, and cost efficient. A total number of 20 insights were generated at the time of development. MZI is the only case that did not generate any novel insights, which is a result of the team's strong belief that they should prioritise must-be requirements. Despite the focus on the needs of MusselCo, the final solution was not accepted by this customer. After rejection, the MZI team began exploring the interest of other fishermen and discovered that their solution did not incorporate key needs from this wider group. Therefore, the MZI approach did not result in complete, accepted, and cost-efficient insights. Tables containing evidence for these results are included in Appendix OO and PP.

The MZI team identified seven potential improvements for Practices A, B, G, H, I, K, L, and M. Improvement of sampling and roles were frequently mentioned themes and demonstrate that the MZI team was aware of the difficulties arising from its strong customer dependence. Inconsistent thoughts on whether or not they could have avoided this indicate, however, a strong reflex to act promptly on customer's needs and suggest that their regular customisation business hinders the team's ability to adopt a more distant position from the customer. Other inconsistent thoughts regarding Innovation Theory — for example, on the timing and approach of market research — reveal the limited 'technical' understanding of DCI generation within this case project. Tables containing evidence for these results are included in Appendix QQ – SS.

8.4 OVERVIEW OF THE SMARTLIGHT CASE STUDY

Section 8.4 presents the results of the SmartLight case study, a newly developed system solution from LightCo, which produces system solutions supporting petrol stations. SmartLight featured in the MKB top 100 in 2016. Both the technology underlying the application and the customer segments being targeted were new to the company. Thus, SmartLight was a radical innovation for LightCo, involving new products, with new technology, aimed at new markets. Data capturing was undertaken from May 2016 through to September 2017 and only involved interviews and documents. SmartLight could not find the time to participate in the workshop and, as a consequence, the findings for RQ2 and RQ3 are missing.

Sections 8.4.1 and 8.4.2 will present background information regarding the SmartLight case study. After which, the findings for RQ1 on the practices, are presented.

8.4.1 Overview of the Company and Case

LightCo is a medium-sized SME whose headquarters is located in the Netherlands. Currently, it employs 50 people across Europe, Asia, and North America. It was founded in 1996 and the current Managing Directors took over ownership in 2003. LightCo's mission incorporates development of innovative solutions and SmartLight was one of the four developed thus far. The idea for SmartLight arose in 2009, formal development started in 2015, and the product, which was launched in 2016, has significantly broadened LightCo's customer base. In the screening survey, SmartLight's technological experience was rated with a score of 2 on a scale ranging from 'none' (1) to 'extensive' (5). For experience in marketing, SmartLight was given a score of 1 on the same scale. Maturity with regard to the DCI processes was considered low with a score of 2 on a scale ranging from 'not managed at all' (1) to 'managed very well' (5).

8.4.2 Data Collection of SmartLight

The sources of data collection at SmartLight consisted of interviews and one document.

8.4.2.1 Interviews

A total of four interviews were held with four different actors from SmartLight's innovation team. The actors held positions in management, R&D, and business development. Total interview length was 262 minutes (4 hours and 22 minutes). The interview details are summarised in Table 8.10. which includes the notations used to label and refer to the interviewees in the case study analysis.

Table 8.11 Interview Details of SmartLight

Interviewees	No of Interviews	Interview Length (min)	Reference Interviewee	Role	Innovation Experience
Owner1	1	86	INT-OM1sl	CEO Petrol	Low
Owner2	1	68	INT-OM2sl	CEO Industry	Medium
R&D Director	1	60	INT-RDsl	Development	Medium
Business Developer	1	48	INT-SLSsl	Business Manager Petrol	Medium
Total	4	262			

Source: Author

8.4.2.2 Documents

One relevant document was available for this case; a total of 20 pages were inspected.

Table 8.12 Documents of SmartLight

No	No of Pages	Title	Document Content	Reference Document	Date	Author
1	20	[SmartLight] Brochure	Overview of the main requirements identified during the project	Brochure	April 2014	Owner1
Total	20					

Source: Author

8.4.2.3 Workshop

The workshop was cancelled because Owner2, the main contact of the SmartLight case study, moved out of the company, leaving it with little time and other priorities

8.4.3 Summary Findings: SmartLight

First-order coding revealed that SmartLight performed 20 out of the 47 total customer insight-related activities. These activities are grouped into 10 different higher-order practices, covering 12 of the 36 total objectives, and drew upon 20 of the 70 total resources. The practices that were observed are connected through 13 relationships. Practices A, H, and F were not performed, and render this a less research-intensive and less deliberately managed case study than the SEMO project.

A key actor generating insights within SmartLight was the Business Developer. In a previous job, he had performed desk research in order to identify the market potential of advanced lighting in industrial markets, and he was hired because this experience and information matched LightCo's remit to develop specific lighting applications. SmartLight was not the result of preceding explorative research but came from strategic considerations and a desire to add new products to LightCo's portfolio. All actors stressed how they developed insights based on market tests, by means of "trial and error" (INT-OM2sl). In this way, the SmartLight team gradually generated insights and convinced customers of the added value of their new solutions. LightCo considered this approach a key feature of the corporate innovation approach. The innovation team searched for customers that were willing to try the lighting systems; step-by-step LightCo improved the systems until the customers were satisfied and willing to keep the solution (and pay for it). Once finished, the new solution was transferred to the sales and production organisation, while the innovation team continued following the same approach for another type of customer. Most of the information drawn from the market tests was confirmatory by nature. The Business Developer also occasionally discovered new insights during casual conversations held with customers. The core innovation team — R&D, Sales, and the Owner — normally visited the customer together, thus immediately sharing the findings captured. The team felt this collaborative approach was highly efficient in accordance with their overall lean approach, saving time for documentation of findings and insights. The tables containing the evidence for these results are included in Appendix TT– VV.

8.5 OVERVIEW OF THE FIBERTOP CASE STUDY

Section 8.5 presents the results of the FiberTop case study, a newly developed remote sensing solution from FiberCo, which produces measurement instruments for academic and industrial research. FiberTop was featured in the MKB top 100 in 2016. At that time, it was a start-up based on completely new fundamental technology, developed by an academic researcher from the Vrije Universiteit of Amsterdam. This researcher took the initiative and decided to commercialise his invention. Although he had a wide network of academic researchers, he did not have any knowledge of the specific needs of the customer group he was targeting with his FiberTop solution. Thus, FiberTop was a radical innovation for FiberCo, involving new products, with new technology, aimed at new markets. Data capturing was undertaken from April 2018 through to December 2018.

Sections 8.5.1 and 8.5.2 will present background information regarding the FiberTop case study. After which, the findings for each research question are presented; RQ1 on the practices, RQ2 on the level of insight, and RQ3 on the perceptions.

8.5.1 Overview of the Company and Case

FiberCo is a small-sized SME whose headquarters is located in the Netherlands, and currently employs 20 people selling the solutions across Europe, Asia, and North America. FiberCo was founded by the R&D Director, who owns the IP, together with a business partner, who is still closely involved at the firm. FiberCo's mission incorporates the development of innovative solutions and FiberTop was one of the four innovative solutions thus far. The idea for FiberTop arose in 2010, formal development started in 2013, and the product was launched in 2014, targeting customers in life sciences and industrial remote-sensing segments. In the screening survey, FiberTop's technological experience was rated with a score of 4 on a scale ranging from 'none' (1) to 'extensive' (5). For experience in marketing, FiberTop was given a score of 1 on the same scale. Maturity with regard to the DCI processes was considered high, with a score of 4 on a scale ranging from 'not managed at all' (1) to 'managed very well' (5).

8.5.2 Data Collection of FiberTop

The sources of data collection at FiberTop consisted of interviews, company documents, two short surveys, and a workshop.

8.5.2.1 Interviews

A total of five interviews were held with five different members of the core innovation team, including the Owner, the R&D Director, the Product Owner, the Sales Director, and a customer. Total interview length was 498 minutes (8 hours and 18 minutes). The interview details are summarised in Table 8.12, which includes the notations used to label and refer to the interviewees in the case study analysis.

Table 8.13 Interview Details of FiberTop

Interviewees	No of Interviews	Interview Length (min)	Reference Interviewee	Role	Innovation Experience
Owner	1	60	INT-OMf	Business partner and Owner	High
Customer	1	36	INT-Cstf	Lead user involved in development first version	High
Product Owner	1	72	INT-POf	Current Business Manager, responsible for DCI	Low
R&D Director	1	58	INT-RDf	Owner IP and initiator	High
Sales Director	1	70	INT-SLSf	Sales and execution market research	Low
Total	8	296			

Source: Author

8.5.2.2 Documents

Seven relevant documents were available for this case. Table 8.13 illustrates that a total of 47 pages were inspected, and includes the notations used to reference the documents in the analysis.

Table 8.14 Documents of FiberTop

No	No of Pages	Title	Document Content	Reference Document	Date	Author
1	3	Summary Business Plan for [FiberCo]	Describes technology, products based on this and holds some sales projections	BP	Jan 2011	Owner
2	3	2013action [FiberCo]	Describes sales results and status of the innovation project. Holds some actions and refers to customers involved in the projects	ActionP	Jan 2013	Owner
3	17	CASE OF [FiberCo]	Describes start-up process and results	CASE	Dec 2017	Professor
4	2	[FiberCo]	Describes the value proposition of FiberTop	STARTDOC	n/a	R&D Director
5	15	PRES[FiberCo]	Presents the features of FiberTop	PRES	Feb 2013	Owner
6	2	Questions	List of questions to explore needs	Questions	Unclear	Owner
7	5	Specs and Hypotheses	Holds a list of hypotheses on customer requirements	S&H	Unclear	Unclear
Total	47					

Source: Author

8.5.2.3 Workshop

The workshop was held at the FiberCo premises. Participants included the Owner, the Sales Director, the Research Director, the Product Owner, and an external advisor. The notations used to refer to them are included in Table 8.14. The workshop lasted 2 hours and 23 minutes and was fully transcribed.

Table 8.15 Workshop Details of FiberTop

Participants	Reference Participant	Role
Owner	WS-OMf	Business partner and Owner
Sales Director	WS-SLSf	Sales and execution market research
R&D director	WS-RDf	Owner IP and initiator
Product Owner	WS-POf	Current Business Manager, responsible for DCI
External Advisor	WS-Mktf	Sparring partner of Owner

Source: Author

8.5.3 Summary Findings: Fibertop

First-order coding revealed that FiberTop performed 37 out of 47 total customer insight-related activities. These activities are grouped into 12 different higher-order practices, covering 20 of the 36 total objectives, and drew upon 40 of the 70 total resources. The practices observed are connected through 19 relationships. The sole practice missing was Practice H and, together with SEMO, this case was one of the most research-intensive.

The most distinctive characteristic of the FiberTop case study is the structured and skilled approach performed by the team of young professionals. The Owner played a much more modest role when compared to the ZKL and Thermo case studies, simply acting as one of the team members. Each of the team members was an academically trained scientist,

research-driven and highly sensitive to commercial and customer aspects. The team was conscious that their individual perspectives would add to DCI and, therefore, key activities, such as information processing, synthesis of findings, and decision making were all undertaken collaboratively. The Sales Director managed the insight generation processes. The team combined explorative research in the beginning of the project with the collection of confirmatory information, presenting the customer with very early versions of FiberTop. They strengthened insights generated from customers, with more general findings regarding markets and market forces in order to understand the opportunity that a position in specific market segments would represent. The team was convinced that a demonstration of the unique features of FiberTop was the only way to have meaningful discussions with customers regarding their latent needs. Early product versions were developed and used to test several hypotheses about customers' needs. The team was particularly keen to involve lead users, as well as representative customers, enabling insights into the specific needs of distinct product market segments. Customers' involvement included giving input information and support in synthesising the findings in requirements. Although FiberTop used an open approach to NPD and considered customers as partners, customers were not involved in development tasks. The team was aware that their insights would grow and change as the project progressed and was careful to draw conclusions regarding findings early in the project. This is also evident in the documentation. Although various documents were created, many of them were in an unfinished state. Tables containing evidence for these results are included in Appendix WW – YY.

The FiberTop team defined DCI by means of six quality criteria: timely, comprehensive, novel, accurate, acceptable, and cost efficient. The level of insight of FiberTop was one of the highest in all case studies, with a total number of 43 insights generated at the time of development, including seven novel insights. Customers' close involvement in synthesising the research findings facilitated their quick acceptance of FiberTop. The 'lean' approach led to highly cost-efficient insights. Consistent with the team's wariness to document insights, the format of the insights was not very well taking care of including a variation of formats types. Despite the inconsistent format, insights were available early in the process and were, therefore, considered 'timely'. Tables containing evidence for these results are included in Appendix ZZ and AAA.

The FiberTop team identified four potential improvements of benefit to Practices A, D, E, F, H, I, and L. The improvements were related to data collection, management of learning, test material, and the format for synthesising findings. The FiberTop team considered using more advanced techniques, enabling them to start testing early in a future project, and started to discuss the advantages and pitfalls of early testing in greater detail. The improvements mentioned by the FiberTop team would benefit the accuracy and the way in which findings were presenting. The most significant barrier can be identified in the evolving nature of insights, making it difficult to decide what should be documented and what should not. Moreover, discussions that emerged during the workshop revealed that the team has not reached consensus yet regarding what could be used to probe customers for their needs — a physical product or a more verbal representation. Tables containing evidence for these results are included in Appendix BBB – DDD.

8.6 SUMMARY OF THE OVERVIEW OF CASE STUDIES

The case studies included in this thesis were all radical innovation projects from SMEs, headquartered in the Netherlands, and all were reaching out to new customer segments. They represented different levels of technological and marking newness and DCI maturity. For each case project, the interviewees and workshop participants included the main actors of the innovation teams, enabling this study to generate an understanding of the main DCI events from different viewpoints. The overview of data sources demonstrated the significant amount of data available for each case study, thus offering a good basis for cross-case analysis in Chapter 9.

Chapter 8's discussion has provided an initial view of the prominent differences and similarities between the case projects. These disparities concern the amount of effort and skill put into researching needs and markets, as well as the approach taken for involving others — both customers and internal members. Furthermore, variations in how the case projects defined DCI, as well as the levels of insight, were clearly determined. Perceptions revealed an overall high interest in adopting a more considerate approach towards DCI, although not every case study was clear on how this could be achieved. Significant barriers hindering improvements have been identified in the role played by Owners, and in the evolving and complex nature of DCI.

CHAPTER 9 CROSS-CASE ANALYSIS

9.0 INTRODUCTION

Chapters 7 and 8 presented the within-case findings of the six case projects. The subsequent analysis demonstrated how the teams involved with these projects purposefully set out to generate DCI and drew on combinations of 13 practices to identify both current and novel insights. Additional analysis of the perceptions confirmed the importance of such practices and showed how the teams would improve their level of insight and what barriers must be overcome.

Chapter 9 presents the findings of the cross-case analysis for each separate research question (RQ). This chapter is descriptive by nature; theory will be used to verify where generalisations apply (c.f. Phillips and Pugh, 1994), which will establish the key dimensions of DCI generation. In Chapter 10, theory will be used in a discussion of the implications of the findings and to demonstrate contributions to academic knowledge.

Chapter 9 is organised into four main sections:

1. The first section presents the findings with regard to RQ1, the practices
2. The second section discusses the findings with regard to RQ2, the level of insight
3. The third section considers the results of RQ3, the perceptions of the practices
4. The fourth section summarises Chapter 9

9.1 THE DEEP CUSTOMER INSIGHT PRACTICES OF SMES

Section 9.1 discusses the similarities and differences between the six case projects with respect to RQ1: *How do small firms' practices enable them to generate DCI for radical innovation projects?* In the analysis, the findings of the six cases are compared in order to reveal themes and patterns in how they generate DCI. The analysis will identify the common characteristics of DCI generation and determine three distinct levels of DCI practice maturity.

The results are presented in six sections:

1. The first section discusses the five groups of practices characterising DCI generation
2. The second section presents the common configuration of DCI practices
3. The third section highlights the composition of the team working on DCI
4. The fourth section provides more details of the resource strategies for DCI
5. The fifth section discusses the three levels of DCI practice maturity
6. The sixth section draws conclusions regarding RQ1

9.1.1 Five Groups of Practices Characterising DCI Generation

Until now, the literatures regarding Market-Based Learning (MBL), Customer Involvement, Innovation Management and Design, and Entrepreneurial Marketing have lacked a consistent and complete perspective on how SMEs generate DCI. Current understanding within these bodies of literature is highly generic, giving rise to many debates regarding, for example. formality (e.g. De Luca, Verona and Vicari, 2010; Marion, Friar and Simpson, 2012a) or the skills and techniques used for market research (Maes and Sels, 2014; Moultrie, Clarkson and Probert, 2007a). Therefore, Section 9.1.1 first offers a more detailed perspective by describing how the cases typically performed the DCI practices. Table 9.1 summarises these details and will support the discussion.

Table 9.1: Overview of the Practices

Group	Practice	Characteristics/Exemplary Quotes	Composition	Thermo	ZKL	MZI	SEMO	Smart-Light	Fiber-Top
				Practice Performance Sum of Activities and Resources Used per Practice					
Mobilising	G. Mobilising customer sources	Helping to prepare for sales and marketing and to get customer information; sometimes done to gain access to funding and to increase labour capacity; done by Owner or Sales Director; uses selection critieria, customer management skills, and communication channels; cases are aware that not all customers can express needs: "You need to be careful with whom you talk. Not everybody is capable of saying useful things." (INT-OMt).	8 components: 4 activities 4 resources	5	**7**	-	6	**6**	6
	K. Mobilising internal sources	Seeking internal sources of customer and market insights; also aiming for access to the customer networks of the source; communication is mostly one-way, flowing from the source to the project team, although some involve internal sources in synthesis as well; internal sources often are from sales: "[…] we actively sat around the table with sales" (INT-PO1s).	6 components: 3 activities 3 resources	-	2	3	3	3	2
Research	A. Exploring customers problems	Trying to understand customers' problems; supports idea generation and selection of target segment; little effort put in preparing interviews and analysing results; uses various data-sources, including customers; performed by (project) Owner, collaboration with Sales: "We went to see a customer in the US and learned that they had difficulty using the system on a much wider scale. At that moment nobody could help them […] We then went visiting other clients to understand what they were missing." (INT-SLSs).	11 components: 4 activities 7 resources	5	5	7	8	-	8
	D. Exploring the market & opportunity	Estimating market potential and supporting business model development; uses various data sources and desk research; company formats help in determining what information needs to be collected; often done by students or persons with a business background: "I made a count of potential customers in specific industries and developed criteria for assessing the attractiveness. I also went talking to a few suppliers and wholesalers and we went to a fair." (INT-Mkt1t).	14 components: 5 activities 9 resources	**11**	-	**12**	**9**	4	**10**
	H. Elaborating customer needs	Seeking a deeper understanding of customer needs; supports solution finding, requirements capturing, and validation of first insights; resources are research skills and company formats; methodological skills steer the activities; preferred approach is interviewing: "These are open conversations. Not structured, but of course we have our ideas about the product, and we try to find out whether this matches." (INT-RD1s).	15 components: 7 activities 8 resources	-	-	**9**	**13**	-	-
	I. Collecting customer feedback	Checking the performance of the solution, or looking for new insighs; except for FiberTop, data collection is mostly done informally; most efforts are put in getting access to customers, yet the samples are small; involved R&D: "I collected a lot of feedback on what works and what doesn't and this goes into the list for a next improvement on functionality."(INT-RD2s).	11 components: 6 activities 5 resources	3	7	5	6	5	**9**
Synthesis	E. Defining the value	Supporting funding and creation of a shared vision on importance of project; both customer and firm value are explored; drawing on structuring and sensemaking skills of Owner, R&D Manager, or business person: "For me it is […] the structural element in my mind to go through this whole process from the first technology to selling products in the market. Always the value proposition is about getting structured." (WS-POf).	7 components: 2 activities 5 resources	3	3	5	4	3	4
	J. Defining customer requirements	Structuring knowledge and tranforming it into customer requirements; has both communication and functional value; the resources include sensemaking skills and corporate formats; for most cases, this is a team effort: "There's not a single person who knows everything. So it requires multiple heads together." (INT-SLSf).	7 components: 3 activities 4 resources	5	4	4	5	4	4
	M. Planning sales and marketing	Contributing to the commercial process; earlier insigths are re-used for sales and marketing; resources are sensemaking skills, company formats, documenting systems, and external student support; the output is operational by nature: "I held a brainstorm session […] about the business case and marketing activities for introduction." (INT-Mkt1t).	7 components: 2 activities 5 resources	5	3	-	5	3	5

Table 9.1: Continued

Group	Practice	Characteristics/Exemplary Quotes	Composition	Thermo	ZKL	MZI	SEMO	Smart-Light	Fiber-Top
				Practice Performance Sum of Activities and Resources Used per Practice					
Utilisation	B. Generating ideas	Starting point of the project, mostly driven by strategic agenda or internal problem; draws on vision for the future and awareness of strengths and weaknesses; some apply creative techniques; mostly done by Owner, sometimes in collaboration with R&D: "[…] I had an issue and to solve the problem I've invented this new [x] and then I realised that this [x] could have application in many different other fields. So, I started to work on that market process with no experience and no knowledge." (INT-RD1f).	8 components: 3 activities 5 resources	6	5	4	6	5	7
	C. Securing innovation funds	Using insights to find funds; funds are then used to generate further DCI; first phase is not always funded; funds often involve grants and subsidies; decisions to allocate funds are often based on strategic reflections and explicit decision criteria; mostly done by Owner: "I started very carefully and took the first [x] euro from the bank. And then I took another amount to learn whether there was interest for this." (INT-OM1z).	7 components: 3 activities 4 resources	4	5	5	5	3	7
	L. Developing the product concept	Using insights, but also fueling further CI generation, by providing the test material; delivering input to the sales and marketing planning; resources are creative and project management skills and customer empathy: "We talked with customers about the value proposition […] then we started development of a proto-type." (INT-MANs).	9 components: 3 activities 6 resources	7	4	**8**	5	4	6
Management	F. Managing CI action	Organising the CI value chain; performed by dedicated people that have research skills; consists of planning, design, and monitoring activities; main objective is to raise the quality of information and to reduce uncertainty: "Formerly, we once and a while collected some information, now the goal was to do this in a more conscious manner." (INT-MANs).	8 components: 3 activities 5 resources	-	-	-	8	-	6
Total number of activities and resources				54	45	62	83	40	74

Source: Author

Table 9.1 list in the last six columns the *practice performance,* of each case project. Practice performance is the sum of all components forming part of a practice, hence the total set of activities and resources used. For example, Thermo applied two activities to Practice A: 'identifying a problem area' and 'conducting conversations'. Additionally, it made use of three resources: 'readily available customer sources', 'interview skills', and 'analytical skills'. Therefore, the total amount of efforts put into Practice A by Thermo is 5.[1] To facilitate comparison, the fourth column of Table 9.1, Composition, shows the composition, or total amount of activities and resources, of a practice. This signifies the maximum amount of effort that cases could put into a practice. For example, for Practice A, four activities and seven resources were identified, resulting in a maximum potential effort of 11. Thermo's score of 5 indicates a relatively low practice performance. The bold printed numbers in Table 9.1 highlight the case projects with a relatively high practice performance score for a particular practice. For example, in Practice D, Thermo's total amount of effort is scored at 11 (out of the maximum potential of 14), which is amongst the highest performance scores when compared with the other cases.

Sections 9.1.1.1 to 9.1.1.5 discuss typical practice performances. The discussion will be organised according to groups of practices and will not follow the original order in which the practices were identified (alphabetically, Practice A, B, etc.).

9.1.1.1 Mobilising Practices

The Mobilising Practices group consists of two components: mobilise customers as a source of information (Practice G), and mobilise internal sources of information (Practice K). Market-Based Learning (MBL) literature recognises the importance of both sources of information (e.g. Griffin and Hauser, 1993; Hulbert, Gilmore and Carson, 2015; Maes and Sels, 2014). However, a more detailed understanding of the processes for finding, selecting, and motivating the sources of information is lacking within MBL. The sparse studies that are available define mobilising processes as a preliminary step for Market Information Processing (MIP) (e.g. Nijssen et al., 2012). Such a definition was found to hold true within this study, with most case companies allocating considerable efforts and resources to processes for mobilising customers and internal sources.

Activities forming part of the practice for mobilising customers are based on the Customer Involvement literature, including: selection processes, and communication and relationship management processes (Gustafsson, Kristensson and Witell, 2012; Mohr and Nevin, 1990; Urban and Von Hippel, 1988). Case project teams spent a considerable amount of time on communicating the purpose and progress of their projects and on developing incentives for stimulating customers' involvement. The activities were primarily performed by the Owner or the Sales team. Case project teams were careful about whom to involve and applied two selection criteria, corresponding to the dual objectives of this practice. First, the teams wanted to generate novel insights and were, therefore, critical regarding customers' ability to explain *why* they had certain preferences or displayed certain behaviour (thus giving access to needs that are not readily articulated). Second, the teams wanted to start selling their solution as soon as possible and, therefore, focused on customers' commercial attractiveness.

[1] The overview tables in Appendix K, T, CC, KK, SS, and VV list each case projects' practices and holds details about the activities and resources employed.

Overall, the case project teams actively approached between one and ten customers, all of which were new customers. Time constraints hindered any efforts to collect input from a larger group. This is illustrated by a quote from the sales manager of FiberTop, a case project using new remote sensing technology from a start-up company: "It is difficult, if you talk to two or three customers, the fourth may have totally different requirements. This is why we seek feedback from a variation of customers across segments. But then, we need to proceed fast. We need to draw a line." (INT-SLSf).[2] The MZI case, a project for the mussel farming industry from a mature SME, did not put effort into this practice. Their project was developed in close collaboration with a single customer and the MZI team feared that involvement of a larger group of customers would raise the attention of competitors.

Activities forming part of the practice for mobilisation of internal sources are not described separately in the academic literature; this study demonstrates that they are similar to the activities for mobilising customers. The main objectives of the two practices are different; internal sources fulfil the role of spokesman for the customer and offer an additional perspective when making sense of research findings, for example, during development of the value proposition. Internal sources, therefore, often act as a team member participating in research and synthesis. Such internal sources were not observed in the case of Thermo. This mature case company worked on new electronic safety equipment, and the owners were clear that they were the only ones having the necessary skills and knowledge for DCI generation: "Not everybody can do that [research], with all respect, that is the glasses you wear, the R&D Manager and I we have a focus on the customer […] not everybody has those glasses and that is perfectly fine." (INT-OMt).

9.1.1.2 Research Practices

The Research Practices group consists of four practices: the first is dedicated to exploring the customer problem situation (Practice A); the second to exploring markets and opportunities (Practice D); the third to elaborating customer needs (Practice H); and the fourth to collecting customer feedback (Practice I). The focus of all four practices is on *information acquisition*. MBL generally portrays information acquisition as the first step of MIP (Cohen and Levinthal, 1990; Day, 1994; Kohli and Jaworski, 1990). It entails the collection, analysis, and reporting of market-based information (Kohli and Jaworski, 1990; Moorman, 1995). This set of consecutive research activities enables the transformation of *data* — objective facts — into *information* — an organised form describing past and present situations (Morgan, 2004). MBL literature generally focuses on a single set of information processing activities, principally referred to by the term 'market research' (Hultink et al., 2011; Veldhuizen, Hultink and Griffin, 2006). However, the analysis shows that DCI relies on four types of research, and not on a single concept called market research. Although the activities of each research practice were found to be highly similar, each practice clearly aimed for distinct information and warranted the use of distinct resources. Consequently, the four practices each contributed in a unique way to DCI.

[2] Reminder on terminology: The first three initials denote the data source; for example, INT stands for interviews. This is followed by two initials denoting the actors' role; for example, SLS stands for Sales Manager. The number signifies the number of interviews held with an actor fulfilling the role. The last initial denotes the case project; for example, 'f' denotes FiberTop. This will enable easy identification of the different sources of data further analysis.

The characteristics of Practices A, D, H, and I are detailed in Table 9.2, which illustrates: the cases utilising each practice; the type of information resulting from the practices; the main objectives; typical activities; their nature; and timing. This is followed by more details on the customers involved as well as their mode of involvement, and the final row indicates the internal actors typically involved.

Table 9.2: Research Practices Within Radical Projects

Characteristics	Customer Research Needs information		Market Research Market information	Customer Research Solution information
Practice	A	H	D	I
Cases having this practice	5	2	5	6
Type of information	Understanding problems	Deeper understanding of needs	Market information	Feedback on solutions
Main objective	Validate and progress idea	To define requirements	To make a business model and estimate market potential	To check performance of solution
Typical activities	Conversations with customers; findings not always documented	Full processing (collection, analysis, and reporting)	Full processing; includes desk research and conference visits	Mostly qualitative research; limited processing
Nature	Explorative	Explorative	Exploitative	Exploitative
Timing	Early in project; interacts with idea generation	After business case and formal approval of budget	After A; before formal investments	Typically late, but also in interaction with A and H
Type of customers involved	Easily accessible users	Useful informants	No	Early buyers, first prospects
Mode of customer involvement	Distant/learning *from*	Distant/learning *from*	Learning *without* direct customer input	Close/learning *with*
Internal Actors involved	Owner and Sales	R&D and Sales	External experts	R&D and Sales

Source: Author

Practices A and H are both customer research activities, generating needs-related customer information. In both, the customer is questioned and treated as a source of information. The mode of involvement is, therefore, 'distant', emphasising learning *from* customers. The resulting research from each practice are, however, different in scope, with Practice A seeking information about customers' problems and Practice H concentrating on customers' needs. The literature recognises problems and needs as two separate components of market-based knowledge, and argues that understanding of their interrelationships adds to the *depth* of understanding (De Luca and Atuahene-Gima, 2007). The difference between the two types of information is clearly seen in the MZI and SEMO cases. Both projects took place in mature companies and were developed by teams including R&D, the Owner, and other disciplines. Neither of the case companies were familiar with the markets they were targeting. Content analysis of the documents suggest that both teams first set out in Practice A to gain a better understanding of customers' problems when working with products similar to the innovation project. Both teams explored different topics which, in MZI, the mussel fishery project, included economic, social, and health issues. In SEMO, the information technology project, topics explored included timing and location issues. The subsequent wide, *explorative* understanding was the result of a series of loosely planned conversations relying on the conversational skills of the Owner or Sales/Business Managers.

Documents from later in the process show how both MZI and SEMO prepared for more intensive information collection activities during customer visits as soon as more funds became available. These research activities were grouped in Practice H, and were undertaken in order to validate the findings of Practice A to establish greater certainty regarding customers' requirements for a solution. Compared to Practice A, customers were now selected more carefully under influence of Practice G, and research specialists became involved in the activities. The UCD Manager of SEMO illustrates the explorative, yet more systematic and resourceful, approach of Practice H:

> We used a qualitative approach and had quite some customer conversations […] We prepared those carefully, sending some easy questions upfront and making sure we could ask all we needed within the limited time available [...] Many people think that you need to ask what people need, but that is not true, you need to probe for their objectives and their problems. (INT-MANs)

It is worth noting that, while all cases performed Practice A, only SEMO and MZI performed Practice H. The cases that do not perform Practice H chose, instead, to start developing a proto-type first. This decision would give them something to show to the customer. Such an exhibition is deemed necessary in order to have more meaningful conversations with customers and to gain access to latent needs, as done in Practice I. This is explained by the owner of FiberTop:

> A latent need is always very difficult. People will always describe their problem based on known products. Therefore, you have to dig deeper. It is our belief that customers do not respond to some vague ideas. You have to present them an early product version to understand how it touches upon their needs. (INT-OMf)

Practice D is a third research practice dedicated to achieving a deep-level understanding of previously collected information. The content of Practice D focuses on the market forces underpinning customers' problems and needs, as well as the size of potential target markets. Market knowledge, thus, helps with the recognition of connections between needs and problems (De Luca and Atuahene-Gima, 2007). The six case projects explicitly referred to this type of research as *market research.* The resulting information was typically used to explain the value of the project to others outside the team. Such information supported the team in accruing the necessary funds for the project, and explains why some of the cases attached great importance to it and relied on outside experts for designing the research approach. "Once you decide to go for it, you need a more scientific approach, be more certain […] Suppose you find out you addressed the wrong market." (INT-OMt). The sole case not performing Practice D, ZKL, confirms the value of market research for funding. The main actor in this railway industry start-up project was the owner, who funded the project himself and, therefore, could afford to rely on his gut feeling: "I've never needed a bank to finance something directly or indirectly […] I've never done anything with a business plan. Honestly, I don't believe in it. I prefer to act on my feelings […]" (INT-OMz).

To preserve efficiency, the case projects relied upon students for the execution of Practice D. This can be seen in the market research reports included in the case documentation of MZI and Thermo. These reports illustrate how the research activities were planned in advance and depended upon desk research and qualitative interviews with a few market parties. Generally, the customer was not involved in this practice, which might explain why the cases entrusted the execution of market research to students. Estimations of market size were rudimentary and did not include extensive quantitative analysis. Altogether, this approach is very different from the prescriptions for market research found in academic literature (e.g. Cayla and Arnould, 2013; Price and Wrigley, 2016). Considering that the resulting information

did not produce new insights, but rather aimed to refine insights generated earlier in the project, market research is *exploitative* by nature.[3]

Practice I is the fourth research practice and captures customers' feedback to generate solution-related information. The Innovation Management and Design literature typically situates this activity in later project phases, after a proto-type has been developed (British Design Council London, 2005; Liedtka, 2015). Such testing of the performance of the proto-type was observed in all case projects. However, some cases started capturing feedback much earlier in the project in order to validate their ideas. As a result of the primary focus of feedback gathering on *refining* ideas and solutions, it is principally *exploitative* by nature. The essence of this practice is, therefore, different from what is mentioned in the literature as trial-and-error learning or experimentation. In Practice I, these types of learning use product concepts to elicit a customer's response. Trial and error learning, or experimentation are, however, much more focused on generating understanding of a wide range of topics and issues and is, therefore, exploratory by nature (e.g. Coviello and Joseph, 2012; Liedtka, 2015; Miner, Bassoff and Moorman, 2001).

Feedback was gathered by provoking reactions from a small set of customers, the sources of which were different from those of the Practices A and H. Largely comprised of potential customers or early buyers, case project teams generally collaborated closely with the customer sources to ensure sufficient tailoring of any solution to customer needs (learning *with*, instead of *from*). These customers were presented the idea or proto-type, after which a loose conversation followed. The approach was predominantly qualitative by nature and involved R&D and Sales executives. Research skills were generally lacking and none of the cases applied methodological knowledge. The most thought-out approach was found at FiberTop, of which the document called 'Questions' evidences the preparations undertaken prior to interviews. Actors followed the natural flow of the conversations and adapted their questions to customers' responses. In some instances, the conversations resulted in new information which lead teams to re-evaluate features previously dismissed as unimportant. This is illustrated by the approach of the lighting industry case project, SmartLight. The Sales Manager coincidentally identified the importance of a certain type of optics just by installing SmartLight at the customers' premises and having casual conversations. In this way, by cleverly improvising during the test, new insights emerged as a by-product of the test activities: "You just hear things when you are installing the solutions together with the customer, it creates a bond and then they tell you all sorts of stuff." (INT-SLSsl). This example demonstrates that,

[3] Kim and Atuahene-Gima (2010, p. 523) refer to seminal work of March (1991) and Kyriakopoulos and Moorman (1998) to define exploitative market learning as follows: "Exploitative market learning emphasises the thorough and detailed processing of market information that has already been acquired and is currently available to the firm." (Kyriakopoulos and Moorman, 1998; March, 1991). Similarly, Tushman and O'Reilly (1996), in the management literature, define exploitative learning as a mechanism relying on feedback gathering, which enables the refinement of current knowledge. They put this in a strategic context, demonstrating that exploitative learning sustains a strategy of incremental innovation, in contrast to *explorative* learning which sustains a strategy of radical innovation. Based on Tushman and O'Reilly (1996), the innovation literature tends to take a strategic, organisation-level perspective to both types of learning (e.g. Berghman, 2012). The co-existence of the two types of innovation strategy is called *ambidexterity*. However, Gupta, Smith and Shalley (2006) make clear that many different perspectives on ambidexterity exist, depending on the emphasis on learning and the level of analysis. This thesis focuses on learning and not on wider innovation strategies. Moreover, it researches exploitative and explorative learning at the *project-level*. How both types of learning may be combined in a project was already described by March (1991) and the project management literature builds on this foundational work to define ambidexterity at the project level and demonstrate its importance to achieve benefits like efficiency, quality, and innovativeness of projects (e.g. Liu and Leitner, 2012)

on occasion, Practice I generated explorative understanding, but that this was predominantly unintentional and the result of improvisation.

9.1.1.3 Synthesis Practices

The Synthesis Practices group consists of three practices: defining the value (Practice E); defining customer requirements (Practice J); and planning sales and marketing (Practice M). The case study projects make clear that data collection and analysis activities (as grouped into the research practices) were not sufficient to produce valuable new knowledge. Synthesising involves the interpretation of information, transforming it into *knowledge*. Much more than information, knowledge holds the capacity to predict further events (Morgan, 2004). The general Organisational Learning (Cohen and Levinthal, 1990; Huber, 1991) and Sensemaking Literature (Beverland, Micheli and Farrelly, 2016; Daft and Weick, 1984) holds a rich body of evidence regarding the importance of interpretation; MBL literature, however, only sparsely describes it as a separate process.

The synthesising practices evident in case projects ensured that research findings were summarised and transformed into new *models*, i.e. new ways of thinking (for example, a value proposition, requirements list, or marketing plan). These new models supported decision making, but also had communicative value and helped to establish a shared vision regarding the importance of the project. Synthesising practices rely on integrative skills. The documents — for example, the PBC of SEMO or the GrantDoc of MZI — record how formats and templates guided the actors to the knowledge required for synthesis. With the exception of FiberTop, which developed its new models in cooperation with all team members, each of the project cases assigned responsibility for synthesis to a single person. This shows how synthesis relied, most especially, on the integrative skills of individuals. Within Thermo and ZKL, these individuals were the Owners: "Everybody can say what they want, but it is our task to develop the requirements." (INT-OM1t). It is important to note that, within MZI, the Owner trusted the customer to make sense of the findings. The GrantDoc document describes the value of the MZI project, which was written solely by the customer. The Owner reinforces this vital customer role: "[Customer] had all kinds of information: the number of systems and all customers having the same problem. In this way, we thought about [the value] […] and together we concluded that it would be interesting for fisheries." (INT-OM2m).

9.1.1.4 Utilisation Practices

The Utilisation Practices group consists of three practices: generating ideas (Practice B); securing innovation funds (Practice C); and developing the product concept (Practice L). MBL literature describes how insights are used conceptually to inspire ideas (as in Practice B), and instrumentally to support decision making regarding the product concept (as in Practice L; Moorman, 1995). The findings of this thesis further refine MBL theory, proving that insights are also used in the generation of funds, and thus they have a direct influence on the viability of an innovation project. Both the grant application form of MZI and the business case of SEMO clearly demonstrate how insights regarding customer problems were used to gain access to substantial amounts of money.

The objectives driving the synthesising activities denote a third type of use, *symbolic* use. Symbolic use is described in MBL theory, but is not yet thoroughly understood (Vyas and Souchon, 2003). It builds on the social and communicative value of market-based knowledge, thus supporting internal and customer relationship building. Such symbolic use contributes to export success (Vyas and Souchon, 2003) and the findings of this study further highlight its value for radical innovation.

The value of symbolic use is explained by the Interaction Designer of SEMO: "[…] everybody has ideas […] suggestions […] and then it is important to put forward your idea well, to prevent that everybody keeps thinking along his own ideas. You have to make a good presentation." (INT-ID1s).

9.1.1.5 Management Practice

Practice F is dedicated to the management of DCI; it involves activities which include planning, design, and monitoring, thus demonstrating the formal approach used for some of the DCI practices. Following the Innovation Management and Design literature, formal processes: (1) are written down; (2) take place in a planned, sequential approach; and (3) are controlled (Marion, Friar and Simpson, 2012). However, the Innovation Management literature holds long-standing debates on the role of formality in small firm innovation (c.f. Maes and Sels, 2014). This study provides a new perspective on the concept of formality, arguing that its definition requires further refinement in order to understand its applicability within SMEs. The only case projects that exhibit use of Practice F, SEMO and FiberTop, show that DCI generation was only partly formal: both case projects developed DCI deliberately and systematically (conditions 2 and 3), but lacked formalised procedures (condition 1). Additionally, SEMO and FiberTop show that formality is not something that is completely 'on' or completely 'off' during a project. Formality may apply to some research practices, but not to others, and, therefore, a refined perspective regarding the full set of practices is required in order to draw conclusions on its presence. This is clearly seen in the SEMO case project, which managed customer research in Practice H, but not in Practices A and I.

Within FiberTop, Practice F was present from the start of the project, before the Practices A and B. The fact that FiberTop was a start-up project and, therefore, had fewer resources available than the more mature case companies, suggests that (partial) formality exists independent of *the number* of resources. Instead, the high level of skills applied to Practice F suggests that (partial) formality is a matter of having *the right type* of resources. In both SEMO and FiberTop, Practice F was performed by a single person holding substantial skill in research management, whereas none of the other cases could count on such elaborate research skills. The analysis documents of both the SEMO (document 'URD') and FiberTop (document 'S&H') projects prove how the actor involved with Practice F relied, especially, on his reflective skills to monitor the insights and correct the processes. In the SEMO project, this person was only available during Practice H, whereas within FiberTop he was a fixed member of the team and took a systematic and reflective approach from the outset of the project:

> It was very important that we had a systematic approach. It is not a matter of just randomly trying some things'. You think about whom to call, what to ask […] you talk about things in a neutral way, just out of curiosity, you are not selling things, in this way you learn what the best approach is […] (INT-SLSf)

9.1.2 Common Configuration of DCI Practices

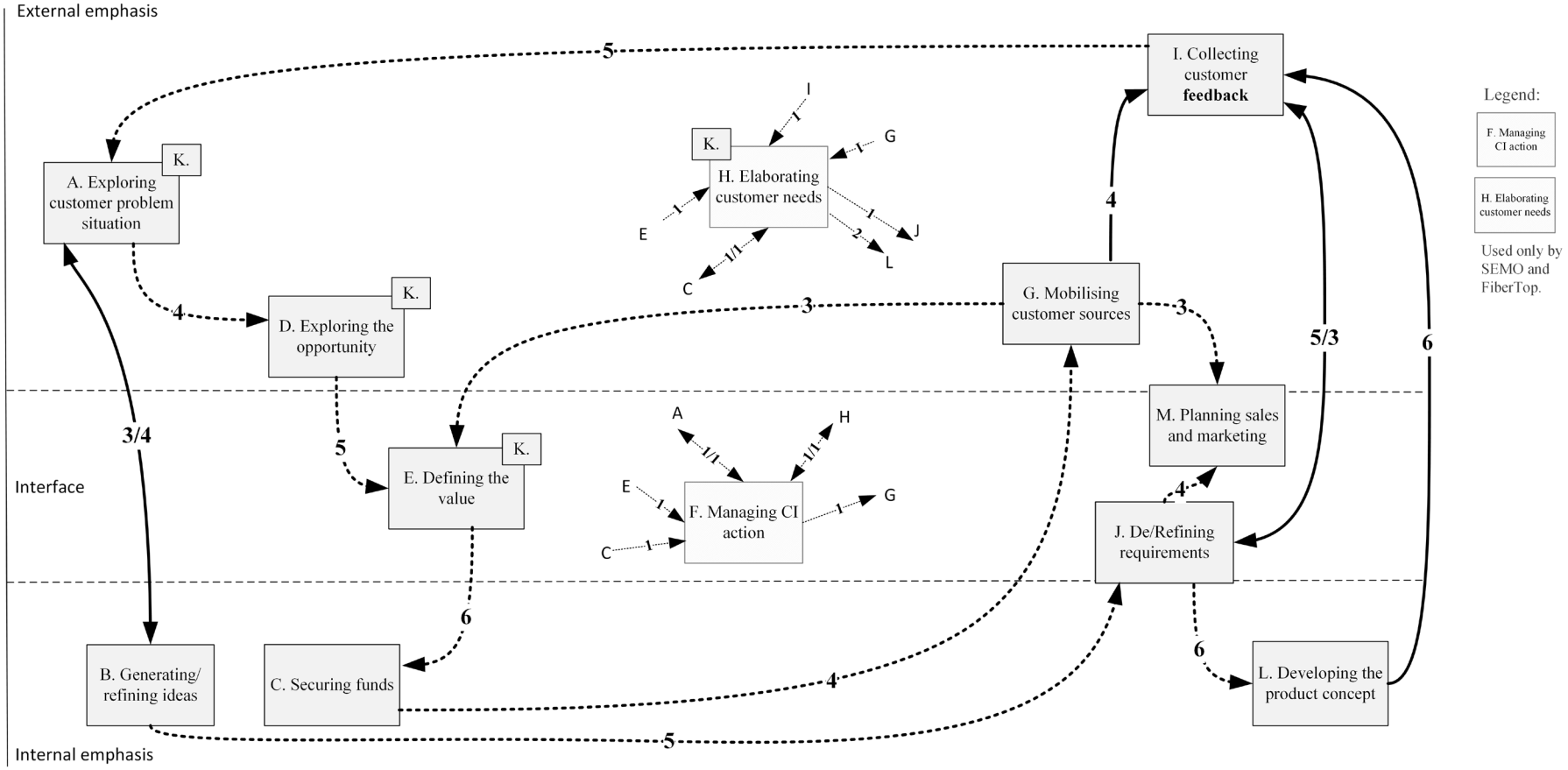
Section 9.1.1 has made it clear that, although all six case project companies put effort into the generation of DCI, they did not always perform all 13 practices. A model was built to better understand the most common configuration of practices, and is based on the relationships identified in Analytical Step 5 in which all sequences and linkages between the practices were coded. Appendix DDD summarises the relationships across all practices.

The common configuration of practices is depicted in Figure 9.1, and only includes relationships shared by 3 or more cases. The arrows between the practices refer to the number of cases which have that particular relationship. Double-headed arrows show the interplay between certain practices. The first number noted with these arrows refers to the number of cases which have the relationship flowing from the practice placed first in alphabetical order to the practice placed at a lower rank in the alphabetical order. This is followed by the number of cases which have the relationship flowing in the reverse direction. For example, the relationship between Practices A and B was observed in 3 cases, while the relationship between Practices B and A was observed in 4 cases. In this way, a model of 10 practices was developed.

Management of insights (Practice F) and elaboration of needs (Practice H) were not fully integrated into the model because they were only performed by SEMO and FiberTop. As will be shown in RQ2, both SEMO and FiberTop were particularly effective in generating DCI and, therefore, both Practices F and H are depicted in the model as add-ons to the common configuration of practices. The mobilisation of internal sources (Practice K) was not retained as a separate practice because of its limited number of relationships. Considering how internal sources were treated as part of the teams, Practice K is included in the practices that were informed by internal sources.

The common configuration of practices adds to the findings in Section 9.1.1 by demonstrating how practices work together. Knowledge generated by means of the externally oriented research and mobilising practices (upper row) is combined and integrated by means of practices that take place at the interface between the internal and external worlds (middle row). The insights resulting from this inspire internally oriented practices (lower row). Two conclusions regarding the timing and order of the practices emerge from the common configuration. The first concerns the interplay between explorative and exploitative research. Although the Innovation Management and Design literature describes the utility of having both types of research in a single radical project, the precise role of each is not clear (Janssen and Dankbaar, 2008; Lynn, Morone and Paulson, 1996; Price, Wrigley and Straker, 2015). The common configuration now shows how insights require both types of research. Feedback collection and requirements listing each have a high quantity of 6 relationships and are, therefore, central to the production of DCI. Feedback collection ensures that new, explorative insights generated in Practices A and H and materialised in ideas and product concepts, become more refined and tested before being adopted and integrated into requirements. As explained in Section 9.1.1.2, this done in a qualitative and loosely organised way and may be as easy as just “send[ing] [some customers] the PowerPoint to check the specifications.” (INT-SLSf).

Figure 9.1: Common Configuration of Practices



Source: Author

However, much more than being a final step of research, the model in Figure 9.1 shows that feedback collection also influences the origin of insights in Practice A. Although actors within the case projects stressed that they took an open-minded, explorative approach to understand customer problems, conversations easily evolved towards testing the applicability of an idea. These 'two minds' are explained by the Product Owner of Fibertop: "In the beginning, we were very open. It is a broad technology and we made a first product that could [functionality], enabling us to ask customers 'What will you do with this […] What can you do with this?' In these first conversations we were kind of developing hypotheses. They touched upon all sorts of things." (INT-POf). This ambiguous approach implies that idea generation preceded the exploration of problems and that conceptual use of insights was limited to refining ideas (instead of inspiring new ideas). The Innovation Management and Design literature describes how this order of doing things may severely limit the scope of exploration and, therefore, could have a constraining effect on insights (see e.g. Liedtka, 2015; Le Masson, Hatchuel and Weil, 2007). The perceptions discussed in Section 9.3 on RQ3 will reveal that this reduced exploration is hardly recognised as problematic or limiting. The implications of the order of undertaking the practices on the level of insight will be discussed further in RQ2.

The second conclusion drawn from the common configuration of practices concerns the role of synthesis. The case projects sometimes acted quickly on market findings and did not always synthesise their findings first. The direct relationship between Practices A and B suggests that the findings of Practice A were not synthesised — for example, in an explicit customer problem statement or design brief — before starting idea generation (Goffin, Lemke and Koners, 2010). A closer analysis of the relationships between the information processing steps confirms that other research findings were also used directly, without synthesis. Figure 9.2 counts the incoming and outgoing relationships between the research, synthesis, and utilisation practices. It shows that, in 21 instances, the regular order of MIP was taken. This means that research findings and customer data (Practices A, D, H, I, G, and K) were synthesised into new models (Practices E, J, and M), before being utilised in idea generation, funding, and new product concepts (Practices B, C, and L). In 12 instances, however, this was not the case and insights were used directly, without the use of any synthesising activity. An example of the lack of analysis and meaning making in research findings is seen in the case of MZI. The feedback generated in Practice I led straight into problem solving: "Then [in the field test] you see what the problems are and then we tried to address the problems." (INT-RD2m)

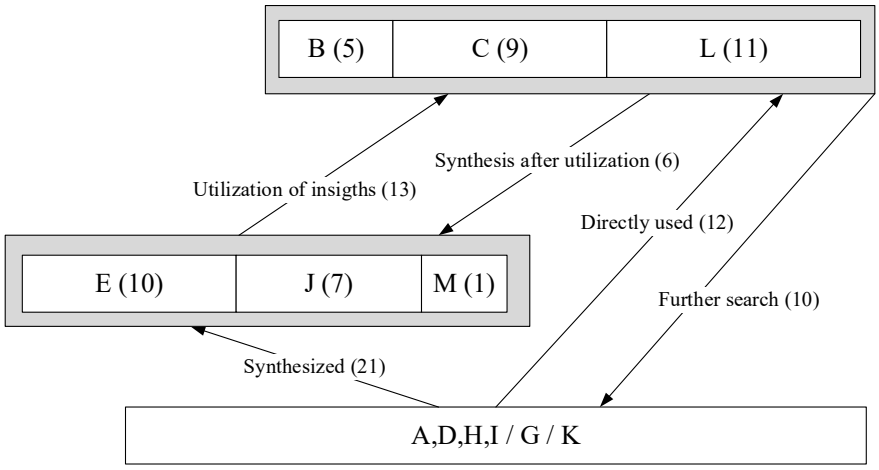
These observations of direct use concur with findings in MBL literature that SMEs omit MIP steps (Maes and Sels, 2014; Veldhuizen, Hultink and Griffin, 2006), but also adds some new understanding. The analysis makes clear that an absence of synthesis in the first place does not mean that it does not take place at all. This is seen in Figure 9.2, in the 6 instances within which synthesis occurred *after* use. This atypical chronology of information processing is often seen in situations of *symbolic use*, the process in which intuitive decisions made earlier are explained in hindsight (Vyas and Souchon, 2003). In this way, symbolic use coincides with iterative DCI processes, in which new insights remain implicit and grow gradually with the increasing experience resulting from customers' feedback on the product concept. Although all case projects developed their concept in several iterations of feedback gathering and concept refinement, symbolic use is especially visible within FiberTop and ZKL. These cases explicitly chose to postpone reaching final conclusions on their observations until their product concept had reached a more advanced state.

This is supported by the Product Owner of Fibertop:

> […] defining the value proposition is a process that is alive. It is also always still a little […]undefined. It is often more implicit. Maybe for some companies it is crystal clear, but still now for FiberTop it is evolving […] I think that the internal part of writing down all those strengths and weaknesses […] I always find that a little bit […] No, you do it. You bring that product out there, you get the feedback, you iterate and then you learn this value proposition. Not by sitting inside and thinking you know what they want. (INT-POf)

Similarly, ZKL was hesitant to draw conclusions regarding insights early in the process, with the Owner stating that he gradually "drew the picture" as the project unfolded. Most of his decisions were based on what he called "gut feeling", and he did not synthesise his observations in a value proposition or requirements until it was needed to align others to his idea. Such symbolic use of DCI is illustrated by his view on the business case, which is not used to plan activities, but rather as a collaboration tool: "[…] the important thing of a business case is that it helps in energising the team. That is more important than planning and time […]" (WS-OMz).

Figure 9.2: Incoming and Outgoing Relationships within Market Information Processing Steps



Source: Author

9.1.3 Composition of the DCI Team

Sections 9.1.1 and 9.1.2 discussed the efforts that the case projects put into the practices and revealed the common characteristics and configurations of DCI generation. Section 9.1.3 concentrates on actors and their roles, thus providing a deeper understanding of the typical composition of teams working on DCI. MBL literature has defined some of the roles played in market-based learning for radical innovation. These include boundary spanning, gatekeeping, and champion roles, which are primarily performed by lower-level employees, R&D, and business personnel. Aside from incremental innovation, Owners and Senior Managers are involved much later in the process, concentrating on decision making (Reid and De Brentani, 2004). Current understanding of actors and roles is highly generic by nature and does not describe other information processing roles. Moreover, MBL findings contrast with findings of small firm literature and, therefore, leave many questions open regarding how the Owner interacts with others during radical innovation (e.g. Bettiol, Di Maria and Finotto, 2011; Maes and Sels, 2014).

Within Analytical Step 1 of RQ1, the main activities for the generation of DCI were identified, which allowed the definition of the actors fulfilling the activities. By inspecting the sets of activities performed by specific (groups of) actors (e.g. Owner, customer, or Sales) nine roles were recognised, including: information processing (the collection and analysis of market-based data); providing input data; champion (promoting the project); gatekeeper/synthesis; relationship manager; boundary spanning (interface between internal team and external parties); decision maker; gatekeeper/quality control; and creativity and development. Appendix EEE list the actors and their roles for each case project.

Table 9.3: Overview of Actors and Roles

	Number of Roles/Out of the Total of 9 Roles Played by Each Actor						
Actor	**Thermo**	**ZKL**	**MZI**	**SEMO**	**SmartLight**	**FiberTop**	**Mostly Involved**
Owner	6/9 information input; creativity and development; boundary spanning	8/9 **not** information input	5/9 **not** information input; quality control; boundary spanning; relationship management	2/9 boundary spanning; decision making	2/9 Integration; decision making	2/9 champion; decision making	Integration; decision making
Customer	1/9 providing input data	2/9 providing input data; integration	8/9 **not** quality control	1/9 providing input data	1/9 providing input data	2/9 providing input data and integration	Providing input data
Sales	-	-	-	6/9 **not** creativity, gatekeeping	7/9 **not** creativity and information input	2/9 relationship management and quality control	Relationship management; decision making; quality control; boundary spanning
Business	-	-	-	3/9 information processing; champion and integration	-	-	Information processing; champion; integration
R&D	7/9 **not** information input; relationship management	1/9 development	4/9 development; quality control; information input; information processing	2/9 information processing and development	3/9 integration; boundary spanning and development	2/9 creativity and development	Information processing; creativity and development
Research specialist	-	-	-	1/9 quality control	-	-	Quality control
External (experts, students)	1/9 information processing	-	1/9 information processing	1/9 information processing	-	-	Information processing
Team	-	-	-	-	-	3/9 information processing; integration; boundary spanning	Information processing; integration; boundary spanning
Number of actors	4	3	4	7	4	5	n/a
Most roles with	Owner and R&D	Owner	Owner and customer	Sales and business	Sales	Team	n/a

Source: Author

Table 9.3 summarises the main actors and their roles for each case project, demonstrating that the case projects involved a variety of disciplines in DCI generation. Typical roles are those found across all cases for a particular actor and are displayed in the last column in order to enable comparison between the case projects. For example, the Owner of Thermo, displayed in the second column, fulfilled six out of the total of nine roles (6/9 roles). Comparing this with the typical role of integration and decision making establishes the fact that the Owner of Thermo was more active than others with providing input data, creativity and development, and boundary spanning roles. The last row of Table 9.3 summarises the roles for each case and demonstrates that DCI generation especially relies on Owners, R&D, Sales, and the customer.

Consistent with literature on SMEs, the results of this study highlight the Owner's typical role in the integration of findings (as in gatekeeper/synthesis) and decision making (e.g. Bettiol, Di Maria and Finotto, 2011). However, within Thermo, ZKL, and MZI, the Owner's role stretched beyond this to include the full set of tasks, including boundary spanning, information processing, relationship management, creativity and development, and gatekeeping/quality control. Crucially, all of the case project companies had available marketing, business, and R&D professionals, but apparently, these individuals were not allocated to the DCI tasks.

The findings of this study identify an important role for R&D professionals in information processing within MZI, SEMO, and SmartLight. Within FiberTop, R&D professionals were an integrated part of the team and were, therefore, involved in the entire project. FiberTop appeared particularly aware of the dual set of competences for R&D. They stressed how their team is composed of multi-skilled, *T-shaped,* professionals, capable of handling both technical and customer-related tasks (Brown, 2008; Hansen, 2019): "Our developers speak two languages, we need people that are expert in one field, but know how to work and collaborate in other fields of expertise." (INT-SLSf). This dual role is, notably, not observed in ZKL and Thermo, in which the Owner's account suggests a predominantly technical focus for developers: "Technicians, as a rule, they just include what is needed, we had this entire discussion about a sensor […] well in the end, they had to put it back, if you want to sell it, it has to be attractive for the client." (WS-OMz).

Anecdotal evidence describes how sales employees may support information processing in innovation projects (Frishammer and Ylinenpää, 2007; La Rocca et al., 2016; Webb et al., 2010). More detailed evidence of the role of Sales in DCI generation has not been available until this study. The findings of this thesis indicate that, within SEMO, FiberTop, and SmartLight, the Sales team was a factor of importance, undertaking roles that were dominated by the Owner in the other case projects (boundary spanning, information processing, relationship management, and quality control). These three case companies characterised themselves as commercially driven and employed sales engineers that held both R&D and commercial skills. The strong presence of Sales is consistent with the general sales-driven — instead of market-oriented — culture of SMEs (Moultrie, Clarkson and Probert, 2007a), thus offering an explanation for why marketing was hardly involved in the DCI processes.

MBL research has just started to reveal the roles that customers may perform within a radical project, including being an input source for needs- and solution-oriented information (Coviello and Joseph, 2012). Similarly, this current research has observed the important role of the customer as an input source. The case projects relying on Owners (Thermo, ZKL, MZI, and partly SmartLight) invested significant effort in the mobilisation of customers and even

co-created[4] with them during testing. In these cases, customers were not only funding the activities but also added to them with labour capacity and a location, as explained by the Owner of ZKL: "It was fantastic, they [the customer] started working for us and took over some of our work. […] For example, this operator, he took our first versions one night, and just put them into operation, running some tests.". However, what becomes clear from this example is that, although the customer acted much more as a partner in Practice I than in the other research practices, the Owners remained in control of the activities. The customer provided the necessary resources and input data and participated in information processing only during synthesis (for example, collaborative interpretation of findings).

An exception to this is MZI, in which the customer's role stretched beyond being an input source. In this case, eight of the nine DCI roles were dominated by a single customer. This significant number of customer roles was the result of MachineCo's expectation that the customer would act like an (internal) marketeer: "We had our client at the table, he visited all conferences and events and talked to everybody. So that was actually our marketing person. We trusted in him." (WS-OMm). The customer, on his part, was motivated to participate in the future new business and, therefore, keen to perform all kind of tasks, including responsibility for DCI. It was this customer who described customers' problems, launched the project idea, signalled the opportunity, generated funds, pointed out relevant reports, held contacts with other fisheries, and decided against surveying them. He, thus, became a champion, boundary spanner, and gatekeeper at the same time and had a continuing influence on the course of events of the MZI project. As will be shown during the discussion of RQ2 Section 9.2, the implications of this strong influence of the customer were far-reaching and set this case project apart from the others.

Comparing actor involvement across the case projects reveals three groups, each having distinct team compositions. First, a group of case projects with a *small and Owner-dominated* team, as was seen within Thermo, ZKL, and MZI. This group strongly relied on their Owners. It is important to note that the Owners in these cases seek close collaboration with the customer, but not with employees. Second, a group of case projects with a *multi-person and Owner-independent* team, as found with SEMO and FiberTop. In this group, Sales have taken over the typical roles of the Owner, and customers generally play a more distant role of 'just' providing information input. SmartLight occupies a middle-ground position between the two groups, with a small team and a strong role for Sales. It will, therefore, be labelled as a *Sales* team. Crucially, the two distinct groups seem to exist independently of the size of the firm. Both SEMO (a project within a larger SME) and FiberTop (a start-up case) assigned a larger group of actors to these nine roles. In contrast, within Thermo (a project within a larger SME) and ZKL (a start-up case) owners fulfilled virtually every role. This suggests that wider team development is determined by the Owner's appreciation of the qualities of his employees rather than the size of the firm in question.

A closer look at the teams of SEMO and Fibertop reveal two fundamental different cooperation models within the group of multi-person and Owner-independent teams. Within SEMO, the PO (included in the actor 'business' in Table 9.3) acted alone in coordinating and

[4] The Customer Involvement literature defines co-creation as an approach in which the customers participate actively in the NPD processes, for example, by engaging in co-development, problem-solving, and decision making. By working actively together, needs and solution information is transmitted in a natural way (without formal research) from the customer to the innovating firm (e.g. Cui and Wu, 2016, 2017; Nambisan, 2002).

gatekeeping DCI. He took responsibility for synthesising research findings and called in the necessary specialists within the marketing, research, sales, and R&D domains to support him when needed. This is explained by the PO in the following way: "You are the voice of the customer within the team. This means lots of conversations and going back and forth between everybody as well as the customer." (INT-PO). On the other hand, FiberTop's team had much more of a collaborative model and undertook many of the research and synthesis activities jointly.

9.1.4 Resource Strategies for DCI

The Systematic Literature Review (SLR) indicated that resources are a key theme in research regarding innovation and DCI, particularly for SMEs undertaking radical innovation projects. Section 9.1.4 highlights the resources strategies for DCI, demonstrating which resources are used and how they are typically combined.

Following the Resource-Based View (RBV) (c.f. Barney, 1991; Eisenhardt and Martin, 2000; Winter, 2003), resources are assets used in organisational processes. They include *physical resources* (e.g. plants, equipment), *human capital resources* (e.g. prior knowledge, experience, and skills), and *organisational resources* (e.g. superior sales force, and customers relations). Considering the fact that few resources have a proven value for radical innovation, it is important to distinguish specific resource-types (c.f. Kyriakopoulos, Hughes and Hughes, 2016). MBL literature has just begun to recognise the importance of skills and techniques for the generation of DCI (e.g. Bonner, 2010; Veldhuizen, Hultink and Griffin, 2006). Furthermore, it has argued for the importance of having organisational-level resources such as a market-based culture or strategic considerations (Reid and De Brentani, 2010). Whether these resources also are used within SMEs is not clear. With less means available than large firms, SMEs are known for their creative use of *close-at-hand* resources (Gruber, 2003; Hills, Hultman and Miles, 2008). However, until this study, it has not been clear exactly what these easily accessible resource are and how they are used within radical innovation projects (e.g. Baker, Miner and Eesley, 2003; Danneels, 2003; Garud and Karnøe, 2003).

Analytical Step 4 of RQ1 identified 70 distinct resources used in the practices. Following the literature, these resources were categorised into four groups: Firm-Level Assets (FLA); Carriers of Information (CoI); Skills & Techniques (S&T); People and Money (P&M). These groups distinguish the level at which resources were made available (organisational, project, and individual). Moreover, they set apart informational resources from skills and techniques, just as they set apart existing resources from newly acquired resources. Table 9.4 shows the number of resource types used within each resource group for each case (both in absolute numbers and in % of total). It also lists the main resource type within each group. Appendix L provides the full overview

FLA resources consist of resources made available at the company level. Overall, they were less intensively employed, which demonstrates a general lack of useful organisational-level resources for DCI within these SMEs. An exception is the more mature case, and highly sales-driven company, SmartLight. They allocated 32% of their resource budget to company-level resources, such as their guidelines for selecting and motivating new customers:

> We use what we call the 'power of soft selling'. We don't ask for money when we do a demo site. We just tell them that they have to try and pay when they are satisfied […] We look for customers like [big consumer brand]. […] just simply the fact that they use it generates trust for other, more conservative customers. (INT-SLSsl)

The resources identified in the project-level CoI group demonstrate that each SME created entirely new resources, such as new customers. These were often found by gaining

access to new industry networks. The case projects supplemented the insights generated from new customers creatively with existing resources, such as information from internal sources. Alternatively, they combined new resources with resources that were relatively easy to find. These will be termed *close-at-hand resources*, and include industry reports and papers acquired by means of internet search or information from existing networks. MZI and SmartLight proved to be particularly interested in acquiring information sources, allocating between 32% and 38% of their total resources to this group. However, these were predominantly comprised of existing or close-at-hand resources, as in the case of SmartLight: "That was easy, we asked the firm at the end of our street if we could do a demo project in their hall." (INT-OM2sl).

The P&M category is a second project-level group of resources, which consists of dedicated people and money attracted in order to support DCI generation. This category includes some new resources, but most were new sources of money, such as grants and subsidies. However, overall, resource creation within the P&M group is primarily limited to close-at-hand resources, such as students. It is important to note that, within both Thermo and MZI, students were attracted in order to gain access to very specific expertise, perceived to be lacking within the firm and often related to market research skills. To gain access to such expertise, SMEs made use of their close-at-hand university networks, thus proving the value of such networks in supplementing SMEs resources. In general, the P&M category represents a small part — only 11% — of the total resource budget. An exception to this is the start-up company ZKL, which allocated 27% of its total resource budget to this category.

S&T stands out as the most widely employed resource group, confirming that, as in large firms, skills and techniques are indispensable. Thermo, SEMO, and FiberTop, most especially, concentrated their resource budgets on skills and techniques. These skills and techniques were already present within the firm, and were, therefore, not new. The repertoire of these case projects did not, however, include the sophisticated techniques prescribed in the literature, but were instead focused on interview techniques. This can be observed in the explanation offered by the Sales Manager of FiberTop:

> You see [shows notes from an interview], this is how I do it. I start with a main topic, and then for each I probe deeper asking 'why are you doing this', 'why are you doing that', and in this way I learn what hypothesis are behind each main topic. So, this is what I report on and then we discuss these with the team and share the essence. (INT-SLSf)

The grey shaded cells of Table 9.4 reveal three distinct resource strategies for combining existing, close-at-hand, and new resources. Firstly, a *skills intensive* strategy found with Thermo, SEMO, and FiberTop. In this strategy, case projects made significant use of available skills and techniques and combined this with an emphasis on acquiring new customer sources. Secondly, a *resource extensive* strategy found within ZKL and SmartLight, in which the resources are spread equally across distinct groups, predominantly comprised of existing resources, sometimes combined with new and close-at-hand resources. Thirdly, an *information source intensive* strategy found within MZI, largely concentrating on close-at-hand and existing resources.

Table 9.4: The Resources Used to Generate Deep Customer Insight

Resource Group	Thermo		ZKL		MZI		SEMO		FiberTop		SmartLight		Overall	
	Total	%	Total	%	Total	%	Total	%	Total	%	Total	%	Total	%
	(absolute amounts of resources and % of case totals)													
Firm Level Assets (FLA)	4 Strategic considerations	14	6 Scope	26	5 Company formats	15	10 Company formats	24	6 Scope	15	6 Strategic considerations	30	16 Scope	23
Carriers of Information (CoI)	6 Customer sources	21	6 Internal and customer sources	26	12 Internal sources	38	11 Customer sources	27	12 Internal and customer sources	31	7 Internal source	35	18 Internal and customer sources	26
Skills and Techniques (S&T)	16 Collaborative sensemaking	55	7 Analytical skills and integrative skills	30	9 Collaborative sensemaking	28	18 Research methods; analytical skills; and integrative skills	44	16 Analytical skills, collaborative sensemaking skills and integrative skills	41	6 Collaborative sensemaking	30	28 Interview and analytical skills	40
People and Money (P&M)	3 Students	10	4 Students and customers	17	6 Students	19	2 Students and DCI manager	5	5 Students, grants, customers, and manager	13	1 Customers willing to pay	5	8 Students	11
Case totals	29	100	23	100	32	100	41	100	39	100	20	100	70	100

Source: Author

9.1.5 Three Levels of DCI Practice Maturity

Section 9.1.5 combines the findings of the Sections 9.1.1–9.1.4 to draw firm conclusions regarding the case projects' distinct levels of practice maturity for generating DCI. Current academic understanding on how SMEs develop their learning — and DCI — capabilities is virtually non-existent. The SLR included one paper describing the different levels of design maturity within SMEs (e.g. Moultrie, Clarkson and Probert, 2007a), but the utility of this paper for understanding DCI maturity is limited. The model of Moultrie, Clarkson and Probert (2007) is derived from the best practices of large firms and, therefore, does not sufficiently incorporate SMEs' unique context. By using observations of the actual DCI behaviour of smaller firms, it is possible to develop a more robust and objective model for drawing conclusions regarding SMEs' capabilities (c.f Panizzolo, Biazzo and Garengo, 2010).

MBL theory states that each consecutive step of information processing — acquisition, synthesis, and utilisation — is a condition for a next one (Cohen and Levinthal, 1990; Kohli and Jaworski, 1990). In this way, each step can be viewed as a level that must be completed before next steps may benefit from the desired effect.[5] Building on this understanding, Table 9.5 compares the efforts put into research, synthesis, and utilisation. The differences between the case projects are explained by taking into perspective the findings of the composition of the DCI team (Section 9.1.3) and the resource strategies for DCI (Section 9.1.4).

The second column of Table 9.5 lists the amount of efforts put into research practices, which is the sum of practice components[6] listed for Practices A, D, H, and I in the Overview Table 9.1. It is compared with the maximum number of components that could potentially be put in the four research practices, represented by the sum of the full composition of each research practice. These compositions are also listed in Table 9.1, and were 11, 14, 15, and 11 respectively, giving a maximum composition of 51 for the group of research practices. By comparing the actual number of components with the maximum potential number of components, the completeness of that case project's performance can be clearly determined. For example, Thermo performed Practices A, D, and I, and used 5, 11, and 3 components respectively. The total number of 19 practice components represents 35% of the maximum number of 51. The third column of Table 9.5 follows the same procedure for the synthesis practices, Practices E, J, and M, which noted a maximum number of 21 components. The fourth column lists the utilisation of insights: conceptually, instrumentally, or symbolically, thus giving an indication of their level of use. The fifth column refers to the composition of the DCI teams, either 'small and Owner-dominated', or 'multi-person and Owner-independent'. The sixth column refers to the resource strategies for DCI, either 'skills intensive', 'resource extensive', or 'information source intensive'. The last column draws conclusions regarding each case by categorising them as having a high, medium, or low level of practice maturity.

[5] Absorptive Capacity literature is a separate and extensive body of knowledge that terms the different levels of information processing *absorptive capacity* (Cohen and Levinthal, 1990). Although absorptive capacity is not limited to market-based information, the concepts of MBL and Absorptive Capacity overlap.

[6] Practice components were defined in Section 9.1.1 as the total amount of activities and resources of a practice.

Table 9.5: Levels of DCI Practice Maturity

Case	Research Efforts (number and % of Practice Components) and Focus	Synthesis Efforts (number and % of Practice Components) and Focus	Utilisation of DCI	Composition of the DCI Team	Resource Strategies for DCI	Conclusion
FiberTop	HIGH 27 out of a total of 51 (53%); Focus of research on Problems, Markets and Solutions	HIGH 13 out of a total of 21 (62%); Equal attention to all	Conceptual; instrumental; symbolic	Multi-person and Owner-independent	Skills intensive	HIGH practice maturity
SEMO	HIGH 36 out of a total of 51 (71%); Focus of research on Problems, Needs, and Markets	HIGH 14 out of a total of 21 (67%); Equal attention to all	Conceptual; instrumental; symbolic	Multi-person and Owner-independent	Skills intensive	HIGH practice maturity
MZI	HIGH 33 out of a total of 51 (65%); Focus of research on Markets and Needs	LOW 9 out of a total of 21 (43%); Focus of synthesis on value proposition and requirements	Instrumental	Small and Owner-dominated	Information source intensive	MEDIUM practice maturity
Thermo	MEDIUM 19 out of a total of 51 (37%); Focus of research on Markets	HIGH 13 out of a total of 21 (62%); Focus of synthesis on requirements and marketing	Symbolic	Small and Owner-dominated	Resource extensive	MEDIUM practice maturity
ZKL	LOW 12 out of a total of 51 (24%); Focus of research on Solutions	LOW 10 out of a total of 21 (48%); Equal attention to all	Symbolic	Small and Owner-dominated	Resource extensive	LOW practice maturity
SmartLight	LOW 13 out of a total of 51 (25%); Focus of research on Solutions	LOW 10 out of a total of 21 (48%); Equal attention to all	Symbolic	Sales-dominated		LOW practice maturity

Source: Author

FiberTop and SEMO are categorised as having a high practice maturity. They clearly fulfilled all information processing steps, with high performance in research and synthesis. These case projects focused their research efforts on three types of information covering distinct content types (needs-based information, market information, and solution information) that, simultaneously, required the involvement of distinct customer groups in different modes of involvement. More than anything, their performance is characterised by a high level of skill. Additionally, these case projects maximised the use of their insights and made them available for both conceptual and instrumental use. Such a combination of uses is known for its positive effects on the uniqueness and cost-efficiency of an innovation (Cillo, De Luca and Troilo, 2010; Hultink et al., 2011; Moorman, 1995). In both FiberTop and SEMO, explanations for such high performance may be found in the team-based approach. By involving a wider group of professionals, each bringing their respective levels of skill, as well as a specific need for DCI, both case projects fully realised their maximum potential.

Congruent with the limited resources of a start-up businesses, FiberTop invested fewer efforts in research activities than SEMO. It is important to note, however, that FiberTop spread their efforts evenly across the remaining three types of research and made maximum use of the resulting insights. This case project did not only draw on the conceptual and instrumental value of DCI, but also on the symbolic value, supporting insight generation during the many iterations of the concept. Entrepreneurial Theory suggest that the capability to combine planned and rational information use (as in conceptual and instrumental use) with more inductive and gradual use (as in symbolic use) are key entrepreneurial competences (Alvarez, Barney and Anderson, 2012).

MZI and Thermo are categorised a case projects that have a medium practice performance. Both were found incapable of performing both research and synthesis at a high level, and both only used insights to a limited extend. Both case projects were dominated by the perspectives of their Owner and, therefore, did not make full use of skillsets of other employees. MZI proved to be an intensive researcher but focused, foremost, on finding the necessary sources of information (and less on having the rights skills and techniques). This may also explain why MZI exhibited low levels of synthesis and focused on instrumental use of their insights. Such a lack of synthesis is explained by pressure to get the proto-type up and running: "We were delayed seriously, so we proceeded fairly quickly. We didn't really have time to think things through, and we were mainly focused on problem solving and getting things up and running in time." (INT-Cust1m). The low-level interest and skill invested in synthesis of the findings is clearly seen in the available case project documents. Content analysis reveals that insights were not systematically progressed. For example, time reduction was put forward as a clear benefit of MZI in the grant proposal and in the interviews conducted for this case study, but it was not elaborated on further in the analysis report or choice matrices.

In contrast to MZI, Thermo did put efforts into synthesising their insights, as seen, for example, in the market research report of the external marketer. However, this approach did not result in full use of DCI. Such limited utility is mainly caused by Thermo’s choice to concentrate research efforts on market data and use the findings of market research relatively late in the process, mostly symbolically, to justify major investments.

ZKL and SmartLight are categorised a case projects that have a low practice performance. They noted an overall low level of efforts in all information processing steps. Research activities concentrated only on one type of information and, like MZI and Thermo, these case projects used this information relatively late to justify intuitively made decisions in hindsight.

9.1.6 Discussion of and Conclusions to Research Question 1

Section 9.1.6 responds to RQ1: *How do small firms' practices enable them to generate DCI for radical innovation projects?* The findings give rise to six sets of conclusions.

First, DCI generation involved 13 distinct practices, which are grouped by type: mobilisation practices (G and K), research practices (A, D, H, and I), synthesis practices (E, J, and M), utilisation practices (B, C, and L), and a management practice (F). Practices H, F, and K are less frequently used and, therefore, the common configuration is comprised of 10 practices. The common configuration reflects perspectives from the Learning and Customer Involvement literature, as well as from the Innovation and Management and Design literature, thus providing a more holistic and fine-grained perception of what is needed to generate DCI (Cui and Wu, 2016; Veldhuizen, Hultink and Griffin, 2006). This more comprehensive approach includes a careful differentiation between the different types of market knowledge content (Kyriakopoulos, Hughes and Hughes, 2016).

Second, the sophistication, temporal ordering, and level of formality found in SMEs' practices exceeds what the literature has described (and prescribed). SMEs typically order things very differently from the prescribed 'discovery' logic, in which ideas and design are based on exploratory market research (Cayla and Arnould, 2013; Cooper and Dreher, 2010). Moreover, the typical real-time, loosely controlled way of testing product ideas was found to be very different from the logic of experimentation, in which situations are created solely for the purpose of learning (Miner, Bassoff and Moorman, 2001). Lastly, SMEs' extensive, and often deliberate, DCI practices cannot be viewed as completely informal, as others have claimed (Marion, Friar and Simpson, 2012). What was actually observed could be classed as a hybrid methodology, sharing important characteristics with *improvisation* (c.f. Weick, 1998), in which different approaches are combined and lead to real-time learning.

The close interaction between Practices A and I indicates that DCI generation within SMEs is comprised of two modes which combine in a single project: explorative learning (collecting a wide range of issues and topics that may explain customers' needs), and exploitative learning (validating and refining earlier findings in order to find the most appropriate solution). Such combinations suggest *ambidexterity at the project level* (Gupta, Smith and Shalley, 2006; Liu and Leitner, 2012), which is known to support both unique and cost-efficient insights (Kim and Atuahene-Gima, 2010). Such a combined, hybrid approach is also evident at the level of individual employees and is visible in how SMEs question their customers. Although they often set out in an open-ended fashion, aiming to generate numerous insights, SMEs easily throw their ideas in the conversation in order to validate and refine them. The duality of approach and mindset can also be observed in how SMEs combine planned and rational research, in which the customer is treated as a source of information with loosely controlled and intuitive research, allowing closer forms of collaboration with the customer. This is defined within Entrepreneurship Theory as a second type of ambidexterity, representing the combination of discovery and creation logic (Alvarez, Barney and Anderson, 2012).

Both forms of ambidexterity play a part within the concept of *improvisation* (c.f. Weick, 1998). Within improvisation, activities are controlled but not predetermined, aiming for both open-ended and refining types of information at the same time. Improvisation is used to tackle surprises and unexpected problems, and can be observed when planned actions are changed into unscripted actions (Miner, Bassoff and Moorman, 2001). Sudden, unscripted actions were observed in all case projects. Improvisation occurred during data collection within the SEMO and FiberTop projects, affecting explorative conversations, and in the feedback gathering of the SmartLight project. Similarly, improvisation affected decisions regarding customer selection, in which the search for a lead user was abruptly ended upon contact with a highly

attractive customer, as was noted in both Thermo and FiberTop. What becomes clear is that all of these instances of improvisation impacted the resource situation of the case projects, such as: preventing the loss time when customers did not respond as expected; relaxing time pressures due to technical complications; and creating extra financial means from a customer. Symbolic use, in which synthesis takes place retrospectively, equally forms part of the concept of improvisation (c.f. Weick, 1998). Thus, observations of symbolic use, for example in the iterative approach of ZKL and FiberTop, further underlines the improvisational nature of the DCI practices within the case projects.

Third, the findings add to the Innovation Management and Design and Entrepreneurship literatures by demonstrating that DCI generation within SMEs is a collective activity, requiring substantial internal coordination and collaboration. Together, the actors were found to perform nine different roles, including core information processing tasks, quality control, and supporting tasks such as relationship management. Despite the fact that Owner dominance was observed within some cases (c.f. Maes and Sels, 2014; Marion, Friar and Simpson, 2012a; Moultrie, Clarkson and Probert, 2007), projects that noted a higher level of practice maturity involved a wider team and demonstrated that DCI is not necessarily the exclusive task of Owners. Marketing professionals were found to play a minor role in the practices, only responsible for operational activities during launch. Consistent with the strong sales-driven culture of many SMEs (Moultrie, Clarkson and Probert, 2007a), Sales played the major part, especially in those case projects within which there was little Owner involvement. This suggests that the combination of commercial attitude and information processing skills turn Sales into a trusted party, capable of undertaking the Owners' role (La Rocca et al., 2016). Overall, it is clear that actors playing larger parts in the DCI process are multi-skilled and, therefore, well-equipped to engage in full set of social, technical, and information processing tasks of DCI generation.

Fourth, the observations of this study that note unique combinations of resources allocated to practices further contributes to Entrepreneurship literature (e.g. Baker, Miner and Eesley, 2003; Danneels, 2003; Garud and Karnøe, 2003). It was found that SMEs do not solely rely on existing or entirely new resources entirely new resources. They use both, and also employ *bricolage,* a creative use of close-at-hand resources. The use of bricolage is consistent with the improvising nature of the practices given that improvisation, by definition, leaves little time to find entirely new resources (c.f. Baker, Miner and Eesley, 2003; Weick, 1998). SMEs were found to combine existing, close-at-hand, and new resources in creative ways. New resources included new customer relationships and financial funds. It was observed that cases which had available skills and techniques allocated most of their resource budget these skills and techniques, and displayed higher levels of practice maturity. Such resource concentration suggests that research skills are pivotal in guiding SMEs through ambiguous processes and explain recent academic findings regarding the importance of research skills (Hultink et al., 2011).

Fifth, the findings of this study contribute to the Customer Involvement literature by demonstrating the different dimensions of customer involvement. Until now, views on the concept of customer involvement were incomplete and confusing. Some authors combined the characteristics of the relationships and the frequency of interaction in the concept of close customer involvement, warning against its negative effects on explorative learning (e.g. Nijssen et. al. 2012). Others used close involvement to refer to the co-creational role that customers may perform in NPD, emphasising the positive effects (e.g. Cui and Wu, 2016). Such confusion was evident in the literature regarding small firms as well, with some studies drawing conclusions on SMEs' limited customer involvement and others, conversely, emphasising the high levels of customer involvement (e.g. Coviello and Joseph, 2012;

Moultrie, Clarkson and Probert, 2007b). The findings of RQ1 uncover three relevant dimensions of customer involvement. First, the research practices referred to different *modes* of customer involvement: *learning from*, in which the customer provides input data as was seen in Practices A and H; *learning with,* in which insights were collected by working together and testing the innovations as in Practice I; and *learning without*, in which secondary sources and other informants were used, as in Practice D. This ties in to the roles identified for the customer, including: input provider; participant in sensemaking; or, sometimes, even gatekeeping. Secondly, Practice G suggested that the research practices involved different *numbers of customers*. Typically, Practice A involved a larger set of customers, randomly selected, without using the selection, communication, and relationship management skills of Practice G. Practice H involved a medium number of customers, which were dedicatedly selected, whereas Practice I involved only a small set of customers. Thirdly, mobilisation Practice G indicated that customer involvement may vary according to *the quality of the customers* involved, referring to characteristics such as their relationship with the SMEs — new contacts, early buyers, current customers — their cultural background or lead user status. By disentangling the concept of customer involvement, the findings of this thesis contribute to the debate on customer involvement. Contrary to findings in the Customer Involvement literature (e.g. Coviello and Joseph, 2012), it is clear that SMEs do not solely rely on learning-with customers but apply all modes of learning. Additionally, when considering the amount of customers involved in the DCI processes, SMEs rely on much a smaller set of customers than what is pre-described in the (large-firm) literature (e.g. Griffin, Abbie; Hauser, 1991).

Sixth, until now, guidelines supporting SMEs in developing their innovation and DCI generation capabilities have not been available (McAdam, Reid and Gibson, 2004). The findings of RQ1 prove to be a valuable starting point for developing such guidelines. A comparison of the case projects' efforts across the externally oriented, interface, and internally oriented levels enabled the categorisation of the cases into high, medium, and low practice maturity. This, in turn, proved the potential of the practice model in offering SMEs' guidelines for DCI capability development.

9.2 THE LEVEL OF INSIGHT OF SMES

Section 9.1 compared the case projects on themes and patterns in the DCI practices. Section 9.2 will focus on the similarities and differences evident in the cases regarding RQ2: *What is the level of insight resulting from DCI practices*? The analysis suggests the most important qualities of DCI and evaluates the level of insight of the five cases. The analysis is based on data from the workshop held with each case project's team; since SmartLight was not available for a workshop, their results are missing. The findings will demonstrate that the case projects seek comprehensive, novel, acceptable, cost-efficient, and timely insights. Three distinct levels of insight describe the differences between the cases.

The findings are presented in three sections:

1. The first section gives an overview of the quality criteria of DCI
2. The second section presents the distinct levels of insight
3. The third section draws conclusions regarding RQ2

9.2.1 Quality Criteria

The SLR in Chapters 2 and 3 suggested that DCI is an ill-defined concept and that academic research into the quality of knowledge has yet to fully develop (Bonner, 2010; Hultink et al., 2011; Zahay, Griffin and Fredericks, 2004). In a first step towards measuring the level of insight, this study will first determine how practitioners within SMEs define and value DCI.

As part of the analytical procedure, all pieces of evidence expressing actors' perceptions of quality criteria for DCI were coded. The six pre-defined quality criteria available from the reviewed literature were used as a starting point for coding, and new codes were created for emerging criteria. To ensure that only criteria of sufficient significance were included, casual remarks regarding criteria were excluded from the coding process. Only criteria mentioned more than once and that appear in more than a single data source — documents, interviews, and workshop — were retained.

The results indicate that DCI is perceived as a multi-factor concept. Overall, nine criteria were identified: 'timely', 'comprehensive', 'novel', 'inspiring', 'format', 'accurate', 'acceptable', 'scope', and 'cost-efficient'. The first five correspond to the quality criteria identified in the literature.[7] Evidence for the sixth pre-defined criterion of *consistency* was not found. Four criteria, namely: 'acceptable', 'accurate', 'scope', and 'cost-efficient' insights, were emerging criteria, and hence are less well described in the literature.

Table 9.6 shows the number of mentions for each of the nine criteria. The number of mentions signifies the extent to which a specific criterion is present in the discussions on DCI quality within a case company and is used as an indicator of its value. The last row of Table 9.6 displays the total number of criteria of each case. With eight criteria, SEMO holds the most sophisticated perspective on DCI. The total number of mentions across the case projects is taken as an indicator of the extent to which the cases agree upon the value of a specific indicator. This number is displayed in the seventh column of Table 9.6, and it makes clear that the value of the DCI qualities of 'comprehensive', 'acceptable', 'novel', and 'cost-efficient' are most prolific. Comprehensive and novel insights are intrinsic qualities and strongly related to the unique *content* of DCI. The value of having accurate insights is not acknowledged by ZKL. The other cases refer to accuracy as a quality inherent of novel insights. The criteria of 'acceptable' and 'cost-efficient' exist independent of the content of DCI and are, therefore, extrinsic qualities. Considering the high number of mentions, these qualities were found to be equally important, describing essential *circumstances*. There is far less consensus on the value of the qualities of 'timely', 'inspiring', 'format', and 'scope', with some of the case projects not mentioning the value of these dimensions of DCI quality at all. It is vital to note that all of these criteria are related to the *presentation* of DCI. Sections 9.2.1.1–9.2.1.3 will give more details on the content, circumstances, and presentation of each group of DCI.

[7] The six pre-defined quality criteria for DCI were identified in the Market-Based Learning (MBL), Customer Involvement, and Innovation Management and Design literatures. They were selected to be used in the measurement instrument for assessing the level of insight.

Table 9.6: Mentions of Quality Criteria for DCI

Criteria	Mentions						Illustrative quote
	Thermo	ZKL	MZI	SEMO	FiberTop	Total	
Timely	-	-	8	-	5	13	"It is something that evolves, you should not regard this as some definite thing that you have to stick to. You have to have some flexibility to let it evolve while you are active and learning about what it means to customers to work with your product. Especially at the early phase." (WS-POf)
Comprehensive	6	6	14	9	14	49	"You need to get a thorough understanding of specific business. For example, I now know all about cows. How they eat, the breeds, stables. […] This goes very broad and helps you to gain trust from the client." (INT-OMt)
Novelty	6	7	8	3	7	31	"Technicians, as a rule, they just include what is needed, we had this entire discussion about a sensor […] well in the end, they had to put it back, if you want to sell it, it has to be attractive for the client." (WS-OMz)
Inspiring	-	-	-	4	-	7	"The user stories in chapter 8 and 9 lack detail for sake of simplicity." (URD, p. 4)
Format	-	3	-	6		6	"We do this [defining requirements] use-cased based, simply because that is more easy to comprehend." (INT-OMz)
Accurate	6	-	4	4	7	21	"Once you decide to go for it, you need a more scientific approach, be more certain […] Suppose you find out you addressed the wrong market, or your specifications weren't correct." (INT-OMt)
Acceptable	3	12	12	10	12	49	"I think you need to validate needs by means of customers' commitment, this is the most powerful way to understand what they want, find out their willingness to pay." (INT-POf) "I believe strongly that the most important thing is to create commitment of customers, while still keeping your independence […] Preserve your uniqueness." (INT-POz)
Scope	5	-	3	4	-	10	"[…] that shows that we were very product focused. We did not have a true focus on the market." (INT-MANs)
Cost efficient	3	4	9	6	7	29	"I send that list to a broader group of customers asking whether this is indeed the list of requirements. And you never can catch it for the full 100%. We understand that we also want to proceed fast […] so if you have to wait three weeks. We want to minimise the risk but, at some point, you just go on." (INT-SLSf)
Total Criteria	6	5	7	8	6		

Source: Author

9.2.1.1 The Content of DCI

Comprehensive knowledge is based on a wide variety of knowledge types and offers the potential to both achieve deeper levels of knowledge and to stimulate creativity (De Luca and Atuahene-Gima, 2007). The case projects' actors widely agree on the value of comprehensive insights. The importance of such insights becomes clear from the high levels of activity put into Practices A and D, and is also evident in the wide variety of content topics with which the cases familiarised themselves. Examples topics include: customers' workflow; the value chain; buying procedures; financial aspects; problems; and workarounds. The actors confirm the benefits of comprehensive knowledge which has been described in the literature. When aiming for comprehensive knowledge the changes that all relevant needs, including novel needs, are identified increases. Additionally, comprehensive knowledge supports achieving deeper levels of understanding, helping to "connect the dots" (INT-POf). A third perceived benefit of comprehensive insights is less well known and connects comprehensiveness to social aspects, such as the relationship with the customer. This is illustrated by the Owner of Thermo, giving an account of how comprehensive insights supported her in building trust with prospective customers: "You need to get a thorough understanding of specific business. For example, I now know all about cows. How they eat, the breeds, stables […] This goes very broad and helps you to gain trust from the client." (INT-OMt).

The SLR revealed significant academic attention in the literature paid to the unique set of capabilities required to generate novel insights. In sharp contrast, research on knowledge quality, specifically novelty, was severely lacking (e.g. Bonner, 2010; Hultink et al., 2011; Mahr, Lievens and Blazevic, 2014). As a consequence, the value of novelty as an attribute of quality remains unclear. Observed perceptions show that, although all case projects' actors agreed upon the importance of novelty, it was a less well-spread topic in conversations than comprehensive insights. The owner of ZKL pointed out that not all disciplines involved in innovation are equally concerned with novelty. In his view, commercially oriented people are more sensitive to novel knowledge than R&D employees.

Strongly related to novelty appears the cases' interpretation of accurate insights. Although 'accuracy' did not dominate the discussions, all case project teams remarked on the importance of identifying the *real* problems and needs, and referred to the hidden nature of novel insights: "[…] when you probe deeper, the problem turns out to be different." (INT-MR1s). Moreover, the actors within the MZI and Thermo cases indicated that the value of accurate insights changes over the course of the project and increased as it matures. Both cases desired greater certainty before making major investment decisions and invested in what they called "a more objective external approach" (INT-OM1t).

9.2.1.2 The Circumstances of DCI

The perceptions of case project actors reveal a wide consensus on the value of acceptable insights. This dimension of quality is scarcely discussed within the current literature, although it is well known that new ideas are often met with resistance (c.f. Mahr, Lievens and Blazevic, 2014; De Moor et al., 2014). The findings demonstrate that such resistance was found both internally, within the organisation, as well externally, with customers. MBL literature only recently begun to recognise the internal dimension of acceptance, describing how insights should facilitate *organisational* commitment (Schirr, 2012). This dimension was clearly acknowledged in the SEMO case, with frequent references from both the PO and the Interaction Designer about how commitment to the insights was lacking. The external dimension of acceptable insights, focusing on *customers'* commitment, has recently been recognised in the Customer Involvement literature (Mahr, Lievens and Blazevic, 2014). Concerns regarding customers' acceptance of DCI were found in all case projects. The PO of ZKL explained this as follows: "I believe strongly that the most important thing is to create commitment of customers, while still keeping your independence […] Preserve your uniqueness." (INT-POz). The importance of generating acceptable insights is also reflected in practices that involve the mobilisation of sources; not only aiming for sources of information capable of explaining needs, but also for sources that promise commercial success. To achieve acceptable insights, the actors drew upon their relationship management and communicative skills, thus managing expectations and creating awareness of the suitability of their solution with regard to customers' needs.

Cost-efficient insights comprise the fourth dimension of quality agreed upon by all case projects. Costs are an important driver for certain activities, but are largely ignored in the Market-Based Learning literature (Mahr, Lievens and Blazevic, 2014). Although all case companies desired new insights, they felt that they had to do this in a lean way. As a result of this cost-sensitive perspective, case projects often chose not to spend too much time on documentation, to skip phases, and to accept lower levels of certainty at the beginning of the project.

9.2.1.3 The Presentation of DCI

'Timely' is one of the least mentioned criteria, with only MZI and FiberTop paying explicit attention to the temporality of DCI. In the case of MZI, the team was under considerable pressure and, therefore, felt forced to postpone market research until a working proto-type was available. As a consequence, their insights focused, above all, on technical aspects. Timeliness within Fibertop held another meaning related to the evolving nature of DCI. The FiberTop team were clearly aware that insights are not static. Knowing that more needs insights would become available as the project progressed, they worked with consideration regarding accuracy early in the project and accepted lower levels of certainty.

Only the SEMO case project highlights the importance of having inspiring insights. This criterion overlaps, to some extent, with the criterion of having a single format. Both the ZKL and SEMO projects referred to the value of using formats like user stories and more abstract, formulated 'epics' to describe customer needs. This format was believed to be easily comprehended by various actors and was used for brainstorming sessions. RailCo started to use epics shortly after the ZKL project, valuing epics more for their ease of use rather than for their inspirational value.

Thermo, MZI, and SEMO all appeared to struggle with the *scope*, or coverage, of their insights. 'Scope' describes the case project actors' perspectives on their markets and customers and, crucially, determines the quality of DCI (c.f. Bucolo and Matthews, 2011). Scope is a

wider concept than 'relevance'. 'Relevance' is defined as the fit of DCI with the projects' objectives (e.g. Mahr, Lievens and Blazevic, 2014), whereas 'scope' ties in to the strategic positioning of a firm and explains in what kind of business the firm is engaged (Bucolo and Matthews, 2011). Despite the fact that SMEs often have difficulty defining their strategic position, the available literature broadly leaves undiscussed the consequences that a lack of or inconsistent scope can have upon DCI (Bucolo and Matthews, 2011). This study demonstrates how such strategic considerations were taken into account by the more mature SMEs, including Thermo, MZI, and SEMO. MZI and Thermo both narrowed their scope from the early project phase; the consequence of this was clearly recognised within the MZI case, in which the team ended up with a solution relevant for only a small subset of the market. According to some team members within SEMO, insights were not truly customer-focused, but, instead, were defined by specific product characteristics. As a consequence, their DCI did not consider less obvious market segments. Furthermore, the scope of the project appeared to change, focusing on other market segments than originally intended, leading to fluctuating priorities and confusion within the team.

9.2.2 The Level of Insight

In a second step aimed at gaining a better understanding of the outcome of DCI practices, the level of insight of the case companies was assessed. Therefore, a multi-component measure of the level of insight was developed. This measure was based on understanding gleaned from the literature regarding the criteria for knowledge quality, as well as the perceptions gathered from the case project actors, as discussed in Section 9.2.1. In order to develop a valid measure, this study considered the criteria, the measurement procedure and indicators, and the scoring of the results.

First, current academic understanding was used as a starting point for deciding which criteria to include in the measure. The few available definitions and measures identified gave an initial indication of the multi-dimensional character of DCI. Six pre-defined quality criteria were identified as candidates for inclusion.[8] In deciding which of these should be included in the final measure, care was taken to involve only those seen as *common* (often present in DCI) and *unique* (setting the concept apart from similar concepts) (Mackenzie, Podsakoff and Podsakoff, 2011). The analysis of the perceptions made clear that two of the six pre-defined criteria for DCI — 'comprehensive' and 'novel' — were commonly recognised and clearly represented the unique characteristics of DCI. Commonality of the other four pre-defined criteria of timely, consistent, inspiring, and format could not be clearly determined. Nevertheless, available evidence regarding the perceptions of timely, consistent, inspiring, and format demonstrated that presentation aspects do form part of DCI, as they ensure that, at some point, insights are explicated and effectively shared with others. This was also shown in the rudimentary list of insights found in the project documentations of MZI, SEMO, and FiberTop. This presentation aspect was deemed best reflected in the criterion of 'timely', a pre-defined criterion which was, therefore, also retained. The perceptions of the case project actors further warranted the inclusion of the criteria of 'acceptable' and 'cost-efficient' insights.

[8] In Section 6.5.2.1, distinct methods and measures for assessing the level of DCI were evaluated. The analytical approach described in Section 6.6.2 motivated the choice for the six pre-defined quality criteria.

The five criteria included in the final measurement instrument thus reflect content, circumstances, and presentation aspects of DCI. Together, the selected criteria represent both intrinsic and extrinsic qualities, a combination considered valid in other knowledge constructs (e.g. Reid and De Brentani, 2010).

Second, the measurement procedure was based on the requirement statements (the insights) found in the case companies' documentation. These were confirmed by all cases as representative of their insights at the time of the project. Measurement took place using six indicators. Two indicators measured whether the insights were 'comprehensive': the total number of needs insights and a verification of missed needs. The indicator for 'novel' insights followed from the workshops in which the case projects' team members scored the insights in any of the following Kano categories: 'attractive', 'one-dimensional', 'must-be', or 'indifferent'.[9] The indicator measures the total number of needs categorised as 'attractive' by 50% or more of the participants in the workshop. The indicators for 'acceptable', 'cost-efficient', and 'timely' were dichotomous and based on the qualitative data from perceptions, assessing whether or not they were met.

Third, an overall evaluative score for DCI quality was used to classify the cases in categories of low, medium, and high DCI quality. Current literature using a multi-component measure to assess and compare firm performance fail to provide details of the classification procedure (see e.g Davis and Eisenhardt, 2011). As a consequence clear guidelines for developing an overall score were not available and the logic had to be derived from the perceptions of quality criteria for DCI. The evaluative score for DCI quality was produced by comparing the case projects and scoring the results of each individual indicator relative to the result on the same indicator of the other case projects. Consistent with the case companies' wide agreement on the value of comprehensive and novel insights, greater weight was placed on these results. For each of the numeric indicators, a total of 15 points was assigned. Five points were given to the case project having the highest number of needs insights, four points to case projects having the second highest number of needs insights, and so on. In this way, FiberTop, with 43 insights, was given five points, whereas MZI, having only ten insights, was given one point. In a similar fashion, the maximum of five points was given to the case company with the highest number of attractive needs. Considering the fact that both SEMO and FiberTop noted seven attractive needs, they were both given five points. The second-best case, Thermo, with six attractive insights, received a score of three. MZI did not identify any attractive needs and, therefore, did not receive any points. The other indicators were dichotomous (missed needs, acceptable insights, cost-efficient insights, and timely insights) and were given less weight as a result. A maximum of one point was given to case projects that met the criterion. The overall result was triangulated with the perceptions of DCI quality. This combination of both objective and subjective measurement diminished the chance for common method bias (Podsakoff et al., 2003).

[9] This was referred to in Chapter 6 as the Kano procedure, based on the methodology of Kano (Kano, 1984).

Table 9.7: Cross-Case Overview of the Level of Insight

Criterion	Comprehensive		Novel	Acceptance	Cost-Efficient	Timely	Exemplar Quote Subjective Evaluation	Conclusion on Level of DCI
Indicator	**Number of needs insights**	**Verification missed needs insights**	**Attractive needs agreed upon by 50% or more of the workshop participants**	**Perceptions**	**Perceptions**	**Availability of list of insights during the project**		
Scoring	**Allocation of 15 points, 5 for highest number of needs insights, 1 for lowest number of needs insights**	**Yes (0), No (1)**	**Allocation of 15 points, 5 for highest number of attractive needs, 0 for lacking attractive needs**	**Yes (1), No (0)**	**Yes (1), No (0)**	**Yes (1), No (0)**		
Thermo	26 (4)	Yes (0)	6 (3)	No (0)	Yes (1)	No (0)	"Once you decide to go for it, you need a more scientific approach, be more certain […] Suppose you find out you addressed the wrong market, or your specifications weren't correct." (INT-OMt)	MEDIUM (8)
ZKL	20 (2)	Yes (0)	5 (2)	No (0)	Yes (1)	No (0)	"You need to have requirements to start. Otherwise you don't know what to develop […] In the beginning this was less clear for us." (INT-POz)	MEDIUM (5)
MZI	10 (1)	Yes (0)	0 (0)	No (0)	No (0)	Yes (1)	"In the end our conclusions were wrong on [assumption on price]. We clearly failed to understand how that would affect the attractiveness of [MZI]" (INT-RD3m)	LOW (2)
SEMO	22 (3)	No (1)	7 (5)	No (0)	Yes (1)	Yes (1)	"To be honest, until now, I haven't come across any new needs with regard to SEMO. Maybe others may have been surprised of certain customer reactions, but they were not as deeply involved as I was." (INT-RD1s)	HIGH (11)
FiberTop	43 (5)	No (1)	7 (5)	Yes (1)	Yes (1)	Yes (1)	"We are scientists, we know how to develop hypotheses and test them. But really, you need to talk to the field, because otherwise you can be so wrong. You need to talk to many people to develop an inclusive and statistical right view on the market." (INT-POf)	HIGH (14)
Overall	24	No	5	No	Yes	Not always		

Source: Author

Table 9.7 summarises the findings, with the first row listing the DCI quality criteria, the second row showing the indicators, and the third row explaining the accompanying scoring procedure. The second-last column includes an exemplar quote demonstrating the subjective evaluation of the cases. The full evidence for each case project is included in Appendix W, GG, OO, ZZ and Section 7.3.4 for the SEMO case. The last row shows how, overall, the cases developed 24 insights consisting of five highly novel, mostly cost-efficient insights. The majority of case projects admitted that they missed insights and had difficulty in creating internal commitment to their insights, as well as timely insights. Sections 9.2.2.1–9.2.2.3 will give more detail on the findings within each category of DCI quality; the discussion will include a comparison with the findings of RQ1, thus showing the relationship between the efforts put into the practices (RQ1) and the outcome (RQ2). This covariance between the two constructs provides initial evidence of the construct validity of the DCI measure (c.f. Mackenzie, Podsakoff and Podsakoff, 2011).

9.2.2.1 High Level of DCI

SEMO and FiberTop were classified as cases with a high level of DCI. This was, above all, the result of their comprehensive insights, consisting of a high number of needs, consistently evaluated to be complete (i.e. not missing important needs). Furthermore, the relatively high number of attractive needs contributed to the high level of insight generated by the SEMO and FiberTop case projects. These results are consistent with the findings of both cases regarding RQ1, showing that their efforts generated understanding of a broad range of topics (problems, needs, markets, and solutions). Moreover, the findings provide support for the theoretical assumption that understanding of a broad range of topics, consisting of both new and existing understanding, is beneficial for novelty (c.f. De Luca and Atuahene-Gima, 2007). The SEMO project has already demonstrated that current needs insights sustained latent needs insights; this was also observed within the FiberTop project. The FiberTop team discovered that, behind known features, some important latent needs could be found. In this way, latent needs insights followed from current needs insights, as becomes clear from the conversation between the Owner, External Advisor and PO: "[…] the feature is known. The performance is order of magnitude." (WS-OMf). "No you can go beyond that, once you are […] because nobody thought of something that can do something a thousand times better." (WS-Mktf). "Right, then you still discover new needs based on that." (WS-POf).

DCI within the SEMO and FiberTop projects further excelled in timeliness. This was clearly the result of the teams explicating their insights in an early phase of the project, thus making them available for different types of use and further refinement. RQ1 proved that both cases used their insights conceptually — albeit in a somewhat restricted manner due to the early conception of the idea — as well instrumentally. Moreover, both cases were found to put efforts in using DCI symbolically, to create commitment. RQ2 demonstrates that FiberTop was more effective in exploiting the symbolic value of DCI than SEMO. SEMO largely underestimated many political internal forces. The resulting substantial delay of innovation success underlines once more the importance of organisational buy-in: "It took a long time before [SEMO] was sold to the right market in Europe." (INT-RD2s).

9.2.2.2 Medium Level of DCI

The case companies displaying a medium level of insight, Thermo and ZKL, collected fewer novel insights than the high performers. This result is consistent with the results of RQ1, proving that the teams of both case projects put limited efforts into research and maintained a narrow focus on a single type of information (market-based information for Thermo, and solution-based information for ZKL). Moreover, the lack of a documented list of requirements

during the project suggests that both cases did not explicate insights until after their innovations were launched. Therefore, both projects failed to meet the timely criterion. The absence of timely insights may explain why both ZKL and Thermo refrained from conceptual and instrumental use in RQ1. Further, it may explain why the teams of both case projects missed important needs — regarding cultures, emotions, and design — thus illustrating the far-reaching consequences brought about by a neglect of the timely criterion.

RQ1 did establish both case projects' strong reliance on symbolic use of DCI, seeking commitment and buy in. However, in both cases, this ambition was not achieved. The insights (as phrased in the brochure) were found to be ambiguous and led to frequent discussion between the marketers and the Owners. The absence of internal consensus regarding the insights may explain the difficulties experienced by both case projects with achieving external acceptance, convincing customers, and presenting them with "the right argument." (INT-OMt).

9.2.2.3 Low Level of DCI

The lowest DCI performer is MZI. Although this case study company did list its requirements shortly before development, the list was far from complete. The actors testified that important emotional and economic needs were not included at the time of development. This incompleteness also shows in the lack of attractive needs, and is directly linked to the poor level of synthesis observed in RQ1. A comparison of the content in the "Project plan innovation in the fishing industry", "MZI analysis report" and "Market research report" confirm that the large amounts of data collected by the customers in the project's early phase were only analysed and synthesised in a discretionary manner. The heavy focus placed by MZI on gaining access to input sources, instead of on research skills and techniques, further explains why the project team did not succeed in turning the large amount of data into insights, and why this case's insights were anything but cost-efficient.

9.2.3 Discussion of and Conclusions to Research Question 2

This section responds to RQ2: *What is the level of insight resulting from DCI practices?* Two main conclusions can be drawn from the analysis.

First, the case study companies considered nine different attributes of DCI; of these, five proved to be widely recognised and unique to DCI. Together, they demonstrate that a greater number of aspects require consideration in order to generate DCI than previously thought (Bonner, 2010; Hultink et al., 2011; Mahr, Lievens and Blazevic, 2014).

The five DCI attributes describe the content of DCI, the circumstances of DCI, and the presentation of DCI. Content aspects include comprehensive and novel insights, such as current needs insights, which was found to sustain and inspire novel insights. It also includes 'accuracy', considered vital in the identification of "real" problems and needs. These content aspects relied, to a large extent, on the cognitive, research-driven skills and activities found in RQ1. On the other hand, the circumstances include the acceptance and cost efficiency of insights and are the result of organisational and communicative skills.

Second, measurement of the level of insight showed that, on average, the cases generated 24 insights, including five highly novel insights that did not require excessive cost. Overall, the cases experienced difficulty generating complete and acceptable insights, and in making these available in a timely fashion. The measurement instrument further allowed this study to categorise cases in terms of high, medium, and low levels of insight, which is consistent with the levels of practice maturity established in RQ1. The availability of a measurement instrument for DCI quality opens up the possibility of future research seeking greater understanding of the level of insight across a wider group of SMEs. Furthermore, this

measurement tool will facilitate conclusions regarding the standards for different levels of DCI within SMEs. Such widespread understanding is vital in order to produce high quality market information, which has been proven to contribute to innovation success (Hultink et al., 2011; Reid and de Brentani, 2010).

9.3 SMES' PERCEPTIONS OF DEEP CUSTOMER INSIGHT PRACTICES

The cross-case analysis has considered the similarities and differences of the case projects in terms of their DCI practices and their outcomes, the level of insight. Section 9.3 will discuss the similarities and differences in the context of RQ3: *What are the perceptions of small-firm actors of DCI practices?* By examining actors' perceptions, more detailed information become available concerning the importance of practices and how actors' would improve their DCI capabilities. The analysis is based on both quantitative and qualitative data captured in the workshops of the second phase of this study. The findings of this study explain the central role of customer research for DCI generation and disclose SMEs' common interest in developing their research skills, as well as improving involvement of internal and external actors. A closer analysis of the case differences reveals two distinct paths towards stronger DCI capabilities.

The findings are presented in four main sections:

1. The first section discusses perceived importance and implementation of the practices
2. The second section considers the details of potential improvements of the practices
3. The third section analyses the case differences
4. The fourth section draws conclusions regarding RQ3

9.3.1 Perceptions of Importance and Implementation

The analysis of perceptions begins with the scores of importance and implementation given by the participants involved in the workshops of each case project.[10] A total of 21 participants across the five case projects completed this rating activity. The qualitative information identified in the interviews, documentation, and workshop of each case study project was used to explain the patterns and themes revealed by the quantitative analysis of importance and implementation. Table 9.8 summarises the mean scores and standard deviations for individual practices within each group of practices and includes an exemplar quote providing details for the bold printed findings.

[10] Perceptions were measured in workshops held with five case projects. Since SmartLight could not participate in this workshop, their results are missing. Actors scored both the importance and the implementation of the practices on five-point Likert scales. For importance, the scale ranged from 'not at all important' (1) to 'very important' (5). The scale for the level of implementation was adapted from Reijonen and Komppula (2010), and ranged from 'managed very poorly' (1) to 'managed very well' (5).

Table 9.8: Cross-Case Perceptions of Importance and Implementation

Group	Practices	Importance			Implementation			Exemplar Quotes (referring to bold printed results)
		% > 4	Mean	Std	% > 4	Mean	Std	
MOBILISING	**G. Mobilising customer sources**	86	4.14	1.014	**61**	**3.61**	**1.092**	"The cultural differences are enormous, and we need to find a way to better capture these differences." (INT-POz)
	K. Mobilising internal sources	52	3.48	0.981	50	3.5	1.033	
RESEARCH	**A. Exploring customer problem situations**	100	4.76	0.436	**89**	**4.21**	**0.631**	"Our secret is understanding the questions behind the questions. This is our talent. You don't get this from a conversation with a single user […] you need to be present in the domain. By asking the question many times, at some point, like artificial intelligence, you start seeing the connections." (INT-OMz)
	D. Exploring the market opportunity	67	4	1.049	44	3.5	0.786	
	H. Elaborating customer needs understanding	86	4.24	0.700	**67**	**3.67**	**0.686**	"I would like to spend more time in this phase, the pressure to proceed is often too high." (INT-POz)
	I. Collecting customer feedback	**100**	**4.67**	**0.483**	78	4.06	0.873	"I believe it is key to have a process of trying of testing." (WS-OMf)
SYNTHESISING	**E. Defining the value proposition**	**90**	**4.05**	**0.669**	81	3.88	0.885	"This is the most defining aspect of the company […] you got all that input from outside and this is the point where you put your structure in […] your first shot in the dark, your heart on the table in front of a first customer […]" (WS-POf) "[…] the point where we say, this is what we have, do you want to buy it." (INT-POf)
	J. Defining customer requirements	**67**	**3.95**	**0.921**	80	3.8	0.862	"When you document things, you are doing the wrong things. We don't have time for that." (INT-POf)
	M. Planning sales and marketing for launch	67	3.67	0.966	22	2.83	1.150	
UTILISATION	**B. Generating ideas**	81	4.38	0.805	**83**	**4.28**	**0.752**	"[…] you simply open the closet and more than 10 ideas fall out of it." (WS-RDs)
	C. Securing innovation funds	76	4.14	0.793	70	3.88	0.993	
	L. Developing the product concept	100	4.33	0.483	**82**	**4.29**	**0.920**	"We are so fast that we are confident to share information with customers. I am convinced that we will be the first in the market […]" (INT-SLSf)
MANAGEMENT	F. Designing and managing CI action	57	3.38	0.973	**29**	**2.71**	**1.047**	"This was the first project in which we gave a central role to DCI. I therefore created the template, but in my opinion, this was not enough." (INT-MANs)
	Total		4.09	0.790		3.71	0.901	

Source: Author

Table 9.8 also includes the proportion of participants giving a score of 4 for importance and implementation; these proportions are part of the Ulwick (2005) procedure, used to draw conclusions regarding the opportunities of improvement in Section 9.3.2. A comparison of the means, standard deviations, and proportions demonstrates how the use of proportions emphasises scores on which there is significant agreement. Furthermore, Table 9.8 demonstrates a consensus among the case companies regarding the high importance placed on research and synthesis, thus demonstrating the reliance of DCI on an information-driven approach. Considering the importance of Practices A, H, and I, the cases exhibit a special interest in generating *customer* information

Consistent with debates in the literature, the role of market research (Practice D) is contested, with some project teams clearly seeing value in it (SEMO) and others considering it to be a peripheral practice (Thermo, MZI) or irrelevant (ZKL). The perceptions of research practices reinforce the conclusions of RQ1 regarding the combined use of *explorative* research (Practices A and H) with confirmatory research — labelled in RQ1 *exploitative* research (Practice I). The observed perceptions demonstrate a preference for starting feedback gathering as early as possible, mainly because the teams see no other way to capture latent needs. This is explained by the Owner of FiberTop in the following way: "A discussion with customers about latent needs is always difficult, people always describe their problems in relation to the product they know […] we were clever and let them work with a premature version of the product." (WS-OMf).

Furthermore, the implementation scores illustrate the fact that case projects felt sufficiently comfortable with their level of mastery of research into customer problems (Practice A). The case companies largely referred to their level of interview skills and emphasised how DCI required them to "dig deeper". Both the Owners of Thermo and ZKL referred to their capability to generate "domain knowledge":

> Our secret is understanding the questions behind the questions. This is our talent. You don't get this from a conversation with a single user […] you need to be present in the domain. By asking the question many times, at some point, like artificial intelligence, you start seeing the connections. (INT-OMz)

Consistent with the findings of RQ1, the perceptions do not provide evidence of the use of sophisticated market research techniques, such as repertory grid or laddering, which would require specific forms of additional analysis (Baxter, Goffin and Szwejczewski, 2014; Van Kleef, Van Trijp and Luning, 2005). The low scores for importance and implementation of Practice F, similarly, suggest that actors exclusively used easy to manage research techniques.

Research Practices H (needs) and I (solutions), both rated as important, were seen as less well implemented than Practice A. This is consistent with findings of RQ1 regarding the absence of Practice H (except in MZI and SEMO), and the overall less systematic and thoughtful approach of Practice I. Other than with regard to research, the case projects are critical with reference to their implementation of Practice G. Perceived improvements for these practices are discussed Section 9.3.2.1.

The majority of case projects made clear that they wanted to start testing early in the process. This is seen in the high importance scores given to developing the product concept (Practice L) and is confirmed by recent investments in 3D printing technology made by SafetyCo and RailCo. The Sales Manager of FiberTop explained how the capability to rapidly develop early product versions does not only allow the project to gather feedback at an early stage, but also creates confidence in sharing information with the outside world.

The Research Director of SEMO justified why the generation of ideas is perceived less important than product development: "You simply open the closet and more than 10 ideas fall out of it." (WS-RDs).

It is vital to note that the value proposition of Practice E is regarded as more important than the requirement statements of Practice J. Generally, the value proposition is seen as pivotal for gaining access to necessary funds and cultivating a willingness to pay from customers. To avoid spending too much time on documentation, the cases employed lower standards regarding the listing of requirements. The same is also evident in the lower popularity of the timeliness, format, and inspiring DCI quality criteria, and the chaotic and missing requirements observed in RQ2.

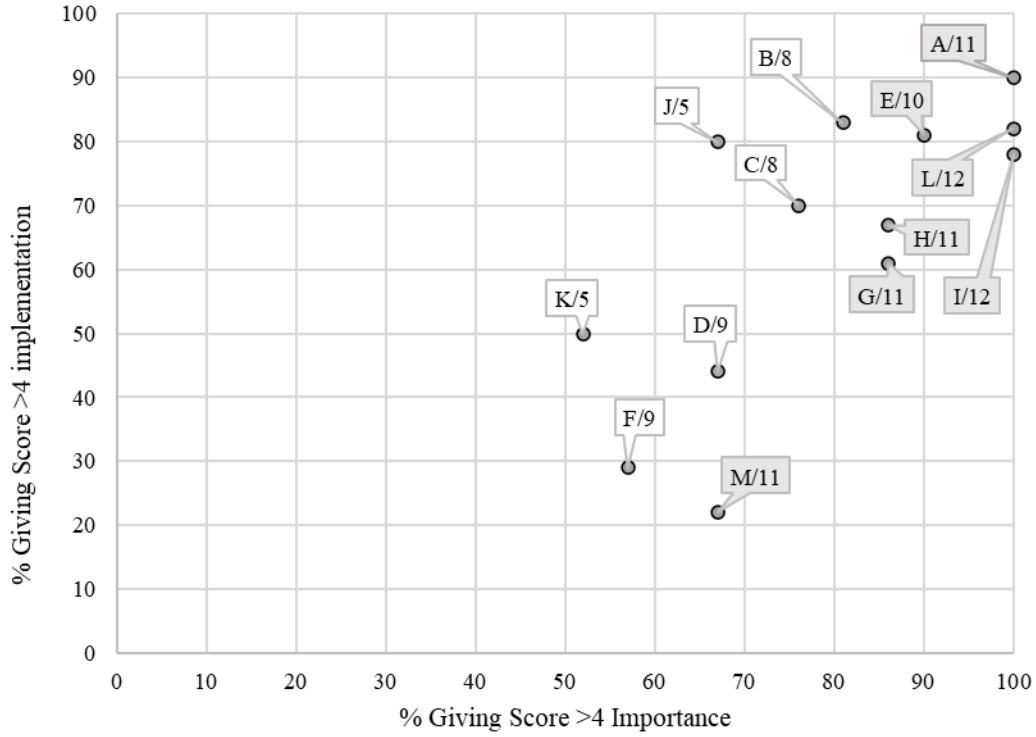
9.3.2 Perceptions of Improvements

Practices offering the highest opportunity for improvement were identified by the equation used in the Ulwick (2005) procedure.[11] High opportunities have opportunity scores >15, moderate opportunities have scores >12, and low opportunities have scores score >10 (Ulwick, 2005). All practices with a score of ten or more, therefore, discussed in the workshop. Appendix P, X, HH, PP and AAA summarises the findings of the individual case projects.

Figure 9.3. visualises the practices offering opportunities to improve across the five cases. It uses the proportions listed in Table 9.8, with the x-axis displaying the proportion of respondents giving a score of ≥4 for importance and the y-axis displaying the equivalent score for implementation. The labels of the practices list their opportunity score. Grey shaded boxes are practices with scores of ≥10, which include: the mobilisation Practice G; research Practices A, H, and I; synthesis Practices E and M; and utilisation Practice L. Sections 9.3.2.1–9.3.2.3 will now discuss the major improvement themes — termed *improvement tactics* — their implications for DCI, and barriers to implementation.

[11] The equation used to identify opportunities for improvement is: % of respondents giving a score of 4 or more for importance + (% of respondents giving a score of 4 or more for importance − % of respondents giving a score of 4 or more for implementation)/10.

Figure 9.3: Practices Offering an Opportunity to Improve



Legend:
Grey Labels: Priority for Improvement
White Labels: No Priority for Improvement

Source: Author

9.3.2.1 Improvement Tactics

Accounts of potential, or recently applied, changes of action were used as an entry point for this study to understand such improvements. Across the five case projects, 48 improvements were identified. An example of such an improvement can be seen in the following quote from the external marketer of Thermo: "If I had to improve my understanding of issues in these markets, I would have needed to be much more active in the field." (WS-Mkt1t). The improvements were categorised into 16 improvement tactics: 'analytical tools'; 'collaborative approach'; 'creative skills'; 'culture'; 'data collection techniques'; 'format synthesis'; 'management of learning'; 'managing customer expectations'; 'market definition'; 'marketing implementation'; 'order of doing things';' roles'; 'sampling'; 'time available'; 'what to test'; 'flexible processes'. The complete list of improvements is included in Appendix M.

Table 9.9 gives an overview of the most important improvements for the practices identified in the Ulwick (2005) procedure. For each practice, the number of improvements is listed, together with the improvement tactics most often employed. The second-last column lists the case projects mentioning the improvements. The last row lists the total number of improvements and shows that 38 out of the total of 48 improvements concern practices identified as offering the best opportunity to improve.

Table 9.9: Cross-Case Improvement Tactics

Group	Practice	# of Improvements	Dominant Tactic (# of Mentions, # of Improvements)	Case Projects Mentioning Improvements	Exemplar Quotes
MOBILISING	G	4	Sampling (13,2)	SEMO	"We had interviews with people in the US via Skype […] one way or another that was less impressive, I couldn't see how things were done […] yes you could call it as something that should be improved." (INT-RD1s)
RESEARCH	A	17	Data collection techniques (23,6)	Thermo; ZKL; MZI; SEMO; FiberTop	"I would like to have more easily accessible information. For example, via Youtube. People share a lot of information via this channel, and it is, therefore, an easy way to see worldwide innovations." (INT-RD2m)
	H	4	Data collection techniques (15,3)	SEMO; Fibertop	"So, what you present is a rather clumsy thing, that is not obvious what it is, hopefully. You want to trigger their imagination and you hope that they... Quite often they see things that are not there […]" (WS-Mktf)
	I	4	Sampling (8,2)	ZKL; MZI; SEMO	"As far as I am concerned, we start validating as soon as possible." (INT-MANs)
SYNTHESISING	E	3	Format synthesis (14,2)	ZKL; SEMO; FiberTop	"We do this [defining requirements] use-cased based, simply because that is more easy to comprehend." (INT-OMz)
	M	3	Roles (16,3)	Thermo; ZKL; MZI; SEMO	"This is our weak spot, strong marketing skills enabling to make solid marketing choices and push the right buttons with the right customer. Just hit them with the right argument." (INT-OMt)
UTILISATION	L	3	Roles (2,1)	ZKL; MZI; SEMO	"We should have had this marketing person involved, we trusted that [mussel farmer] would do this, but in the end, we focused on technical issues." (INT-RDm)
Total		38			

Source: Author

Table 9.9 shows that, despite the relatively high level of implementation of Practice A, the case companies still see room for improvement in this practice. Similarly, for Practice H, they feel they can improve their data collection skills. The cases are, however, not specific in *how* exactly they wish to improve these skills, only mentioning generic improvements like taking more time to visit and observe customers (SEMO and MZI), and probing deeper to go beyond technical needs (Thermo, MZI). These findings suggest that the case companies either lack awareness of advanced research techniques or simply do not think such techniques are suitable. The absence of improvements in analytical tools (due to the low number of mentions) confirms that advanced techniques are not considered. Exceptions to this apparent lack of understanding regarding research techniques are the SEMO and FiberTop projects, which both note a high practice maturity in RQ1. SEMO displayed awareness of how bias influences the findings, whereas the team at FiberTop discussed the pros and cons of product concepts to elicit needs insights during the workshop.

Improvements in sampling are mentioned on behalf of Practices G and I, with virtually all cases expressing the need to increase the quantity of customers involved. Similarly, they express a desire to improve the quality of the sample, to include customers that are motivated to participate and have the ability to explain their needs. Most cases talked about involving lead users and would like to consider cultural differences. Similar to the views expressed regarding the data collection techniques, *how* exactly they want to achieve improvements is not clear.

Opportunities for improving the internal organisation are identified in the format of synthesis and the roles. Improvements of the format of the documents tackle the issues found with structure and clarity (as was described in RQ2). Consistent with case projects' hesitance to spend too much time on documentation, InfoCo and FiberCo recently streamlined their format for the value proposition. ZKL has found a straightforward way of communicating their insights in user stories and epics.

Improvements in the roles include a consideration of the quantity of people involved. This is clear in the MZI case project, which would extend its teams with the inclusion of a marketing professional. Further, improvements in roles would also consider the quality of people involved in each project; this is clearly seen in the case of ZKL, which would seek to include people in possession of both technical and marketing skills.

9.3.2.2 The Implications of the Improvements

Analysis of the implications of the improvements offers a an additional perspective on the improvements showing in what way they would impact the case project's level of insight. The quality criteria for DCI (identified in RQ2) were used to describe the implications.

Table 9.10 summarises the implications at the improvement tactics level, including all improvement tactics for practices offering the highest improvement opportunity and not simply the dominant tactics discussed in Section 9.3.2.1. The analysis shows that the improvements will most significantly impact the accuracy, comprehensiveness, and novelty of DCI. These qualities were defined in RQ2 as the *content* aspects of DCI. The large number of improvements impacting content reinforces the conclusion that this is an essential quality of the DCI concept. The content of DCI is impacted by data collection techniques and sampling. Moreover, a positive impact on the *circumstances* of DCI — in particular the acceptance — is expected from the improvements in roles and format. RQ2 revealed that the case projects' were much less clear on the value of *presentation* aspects of DCI (timely, inspiring, format, and scope). RQ3 demonstrates that the improvements will have a relatively high impact on timely insights, following from case projects' desire to improve the order of doing things, which is chiefly focussed on starting testing at an earlier stage.

Table 9.10: The Benefits of the Improvements

Improvements per Improvement Tactics	Implications for the Level of DCI									
	Timely	**Comprehensive**	**Novel**	**Consistent**	**Inspiring**	**Format**	**Accurate**	**Acceptable**	**Scope**	**Cost efficient**
Analytical tools	1	1								
Collaborative approach	3				2			3	1	
Creative skills			1							
Culture	1	1	1	1	1	1	1	1	1	1
Data collection techniques		1	6				3			
Flexible processes	1									1
Format synthesis					4	4		4		
Management of customer expectations		1					1	1		
Management of learning	3	3	2	2	2	2	2	2	2	2
Market definition							1	1	2	
Marketing implementation								1		
Order of doing things	2		2							1
Roles	5	5	5	5	5	5	5	5	5	5
Sampling	1	2					3			1
More time available		3					2			1
Test material	1		1		1		2			
Total impact (number of improvements)	**18**	**17**	**18**	8	15	12	**20**	**18**	11	12

Source: Author

9.3.2.3 The Barriers to Implementation

Barriers offer a greater understanding of the factors hindering the implementation of improvements. Barriers were identified separately for each improvement by paying attention to phrases such as “it is very difficult”, “the problem is that”, or “we needed to […] but […]” in connection to specific improvements. The relatively high number of 64 barriers suggests that substantial change is needed before the proposed improvements would exert any impact. The full list of barriers is included with Appendix XX.

Table 9.11 focuses on the barriers for the most important improvement tactics identified in Section 9.3.2.1: ‘data collection techniques’; ‘sampling’; ‘format’; and ‘roles’. Together, these barriers cover 30 of the 64 total barriers.

Table 9.11: The Barriers Hindering DCI Generation

Barriers for Improvement Tactics	# of Mentions, # of Barriers	Affected Practices	Cases with this Barrier	Exemplar Quote
Data collection techniques	**23, 8**	A, D, H, I, M	ZKL; Thermo; MZI; SEMO; FiberTop	
Pros and cons of early testing	12, 3			"Customers only respond to a product. They don't respond to ideas, you have to put something on the table, you make them use it and then they can say something about it." (WS-OMf); "But what you present is more conceptual. It encompasses a solution, it is a problem, maybe more problems. But it is quite conceptual but not too abstract otherwise. So, there is a balance between concrete and abstract and conceptual. The purpose is to provoke, that is true." (WS-POf)
What is market research (terminology)	7,4			"I would make a survey and ask my colleagues to fill it in […] ask their needs, what they would pay for a solution for [specific problem], how much time they would expect to save with it." (INT-Cust1m)
No measures to correct for biases	4,1			"[…] they easily say everybody wants that feature, but you have to validate that, of course." (INT-SLSs)
Sampling	**31, 10**	G, H, I	Thermo; MZI; SEMO	
Lack of method for customer selection (quality)	14,3			"[…] isn't it perfect, talking to the [big national business customer]? Imagine! Well and then it turns out that nothing useful comes out of these conversations […] they appear to use their existing means creatively and are happy with that. They weren't able at all to think beyond that." (INT-OMt)
Geographical location	8, 2			"It is very difficult to get useful feedback, for example, out of China. This culture is so different. Sometimes when response gets back, you find out that they didn't understand everything." (INT-Mkt2s)
Lack of attention for sample size	7, 4			"You try to develop for a wider target group. But you cannot do this with 100% certainty, then you put in too much time. So, the question is, when is good, good enough?" (INT-RD1s)
Motivation of customers	2, 1			"You need to have customers that are willing to cooperate. It is not that such customers are not available, but they do not come in great numbers. Especially not if they need to sit with you regularly." (INT-Mkt2s)
Format	**11, 5**	E	ZKL SEMO; FiberTop	
Disagreement on what to document	4, 1			"We still do this mostly based on feeling." (INT-OMz); "We could use some more time to elaborate on the motivation." (INT-POz)
What should be documented	7, 4			"It is something that evolves, you should not regard this as some definite thing." (WS-POf); "We can't document everything and, therefore, sometimes things get lost." (INT-Mkt2s)
Roles	**25, 7**	A, I, M	Thermo; ZKL; MZI; SEMO	
Owners' lack of trust in others	13, 3			"You have to have had some experience in life, seen what goes around. I have 20 years' experience […] this is why I see things. It gives you the glasses […] with all due respect but not everybody has that […]" (WS-OMt); "Marketing only comes in when we are making everything ready for production." (INT-POz)
Too wide or too narrow roles for the customer: mindset and reputation	9,3			"This is what we do, our customer he is king, isn't he? [external engineer agrees]" (WS-OMm)
Sales responds to short term needs	3, 1			"Salespeople are opportunistic, they want to sell. So, they easily say everybody wants that feature […]" (INT-SLSs)

Source: Author

Barriers Hindering Improved Data Collection

The absence of concrete improvements for data collection techniques suggests a lack of awareness of specific research techniques for DCI generation. The analysis of barriers confirms this and demonstrates that the case companies do not possess a clear understanding of relevant methods and terminology. What stands out is the low awareness of the potential negative impact of early testing; these impacts are well described in the Innovation Management and Design literature (Goffin, Lemke and Koners, 2010; Liedtka, 2011; Le Masson, Hatchuel and Weil, 2009). Nevertheless, the cases tend to highlight, above all, the positive effect of early testing, which is clear from thoughts of the experienced UCD Manager at SEMO: "We should start with validation as early as possible, to get this feeling with the market as early as possible. For example, when we have an idea and we develop some hypothesis and go to a conference to test it, with say 20 people." (INT-MANs). Similar perceptions were observed within FiberTop, which also displayed a high DCI maturity, and in which the Owner strongly believed that a product should be shown to the customer in order to identify latent needs. FiberTop was, however, the only case in which alternative perspectives on early testing were expressed. During the workshop, the external advisor and the PO proposed using highly abstract product concepts to prevent customers from expressing only current needs. This led to a lively discussion and confirmed the fact that the FiberTop team possessed some awareness of advanced methods.

Furthermore, the case projects experienced difficulty in understanding what market research actually entails. This was already observed in the SEMO exemplar case; the cross-case analysis further reveals that similar confusion existed within Thermo and MZI. Team members in these cases sometimes used the term 'market research' to indicate desk research: "We requested lists from the chamber of commerce and identified the most interesting market segments […] just how market research should look like." (INT-OMt). Other times they used the term to summarise different type of research: "I love doing market research, you go from inside to the outside, you Google, you think about what makes you unique and talk to some people […]" (INT-OMt).

The counterproductive improvements suggested by some cases demonstrate the threat posed by a lack of awareness of data collection techniques. For example, in the MZI case project, market research is equated with doing a survey among customers and the MZI team believes that such market research would improve their practices in the future: "If we ever do this again, then I would first do market research." (INT-Cust1m). In a similar vein, SEMO would start off a next project with validating assumptions with prospects, thus, like MZI restricting the in-flow of new information.

Barriers Hindering Improved Sampling

Important barriers with regard to sampling are found in the quality, geographic location, and the quantity of the sample. Barriers related to the quality of the sample emerge from the difficulty in finding customers of the right type (i.e. representing different cultures and having the right motivation and abilities). As was discussed in Section 9.3.2.1, each of the case study companies expressed the need to improve the quality of their sample but were unable to explain exactly how they would do this. Such uncertainty points to a lack of methodology regarding customer selection. Although most companies defined some selection criteria, in reality, practical concerns actually determined their choice of customers. The attractiveness of the customer appeared to frequently override criteria like lead user status. This was clearly witnessed at Thermo, whose Owner chose to involve a highly commercially attractive client, who turned out to be conservative in using Thermo-type products, and was anything but a lead user: "Isn't it perfect, talking to the [big national business customer]? Imagine! Well and then

it turns out that nothing useful comes out of these conversations […] they appear to use their existing means creatively and are happy with that. They weren't able at all to think beyond that." (INT-OMt). Furthermore, cultural differences and geographic distance were perceived to be clear hindering factors. SEMO and FiberTop mitigated the negative impact of these factors by making use of online tools for interviewing customers in other countries, but also point out the drawbacks of not having personal contact: "Somehow, the customers that I visited, left me with a better impression, so yes you may call this [observations of the customer] critical." (INT-RD1s).

Barriers with regard to sampling also concern sample size, which was frequently sacrificed in favour of other criteria. In the case of the MZI project, the fear that competitors would pick up the new idea prevailed over consulting a wider group of customers. Such perceived threat of competitive rivalry was clearly missing within the FiberTop case, whose team was confident in being the first in the market and was, therefore, not afraid to involve a wider group of customers. Moreover, the urge to quickly move on to the next phase of development was found to dominate sample size decisions and was observed within the MZI, FiberTop, and SEMO projects: "You try to develop for a wider target group. But you cannot do this with 100% certainty, then you put in too much time. So, the question is, when is good, good enough?" (INT-RD1s). Taking into account time constraints, the FiberTop case chose to vary their limited sample across segments and customers: "[…] we seek feedback from a variation of customers across segments, but then, we need to proceed fast. We need to draw a line." (INT-SLSf). Further, FiberTop used literature to confirm some of the findings, thus giving way to some accepted logic, enabling them to compensate for sampling issues.

Barriers Hindering Improved Formats

Barriers hindering the improvement of formats emerge from opposing views on the value of documentation. This is clearly seen in the ZKL project, in which the Owner expressed strong beliefs that documenting the value proposition undermines trust: "I refuse to make business plans or whatever, we just need to trust the roadmap [strategy document]." (INT-OMz). The PO, however, did feel a need to explicate the value proposition, thus revealing a potential source of conflict. The evolving nature of insights further complicates documentation and enhances the belief that with documentation efforts are put "in the wrong things" (INT-POf).

Barriers Hindering Improved Roles

A significant number of mentions concern barriers with regard to the roles, including roles of the customer, Sales, and the Owner. Whereas the other barriers were more technical by nature, barriers with regard to roles involve social issues. Issues with the customers' role concern the mode of involvement: 'learning from'; 'learning with'; and 'learning without'. Too strong a reliance upon 'learning-with' was observed in the case of MZI, which also assigned the customer to many of the DCI roles. This approach was born of the high appreciation for the customers' 'voice': "[…] but of course, we were customer-focused, the client was at our table, working with us, what else would you need in terms of customer involvement? I can't imagine anything better than that." (WS-RD3m). MachineCo's routine business required *customisation* — tailoring specific solutions to needs of specific customers and careful attention paid to the expressed needs of the customer — and explains how this led to a strong current-need mindset: "This is what we do, our customer he is king, isn't he? [external engineer agrees]" (WS-OMm).

In contrast to MZI, SEMO was found to strongly rely on 'learning from' the customers and, therefore, adopted a more distant stance. The SEMO team feared that allowing customers to collaborate on an unfinished product would harm InfoCo's market reputation. FiberTop

demonstrates how dedicated efforts in managing customers' expectations and preserving relationships may help in overcoming this barrier:

> Again, it's a conversation, right? I mean from the beginning […] nobody knows what you are doing […] But in the exploration phase, before even setting up a sale, I was able to put that stuff in some of the laboratories [of customers] […] Well, there is a lot of personal skills that you have to put in. So, what I'm saying is that scientists are very interested in our segment, scientists are very busy and very sceptical in general, but you can trigger their attention easily if you find the right spot. (WS-RDf)

Issues with the role of Sales were noted within SEMO and are related to Sales' tendency to respond to current needs: "Salespeople are opportunistic, they want to sell. So, they easily say everybody wants that feature […]" (INT-SLSs). These issues were clearly absent within FiberTop; the Sales Manager of this case advocated a highly systematic and reflective approach, and maintained a proclivity to explore needs across a wider group of customers before reaching conclusions. Although the FiberTop team was clearly sensitive to commercial opportunities, their research attitude prevented them from responding too quickly to expressed current needs: "We are scientists, we know how to develop hypotheses and test them. But really, you need to talk to the field, because otherwise you can be so wrong. You need to talk to many people to develop an inclusive and statistical right view on the market." (INT-POf).

Issues with the role of the Owners were identified in the ZKL and Thermo case projects and relate to their respective Owners' lack of trust in others. RQ1 revealed that, in both ZKL and Thermo, the Owners fulfilled the majority of roles and did not involve personnel with marketing and R&D competences. The perceptions demonstrate that the Owners of ZKL and Thermo held high self-regard for their own experience, which had taught them to play concomitant roles, gain a "broad domain knowledge", and to place great trust in their own decisions. The R&D Director/Owner of Thermo held a previous position as Innovation Manager in a renowned large firm which had made him sensitive of customers' problems, while simultaneously thinking in terms of technical solutions. The ZKL Manager held a previous position in the railway industry and had numerous conversations with "stakeholders". This allowed him to see patterns that other, less experienced people, could not see. He had a propensity to base decisions on his instincts and not to get distracted by opposing views and perspectives: "People who do not see what you are telling, I've learned that, I am not going to put energy in them […] I seek my allies, those who go with you […]." (INT-OMz). It is clear that, within both cases, such broad experience was not recognised within the available R&D and marketing personnel. Furthermore, it is evident that the Owners held strong opinions regarding both disciplines. In both cases, it was stressed that R&D is generally too concerned with technical issues and marketing's only value is the development of marketing materials.

The perceptions of FiberTop, relying strongly on its team, instead of its Owner, provided a contrasting stance. Lack of experience was clearly not an issue given that the entire team was comprised of young professionals. FiberTop did, however, appreciate multiple competences, with all personnel, including R&D, having both technical and customer-related competences and research skills. Moreover, the strong presence of sales engineers within the FiberTop, SEMO, and SmartLight projects suggests that Sales may offer competences and experiences that better match the values and beliefs of Owners than those of marketers and R&D personnel.

9.3.3 Differences in Perception

An analysis of the differences in perceptions between the cases offers additional understanding of the findings regarding practice maturity (RQ1) and levels of insight (RQ2). Table 9.12 summarises the findings of RQ1 and RQ2 in the first two columns. This is followed by the perceptions of important practices; the focus of the improvements; the implications of the improvements; and the main barriers. The findings disclose how the path towards higher levels of practice maturity begins with the development of research skills and customer involvement competences, before later improving synthesis and internal involvement competences.

Table 9.12 shows that SEMO and FiberTop both appreciated their externally oriented research practices which, in RQ1, were found to underscore their high practice maturity. Consistent with this, both companies concentrated improvements on internally oriented practices. For SEMO this included management of learning, which was done only in the middle phase of the project, and not, like FiberTop, throughout the project. Additionally, SEMO intended to improve its collaborative approach. Compared to the concerted team effort of FiberTop, SEMO's internal actors were less intensively involved, requiring the PO to invest a significant amount of efforts into coordination. Together with an increase of the modes, amounts, and quality of customers, these improvements are expected to impact all aspects of DCI: content, circumstances, and presentation. For the FiberTop case, the relative weakness in the practices was the synthesis, which, compared to SEMO's approach, was undertaken in a less structured way. The improvement foreseen by the FiberTop team is consistent with this gap and will impact the circumstances as well as the presentation of DCI. Remaining barriers within these two cases include a more advanced understanding of data collection and sampling.

The MZI project noted a medium level of practice maturity and clearly had research skills available. The team recognised that its main weakness was reliance on the customer, making the project irrelevant to others. Consistent with this, the MZI team especially sought improvements to increasing the number of customers involved in the process. MZI also made a start on improving its internal involvement, looking for an additional team member in possession of the right skills. The Owner recognised that he would need to hire new people: "I am not good in all this analysis stuff, somebody else would do a far better job […]" (INT-OM2m). MZI's improvements would increase the comprehensiveness of the insights, which seems sensible considering MZI's exceptionally low level of insight. The remaining barriers for this case include the high appreciation of the customers' voice.

Both Thermo and ZKL, noting medium and low levels of practice maturity respectively, admit that they would need more people that are capable of performing research practices. Thermo is especially keen to put more skill into the identification of latent needs, thus promoting the novelty of their insights. This is consistent with Thermo's value of creativity: "You have to have visionary ideas, the market itself doesn't tell you, so […] This is creativity and this is the core of our firm. If we wouldn't have that I would close the door. [R&D manager] is very good at this. Our [other] R&D people try to do the best they can." (WS-OMt). Conversely, ZKL is focused on the comprehensiveness of insights, and would seek to improve data collection by involving more people, thus increasing the in-flow of information. According to the Owner, this would require a customer-driven culture: "Finally now, as people are working for some time now with me, they are starting to understand what it is that this market needs. This is all about culture. Our pitfall is that it is currently just me who has this strength." (INT-OMz). Remaining barriers within both cases include the need to overcome issues identified surrounding the lack of trust that Owners have in other peoples' competences.

Table 9.12: Differences in Perception

Case	Practice Maturity (RQ1)	Level of Insight (RQ2)	Perceptions of Importance	Improvements	Focus of Improvements	Implications	Main Barriers
FiberTop	HIGH multi-person and Owner-independent	HIGH	Values research skills and the collaborative approach	More structure in synthesis; Improved DCI management; Advanced techniques	Process improvements	Inspiring; Acceptable (circumstances and presentation of DCI)	Advanced understanding of methods: the role of the product
SEMO	HIGH multi-person and Owner-independent	HIGH	Values research skills and the way of documenting requirements	More collaboration; Improved DCI management; Increased customer involvement	Process improvements	Timely; Comprehensiveness; Accuracy; Acceptance (Content, circumstances, and presentation of DCI)	Advanced understanding of methods: how to improve sampling
MZI	MEDIUM small and Owner-dominated	LOW	Values timing of testing	Increased customer involvement; Enlarge team	People and money	Comprehensiveness (content of DCI)	Current needs mindset
Thermo	MEDIUM small and Owner-dominated	MEDIUM	Values creative skills	Improve data collection skills	Skills and techniques	Novelty (content of DCI)	Owners' lack of trust in others
ZKL	LOW small and Owner-dominated	MEDIUM	Values timing of testing and lean way of documenting the findings	More people should collect data; Install a customer-focused culture	Skills and techniques	Comprehensiveness (content of DCI)	Owners' lack of trust in others

Source: Author

9.3.4 Discussion of and Conclusions to Research Question 3

Section 9.3.4 responds to RQ3: *What are the perceptions of small-firm actors of DCI practices?* Four distinct sets of conclusions can be drawn from the findings.

First, Entrepreneurship Theory views the perceptions of entrepreneurs as an important determinant in the successful creation of new opportunities (Kor, Mahoney and Michael, 2007). The analysis of actors' perceptions, therefore, offers a valuable additional perspective to practices and their consequences. The findings of this study confirm the observations of RQ1 regarding the hybrid method of information processing, and show the high value placed on a combined explorative and exploitative approach. In general, the cases are convinced that they should start gathering feedback information early in the project and do not feel this limits exploration or creativity.

Second, the available literature makes clear that process awareness is a key condition for future improvement (c.f. Eisenhardt and Martin, 2000). Until the findings of this study, whether or not SMEs have such process awareness has not been made clear (Mosey, 2005; Moultrie, Clarkson and Probert, 2007b). The findings of RQ3 demonstrate that SMEs are aware of what was required in order to improve their practices, and their improvements are consistent with their level of maturity (RQ1) and level of insight (RQ2). However, the overall general way of describing the improvements, together with observed barriers, suggest that this level of understanding is not very elaborate.

Third, until this study, it has not been clear how DCI capabilities evolved across distinct SMEs (McAdam, Reid and Gibson, 2004). The perceptions identified in this thesis confirm the findings of RQ1 and show how differences between the case companies are irrespective of company age. Instead, the differences are closely related to the research and involvement competences of the firm. Like the practices, the case companies' improvements focus on either externally oriented or internally oriented improvements. The externally oriented improvements consist of research skills, as well as competences for *customer involvement*. The internally oriented improvements consist of synthesis skills, as well as the competences for *internal involvement.* Such improvements suggest that a higher level of DCI maturity is built upon strong research skills, which then opens up the possibility of more advanced levels of customer and internal involvement.

Fourth, until this thesis, the Entrepreneurship literature has lacked specific detail regarding how SMEs collaborate with internal and external actors. The majority of the barriers put forward in the literature are derived from a comparison of SMEs practices with the best-practices drawn from large firms (e.g. Maes and Sels, 2014; Marion, Friar and Simpson, 2012a; Moultrie, Clarkson and Probert, 2007a; Nijssen et al., 2012). The analysis of barriers in this study builds upon SMEs' perceptions and, therefore, offers a unique view from within SMEs on what is actually required in order to develop their capabilities. The overall high number of barriers identified indicates the need for substantial change essential to the advancement of the case projects' DCI capabilities. Areas of particular concern included: awareness of advanced data collection techniques; a clear sampling logic; the role of documentation; current needs mindsets; expectation and relationship management; and Owners' lack of trust in others. By detailing the origin of these barriers and linking them to solutions found within some of the other case projects, the understanding developed by this study is of high practical value and supports SMEs reaching higher levels of DCI practice maturity.

9.4 SUMMARY OF THE FULL FINDINGS OF RQ1, RQ2, AND RQ3

Chapter 9 has presented a cross-case analysis in response to RQ1, RQ2, and RQ3. It has illustrated the following:

Section 9.1 has addressed RQ1: *How do small firms' practices enable them to generate DCI for radical innovation projects?* The findings of this study identify a set of practices that the case study companies used to generate DCI, thereby showing four distinct types of information — problems, needs, solutions, and markets — sustaining DCI. The case study companies used this information not only to inspire their concepts and make go/no go decisions, but also to strengthen internal and external relations and to achieve buy-in for the decisions made. Different types of resources were used in the practices, including: new resources, such as new customers; close-at-hand resources, such the contacts of existing industry networks; and existing resources, such as the existing technical research skills and techniques. The practices combined both explorative and exploitative types of research and, moreover, involved different amounts and types of customers, at different modes of involvement. In a similar vein, the practices involved different amounts and types of internal actors, performing different roles. In many cases, DCI activities were planned and controlled; in other instances, they were conducted in a much more intuitive way. Overall, these findings demonstrate the fact that the nature of the processes is not fixed, but rather an evolving result of improvisation. The differences between the case projects reveal three distinct levels of practice maturity.

Section 9.2 has addressed RQ2: *What is the level of insight resulting from DCI practices?* The findings of this study confirmed the value that SMEs place on DCI, and revealed that they carefully consider DCI qualities reflecting the unique content (comprehensiveness, novelty, accuracy) and circumstances (acceptance and cost efficiency) of DCI. A measurement instrument based on content, circumstances, and presentation aspects (timely, consistency, inspiring, and format) was used to assess the level of DCI within the case projects. The findings were consistent with the results of RQ1; cases that exhibit high levels of DCI demonstrated the most mature practices, whereas cases exhibiting low levels of DCI demonstrated the least mature practices.

Section 9.3 has addressed RQ3: *What are the perceptions of small-firm actors of DCI practices?* The findings of this study confirmed the results generated in RQ1 and RQ2, and uncovered how SMEs further develop their DCI capabilities. The analysis demonstrated the centrality of research skills and improvements were most especially determined by the availability of these skills. Cases exhibiting a relatively weak DCI maturity focused on improving these skills first, whereas cases that already had established a certain level of research competence focused on achieving higher levels of customer involvement. Only the cases noting a high DCI maturity considered improving internal involvement — for example, by means of enhanced collaboration and management of learning. The findings further revealed a number of barriers that would hinder the implementation of improvements; these obstacles included technical barriers — for example, sampling and data collection — as well as social barriers identified in the roles performed by Owners, Sales, or the customer.

CHAPTER 10 DISCUSSION AND CONCLUSIONS

10.0 INTRODUCTION

Chapter 9 has presented the findings of the cross-case analysis and answered each of the three research questions. The findings of Research Question 1 (RQ1) revealed the elaborate set of practices used to generate the four types of information sustaining DCI, including information regarding customers' problems, customers' need, markets, and customers' feedback on solutions. The distinct uses of DCI — in concepts, decisions, and relationship building — demonstrated the value that SMEs place on DCI. Moreover, the identified practices uncovered the distinct modes of learning — combining exploitative and explorative learning — and explored the varying levels of formality and improvisation of such learning. The results addressing RQ1 further generated in-depth understanding of the internal actors, indicating that DCI is not necessarily a task for owners alone. Lastly, the practices demonstrated the value of research skills, which were addressed more than any other resource-type.

The findings addressing RQ2 confirmed the value that SMEs place on DCI and revealed the relevance of describing and measuring DCI in terms of its content (comprehensiveness, novelty, accuracy) and circumstances (acceptance and cost efficiency).

Lastly, the findings addressing RQ3 generated in-depth understanding of the practices utilised and demonstrated how SMEs would improve their data collection techniques, sampling logic, and roles. The findings of this study also identified clear technical and social barriers to the improvement of practices.

Chapter 10 will discuss how this study has addressed the gaps in the current literature identified in Chapter 4. Furthermore, it will also develop broader findings and present the methodological and managerial implications of this study.

Chapter 10 is organised into eight main sections:

1. The first section discusses how this research has addressed the six knowledge gaps
2. The second section discusses how this study closes the theoretical gaps
3. The third section gives an overview of the contributions of this study
4. The fourth section discusses the wider implications of this study
5. The fifth section discusses the methodological contributions
6. The sixth section discusses the managerial contributions
7. The seventh section gives a personal reflection
8. The eighth section provides a summary of the main conclusions of this thesis

10.1 CLOSING THE THEORETICAL GAPS

Although the six cases[1] are a small base from which to draw general conclusions, the comparison of empirical results with current literature does offer the opportunity to generalise to theory. By theorising how SMEs actually generate DCI, this thesis makes six contributions to current theory, each one related to a specific knowledge gap identified in the SLR.

[1] Since the SmartLight team was not available for a workshop at the time of this study, their findings are only partly taken into consideration during Chapter 10's discussion.

10.1.1 Knowledge Gap 1: The Intention to Generate DCI

Current Gap in the Literature

Current academic understanding does not clearly establish to what extent SMEs value DCI and have the explicit intention to generate insights. Evidence for this gap is found in the many academic debates surrounding the role of market research and its value to radical innovation in SMEs. Some studies conclude that SMEs deliberately generate market knowledge and apply the techniques of 'formal market research' (De Luca, Verona and Vicari, 2010). Others argue that SMEs do not need formal research, observing that they develop insights *unintentionally* while closely collaborating with customers in the innovation process (Coviello and Joseph, 2012). Addressing this gap is vital to fully develop the key role of intentions in organisational learning and change (c.f. Argyris and Schon, 1978; Feldman and Pentland, 2003; Zollo and Winter, 2002). Clarifying SMEs' perceptions of DCI will, therefore, provide valuable understanding regarding how SMEs adapt to the demanding conditions of radical innovation.

Key Empirical Findings

The findings indicate that SMEs targeting new customer segments recognise DCI as the driving force for radical innovation, and that they consciously consider options to generate it. Such recognition is clearly identifiable in the perceptions found in RQ3, which show SMEs' appreciation of research and synthesis. This value can also be seen in SMEs' intention to improve data collection and sampling activities in future projects.

Moreover, the findings of RQ1 illustrate how SMEs use DCI and give value to it. Like large firms, SMEs use DCI conceptually, to refine their concepts, as well as instrumentally, in decision making. Beyond this, SMEs employ DCI symbolically, to explain the importance of an innovation to others. Such DCI utility was clearly identified in all cases; within established case companies such as MZI, but also within start-up companies such as FiberTop. DCI was valuable in developing arguments about the importance of the project which could then be used to secure the support of funders. Thus, it exerted a direct and fundamental impact on the viability of the project. Similarly, DCI was used to explain the value of the project to internal actors, thus gaining acceptance and buy-in from sales personnel as well as marketing, thus, directly influencing market success. Note that each of these use types involved different actors, clearly illustrating how DCI touches upon the daily activities of many individuals within SMEs.

Despite the conscious character of DCI, SMEs' knowledge of the methods and tools for generating DCI was not very elaborate and not widely shared among actors. This was identifiable in the different beliefs held by actors regarding the value of early testing, but also in the different interpretations given to the term 'market research'.

Implications

The findings indicate that SMEs moving into completely new territory (new products, new technology, new customers) deliberately seek DCI rather than expecting it to simply 'happen'. This suggests that DCI generation is a key radical innovation capability for SMEs and contravenes the dominant view in Customer Involvement literature that DCI is unintentionally generated. Furthermore, the findings add new understanding to MBL theory by demonstrating the unique value of DCI, which sets it apart from other forms of knowing deemed relevant in radical innovation, including the concept of *intuition* — a feeling of rightness which does not include *knowing why* (see e.g. Eling, Griffin and Langerak, 2014; Roberts and Palmer, 2012). Moreover, the value of DCI highlights the role of the symbolic use of insights for radical innovation, a quality largely ignored in MBL literature despite its vital role in export success (Vyas and Souchon, 2003).

10.1.2 Knowledge Gap 2: The Modes and Nature of DCI Processes

Current Gap in the Literature

Currently available literature does not sufficiently describe the processes by which SMEs generate DCI. Evidence for this gap can be found in the frequent use of concepts from studies of large firms by scholars investigating SMEs' behaviour. These concepts emphasise formal processes, but lack validity for small firm contexts (c.f. Roersen, Kraaijenbrink and Groen, 2013). Moreover, current studies tend to focus a single set of market research processes, despite understanding that DCI is the result of several connected phases of market research, each with a different focus and approach (Beverland, Micheli and Farrelly, 2016; Cayla and Arnould, 2013; Cui and Wu, 2017). As a consequence, current findings are confusing and incomplete, and have led to strong debates regarding how SMEs learn and innovate (e.g. Marion, Friar and Simpson, 2012; Mosey, Clare and Woodcock, 2002; Moultrie, Clarkson and Probert, 2007). Addressing this gap is vital because process understanding that incorporates SME's specific challenges support them in developing effective radical innovation capabilities (c.f Berends et al., 2014; Coviello and Joseph, 2012; Marion, Friar and Simpson, 2012).

Key Empirical Findings

The findings of RQ1 illustrated that SMEs generate DCI by means of up to 13 different practices. Together, the practices encompass four types of research: into customers' problems; into customers' needs; into customers' feedback on solutions; and into market characteristics. The unique way in which these types of research are combined revealed a close interaction between open-ended, *explorative*, research and confirmatory, *exploitative*, research. Similarly, it was clear that planned research alternates with unplanned research.

Such a hybrid approach between explorative an exploitative research is illustrative of the *improvisational* nature of DCI generation. Current literature describes improvisation as a tactic, a separate mode of 'real-time' learning, preluding other 'conscious' forms of learning, such as trial and error learning (Miner, Bassoff and Moorman, 2001). Improvisation can be identified within the founding processes of start-up businesses, but is assumed to become less relevant as firms mature (c.f. Baker, Miner and Eesley, 2003). The findings of this study demonstrated that improvisation is much more than a tactic; it is a universal way for SMEs to deal with surprises during DCI operations. Improvisation determined the order of doing things, as was observed in MZI's decision to postpone their original plan of customer research in order to deal with time pressure. Moreover, improvisation influenced many operational decisions: it determined the flow conversations when customers did not readily explicate their needs; it altered the quality and quantity of the customers involved in the processes when customer were found unavailable or unattractive; and it even changed the list of requirements when new opportunities were detected.

Implications

The findings of this study demonstrate how SMEs' practices exceed that which has been described previously. What is commonly regarded as 'market research' was identified in the case studies as an intricate, partly iterative, set of inter-related practices, governed by improvisation. These findings offer a new, detailed perspective on what will be termed *customer-focused learning* within SMEs, thereby contributing to current academic debates. Moreover, by showing how improvisation is more widely present and persistent than currently accepted, this study highlights the importance of improvisation, a concept that is not yet fully developed (c.f. Baker, Miner and Eesley, 2003).

10.1.3 Knowledge Gap 3: Actors and Their Roles in DCI Generation

Current Gap in the Literature

Current literature does not offer sufficient understanding of *who* is doing *what* in order to generate DCI within SMEs. Evidence of this gap can be identified in the high-level descriptions of the roles played by owners and customers (e.g. Coviello and Joseph, 2012; Maes and Sels, 2014; Marion, Friar and Simpson, 2012a). These descriptions do not elucidate what specific tasks owners and customers perform in information processing, nor do they clearly show how actors interact with others. Addressing this gap is crucial because of the significant impact that individuals within SMEs exert on radical innovation success (c.f. Gruber 2008).

Key Empirical Findings

The findings of RQ1 facilitated the definition of nine distinct DCI-related roles. By linking those roles to case project actors, this study demonstrates that DCI engages more people than typically mentioned, including sales, R&D, external experts, and, albeit to a minor extent, marketing. It is clear is that DCI generation is, above all, a shared responsibility. Case projects that managed to involve different actors in the key roles of data collection and synthesis displayed higher levels of DCI than cases that assigned these key roles to a single actor, predominantly the Owner or, in the MZI case, the customer.

The findings of RQ3 established that owners who dominate DCI practices tend to make poor use of available employees, and value their own experience in gathering a broad domain of knowledge over any approach or perspective offered by others. The ineffectiveness of this methodology becomes readily apparent in badly documented and flawed requirements, misinterpreted both by internal employees and customers. The MZI case assigned many of the DCI roles to the customer partnering in the project. Its current customisation business had taught them to appreciate the 'voice of the customer' and, therefore, the MZI team trusted the customer in delivering required insights. The absence of novel insights, combined with the lack of relevance of the innovation to other customers, demonstrated the disastrous consequences of this choice.

The observed practices further uncovered the potential value of sales to DCI activities. Most of the sales employees were both technically skilled and customer-focused, and they were perceived as valuable contributors to data collection and analysis in all but the owner-dominated cases. However, the perceptions clearly indicate that effective sales involvement required dedicated measures, such as incentives encouraging actors to look beyond current needs and explore a wider group of customers. The research attitude observed with the multi-skilled sales professionals of FiberTop proved effective.

Implications

By defining the full set of nine roles involved in DCI generation, this study demonstrates, with more detail than any previous academic paper, how SMEs draw upon multiple perspectives during their DCI process. This explains *when* and *how* the dominant perspectives of customers and owners become a danger to DCI, thus adding new and occasionally contrasting perspectives to MBL, Customer Involvement, and Entrepreneurial Marketing theory. By recognising the important role of sales, a new stream of theory can be defined; one that explores the customer-supplier interface and expedites a greater understanding of actors and roles (c.f. La Rocca et al., 2016).

10.1.4 Knowledge Gap 4: The Skills and Resources for Generating DCI

Current Gap in the Literature

Current literature does not clearly describe the skills and resources that SMEs utilise for the generation of DCI. Evidence for this gap can be found in the many open questions identifiable in Market-Based Learning and Entrepreneurial Marketing literatures. The large firm literature argues that the generation of DCI requires *new* resources, which are different from the skills generally applied in incremental innovation (Kim and Atuahene-Gima, 2010; McDermott and O'Connor, 2002). These skill-sets should include research skills (Hultink et al., 2011). However, the literature on small firms suggests that such new and sophisticated resources are not available within SMEs. It is argued that SMEs rely, above all, on existing resources or on relatively easy to find, *close-at-hand,* resources; yet, these are known for their limiting effect on the novelty of innovations (c.f Baker, Miner and Eesley, 2003; Maes and Sels, 2014). Research on the resources for knowledge generation is, however, sparse and not very detailed (c.f. Hultink et al., 2011; Zahay, Griffin and Fredericks, 2004). Addressing this gap is essential. The combination of resources may yield different results and impact radical innovation success in different ways (Kyriakopoulos, Hughes and Hughes, 2016). Gaining a detailed understanding of resources and their strengths will, therefore, significantly contribute to radical innovation success.

Key Empirical Findings

The findings of RQ1 indicated that SMEs access resources for DCI in three different ways. Firstly, as expected, SMEs relied on existing resources including, above all, research skills and relationship management competences. Secondly, SMEs engaged in what is called *bricolage*, creatively using close-at-hand resources. Such easily obtainable resources were often found in existing university and industry networks. Thirdly, SMEs created entirely new resources, especially in the form of newly engaged customers informing case project teams.

The study findings further unveiled four groups of resources: skills and techniques, firm-level assets, carriers of information, and dedicated people and money. Case projects exhibiting higher levels of DCI concentrated their resources on skills and techniques, thus confirming the pivotal role that skills and techniques play DCI generation. It is crucial to note that this strategy was not exclusively used in bigger-sized SMEs such as SEMO, which had the resources to employ large teams including marketing research specialists. It was also found in the start-up FiberTop, where the project team sourced their research skills from their young, but highly trained, *T-Shaped* professionals (Hansen, 2019).

Implications

By identifying distinct resource groups and typical resource combinations, this study has demonstrated with *what* resources SMEs generate DCI. Moreover, by explaining how SMEs combine new, existing, and close-at-hand resources, this study has shown *how* SMEs create these resources. The pivotal role of research skills clearly highlights the importance of existing resources, which is greater than popularly believed. Moreover, it explains why SMEs, despite their ostensible lack of (new) resources, are capable of generating DCI. Based on the findings of this thesis, new propositions regarding critical resources and critical resource-seeking strategies may be developed, bringing greater clarity to ongoing debates concerning SMEs' radical innovation capabilities (Marion, Friar and Simpson, 2012; Moultrie, Clarkson and Probert, 2007b). By integrating perspectives from the available literature on bricolage, a new stream of literature can be described which will benefit future research.

10.1.5 Knowledge Gap 5: Capability Building

Current Gap in the Literature

Current literature does not clearly define the different levels of mastery of a DCI capability. Evidence for this gap can be found in the sparse literature regarding capability development. The majority of studies focus on large firms and do not incorporate the daily operations of SMEs. Moreover, most studies are static; they look at the requirements for effective implementation of tools and methods in a single project (e.g. Carlgren et al. 2016; Van der Hoven et al., 2013). The scarcely available studies taking a dynamic view of SMEs' capabilities suggest that capability building within small firms is especially difficult. SMEs suffer from a lack of process awareness, preventing them from pinpointing success and failure factors (e.g. Mosey, 2005; Moultrie, Clarkson and Probert, 2007). Such awareness is, however, a necessary first step in growing capability across projects (Eisenhardt and Martin, 2000; Sinkula, 1994). Addressing this gap is vital; SMEs' level of DCI capabilities determines both current and future radical innovation success (c.f. Schindehutte, Morris and Kocak, 2008).

Key Empirical Findings

The findings of RQ3 demonstrated that SMEs have awareness of the practices for DCI generation and are capable of identifying issues and possible improvements. Nevertheless, the plethora of improvements and barriers that were noted is indicative of the substantial change required in order to develop mature DCI capabilities. Overall, 'technical' understanding of DCI generation — for example, data collection techniques and sampling logic — proved superficial.

The findings across RQ1, RQ2, and RQ3 enabled this study to build a practice maturity model. Based on the theoretical guidelines of MBL theory, the model argues that each consecutive step of information processing — acquisition (research), synthesis, and utilisation — is a condition for a next one (Cohen and Levinthal, 1990; Kohli and Jaworski, 1990). It was clear that cases investing significant effort into research expressed higher levels of DCI and more advanced levels of comprehensiveness and novelty than others.

The perceptions of RQ3 allows this study to generate an understanding of how SMEs would choose to develop their DCI capabilities, thus providing a future perspective on DCI capabilities and confirming the implementation order prescribed by MBL theory. A strong researcher would begin with improving their internally oriented competences, synthesis, and internal collaboration. Weaker researchers would concentrate on improving their skills and mindset for undertaking research. Impediments to the realisation of these improvements were identified in technical barriers — the skills and techniques for data collection and sampling — and the social barriers inherent in dominant roles for owners, customers, and sales.

Implications

This study's practice approach facilitated a detailed understanding of the actions and perceptions of SMEs with regard to DCI generation, revealing different levels of process maturity. Contravening current understanding, this study adopts a positive stance regarding SMEs' capability for change. Moreover, the findings reinforce MBL theory guidelines for developing DCI capabilities within SMEs and encourage future research into understanding what factors take SMEs off the ideal development route. Technical and social barriers confirm suggestions in the literature regarding the distorting influence of such factors (e.g. Liedtka, 2015; Maes and Sels, 2014) and may give rise to new research propositions which, in turn, could lead to a deeper understanding of what drives behaviour and change within SMEs.

10.1.6 Knowledge Gap 6: The Level of Insight

Current Gap in the Literature

Current literature does not clearly determine if SMEs generate DCI or not. Evidence for this gap can be found in the sparsely available studies that include market knowledge — or specific forms of market knowledge, like DCI — in their research models. Only a small number of large firm papers were found to study market knowledge specifically, and these only defined the *extrinsic* qualities of market knowledge, existing independent of its unique content, which may include accurate, relevant, actionable, and timely (e.g. Bonner, 2010; Hultink et al., 2011; De Luca and Atuahene-Gima, 2007; Mahr and Lievens, 2012). Some of these characteristics may be present in DCI as well; however, the essence, the intrinsic elements, the unique content, and form of DCI are left undiscussed. Within the small firm literature, the characteristics of market knowledge is not a theme of research at all. Addressing this gap is vital; possessing the correct type of information is an important driver of radical innovation (Hultink et al., 2011; Reid and de Brentani, 2010).

Key Empirical findings

In order to determine the level of insight of SMEs, this study followed the guidelines of Mackenzie, Podsakoff and Podsakoff (2011) to develop a suitable measurement instrument. RQ2 focused, in particular, on DCI's attributes — the underlying dimensions of DCI and the stability of those dimensions in different situations. The findings suggest that SMEs consider five key attributes, or *qualities* of DCI, which are each related to one of three dimensions. Two of the attributes represent the intrinsic quality of DCI and describe its unique *content* in terms of comprehensiveness and novelty. The other three attributes represent the extrinsic qualities of SMEs, describing the *circumstances* in terms of acceptable and cost-efficient insights, and DCI's *presentation* in terms of timeliness.

The multi-factor measure, based on these attributes, demonstrated that SMEs, on average, generated 24 insights. Of these, five were highly novel and the remainder were current needs insights. Current needs were strongly related to latent needs and, therefore, both were considered important for DCI. These insights were generated without excessive cost, but often displayed serious issues with timeliness, comprehensiveness, and acceptability. As a result, they may not have been as cost effective as initially believed. Across the case projects, three levels of insights were uncovered; low, medium, and high. The level of insight remained consistent with the efforts that each case study put into research, synthesis, utilisation, and management practices. This resulted in the levels of maturity identified in RQ1. The covariance between DCI generation maturity and the level of insight provides the first proof of construct validity (c.f. Mackenzie, Podsakoff and Podsakoff, 2011). The findings of RQ3 added further understanding regarding the stability of the DCI construct by linking the improvements of the DCI generation practices to the DCI attributes. This finding of this thesis established that DCI content is a first condition for reaching high levels of DCI.

Implications

This study's construct for the level of insight enabled it to identify and provide evidence of DCI within SMEs. It has contributed to the long-standing debate in MBL literature regarding the capability of SMEs to develop DCI. The construct offers the opportunity for future study on DCI and compare the level of insight across a wider group of SMEs. This will facilitate robust conclusions regarding DCI that can be applied to SMEs in general.

10.2 OVERVIEW OF CONTRIBUTIONS

Table 10.1 summarises the knowledge gaps and includes a synopsis of the different contributions made by this study. For each gap in the knowledge, the main conclusions are given in the second row. Current understanding within each stream of literature is summarised in the lower rows, accompanied by a breakdown of how the conclusions drawn by this study contributed to current understanding. For example, the third row of Table 10.1 reviews the current understanding of MBL literature. It explains that, for Knowledge Gap 1, this stream of literature uses large firm concepts to understand small firms' MBL activities. The findings are inconclusive, leading to numerous long-standing debates. Moreover, it is not clear how the findings relate to DCI. This study contributes to MBL literature by adding new theory regarding the intentionality of market research within SMEs. This sets DCI apart from intuition, integrating perspectives of the symbolic value of DCI.

The findings of this study contributed in one of the following ways: by adding new theory, by contrasting existing theory, by integrating new streams of literature, or by solving a puzzle. Aside from the various new theories offered, this study provides a number of interesting new contrasting perspectives, in particular, regarding: SMEs' intentions to develop DCI; the role of the owner; and the role of existing resources. Moreover, it calls for the integration of various new streams of literature, including theories regarding: the symbolic use of knowledge; improvisation; customer-supplier interface; and bricolage. Lastly, this thesis solves the puzzle of how SMEs can generate DCI with scarce resources.

Knowledge Gap 1 made clear that SMEs deliberately developed DCI and derive clear value from it in return. This contributed to the debates found within MBL and Entrepreneurial Marketing literature and offered a contrasting perspective in Customer Involvement literature.

Knowledge Gap 2 demonstrated that improvisation is not only a tactic, a mode of learning, but a fundamental principle governing DCI operations during executing of the four types of research. This contributed to the many debates found in all steams of literature and calls for the integration of the literature on improvisation to study DCI within SMEs.

Knowledge Gap 3 demonstrated that DCI requires multiple perspectives, found externally with customers, but also internally with employees. It demonstrated that poor customer and internal involvement give room to dominant perspectives and threaten DCI. This assertion adds new theory to all streams of literature and offers a contrasting view regarding experience in Entrepreneurial Marketing literature.

Knowledge Gap 4 noted that SMEs concentrating their DCI resource budget on research skills proved more effective. This offered a new and positive perspective on the role of existing resources in radical innovation. Further, it solved the puzzle evident in the Innovation Management and Design literature of how SMEs can develop DCI despite their scarce resources. The findings also offered a new and contrasting perspective on the value of experience and calls for integration of the literature on bricolage to study DCI within SMEs.

Knowledge Gap 5 demonstrated how SMEs grow their capabilities by passing through maturity levels which are defined by research and customer involvement capabilities at the ground level, moving on to synthesis capabilities at the next level, and internal involvement capabilities at the highest level. These findings proved the value of MBL guidelines.

Knowledge Gap 6 provided the first evidence of DCI within SMEs, thus contributing to the long-standing debate in MBL literature.

Table 10.1: Theoretical Contributions

Gap	1. Intention to Generate DCI	2. The Modes and Nature of the DCI Processes	3. Actors and their Roles in DCI Generation	4. The Skills and Resources for Generating DCI	5. Capability Building	6. The Level of Insight
Conclusions	SMEs targeting new markets are aware of DCI and its value. DCI is different from intuition. SMEs use DCI conceptually, instrumentally, and symbolically.	DCI generation is more than front-end market research. It involves two types of ambidexterity and the processes are characterised by improvisation.	DCI generation includes nine information processing roles. DCI is a shared responsibility. Assigning too many roles to single actors compromises the quality of DCI. Sales is an important actor.	DCI generation builds upon resources from four resource groups. Three distinct research-seeking strategies enable SMEs to acquire the necessary resources. These include resource-creation but rely, importantly, on existing resources of strong research skills.	SMEs are aware of DCI processes and follow the paths argued by MBL theory for improving their capabilities.	DCI is a separate construct, with a unique conceptual domain and theme, including five dimensions representing intrinsic and extrinsic qualities.
MBL Small Firms	Uses large firm concepts to study MBL in small firms. Debate regarding SMEs' use of formal market research. Unclear if this also includes DCI. ***Contribution:*** *Adding new theory to debates; set DCI apart from intuition; integrating literature on symbolic use of knowledge.*	Uses large firm concepts to study MBL in small firms. Debate regarding SMEs' use of formal market research. Unclear if this also includes DCI. ***Contribution:*** *Adding new theory to debate; integrating literature on improvisation.*	Emphasises important role of entrepreneur, does not define roles of others. ***Contribution:*** *Adding new theory on DCI roles; demonstrates how and when dominant roles arise.*	SMEs develop new skills for MIP. ***Contribution:*** *Contrasting existing theory on new resources needed for radical innovation.*	No attention for capability development. ***Contribution:*** *Adding new theory* *Research capability is necessary condition for increased maturity of DCI practices.*	Does not define knowledge quality of DCI concept. ***Contribution:*** *Adding new theory to debate.*
Customer Involvement Small firms	DCI emerges while collaborating with customers. It is not the result of intentional action. ***Contribution:*** *Contrasting existing theory about the unintentional nature of learning.*	Learning is experienced-based, informal, and short-term focused. It is a by-product of a trial-and-error approach. Others, however, observe more formal research is the front-end as well. ***Contribution:*** *Adding new theory to debate.*	Describes innovation tasks of the customer. Understanding of information processing roles is limited. ***Contribution:*** *Adding new theory on DCI roles; demonstrates how and when dominant roles arise; integrating literature on customer-supplier interface.*	Little attention for resources other than existing customers. SMEs use mix of distant and close relations. ***Contribution:*** *Adding new theory.*	No attention for capability development. ***Contribution:*** *Adding new theory* *Research capability is necessary condition for increased maturity of DCI practices.*	Does not define knowledge quality of DCI concept *Contribution: Adding new theory*

Table 10.2: Continued

Gap	1. Intention to Generate DCI	2. The Modes and Nature of the DCI Processes	3. Actors and their Roles in DCI Generation	4. The Skills and Resources for Generating DCI	5. Capability Building	6. The Level of Insight
Innovation Management & Design Small firms	Low process awareness and debate regarding the use of tools and techniques implies little attention of SMEs for DCI. ***Contribution:*** *Contrasting existing theory on unawareness.*	Identified important barriers to formal market research and cross-functional approaches. ***Contribution:*** *Adding new theory to debate.*	MIP is done by entrepreneur. Demonstrates negative impact of entrepreneur. ***Contribution:*** *Adding new theory on DCI roles; demonstrates how and when dominant roles arise.*	SMEs lack skills and do not involve customers. ***Contribution:*** *Contrasting existing theory on customer involvement; solves puzzle of how SMEs can generate DCI with scarce resources.*	Capability building within SMEs is difficult and suffers from a lack of process awareness. ***Contribution:*** *Adding new theory; research capability is necessary condition for increased maturity of DCI practices.*	Does not define knowledge quality of DCI concept. ***Contribution:*** *Adding new theory*
Entrepreneurial Marketing	Market-Based Learning is part of the tasks of entrepreneur. Sometimes this is done intentionally, sometimes not. ***Contribution:*** *Adding new theory to debate.*	SMEs rely upon some form of MIP to develop opportunities. The formality of these processes is debated. ***Contribution:*** *Adding new theory to debate; integrating literature on improvisation.*	MIP is done by entrepreneur. Demonstrates positive impact of entrepreneur. ***Contribution:*** *Adding new theory on DCI roles; contrasting on role of the Owner.*	SMEs rely on MIP competence (or prior knowledge) of entrepreneur. SMEs make creative use of existing marketing resources, like networks. ***Contribution:*** *Contrasting existing theory regarding value of experience; integrating literature on bricolage.*	No attention for capability development. ***Contribution:*** *Adding new theory Research capability is necessary condition for increased maturity of DCI practices.*	Does not define knowledge quality of DCI concept. ***Contribution:*** *Adding new theory.*

Source: based on Author's own analysis.

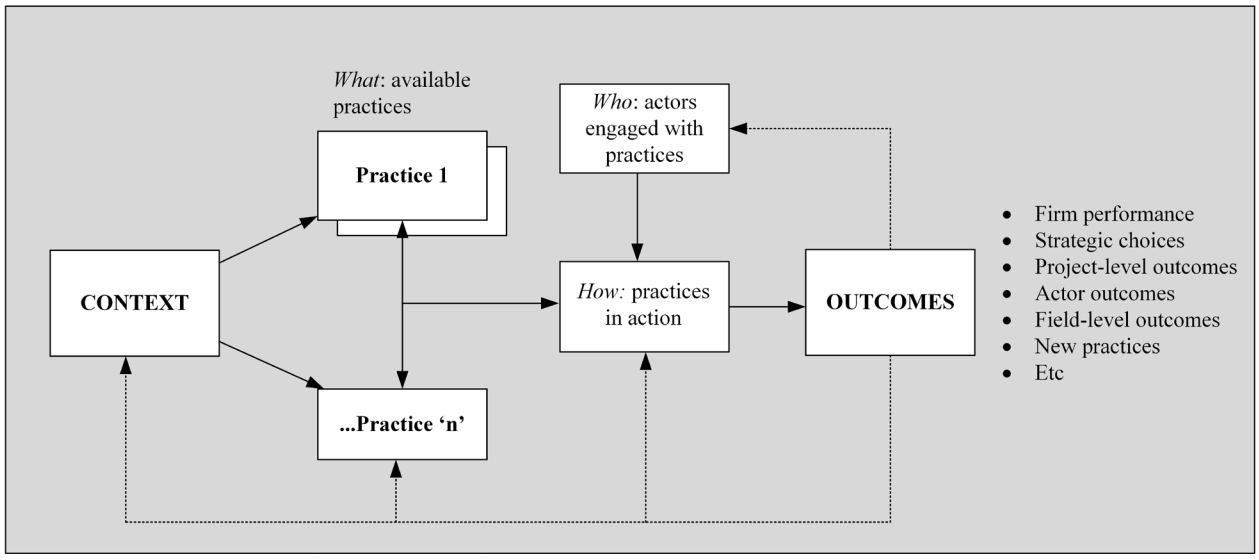
10.3 WIDER IMPLICATIONS

Sections 10.2 and 10.3 demonstrated how this study has advanced understanding of each of the six knowledge gaps individually. Section 10.4 will consider the six gaps in unison to reveal the wider implications of this study. The wider implications have been placed into a conceptual model specifying DCI, its relations, and its key dimensions. Both will clearly set DCI apart from other knowledge concepts such as intuition (Eling, Griffin and Langerak, 2014), market vision (Reid and De Brentani, 2010), and current needs insights, and will offer new avenues of study regarding the value of knowledge for radical innovation.

10.3.1 Conceptual Model

This thesis has been based on Practice Theory and the Schematic Model of Strategy Practice, developed by Jarzabkowski et. al. (2016), was used as a guiding model. Figure 10.1 illustrates the fact that this model identifies with 'what' practices an outcome is generated, 'who' implements the practices, and 'how' this implementation is undertaken. Moreover, the schematic emphasises careful definition of context.

Figure 10.1: Schematic Model of Strategy Practice



Source: Jarzabkoswki et al., 2016, p. 251.

This study's unique contextual focus on radical innovations for new customer segments has been neglected in current literature, but it is vital in order to fully understand the role of market-based knowledge (c.f. Danneels, 2003). By bringing the findings of this study into the Schematic Model of Strategy Practice, a more accurate and contextually sensitive theory can be constructed (c.f. Jarzabkowski et al., 2016). The robust guidelines generated by such theory will give SMEs access to insights that are critical when entering completely new territory (new products, new technology, new customers). Such insight will facilitate SMEs' radical innovation success.

The new encompassing perspective is visualised in Figure 10.2, and illustrates a clear distinction between DCI, the 'outcome', and the 'what', 'who', and 'how' enclosed in the practices for DCI generation. Moreover, by including a tentative view on how DCI influences radical innovation, the entire DCI value chain is defined. The term *customer-focused learning* (inspired by Baker and Sinkula, 2005) will be used as an umbrella term for this value chain.

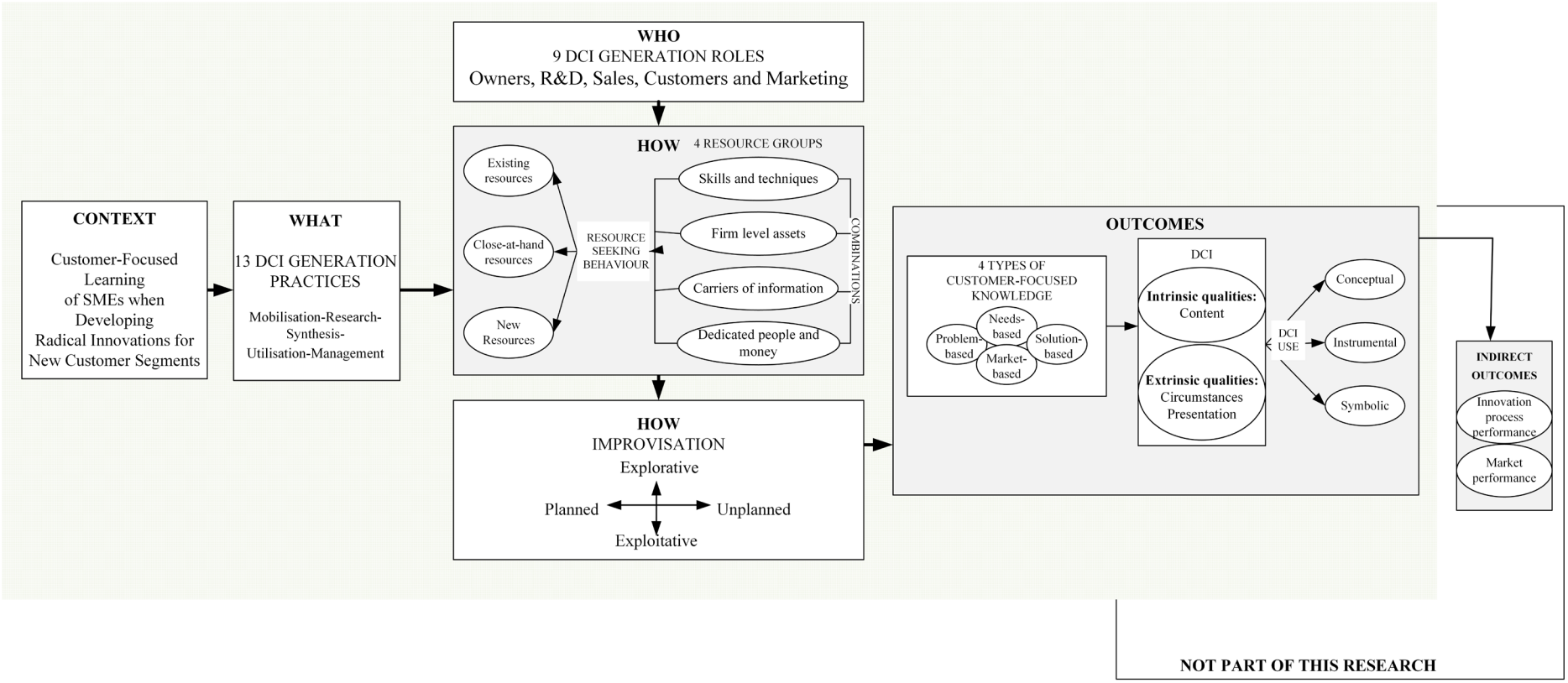
The concepts included in Figure 10.2 describe the full conceptual domain — i.e. what DCI and DCI generation represent, to whom it belongs, and the key attributes (Mackenzie, Podsakoff and Podsakoff, 2011). The context is displayed at the left-hand side of Figure 10.2, and was developed by means of the sampling procedure, including only cases labelled as radical innovations aiming for new customer segments.

The *DCI generation concept* is built around the 'what', or the 13 practices and practice groups to which these belong: customer mobilisation, research, synthesis, utilisation, and management. The 'who' and 'how' also form part of the DCI generation concept and, together, describe three key attributes all related to different levels of DCI. First, starting in the upper middle of Figure 10.2, the main roles for DCI and the actors playing these roles are presented; these include the owners, R&D personnel, sales and marketing officials, and the customers. Second, the figure displays the resources, or the basic inputs drawn upon by the actors, consisting of four resource groups: skills and techniques; firm-level assets; carriers of information; and dedicated people and money. Individual resources are found in existing, close-at-hand, and new resources, and are made available to the actors in different combinations. Third, the lower middle of Figure 10.2 illustrates how actors rely on improvisation to maximise the outcomes in light of their available (or lack thereof) resources. Further, it highlights the dualities found in DCI generation; explorative and exploitative; planned and unplanned.

The right-hand side of Figure 10.2 defines the *DCI concept*. This describes the outcomes of DCI generation, as explained in Knowledge Gap 6. It includes the four groups of knowledge together specifying the content of DCI, made available under the right circumstances, and in the right mode of presentation.

Lastly, at the far-right side of Figure 10.2, the model includes the indirect outcomes of DCI. Although these were not part of this study, the uses of DCI suggest that it supports *improved innovation performance* — e.g. through the funds or increased internal commitment made available with the support of DCI — and increased *market acceptance* — e.g. through customers' acceptance created with the support of DCI.

Figure 10.2: Overarching Conceptual Model



Source: Authors' own model inspired by the model of Jarzabkowski et al. (2016).

10.3.2 Key Dimensions of DCI Generation

Sections 10.2 and 10.3 as well as the Overarching Conceptual Model have focused on the DCI generation practices and have addressed the six knowledge gaps. Knowledge Gap 4 identified the pivotal role of research skills. When reconsidering the findings of the case studies in light of the availability of research skills, some additional explanations become available for why some SMEs were able to achieve high quality insight, while others were not. This section 10.3.2 discusses how research skills are at the basis of sufficient levels of involvement and drive the development of strong DCI competence. Improvisation theory is the basis of the arguments presented and the key dimensions emerging from the discussion will be summarised in a dynamic model.

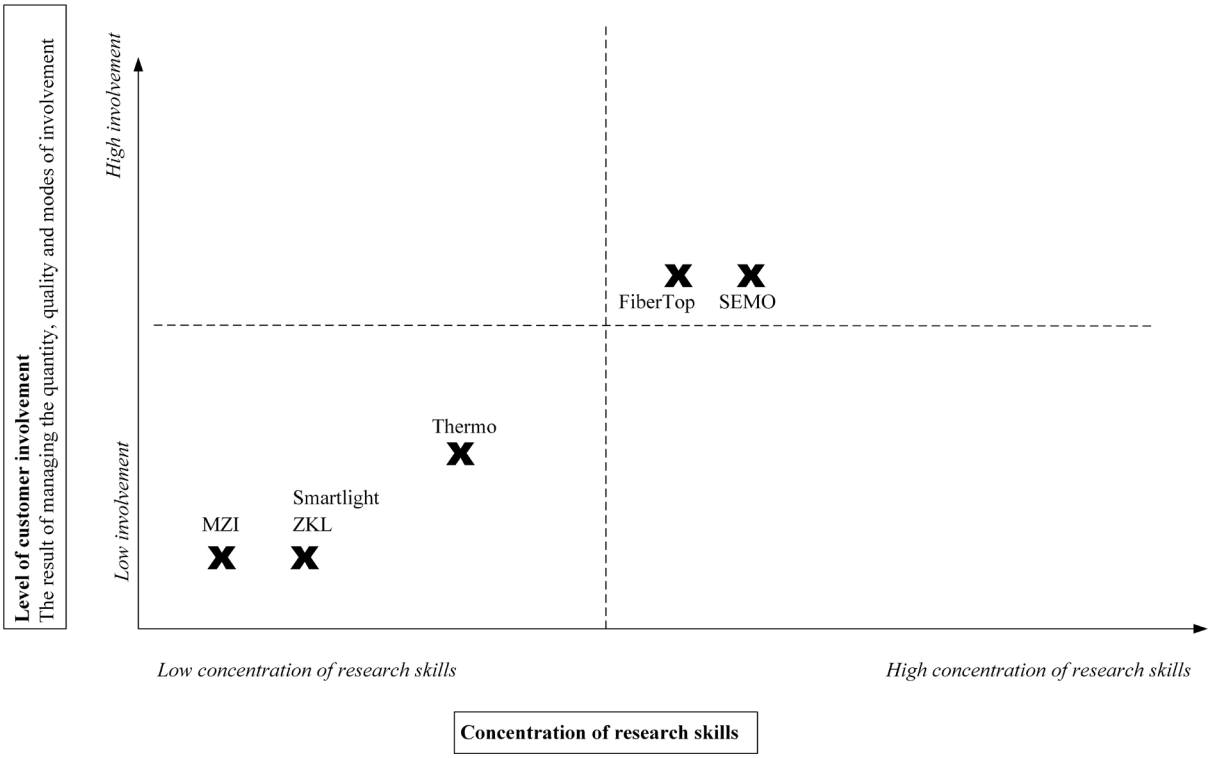
Based on the findings of RQ1, it can be argued that higher levels of research skill induce higher levels of customer involvement and protect against any dominant current needs perspectives of customers. The SEMO and FiberTop case projects both exhibit a high level of insight and, therefore, more comprehensive and novel insights. These cases allocated a relatively high concentration of skills and techniques to research. Furthermore, they clearly recognised the value of understanding different types of market information and allocated their research skills to at least three of the four types of research. RQ1 also explained how each type of research involved different *types* of customers, in different *amounts*, and in different *modes* (learning from, learning with, and learning without).[2] These aspects were defined in RQ1 as the different dimensions of customer involvement. This spreading of efforts across the different types of research resulted in a higher level of customer involvement — i.e. higher amounts of customers — and a greater variation in the types of customers and modes of learning than observed in the other cases.[3]

Figure 10.3 depicts how a certain level of research skill results in higher levels of customer involvement. On the x-axis, the figure displays the concentration of research skills, which was found in RQ1 and indicated by the concentration of resource skills in the total resource budget. The y-axis displays the level of customer involvement as indicated by the different types of research.

[2] Research on problems was usually conducted with easily accessible users found in current networks. These users were approached as a source of information and were, hence, involved relatively distantly in a mode termed 'learning *from*'. Research on needs was usually conducted with customers that were deliberately selected. These customers were, again, used as a source of information, hence, indicating a mode of learning *from.* Research on markets was undertaken without the customer, providing the most distant perspective on DCI. Research on solutions was largely done with early buyers or first prospects, thus offering the most intimate perspective on the customer by means of a mode termed 'learning-*with*'.

[3] Evidence of this is found in the UCD plan of SEMO that demonstrated, at numerous points, the technical research skills put into designing the sampling logic, thus ensuring that sufficient customers of different types were available. In the same plan, arguments for different modes (or methods) of involvement are found and demonstrate SEMO's level of research skill: "Depending various project characteristics such as project size, innovation level, product maturity phase, focus group size, expected commercial revenue, market segmentation, a subset of methods can be proposed per development phase [followed by a checklist]." (UCD Plan, p. 9). "Not applied methods: User surveys are considered not feasible since there is no installed base." (UCD plan, p 5). Although FiberTop did not document its arguments as fully as SEMO, they, similarly, were found to have technical arguments establishing a relatively high level of customer involvement. "It is difficult, if you talk to two or three customers, the fourth may have totally different requirements. This is why we seek feedback from a variation of customers across segments and customers […]" (INT-SLSf). The perceptions of SEMO and FiberTop found in RQ3 regarding data collection techniques, sampling, and the role given to the customer confirmed their relatively well-developed level of research skills and suggests how this led to higher levels of customer involvement.

Figure 10.3: Research Skills and Customer Involvement



Source: Author

In Figure 10.3, the other four case studies are positioned in sharp contrast to the SEMO and FiberTop projects. Although Thermo did concentrate a large portion of its resource budget to skills and techniques, these skills did not include the reflection and research management skills of SEMO and FiberTop. Furthermore, the perceptions of RQ3 suggested that Thermo, just like the ZKL project, emphasised domain knowledge. This resulted from being active in the field and is, therefore, much more reliant on experience than on research skills. Moreover, aside from its focus on researching solutions, Thermo was keen to research *markets*. This type of research does not involve any customer and, therefore, places Thermo in only a slightly better position than ZKL, MZI, and SmartLight in terms of its level of customer involvement.

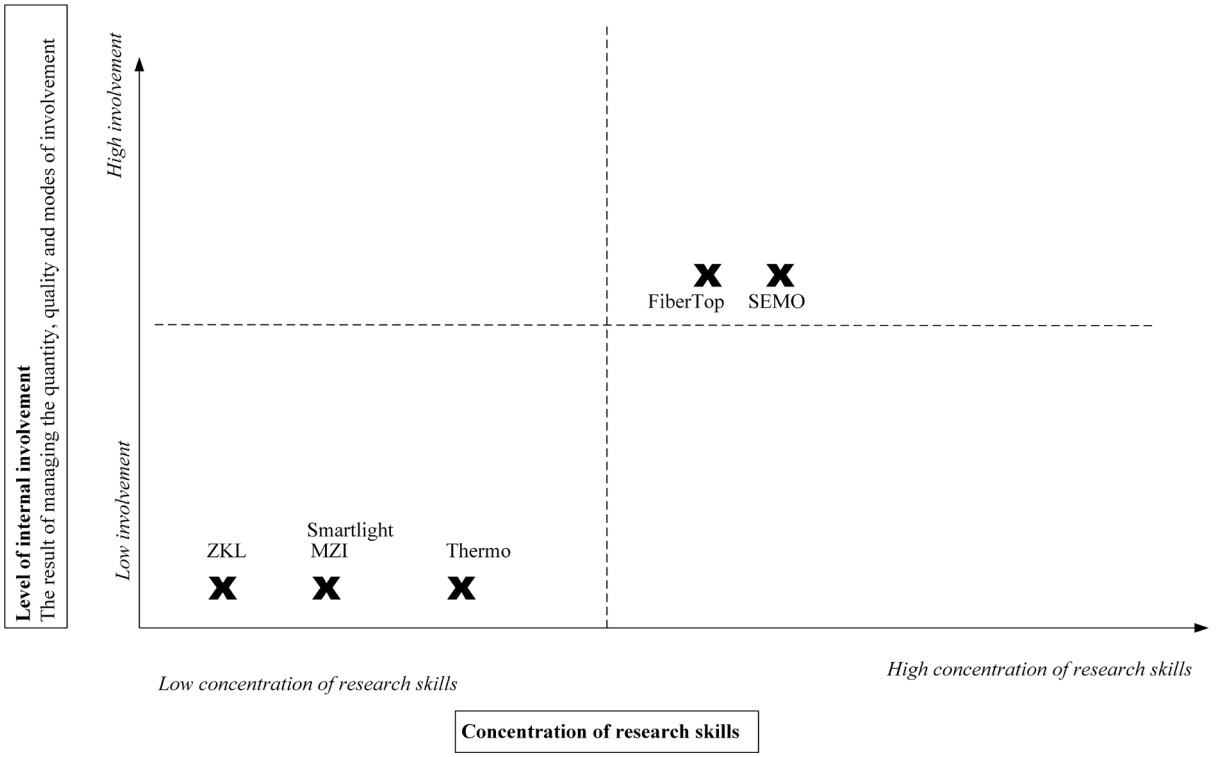
The concentration of research skills in both the ZKL and SmartLight projects was relatively low when compared to the others. Moreover, ZKL and SmartLight focused, above all, on researching solutions, working solely with early customers, and missing the in-flow of perspectives from a wider and varied group of relations. This lack of a variety of perspectives was also observed in the MZI case, in which all research — problems, needs, markets, and solutions — was organised around a single customer. The perceptions of RQ3 confirmed MZI's position in the diagram, noting the Owner's ignorance of analytical skills and clear misunderstandings regarding the best way of researching customers. The findings of RQ2 with regard to the MZI case indicated a lack of research skills which resulted in a focus on the dominant perspectives of customers, ultimately leading to poor comprehensiveness and novelty of insights.

Furthermore, the findings of this study suggest that research skills are at the root of strong internal involvement. SEMO and FiberTop, the cases displaying strong research skills and higher levels of customer involvement, both involved more internal personnel in a wider set of roles than other cases. They were clearly conscious of how DCI requires multiple perspectives, thus proving, again, some level of technical understanding regarding the

requirements of DCI. The strong drive of both cases to establish internal acceptance of their insights further indicates the level of skill put into establishing internal involvement. Furthermore, this clearly forced SEMO and FiberTop to place more effort on synthesis in order to record and share the many findings, as exemplified by their more elaborate documents.

Overall, the approach adopted by SEMO and FiberTop is in sharp contrast with the owner-dominated cases whose perceptions and lack of documentation revealed their ignorance of the advantages offered by involving others and sharing insights. Figure 10.4 depicts how a certain level of research skill opens us higher levels of internal involvement. On the x-axis, the figure displays the concentration of research skills, identified in RQ1, and indicated by the importance of resource skills in the total resource budget. The y-axis displays the level of internal involvement, as indicated by the amount of other people involved other than the owners. Figure 10.4 reveals a similar situation as in Figure 10.3 with the two skills-intensive cases clearly realising higher levels of internal involvement.

Figure 10.4: Research Skills and Internal Involvement



Source: Author

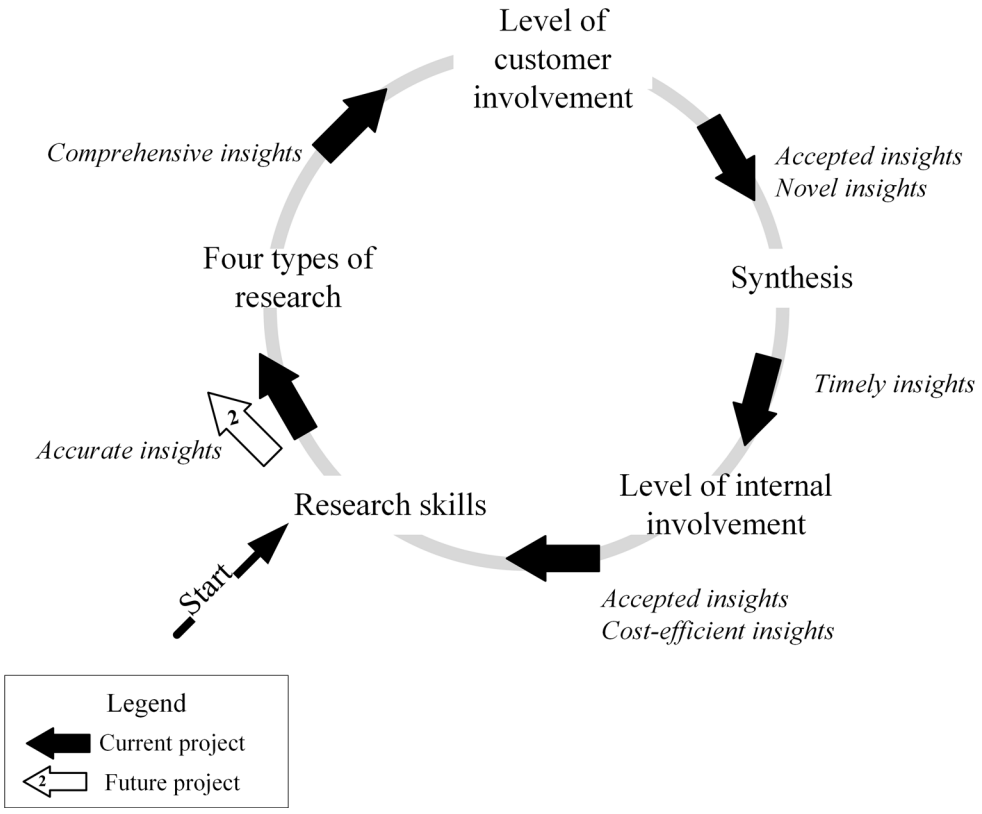
The available literature regarding improvisation offers some interesting thoughts which confirm the pivotal role of skills. The literature describes how technical skills and effective collaboration are the key raw materials required for improvisation. Weick (1998) argues that, like jazz musicians, competent improvisors in organisations need both skills and experience. Experience puts in the feeling needed for spontaneous action. Experience is, however, only partly relevant when trying to create highly novel new products, as it often leads to known paths. Moreover, improvisation does not start from "thin air" and requires solid "precomposed material" that can be reworked to create something new (Weick 1998, p. 546). Cognitive thinking skills complement the skillset of competent improvisors, allowing that actor to draw from experience and to move ahead while remaining synchronised with other activities. This draws on memory, reflectivity, and listening skills; all of which were clearly present in the

SEMO and FiberTop case projects, whereas the owner-driven cases, above all, relied on experience.

While previous arguments focused on the key role of research skills for establishing more comprehensive, novel, and acceptable insights, research skills were also identified as the foundation for growing DCI capability. Knowledge Gap 5 demonstrated that technical research skills facilitated a strong research capability at the ground level of DCI maturity. Furthermore, it was clear that, once this level of capability was achieved, the emphasis of the project team could be shifted to improving internally oriented practices. This was evident at both SEMO and FiberTop. Moreover, it was found that both of these cases' confidence in research skills facilitated the development of more advanced techniques and strengthened future levels of DCI by means of more accurate insight. In contrast, the other case studies retained a need to establish ground-level research skills and did not appear ready for more advanced and internally oriented improvements.

Figure 10.5 demonstrates that DCI generation is a research-driven competence, beginning with a basic level of research skill and evolving over the key building blocks identified in the arguments of Section 10.2.8: research types; level of customer involvement; synthesis; and internal involvement. By linking this to DCI qualities, it is clear how each building block enables an SME to achieve those specific DCI qualities, ultimately resulting in comprehensive, acceptable, novel, timely, and cost-efficient insights, and increased accuracy in future projects.

Figure 10.5: The Key Drivers of DCI Generation



Source: Author

The additional thoughts presented in Section 10.3.2 hold strong practical value, demonstrating how SMEs can create maximum value from their scarcely available resources. From a theoretical perspective, the findings of this study foster arguments that clearly distinguish technical skill from experience and define them as two distinct aspects of competent improvisation. This distinction will encourage future research into the conditions that may transform improvisation into an effective mechanism for radical innovation. Weick defined some guidelines for competent improvisation; nevertheless, the prerequisites for competent improvisation, supporting, instead of harming radical innovation, have not been studied (e.g. Miner, Bassoff and Moorman, 2001).

A reconsideration of the definition of DCI presented in the introduction of this thesis is deemed relevant upon completion of this section on wider implications:

> An intimate and shared understanding of the latent, unarticulated, needs of the customer. It is the result of understanding many individual pieces of information gathered during market research, all of which are brought into a coherent view about how new products can address customers' latent needs.

Looking back now at the full set of findings and arguments, the following definition more accurately expresses the conceptual domain of DCI:

> DCI is a comprehensive, shared, and cost-efficient understanding of innovation teams regarding how new products can address future customers' latent needs. DCI builds upon unique content describing both the current and latent needs of prospective customers. It is the result of understanding many individual pieces of information describing customers' problems, needs, and preferences, as well as the market characteristics influencing these aspects.

A separate definition of the conceptual domain of DCI generation establishes the full perspective offered by this thesis:

> DCI generation is a research-driven improvisation competence by means of which an SME manages the levels of customer and internal involvement in order to effectively turn data into insights.

10.4 METHODOLOGICAL IMPLICATIONS

This study's methodological approach is at the basis of its contributions to current understanding and offers a number of clear advantages. Although several measures have been employed to maintain the quality of this case study research, several limitations remain. When considered together with the contributions made by this thesis, the limitations reveal some compelling avenues for future research.

10.4.1 Methodological Contributions

The methodological contributions of this study include its practice approach, the case study selection criteria, and the method of measuring DCI. First, the new perspective on customer-focused learning is grounded in Practice Theory. The choice to utilise a practice lens was inspired by the methodological and conceptual issues found in current understanding. It is important to note that the currently available comprehension of Market-Based Learning, Customer Involvement, Innovation Management and Design, and Entrepreneurial Marketing is based on surveys and, therefore, does not offer detailed and processual perspectives regarding DCI. Moreover, the concepts used within these streams of literature neglect the specific attributes of DCI and tend to emphasise SMEs' beliefs about their innovation and marketing processes. Beliefs and actual behaviours are, however, very different properties of a

process, especially within SMEs (c.f. Feldman and Pentland, 2003; Roersen, Kraaijenbrink and Groen, 2013).

The sophisticated practice-based approach of this thesis enabled it to study the daily reality of DCI with greater detail and precision. It followed the recommendations for practice-based studies, 'zooming in' on the enactment of practices and 'zooming-out' on the input-output relations between the practices (Nicolini, 2012, p. 219). Moreover, this study identified an explicit distinction between actual activities (RQ1) and perceptions of these activities (RQ3). Although this study did not include an analysis of the specific differences between actual behaviour and perceptions, its distinctive approach allowed the measurement of both, offering a good basis for triangulation of the findings. As a result, new concepts for DCI generation and DCI are grounded in the daily practice of SMEs and, moreover, offer a unique view of the key dynamics enabling the development of DCI capabilities.

This study's sampling procedure considered the nature of the customers targeted by the radical innovation project. Current literature ignores this extra dimension of 'newness' confronting firms in the process of developing radical innovation. The type of target market for an innovation is however, known for changing the role of market knowledge significantly (Danneels, 2003). By carefully defining the context within which DCI is generated and incorporating this in the selection of case study projects, this thesis has taken a first step towards a better understanding of the conditions under which DCI becomes of value to radical innovations.

This study's approach for measuring the level of insight offered a unique view regarding what DCI signifies within SMEs' daily practice. In response to the lack of valid measures in current literature, this study began developing a DCI construct. This construct was based on understanding gleaned from Attractive Quality theory (Kano et al., 1984) and was supplemented with knowledge gathered during the analysis of perceptions of DCI quality. Moreover, the measurement procedure allowed this study to avoid issues arising from subjective, single-informant measurement of key outcome variables. Such an approach was a common practice in current research and may well be responsible for some inflated outcomes of customer involvement (Chang and Taylor, 2016). By using a procedure allowing both subjective and objective measurement, this study offers a more valid and comprehensive view of DCI within SMES. Furthermore, the construct and approach for measuring DCI facilitates DCI measurement in future research.

10.4.2 Limitations of this Research

The limitations of this study concern its internal validity and generalisability, and its foundation in Practice Theory. Given that the operationalisation of DCI is not yet sufficiently proven, the internal validity of this study may be subject to criticism. For example, it could be argued that, in order to generate conclusions regarding any attractive quality, another level of analysis would be required (e.g. on the customer-level). This option was not explored due to the limited time frame of this study. Furthermore, the lack of available benchmarks complicates conclusions drawn regarding the level of insight. Nevertheless, the first steps undertaken in this study to assess the quality of the output of DCI generation and to operationalise DCI present a suitable starting point from which a valid DCI scale and benchmark levels can be developed in the future.

The limited time frame of this study hindered its ability to objectively establish the *radicalness*, or uniqueness, of the case study projects. This might have been accomplished by using an expert panel (e.g. Coviello and Joseph, 2012). Such a panel would require careful design and was, therefore, not deemed feasible. Instead, the radicalness of the projects was

assessed on the basis of self-reporting during case study selection and might, therefore, have been inflated.

Moreover, this study did not fully incorporate the requirements for a Practice-based study. Tracing practices in daily reality requires direct observation (Pilbeam and Turner, 2017). However, this was not deemed feasible considering the time frame of this study and the difficulty in gaining access as an external observer during radical innovations. The interview-protocol and coding procedures took into account the drawbacks of a retrospective approach. However, it is believed that the internal validity of this study has been preserved to a sufficient level through the *emic* approach, involving entire teams, and the feedback of the participants regarding the full description of events.

The data-analysis was the sole work of the researcher and, therefore, inter-coder reliability checks were not performed. However, given that the transcripts were used in two editions of an educational course at the researchers' university, discussions and reflections with research students and peers offered the unique opportunity to reflect on coding and conclusions, thus preventing researcher bias.

Limitations of this study's generalisability result from the case study research approach. Case studies are not suitable for drawing statistical generalisations across a wider population, but rather they focus on achieving theoretical generalisation (Yin, 2014). Therefore, despite the sufficient number of case study projects and the sophisticated sampling procedure, caution should be taken with generalisation of the results. The case study projects were all based in the Netherlands and cultural differences were not incorporated. The cases were all technological innovators for business-to-business target groups and the findings may, therefore, be less applicable to consumer markets and service innovations. Furthermore, considering the case projects' application for a Dutch Innovation Award, they are demonstrably ambitious and, given their interest in cooperating with this study, were willing to learn. Such a disposition towards learning is known to influence market-based learning within highly innovative SMEs (Gnizy, Baker and Grinstein, 2014). The findings of this study may, therefore, not apply as accurately to more mainstream innovation projects and teams with other learning attitudes.

A final limitation of this study is the theoretical basis of Practice Theory and its focus on *purposeful* activities. As consequence of this choice, this study did not identify less purposeful activities, like those based on intuition. Nor did it study the repetitive character of certain activities, which would have been incorporated when drawing upon theory regarding routines. Moreover, although the practice perspective offered by this study did facilitate the observation of a hybrid approach characteristic for improvisation, it did not systematically identify at what points improvisation started and ended. Such a view could possibly have been achieved by incorporating the principles of Effectuation Theory.

10.4.3 Future Research

The contributions and limitations of this study suggest a number of interesting areas for future research. First, future research may focus on understanding more precisely how the two types of ambidexterity impact DCI. Innovation Management and Design studies tend to view ambidexterity as a strategic, organisational-level concept, linking exploitation to incremental innovation and exploration to radical innovation. However, ambidexterity is a concept with many different manifestations (Gupta, Smith and Shalley, 2006). Recent publications within the Project Management, Market-Based Learning, and Entrepreneurship literatures have incorporated such different instances of ambidexterity (Alvarez, Barney and Anderson, 2012; Gnizy, Baker and Grinstein, 2014; Liu and Leitner, 2012). This includes perspectives similar to that which was observed in this study; linking exploration to the development of ideas or

concepts and exploitation to streamline and refine ideas and concepts. Moreover, the literature refers to a different type of ambidexterity, describing planned and unplanned learning. Developing these different concepts of ambidexterity would, therefore, offer a promising direction for future research and respond to calls for more detailed level of research regarding ambidexterity (Gupta, Smith and Shalley, 2006).

Future research may elaborate on the concept of competent improvisation and study its conditions and influences on DCI. A more detailed understanding of how and when departures from original plans occur, and when improvisation begins and ends, would contribute to an understudied theme in Entrepreneurship literature (c.f. Baker, Miner and Eesley, 2003).

Greater understanding regarding the conditions of DCI could be achieved by adding more cases and using qualitative comparative analysis, a structured approach to hypothesise and test causal relations on the basis of qualitative cases (Ragin, 2014). Alternatively, the same results may be achieved by using a survey-based approach. Both routes would also open up the possibility of comparing contexts, thus establishing the importance of DCI for a broader group of SMEs. A valuable comparison would be to compare radical innovations targeting new customers against radical innovations targeting current customers. This would expedite a more detailed understanding of the different resources, practices, and knowledge components needed for each customer strategy. Similarly, a comparison of technological innovations with non-technological innovations would facilitate greater understanding of the challenges involved in simultaneously learning about new technology and new markets.

Instead of focusing on the precursors to DCI (the practices, resources, or contextual differences), future research may decide to further refine the DCI construct itself. An interesting avenue for such future research would be a closer analysis of other DCI formats, such as the business case or business model. This would allow for the analysis of DCI in different situations of use, and investigation into how insights grow across the DCI value chain. Alternatively, future research may seek a greater understanding of the distinct attributes of DCI, in particular how current needs insights sustain latent needs insights. Both avenues of future research would add to the conceptual theme and strengthen the internal validity of the DCI construct.

This study did not investigate indirect outcomes, such as innovation success. Furthermore, the *radicalness*, or uniqueness, of the project was not objectively established. Future research might address these shortcomings and study the relationships between DCI, a more objectively measured uniqueness, and the market success of the radical innovation projects.

A final intriguing avenue for further research would be to follow up on improvement programs and adopt a longitudinal research design approach to understand how DCI practices evolve over time. This would uncover the real-word results of how the expressed intentions to improve research practices unfolded. Moreover, such a research approach would answer questions about the effects of training and education programs. Lastly, this research design would explore the impact of the vision of expert entrepreneurs — e.g. on team composition — and generate a deeper understanding of how the role and impact of the expert entrepreneur changes over time.

10.5 MANAGERIAL CONTRIBUTIONS

The managerial implications of this study are found at three different levels: (1) the practices of SMEs; (2) innovation support policies; and (3) education and training programmes.

10.5.1 Implications for the Practices of SMEs

This study has many implications for professionals involved in the DCI practices of SMEs, and four main suggestions follow from these implications. First, the detailed practice-based approach may support professionals in raising awareness of the interdependencies between practices in SMEs. The connections between practices demonstrate how one provides input to others, forming a web of interrelated practices. SMEs with ambitions to create radical innovations are, therefore, recommended to start their projects by developing an overall vision and plan of approach for DCI, in close cooperation with the actors assigned to those activities. The practice descriptions will guide them in this process. The combinations of activities, objectives, and resources clearly illustrate how and why SMEs generate DCI and provide a rich set of options with which to improve current processes. The full overview of the recommendations that follow from these descriptions is included in Appendix GGG.

Second, the key drivers and building blocks identified in this thesis demonstrated how research and customer involvement competences are essential to achieving higher levels of DCI. This study, therefore, invites managers within SMEs to review current practices and begin reconsidering their components and timing. Special care should be taken not to assign too many of the DCI generation roles to customers (i.e. data collection and analysis and utilisation). The SEMO and FiberTop case projects sampled customers across types of involvement, quantities, and qualities, which was similar to literal and theoretical sampling in case study research. This sampling logic may help SMEs establish some clear rules and methods for selecting customers.

Third, the strong role played by sales professionals within FiberTop suggests that Sales are at the centre of SMEs performance, contributing to both innovative projects and DCI, as well as routine business. A key skill necessary to fulfil this dual role was a strong customer-focused research competence. By firmly incorporating this skill in human resource policies, SMEs can take full advantage of their available resources and manage compliance of those resources for both short-term and long-term objectives.

Fourth, it is clear from the workshop discussions that understanding of the outcomes of practices is a powerful instrument for reflection on priorities, the development of future improvements of both innovation and DCI practices, and improved team performance. The identification of the poor level of insight in the MZI case project resulted in a continuing discussion of MachineCo's innovation ambitions and new product vision. Comparison of the outcomes across the cases led even the most successful projects, ZKL and FiberTop, to reconsider the requirement statement procedure and format. Furthermore, understanding of the actual practice performance created greater comprehension within the teams of each other's work. In the SEMO case project, this has led to clearly defined job descriptions for the recently hired usability tester, who is now much more involved in managing DCI from the earliest innovation phase onwards. Other improvements currently taking place within the SEMO case illustrate how a better understanding of practice performance leads to improved skills and techniques, with pilots now taking place on the basis of quantitative testing of requirements across a wider customer group, and the application of Kano to follow up on attractive qualities.

10.5.2 Implications for Innovation Support Policies

The findings of this thesis have led a local innovation funds in the Netherlands to reflect on criteria and procedures for subsidies and grants awarded to small firm innovators. These funds traditionally placed heavy emphasis on the availability of solution-based knowledge, with little attention paid to high-quality, problem-based, needs-based, and market-based knowledge. This weight on validation also affects coaching and monitoring of the funded projects. An important practical contribution of this study is, therefore, the set of guidelines for a redesign of the application and coaching procedures, with greater attention paid to all types of knowledge underpinning DCI. In a similar fashion, the approaches taken in large EU-funded projects can be improved; the findings of this study have already led to greater attention for DCI in current projects seeking alternative approaches for water management and bio-based building.

10.5.3 Implications for Education and Training

The findings of this study which demonstrate the added value of young, T-shaped professionals and students indicates how education and training institutes may benefit from this study. Therefore, an important practical contribution of this thesis is the set of guidelines it offers for educational material. Material placing greater emphasising on a variety of skills, with ample focus on research competences, is now implemented in the innovation courses of the polytechnical departments of the HZ University of Zeeland. Similar material has been incorporated in the training programmes for SMEs via the local incubator DockWize. The high course evaluations of participants, together with their more documented approach towards investors and grant funds, once more proves the value of increased awareness of DCI generating practices.

10.6 PERSONAL REFLECTION

This project started from a sincere curiosity to the application of DCI in SMEs and have provided me with a chance to take a look behind the scenes of innovation in SMEs. Although I was not necessarily setting out to understand this, it has become abundantly clear what role higher education, such as the University of Applied Sciences HZ, plays in knowledge processes in SMEs. The manner in which companies involved our students, as well as the trust these entities put onto them, speaks to the impact higher education has in this sector.

My cases studies have also given me insight into which subjects our university can differentiate itself with. The MZI case showed the amount of consideration that should be given to the role of a customer, and that there are various forms of market research. Thermo and ZKL showed how significant it is to fit knowledge generation into an owner-driven culture. Finally, Semo and Fibertop show the significance of interdisciplinary cooperation and how hard it is to express and give definition to customer needs. In practically every company where we held workshops, interest was generated to know more about these subjects however often many were not aware of what options were available and how to go about them.

The fact that these conversations developed and led to lasting relationship with companies involved is a tremendous confirmation of the usability of my study. It gave me confidence that I made the right investment and I look forward to define a sequel to this project with my colleagues at the HZ.

10.7 SUMMARY

Chapter 10 has presented an overview of the main conclusions and contributions of this thesis, providing answers to the six knowledge gaps identified, and offering a discussion of some wider implications. Moreover, it has addressed methodological considerations and managerial contributions. Answers with regard to Knowledge Gap 1 demonstrated that DCI generation has a clear purpose and is recognised by SMEs as a critical input for radical innovations. Knowledge Gap 2 demonstrated the improvising nature of DCI generation, whereas Knowledge Gap 3 clarified how DCI touches upon the activities of a variety of professionals working within, or on behalf of, SMEs. Knowledge Gap 4 revealed essential resources for DCI generation and highlighted the importance of research skills. Knowledge 5 demonstrated what levels of maturity a growing DCI capability has to pass. Lastly, Knowledge Gap 6 described, for the first time in academic research, both the characteristics of DCI and the levels of insight achieved by SMEs.

The wider implications of this study resulted from the identification of research skills as a crucial factor in successful DCI generation. These skills had a positive impact on the level of involvement and were key to achieving DCI quality (i.e. a comprehensive, novel, accepted, cost-efficient, and timely insights). Moreover, research skills enable the establishment of more accurate insights in future projects and are, therefore, at the very heart of a growing DCI capability.

Methodological contributions were found in this study's practice approach, the case study selection criteria, and the method of measuring DCI. These contributions enabled this study to more accurately define the DCI concept and observe, with more precision and detail, how SMEs attempt to generate DCI. Moreover, it has placed DCI within the context of new customers, thus focussing critical attention on the level of newness in radical innovation — something that largely remains implicit. The limitations of this study concern its internal validity and generalisability, as well as its foundation in Practice Theory. Future research should, therefore, take next steps in developing a DCI scale and use metric to seek understanding across a wider group of SMEs. Furthermore, alternative perspectives could be sought in order to better understand the role of routines and intuition in the midst of improvisation.

This study has noted some impacts, demonstrated by increasing the process awareness of both practitioners, policy makers, and educational partners. The clear view offered on the consequences of specific actions proved powerful in raising attention for good and bad practices, thus laying first foundation for change and strong radical projects of SMEs.

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APPENDIX A METHODOLOGY FOR THE SYSTEMATIC LITERATURE REVIEW

A Systematic Literature Review (SLR) enabled to synthesise current academic understanding of why, how, and when Small and Medium-sized Enterprises (SMEs) generate DCI. Based on this gaps in current academic understanding of Deep Customer Insights (DCI) were identified.

To ensure that all relevant publications were included and thoroughly appraised, the review process followed a systematic approach (Tranfield, Denyer and Smart, 2003). An explicit procedure was set, and a review panel, consisting of experts in innovation, business performance, systematic literature review and information management, was installed to supervise execution.

Appendix A summarizes the methodological approach taken in six sections:

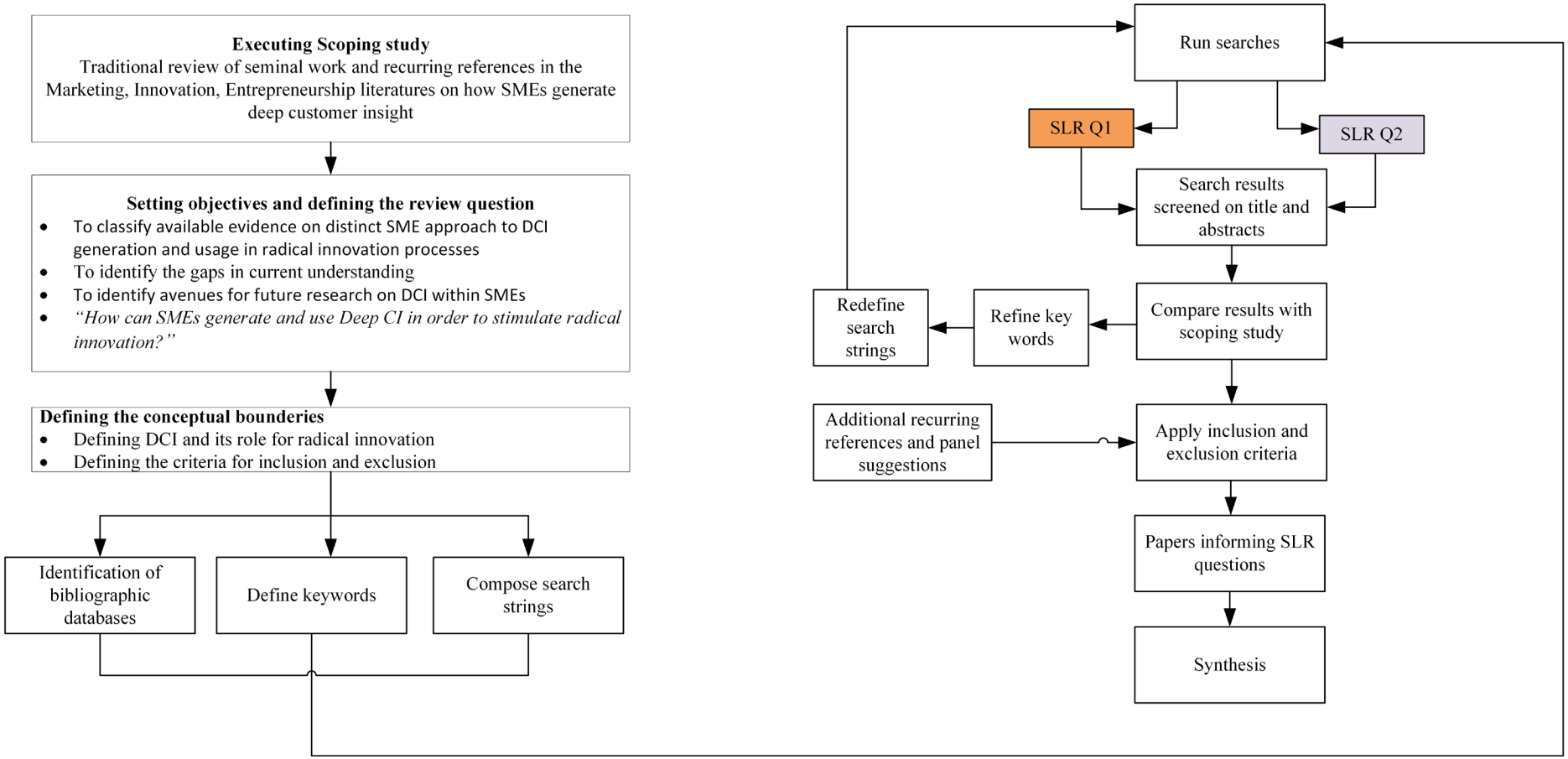
1. The first section presents the overall procedure
2. The second section describes the review questions and conceptual boundaries
3. The third section describes the criteria for inclusion and exclusions
4. The fourth section highlights the keywords and search strategy
5. The fifth section summarizes the output of the review
6. The sixth section explains how the findings were synthesised

A1 OVERVIEW OF THE PROCEDURE

The SLR procedure was based on the guidelines of Tranfield, Denyer and Smart (2003). An overview of the procedure is given in Figure A1.

In a first step, a scoping study identified the main themes and debates with regard to DCI and generated a first transdisciplinary understanding. The findings were used to set objectives and define the review question for the systematic review. Also, the findings were used to set the conceptual boundaries and to develop the criteria for inclusion and exclusion. Searches were run in two bibliographic databases, EBSCO host and ABI/INFORM, and a dedicated set of keywords, combined in carefully designed search strings guided the activities. The approach was refined by comparing the findings with those of the scoping study. Appraisal of the resulting set of papers led to a final set of papers for synthesis.

Figure A.1: Overview of SLR procedure



Source: Author

A2 REVIEW QUESTIONS AND CONCEPTUAL BOUNDARIES

The scoping study identified the main themes and debates concerning DCI. This revealed a lack of consensus on what DCI is and how it forms part of radical innovation processes and gave rise to the overall SLR question: *How can SMEs generate and use DCI in order to stimulate radical innovation?* To understand how approaches of SMEs are different from those of large firms, two distinct research questions were defined. SLRQ1 aimed for understanding of large firms: *How do large firms generate and use DCI to stimulate radical innovation?* SLRQ2 aimed for understanding of small firms: *How do SMEs generate and use DCI to stimulate radical innovation?* This dual focus ensured sufficient grounding within mainstream theories and adequate tailoring of the search strategies to the specific characteristics of research on large firms and SMEs.

The conceptual boundaries became clear from a closer inspection of how DCI is defined within the Marketing, Innovation and Entrepreneurship literature. This revealed a widely held recognition within the Marketing and Innovation literature that understanding of customer's *latent* needs is vital to develop radical new products and services (see e.g. Cooper and Dreher, 2010; Hauser, Tellis and Griffin, 2006; Rosenthal and Capper, 2006). Latent needs are needs customers are not aware of (Narver, Slater and Maclachlan, 2004), and, consequently, are hard to express (Slater and Narver, 1998). Goffin, Lemke and Koners (2010) refer to these latent needs as *hidden* – or unidentified – needs. Innovations based on this type of needs offer more potential to excite and surprise customers compared to innovations based on expressed, or known needs (Griffin and Hauser, 1993). Understanding of latent needs was found to be a focal concept in research on Market Based Learning (MBL). When focusing on radical innovation, MBL highlights the use of highly novel and heterogeneous information about customers and competitors (Kim and Atuahene-Gima, 2010; Narver, Slater and Maclachlan, 2004). Due to the tacitness of latent needs, a thorough understanding of latent needs requires *deep* or *sophisticated* customer knowledge, explaining the *"unique and interdependent relationships among the factors that describe key issues about customers"* (De Luca and Atuahene-Gima, 2007, p. 98). These factors include emotions, expectations, experiences, emerging trends, wider needs and problems (Bohlmann et al., 2013; Cayla and Arnould, 2013; Day, 2011; Deszca, 1999), and factors related to customer choice and usage situations (Baker and Sinkula, 2005; Baxter, Goffin and Szwejczewski, 2014; Van der Hoven et al., 2013).

References to the term *insights* were found in the Innovation Management and Design literature and refer to the unique and novel type of knowledge that explain latent needs (e.g. Cayla and Arnould, 2013; Cui and Wu, 2016; Gruner and Homburg, 2000b; Madsbjerg and Rasmussen, 2014.

Building on these thoughts DCI is defined in this thesis as an intimate and shared understanding of the *latent*, unarticulated, needs of the customer. It is the result of understanding many individual pieces of information gathered by means of research, all of which are brought into a coherent view about how new products can address customers' latent needs (Goffin, Lemke and Koners, 2010; Price and Wrigley, 2016). This definition highlights the role of DCI for radical innovation and excludes DCI used for daily operations or for incremental innovation.

A3 CRITERIA FOR INCLUSION AND EXCLUSION

The criteria for inclusion and exclusion enabled to exclude papers not fitting the conceptual boundaries. Moreover, they permitted to perform a baseline quality check. A more in-depth

reflection on the weight and rigor of the evidence took place during synthesis (Pawson et al., 2005). Table A.1 Lists the criteria for inclusion and exclusion. Papers that discussed radical innovation only to a limited extent, were excluded. Likewise, papers in which customer insight was just one of the many other variables were not included. Based on findings stressing the influence of culture and macro-economic contexts on innovation and learning, papers studying DCI in developing countries and countries from the far east were excluded (see e.g. Calantone, Harmancioglu and Droge, 2010; Deshpandé and Farley, 2004; Wren, Souder and Berkowitz, 2000; Zhou et al., 2007). Considering the complexity of the research area and fragmentation of Marketing, Innovation and Entrepreneurship research journal rating was not considered as an exclusion criterion.

Table A.1: Criteria for Inclusion and Exclusion.

Criteria	Inclusion	Exclusion
Focus	Literature focusing on innovative product or service development within SME context	Literature focusing on process and administrative innovation or other functional capabilities
Focus	Papers describing innovation management approach, tools/techniques/instruments contingencies and particular challenges of innovation	Literature exploring effects of innovation, for example on economies or regions
Focus	Papers describing marketing and market research approaches, tools/techniques/instruments contingencies (mechanism of action) and particular challenges of marketing within the innovation process of SMEs	Literature discussing marketing management challenges, without touching upon the innovation process like e.g. exporting, CRM or Supply Chain Management Literature describing market research reports Literature on the market research industry Hits solely due to journal title (e.g. Qualitative Market Research)
Population	Sampled firms are within developed, West European, US and Australian countries	Sampled firms are Asian firms or from developed or under-developed countries
Population for RQ2	Literature focusing on SMEs, subset of SMEs, or segmented target groups including SMEs within we	Literature sampling large firms Literature sampling members of Society of Manufacturing Engineers (e.g. SMEs of Koufteros) Undefined target groups Conceptual papers not fitting SME context
Baseline quality	Peer-reviewed and Scholarly journals	Anonymous papers, Papers expressing opinions or Descriptive papers without a clear theoretical background Checklists and overviews
Language	The article must be in English, either originally or via translation	Any other language
Journal rating	Any	N/A
Author	Both practitioner as academic	N/A

Source: Author

A4 KEYWORDS AND SEARCH STRATEGY

The keywords allowed to identify papers studying DCI from different perspective. For SLRQ1 the keywords referred to the related processes, the results of these processes, customers' needs, and innovation. For SLRQ2 the same keywords were used, but here keywords addressing the SME context were added. The Tables A.2 and A.3 give an overview of the keywords.

Table A.2: Keywords used for SLRQ1

Topic	Search string reference	Keywords	Purpose
Processes	MECH	“market learning” OR "market research" OR "customer research" OR "customer input" OR "customer learning"	mechanisms for DCI
The outcomes of the processes	CI	"customer intelligence" OR "market intelligence" OR "customer insight?" OR "market knowledge" OR "customer information" OR "customer knowledge"	results of general DCI mechanisms
Customers needs	NEEDS	“customer* w/4 needs” OR "market needs" OR "latent needs" OR "future needs" or "Hidden Needs" or "unarticulated needs"	focus of customer insight
Innovation	INNO	innovation OR "product development" OR opportunit? OR "idea generation" OR "fuzzy front end" OR "concept development" OR "launch" OR commerciali?tion OR NPD OR "new product development" OR "product design" OR "stage?gate"	the usage situation of DCI (not limited to radical innovation to allow inclusion of studies not making explicit references)

Source: Author

Table A.3: Additional Keywords for SLRQ2

Topic	Search string reference	Keywords	Purpose
SME	SME	SME OR "small w/3 firm*" OR "small w/3 business*" OR "entrepreneurial firm*" OR "entrepreneurial ventures" OR "small w/3 companies" OR "young firm*" OR gazelle	subset of firms

Source: Author

Searches for both SLR questions took place in EBSCO and ABI/INFORM databases and were limited to English-language papers. To ensure sufficient validity, searches were limited to peer-reviewed articles (Podsakoff et al., 2005). Table A1.4 summarises the search strategies used for SLRQ1 and SLRQ2. As can be seen in the second column, five different search strategies (SS1 – SS5) were used. The search strings combine the keywords in different ways. Taking into account the high fragmentation of studies on SMEs, SLRQ2 included searches on both full text as on abstracts, titles and keywords.

Table A.4: Search Strategies SLRQ1 and SLRQ2

SLR question	Reference	Search Strings (building on the search string references mentioned in Tables A.2 and A.3)	Search fields
SLRQ1	SS1	MECH OR CI AND NEEDS AND INNO	Abstracts, titles and keywords
	SS2	MECH OR CI AND NEEDS	Abstracts, titles and keywords
SLRQ2	SS3	MECH OR CI AND NEEDS AND INNO AND SME	Full text
	SS4	MECH OR CI AND INNO AND SME	Abstracts, titles and keywords
	SS5	MECH OR CI AND NEEDS	Abstracts, titles and keywords

Source: Author

A5 THE OUTPUT OF THE SLR

To prevent that important articles were missed, the results of the bibliographic database search were complemented with the papers of the scoping study and a second set resulting from cross-reference search and panel suggestions. Table A.5 summarizes the amount of papers identified in each search.

For SLRQ1 a total of 240 papers were identified by means of database search. After inspection of titles and abstracts 82 papers were retained. Together with the papers identified in the scoping study and by means of cross-referencing, 182 papers were available for full test inspection. After the full text review, 82 papers were retained. For SLRQ2 a total of 868 papers were identified by means of database search. This number was reduced to 200 papers after title and abstract inspection. Together with the papers identified in the scoping study and cross-referencing 279 were available for full test inspection. After full text review, 39 papers were retained

Table A.5: Overview of SLR results

SLR question	Database search		Other sources			
	Identified	Retained after titles and abstracts (A)	Positioning study (B)	Cross-referencing (C)	Available for full text inspection (A + B= C)	Final set of paper retained
SLRQ1	240	82	55	45	182	82
SLRQ2	868	200	72	6	279	39

Source: Author

A6 SYNTHESIS

The papers were reviewed by means of thematic approach (Mays, Pope and Popay, 2005). Ten thematic themes were identified: the value of a Market Orientation (MO) culture; organisation-wide Market Information Processing (MIP); MIP within projects; sources of information; customer involvement processes; quality of knowledge; tools and techniques; implementation; practices of teams; and practices of individuals. The themes describe conditions for successful generation of DCI at three distinct levels of organisation: the organisation-wide level, the project level and the individual level. The themes and their level of organisation are summarised in Table A.6

The findings within each theme were structured and summarized by means of a thematic approach (Mays, Pope and Popay, 2005).

Table A.6: Overview Research Themes

Level	Theme
Organisational	**(1) Value of an MO culture:** The influence of organisation-wide norms and beliefs about being market-oriented on new products' or new programs' success
	(2) Organisation-Wide MIP: The influence of organisation-wide processing of market information on new products' or new programs' success
	Total references to themes at organisation-level
Project	**(3) MIP Within Projects:** How information processing takes place within distinct NPD phases
	(4) Sources of Information: The background characteristics of the input sources of DCI, as well as the processes and methods for selecting sources of information
	(5) Customer Involvement Processes: The processes for engaging with customers
	(6) Quality of Knowledge: The dimensions, determinants and consequences of knowledge quality
	(7) Tools and Techniques: The applicability of tools and methods for DCI
	(8) Implementation: Guidelines or barriers for the implementation of DCI capabilities
	(9) Practices of Teams: Roles, tasks, and interaction of team members during the generation of DCI
	Total references to themes at project-level
Individual	**(10) Practices of Individuals:** The roles and tasks of specific individuals in the generation of DCI

Source: Author

APPENDIX B EVALUATION OF CASE STUDY RESEARCH USING CASET[1]

Author	# of cases	# of sources	Theoretical foundation	Pilot study	Theoretical Sampling	Triangulation	Review and validation of evidence	Transparency of data collection	Inter-coder agreement	Case presentation	Case interpretation	Reflecting on validity and reliability	Total CASET
Berends et al. (2014)	5	3	0	0	1	1	1	1	1	1	1	1	8
Meyers and Athaide (1991)	6	4	1	0	1	1	0	0	0	0	0	1	4
Coviello and Joseph (2012)	6	2	1	0	1	1	1	1	1	0	1	1	9
Marion, Friar and Simpson (2012)	2	2	1	0	1	1	0	1	0	0	0	1	5
Thomas, Painbéni and Barton (2013)	1	3	1	0	0	1	1	1	0	0	0	0	4
Parry et al. (2012)	2	3	1	0	1	1	1	1	0	0	0	0	5
Bettiol, Di Maria and Finotto (2011)	4	4	1	0	1	1	0	0	0	0	1	0	4
Massa and Testa (2011)	20	3	0	0	1	1	0	1	0	0	1	1	5
(Frishammer and Ylinenpää, 2007)	4	2	0	1	1	1	0	0	0	0	1	0	4
Mosey, Clare and Woodcock (2002)	7	2	0	0	1	1	0	0	0	0	0	0	2
Mosey (2005)	5	4	1	0	1	1	1	0	0	0	0	0	4
Millward and Lewis (2005)	3	3	0	0	1	1	0	0	0	0	0	0	2
Average													4,67

Source: Author

[1] The ten quality criteria used are adopted from Goffin, Richtnér and Ahlstrom (2012)

APPENDIX C OPERATIONALISATION SCREENING SURVEY

Items measured	Purpose	Scales used	Literature references
Year of starting current business	Screening	Open ended	
Still active selling innovation that was nominated for the innovation award	Screening	Closed yes/no	
Reason why not active anymore	Screening	Open ended	
Number of employees	Screening	Numerical value	
Newness of customer segment	Screening	Closed yes/no	
Customer experience with product	Perception of experience of the customer in using this product	Likert Scale 1 to 5, No experience – high experience	Adapted from Olson, Walker and Ruekert, 1995; Bonner, 2010).
Experiences in product development	Perception of experience of firm with developing the product	Likert Scale 1 to 5, No experience – high experience	Adapted from Olson, Walker and Ruekert, 1995; Bonner, 2010).
Experience in producing the product	Perception of experience of firm with producing the product	Likert Scale 1 to 5, No experience – high experience	Adapted from Olson, Walker and Ruekert, 1995; Bonner, 2010).
Experience in marketing the product	Perception of experience of firm with marketing the product	Likert Scale 1 to 5, No experience – high experience	Adapted from Olson, Walker and Ruekert, 1995; Bonner, 2010).
Experience of industry with the new product	Perception of experience of industry with product	Likert Scale 1 to 5, No experience – high experience	Adapted from Olson, Walker and Ruekert, 1995; Bonner, 2010; De Luca and Atuahene-Gima, 2007.
Newness customer needs firm	Perception of knowledge of firm with customer needs related to product	Likert Scale 1 to 5, very poor - excellent	Adapted from Olson, Walker and Ruekert, 1995; Bonner, 2010.
value DCI	Perception of importance of DCI for market success innovation	Likert scale 1 to 5 Not at all important - Very Important	Adapted from Slater and Olson, 2001; Reijonen and Komppula, 2010
DCI maturity	Perception of measure indicating level of DCI expertise	Likert scale 1 to 5 CI is not managed at all – CI is managed very well	Adapted Reijonen and Komppula, 2010

Source: Author

APPENDIX D TRANSLATED TOPIC LIST

Demographic background

- Name interviewee
- Number of employees case company
- Turnover case company
- Role interviewee within case project
- Experience within field of expertise interviewee
- Number of innovation projects in which the interviewee participated during his/her career

Innovation context

- Importance of innovation for case company
- Other successful innovations
- Innovation experience of the actors
- Market opportunities for case project, including arguments
- Market segments for case project
- Rating of newness of market segment
- Rating of newness to the firm of applied technology
- Rating of newness to the industry of applied technology
- Rating of newness of customer needs
- Innovation process-steps of case project
- Important events during innovation process-steps
- Actors involved in the case project and their tasks
- Current market results of the case project (acceptance, more than anticipated/than competitors)

DCI content

- List of insights within each phase, why was this insight important
- Rating of quality of overall DCI quality

DCI practices

- Activities done to understand market opportunities for case project
- Rating of importance of DCI for case project
- For each DCI content topic (see above):
    - When did this insight arise -> link to innovation phase
    - What did you do to arrive at this insight
    - Who was involved
    - What other means did you need to arrive at this insight
    - What did you do with the insight
        - Outcomes
        - Usage processes
        - Sharing -> with who, how often
        - Documentation ->
- Rating of DCI management

CI perceptions

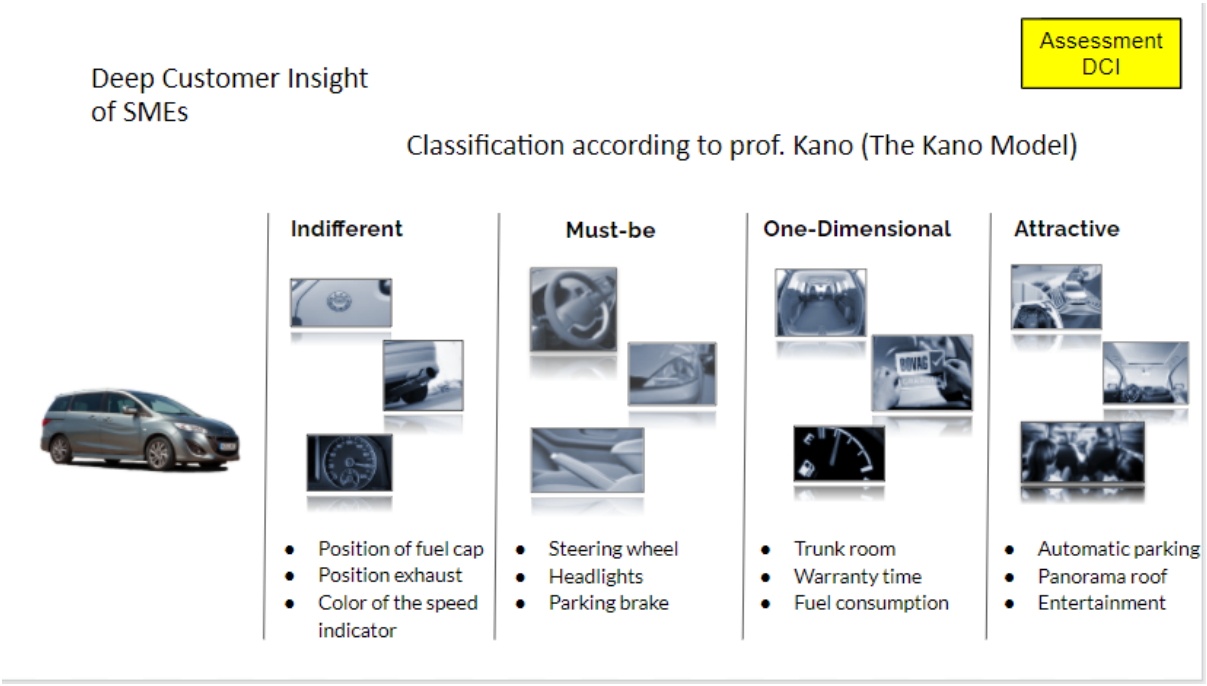
- DCI factors of success, and for each factor:
    - why is this factor important,
    - what is needed to achieve this factor
    - are guidelines present, is the approach different in other projects

Prompt:

- Issues not discussed but found important for DCI generation

APPENDIX E PROCEDURE NEEDS INSIGHTS ASSESSMENT SURVEY

1. Introduction and explanation by means of an example



2. Administration of the needs insights assessment survey

Table E.1: Operationalisation Needs Assessment Survey

Items measured	Purpose	Scales used	Literature references
Role within the case project	Screening	Open ended	
Type of needs insights Requirement 1 - xx	Assessing type of needs insight	Nominal scale 'indifferent'; 'must-be'; 'one-dimensional'; 'attractive'.	Adapted from Kano (1994).

Source: Author

APPENDIX F WORKSHOP SCRIPT

Topic	Objective	Duration (minutes)	Arrangement	Material
Introduction to workshop	Agree on timing, prepare for content	15	Plenary presentation	Check for audio recording
Explain what insights are and discuss example of KANO	Prepare for needs insights assessment survey	15	Plenary presentation	exercise
Needs assessment survey	Scoring of type of insights	10	Individual scoring	Online survey, each participant has access via smartphone or computer. Each participant is accompanied by researcher to assist in case of questions. Researchers were trained up front.
Display results and discuss findings	Validate results	15	Plenary discussion	Real-time presentation of results via Google forms/sheets
Give overview of 13 practices	Validate practices, to prepare for practice maturity survey	20	Plenary presentation	Each participant has set of cards giving an overview of each practice (see Figure F.1 for example Practice Card)
Practice maturity survey	Establish levels of importance and implementation of the practices	20	Individual scoring	Online survey, each participant has access via smartphone or computer. Each participant is accompanied by researcher to assist in case of questions. Researchers were trained up front
Display results and discuss findings	Validate results	15	Plenary discussion	Real-time presentation of results via Google forms/sheets, include opportunity matrix
Improvements and barriers for practices most valuable to improve	Have full inventory of potential improvements and barriers, create consensus on most important improvements	20	Individual exercise, afterwards plenary discussion	Use of cards to establish shared terminology
Probe for best practices from the literature	Establish how best practices from the literature apply to practice of case study company	10	Plenary discussion	Challenging probes (see Figure F.2 for example)
Closure	Evaluate session and make appointments for further questions and follow up	5	Plenary discussion	

Source: Author

Figure F.1: Example Practice Card

Deep Customer Insight in SMEs

What are the outcomes?

Ideas to solve the identified problems of customers.

What activities are undertaken?

Brainstorming on ideas of customers, or on solutions for customer problems. This may take place in a multidisciplinary team and may make use of creative techniques .

B. Generating innovation ideas

What are possible next steps

- Exploring the market opportunity;
- Defining the value proposition;
- Securing innovation funds.

Figure F.2: Example probe for use of best practice

Deep Customer Insight in SMEs

Potential for improvement

Can you identify needs without an idea / product and what is needed for this?

APPENDIX G CODE BOOK DCI ACTIVITIES

A1 Identifying a problem area	Everything that is done to select the main problem to be investigated further.
A2 Conducting customer conversations	Exploring customers' problems and issues by interviewing them
A3 Analysing customer problems	Everything that is done to summarise the data from customer conversations into main findings
A4 Documenting customer problems	Writing down a summary so that main findings can easily be transmitted to others
B1 Checking ideas of customers	Exploring ideas/solutions from customers
B2 Consensus and decision making	Decide on the suitability of ideas
B3 Generate new ideas	Everything done to generate new ideas, for example by means of brainstorming
C1 Finding funds for problem analysis	Everything done to find funds or get approval for doing a problem analysis
C2 Finding funds for needs analysis	Everything done to find funds or get approval for an in-depth analysis of customers' needs
C3 Finding funds for testing	Everything done to find funds or get approval for testing the product with customers
D1 Desk research	Activities related to searching and inspecting existing information like reports or emails
D2 Visiting conferences	Observations and talks with experts and potential customers at conferences and fairs
D3 Interviewing	Interviewing of customers, experts or others about market characteristics
D4 Analysing the opportunity	Summarising data found into main findings
D5 Documenting the opportunity	Writing down summaries of the findings so that main findings can easily transmitted to others
E1 Defining customer value	Everything done to conclude on the value of the innovation for the customer
E2 Defining firm value	Everything done to conclude on the value of the innovation for firm (e.g. business case)
F1 Planning	Activities with regard to the planning of DCI activities (research, mobilising customers)
F2 Developing methods	Everything that is done to have appropriate methods for researching
F3 Monitoring	Everything done to follow-up on the activities and to correct for mistakes or inefficiencies
G1 Defining customer criteria	Defining the criteria for including and excluding informants in the sample
G2 Identifying of customers	Selection of customers that will be included in the sample
G3 Activating of customers	Approaching participants and making sure that are willing to cooperate
G4 Managing of expectations	Everything that is done to manage expectations and the relationship with the informants
H1 Preparing for efficient data collection	Developing the procedures and protocols guiding data collection
H2 Visiting customers	The actual visiting and observation of how customers work with the products being researched
H3 Watching movies	Looking at videos demonstrating how customers work with the products being researched
H4 Conducting conversations	Exploring customers' needs by interviewing them
H5 Analysing needs	Summarizing data found into main findings
H6 Documenting needs	Writing down summaries of the findings so that main findings can easily transmitted to others
H7 Reflecting on assumptions	Monitoring results, analysing the process and deciding on the most appropriate next step
I1 Surveying customers	Surveying customers on their preferences for certain attributes
I2 Conduction conversations	Exploring customers' preferences for solutions by interviewing them
I3 Watching movies of use	Looking at videos demonstrating how customers work with the products being researched
I4 Analysing feedback	Summarizing data found into main findings
I5 Documenting feedback	writing down summaries of the findings so that main findings can easily transmitted to others
I6 Reflecting on assumptions	Monitoring results, analysing the process and deciding on the most appropriate next step
J1 Listing user requirements	Putting together a final list of requirements
J2 Setting priorities	Everything that is done to decide on the priorities
J3 Refining requirements	Everything that is done in refining requirements after a first proto-type or release
K1 Acquisition of internal sources	Asking colleagues of other departments for input
K2 Sharing of information	Share relevant findings with colleagues of others departments
L1 Generate ideas for solution	Everything done to generate new solution concepts, for example by means of brainstorming
L2 Consensus and decision making	Decide on the suitability of ideas
L3 Developing the solutions	Actual development of the solutions
M1 Re-using CI	Using insights captured earlier to develop a plan for launch
M2 Communicating insights	Present and explain launch activities

APPENDIX H CODE BOOK OBJECTIVES

AO1 To define product market segments	Arguments explaining how this practice enabled to define product market segments
AO2 To further develop first ideas	Arguments explaining how this practice enabled to develop first ideas
AO3 To validate a first idea	Arguments explaining how this practice enabled to validate first ideas
AO4 To build trust with potential customers	Arguments explaining how this practice enabled to build trust
BO1 To define a project fitting into the strategic agenda	Strategic arguments for idea generation
BO2 To define a solution for observed needs	Arguments relating the fulfilment of customer needs to idea generation
BO3 To define a project that can be funded	Arguments relating financial feasibility of a project to idea generation
CO1 To get authorisation from management	Arguments explaining how the securing of funds creates authorisation from management
CO2 To create means for next development	Arguments explaining this practice enabled means for next phase of development
CO3 To create a customer base	Arguments explaining how this practice enabled to create a customer base
DO1 To make a business model	Arguments explaining how this practice enabled to make a business model
DO2 To estimate market potential	Arguments explaining this practice enabled to estimate the market potential
EO1 To justify investments in development, production, and marketing	Arguments explaining this practice enabled to justify investments
EO2 To establish a shared vision on the importance of the project	Arguments explaining how this practice enabled to establish a shared vision
FO1 To collect information in a conscious, efficient, and impartial manner	Arguments explaining how this practice enabled to collect information in a conscious, efficient, and impartial manner
FO2 To make sure uncertainty decreases	Arguments explaining how this practice enabled to decrease uncertainty across the process
GO1 To increase development capacity	Arguments explaining how this practice enabled to increase the development capacity
GO2 To find money for further development	Arguments explaining this practice enabled s to find money for further development
GO3 To prepare for sales & marketing	Arguments explaining how this practice enabled to prepare for sales & marketing
GO4 To get customer information	Arguments explaining how this practice enabled to get customer information
HO1 To support solution-finding	Arguments explaining how this practice enabled to support solution-finding
HO2 To define customer requirements	Arguments explaining how this practice enabled to define customer requirements
HO3 To validate the scope of the project	Arguments explaining how this practice enabled to validate the scope of the project
IO1 To validate and refine customer requirements	Arguments explaining how this practice enabled to refine customer requirements
IO2 To identify missing information	Arguments explaining how this practice enabled to identify missing information
IO3 To check performance of the solution	Arguments explaining how this practice enabled to check performance of the solution
JO1 To achieve a shared understanding	Arguments explaining how this practice enabled to achieve a shared understanding
JO2 To supervise the development process	Arguments explaining how this practice enabled to supervise the development process
JO3 To manage expectations of customers	Arguments explaining how this practice enabled to manage expectations of customers
KO1 To learn about new customers and markets	Arguments explaining how this practice enabled to about new customers and markets
KO2 To validate findings	Arguments explaining how this practice enabled to validate findings
KO3 To get access to customer network	Arguments explaining how this practice enabled to get access to customer network
LO1 To provide material for testing	Arguments explaining how this practice enabled to provide material for testing
LO2 To prepare for sales & marketing	Arguments explaining how this practice enabled to prepare for sales & marketing
MO1 To start up the commercial process	Arguments explaining how this practice enabled to start up the commercial process

APPENDIX I CODE BOOK RESOURCES

A1 A sufficiently broad scope	A broad perspective on the market, not limited by a specific solution. Includes distinct problems and customer groups
A2 Readily available internal sources	Sources of information found within the firm
A3 Readily available customer sources	Customers that can be approached easily (current customers, close relationships, network relations)
A4 Readily available expert sources	Experts that can be approached easily (e.g. via relationships, existing networks)
A5 Readily available secondary sources	Sources found via internet search
A6 Interview skills	Knowing how to conduct interviews
A7 Analytical skills	The ability to structure raw data and reduce it to main findings
B1 Vision of the future	Long term view on the future of the firm
B2 Overview of current products and capabilities	A good overview of current products, strength and weaknesses
B3 Experience with creative techniques	Techniques stimulating creative thinking
B4 A sufficiently broad scope	A broad perspective on the market, not limited by a specific solution. Includes distinct problems and customer groups
B5 Market reputation	A certain market reputation enabling that customers bring forward their ideas
C1 Corporate decision-making criteria	Explicitly defined criteria for go/no go decision and allocation of funds
C2 Strategic reflections	Strategic awareness on how the new product will affect long-term results and what priorities should be given to certain requirements given competitor activity
C3 Availability of grants	Availability of subsidies and grants
C4 Customers willing to pay	Expressed willingness of customers to pay for the new solution
D1 Research method expertise	Expertise of research techniques
D2 Interview skills	Knowing how to conduct interviews
D3 Analytical skills	the ability to structure raw data and reduce it to main findings
D4 Student support	Students supporting in executing the tasks
D5 Internal sources of market knowledge	Sources of information found within the firm
D6 Readily available customer sources	Customers that can be approached easily (current customers, close relationships, network relations)
D7 Readily available expert sources	Experts that can be approached easily (e.g. via relationships, existing networks)
D8 Readily available secondary material	Sources found via internet search
D9 Company formats	Predefined documents and templates specifying what information should be generated and described
E1 Individual integration skills	The ability of an individual to combine different pieces of information and to define what the findings mean for the project/task at hand
E2 Sensemaking with customer	Involving the customers in giving meaning to research findings
E3 Collaborative sensemaking within team	A collective approach to give meaning to research findings
E4 External legitimacy	Approval of the project by external parties, thereby legitimising its existence
E5 Company formats	Predefined documents and templates specifying what information should be generated and described
F1 Research method expertise	Expertise of research techniques
F2 Reflectiveness	The capability of quiet thought or contemplation
F3 A manager	Somebody supervising the process
F4 Company formats	Predefined documents and templates specifying what information should be generated and described
F5 Criteria for customer selection	The criteria used to select customers that will inform the project
G1 Customer incentive	All things that motivate customers within the firm to contribute to the project
G2 Internal incentive	All things that motivate people within the firm to contribute to the project
G3 Marketing channels	All things needed to transfer goods to the customer
G4 Customer management skills	The ability to make customers feel good with the product and services

H1 Research method expertise	Expertise of research techniques
H2 Interview skills	Knowing how to conduct interviews
H3 Analytical skills	the ability to structure raw data and reduce it to main findings
H4 Student support	Students supporting in executing the tasks
H5 Readily available internal sources	Sources of information found within the firm
H6 Readily available customer sources	Customers that can be approached easily (current customers, close relationships, network relations)
H7 Awareness of uncertainties	Interest in understanding the uncertainties surrounding customers' needs
H8 Company formats	Predefined documents and templates specifying what information should be generated and described
I1 Minimum Viable Product	Product version used to validate assumptions
I2 Interview skills	Knowing how to conduct interviews
I3 Analytical skills	the ability to structure raw data and reduce it to main findings
I4 Documentation system	Collection of documents describing a process of product
I5 Readily available customer sources	Customers that can be approached easily (current customers, close relationships, network relations)
J1 Individual integration skills	The ability of an individual to combine different pieces of information and to define what the findings mean for the project/task at hand
J2 Sensemaking with customer	Involving the customers in giving meaning to research findings
J3 Collaborative sensemaking within team	Collective approach to give meaning to research findings
J4 Company formats	Predefined documents and templates specifying what information should be generated and described
K1 Readily available internal or partner sources	Sources of information found within the firm
K2 Internal Incentive	All things that motivate people within the firm to contribute to the project
K3 Communication channels	A system or method that is used for communicating with other people
L1 Experience with collective idea generation	Knowing how to engage with others in creative tasks
L2 Customer empathy in R&D team	The ability to recognize, understand, and share the thoughts and feelings of the customers
L3 Developing the solutions	Create the solution
L4 Visual material supplied by the customer	Examples, sketches, diagrams provided by the customer and supporting the creation of the solution
L5 Co-creating customer	A customer actively involved in the generation of ideas
L6 Student support	Students supporting in executing the tasks
L7 Project management tool	Aids to assist an individual or team to effectively organize work and manage projects and tasks
M1 Individual integration skills	The ability of an individual to combine different pieces of information and to define what the findings mean for the project/task at hand
M2 Collaborative sensemaking within team	Collective approach to give meaning to research findings
M3 Student support	Students supporting in executing the tasks
M4 Documentation system	Collection of documents describing a process of product
M5 Company formats	Predefined documents and templates specifying what information should be generated and described

APPENDIX J CODE BOOK RELATIONSHIPS

A to B	Pieces of information describing how the exploration of customers' problems provided input for idea generation
A to C	Pieces of information describing how the exploration of customers' problems provided input for the securing of innovation funds
A to D	Pieces of information describing how the exploration of customers' problems provided input for exploring markets & opportunity
A to E	Pieces of information describing how the exploration of customers' problems provided input for defining the value proposition
A to F	Pieces of information describing how the exploration of customers' problems provided input for managing DCI action
A to G	Pieces of information describing how the exploration of customers' problems provided input for mobilising customer sources
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A to K	Pieces of information describing how the exploration of customers' problems provided input for mobilising internal sources
A to L	Pieces of information describing how the exploration of customers' problems provided input for developing the product concepts
A to M	Pieces of information describing how the exploration of customers' problems provided input for planning sales and marketing
B to A	Pieces of information describing how idea generation provided input for the exploration of customers' problems
B to C	Pieces of information describing how idea generation provided input for the securing of innovation funds
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L to A	Pieces of information describing how developing the product concepts provided input for the exploration of customers' problems
L to B	Pieces of information describing how developing the product concepts provided input for idea generation
L to C	Pieces of information describing how developing the product concepts provided input for securing innovation funds

L to D	Pieces of information describing how developing the product concepts provided input for exploring markets & opportunity
L to E	Pieces of information describing how developing the product concepts provided input for defining the value proposition
L to F	Pieces of information describing how developing the product concepts provided input for managing DCI action
L to G	Pieces of information describing how developing the product concepts provided input for mobilising customer sources
L to H	Pieces of information describing how developing the product concepts provided input for elaborating customer needs
L to I	Pieces of information describing how developing the product concepts provided input for collecting customer feedback
L to J	Pieces of information describing how developing the product concepts provided input for defining customer requirements
L to K	Pieces of information describing how developing the product concepts provided input for mobilising internal sources
L to M	Pieces of information describing how planning sales and marketing provided input for planning sales and marketing
M to A	Pieces of information describing how planning sales and marketing provided input for the exploration of customers' problems
M to B	Pieces of information describing how planning sales and marketing provided input for idea generation
M to C	Pieces of information describing how planning sales and marketing provided input for securing innovation funds
M to D	Pieces of information describing how planning sales and marketing provided input for exploring markets & opportunity
M to E	Pieces of information describing how planning sales and marketing provided input for defining the value proposition
M to F	Pieces of information describing how planning sales and marketing provided input for managing DCI action
M to G	Pieces of information describing how planning sales and marketing provided input for mobilising customer sources
M to H	Pieces of information describing how planning sales and marketing provided input for elaborating customer needs
M to I	Pieces of information describing how planning sales and marketing provided input for collecting customer feedback
M to J	Pieces of information describing how planning sales and marketing provided input for defining customer requirements
M to K	Pieces of information describing how planning sales and marketing provided input for mobilising internal sources
M to L	Pieces of information describing how planning sales and marketing provided input for planning sales and marketing

APPENDIX K EVIDENCE OF PRACTICES SEMO

Table K.1: Evidence of Practice A Within SEMO Case

Case SEMO: Practice A. Exploring Customer Problem Situation					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To define product market segments	n/a	DOC	2	The PBC, p. 4, lists potential target groups, without defining these more carefully. The URC, p. 4, does discuss market segments in more detail, but this is at a much later stage of the project.	n
To further develop first ideas	"We went to see a number of customers […] to get more insight for other ideas […]" (INT-SLSs)	SLS	2	n/a	y
To understand the opportunity of a customer idea	"And that is what you go out for and test. To see whether there are more people having such needs" (INT-PO1s)	PO	3	n/a	y
To build trust with potential customers		DOC	2	The PBC and Roadmap state that, at this stage of the project, both idea and target group are open for discussion. At later stages, customer management goals drive the activities.	n
Activities		**Actor**	**#**		**y/n**
Identifying a problem area	"Already in 2010, we received a request for a tool which can [functionality] (PBC, p.1). "They had written their own program to do [functionality], this enabled [user-group] to [lists tasks] [...] And then we wondered why can't we do this?" (INT-SLSs)	POs	1	n/a	y
		SLSs	1		
		DOC	2		
Consensus and decision making	"Discussion with development team pending. First a SC-approved decision on the product definition is required." (URD, p. 13)	POs	1	n/a	y
		SLSs	3		
		DOC	2		
Conducting customer conversations	"We call them and get in touch (INT-PO1s). "At least 5 visited prospects have this requirement." (PBC, p.2)	POs	2	n/a	y
Reporting of customer problems	"I wrote the use case." (INT-PO1s) "3. Market Request" PBC, page 2)	POs	1	n/a	y
		SLSs	1		
		DOC	1		
Resources		**Actor**	**#**		**y/n**
A broad scope	n/a	DOC	2	The first rudimentary ideas, expressed in the Roadmap and PBC, centre around the addition of a new functionality. The underlying customer problems remain within the boundaries set by this functionality and do not take a broader perspective.	n
Readily available internal sources	"You need salespeople with experience […] to understand customer needs" (INT-SLSs) "We started of course from a use case. That sparked the idea." (INT-PO1s)	POs	2		y
		SLSs	2		
Readily available customer sources	"[…] and in order to be able to fulfil their request we talked to one particular customer in [city] [...]" (INT-PO1s) "We went to see a number of customers […]" (INT-SLSs)	POs	2		y
		SLSs	1		
		DOC	1		

Table K.1: Continued

Readily available expert sources	Readily available expert sources	PO	1	"I did do desk research and I went to talk to people at conferences, but that was later. Were there any other things, I should have done besides of talking to the customers? I don't know […]" (INT-PO1s)	n

Source: Author

Table K.2: Evidence of Practice B Within SEMO Case

Case SEMO: Practice B. Idea Generation					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To define a project fitting into the strategic agenda	"We said we wanted another strategic pillar. That had to do with spreading the risk. And [SEMO] became one of these new pillars" (INT-Mkt2s)	Mkt	2	n/a	y
		DOC	1		
To define a solution for observed needs	n/a	DOC	1	The PBC does not contain evidence of a creative process. In fact, the most important need and best fitting solution is already described in the introduction of the document (PBC p. 1); "We searched for a problem that the solution could solve" (WS-PMs)	n
		PM	1		
To define a project that can be funded	n/a	DOC	1	Estimated revenues are stated in the PBC (p. 13). However, there are no indications of projected costs to develop the solution.	n
Activities		**Actor**	**#**		**y/n**
Checking ideas of customers	"They had written their own program to do [functionality], this enabled [user-group] to [lists tasks] [...] And then we wondered why can't we do this?" (INT-SLSs)	SLS	1	n/a	y
		PO	2		
Consensus and decision making	"Discussion with development team pending. First a SC-approved decision on the product definition is required." (URD, p. 13)	DOC	2	n/a	y
Generate new ideas	"During our visit today to the Child Development Centre at Los Angeles Southwest College (LASC) we discussed the requirements for their multi-room observation facility" (ROADMAP, p.1)	DOC	1	n/a	y
		SLS	2		
Resources		**Actor**	**#**		**y/n**
Vision of the future	"While discussing the requirements, we gradually saw the contours of new software functionality (extensions of UMR) with widespread applicability" (ROADMAP, p. 1)	DOC	1	n/a	y
		PO	1		
		SLS	1		
Overview of current products and capabilities	"We are well aware of the shortcomings of the current products when developing ideas" (INT-SLSs)	SLS	1	n/a	y
Experience with creative techniques	n/a	MAN	2	New ideas are based on old products. Key features are decided upon before the creative process; "You could say that the base is the product, the shortcoming of an existing product. (INT-MANs)	n
A sufficiently broad scope	n/a	MAN	1	"During the UCD analysis we did not research the potential any further" (INT-MANs)	n
Market reputation	"There are always people who do things differently [...] who search for solutions and come to us." (INT-SLSs)	SLS	2	n/a	y
		PO	2		

Source: Author

Table K.3: Evidence of Practice C Within SEMO Case

Case SEMO: Practice C. Securing Innovation Funds					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To get authorization from management	"It [management approval] ensured that there was commitment to spend time on researching this new product" (INT-Mkt2s)	Mkt	3	n/a	y
To create means for next development step	n/a	Mkt	1	Having external funding does not appear to be a problem during product development. Instead, the importance of managerial approval is stressed; "[…] to help management in deciding how much it [SEMO] costs to develop […]" (INT-RD1s)	n
		RD	1		
To create customer base	n/a	PO	1	"We did not have launching customers until 2015 […] we chose for a release because we wanted to push the product[…]" (INT-PO1s)	n
Activities		**Actor**	**#**		**y/n**
Finding funds for problem analysis	" During the Roadmap discussion in March 2012 MT indicated to prioritize the development of [SEMO]" (PBC, p. 1)	DOC	2	n/a	y
Finding funds for needs analysis	"…we decide on the basis of criteria whether the product can go to R&D" (INT-Mkt2s)	Mkt	2	n/a	y
		PO	2		
Finding funds for testing	"The final priority set by the PM and approved by the steering committee. The Must priority determine which User Stories will be covered by the R1 release" (URD, p. 13)	DOC	1	n/a	y
		PO	2		
Resources		**Actor**	**#**		**y/n**
Corporate decision making criteria	"Sales projections" (PBC, p. 14); "Estimation of revenues" (PBC, p. 14); "Estimation of margin" (PBC, p. 14)	DOC	3	n/a	y
		MAN	1		
Strategic reflections	"When MT has the intention to develop a new pillar of growth, they are more open for that [approving the business case]." (INT-Mkt2s); "We had extensive discussions on what should be brought to market and what could wait" (INT-RD2s)	Mkt	1	n/a	y
		PO	1		
		RD	1		
		MAN	1		
Availability of grants	n/a	Mkt	1	Some projects have access to grants, but this was not the case for SEMO; "Often it [developing products] is linked to collaboration projects subsidised by Europe, the nation or the region […]" (INT-Mkt2s)	n
Customer willing to pay	n/a	PO	1	"We did not have launching customers until 2015 […] we chose for a release because we wanted to push the product[…]" (INT-PO1s)	n

Source: Author

Table K.4: Evidence of Practice D Within SEMO Case

Case SEMO: Practice D. Exploring the Market & Opportunity					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To make a business model	n/a	Mkt	1	"No, we were not doing that [Business Model Canvas] yet."(INT-Mkt2s)	n
To estimate market potential	"You also take a look at the competitors… you want to make something unique" (INT-Mkt2s); "A tool for [list of functionalities] has market potential. At least 5 known prospects have this requirement" (PBC, p. 3)	Mkt	1	n/a	y
		DOC	1		
To understand the market forces affecting customer needs	n/a	Mkt	1	Initial market research does not capture market forces, this is done later; "Once that [customer segment] has been defined we make a prototype […] afterwards we collect more information […]" (INT-Mkt2s)	n
		PO	1		
Activities		**Actor**	**#**		**y/n**
Desk research	"This is desk research, and requesting input from colleagues, which I also call desk research." (INT-PO1s)	PO	3	n/a	y
Visiting conferences	"I went to talk to people at conferences […]"(INT-PO1s)	PO	2	n/a	y
Interviewing	n/a	DOC	1	"Sometimes we only do desk research, to save time." (INT-Mkt2s)	n
		Mkt	1		
Analysing the opportunity	"I searched for commonalities and then wrote the PBC" (INT-PO1s)	PO	1	n/a	y
		DOC	3		
Documenting the opportunity	Chapters 3- 8 of the PBC describe the opportunity (PBC, p. 3 onward).	DOC	1	n/a	y
Resources		**Actor**	**#**		**y/n**
Research method expertise	"To find information about new customers is difficult […]" (INT-PO1s)	PO	1	n/a	y
		Mkt	1		
Interview skills	n/a	Mkt	1	"The geographic aspect is a factor […] we have to implement other techniques" (INT-Mkt2s)	n
Analytical skills	"[…] you get an enormous amount of information. You try to canalize this information" (INT-PO1s)	PO	2	n/a	y
Student support	"Ideally initial research is done by students. I don't have the time for this" (INT-PO1s)	PO	1	n/a	y
		Mkt	1		
Readily available internal sources	n/a	RD	1	There only is internal knowledge of existing customers, not of new customers; " Everyone has ideas about how [SEMO] should work […] but the development team has insight of existing needs […]" (INT-RD1s)	n
Readily available customer sources	n/a	RD	1	A different segment was targeted initially; "[SEMO] was originally developed for a different market" (INT-RD1s)	n
Readily available expert sources	n/a	DOC	1	Some expert interviews are logged by Mkt2s (p. 6 onward). However, these interviews focus on usability and not on market size or characteristics.	n
Readily available secondary sources	"[…] many of our customers publish results and by analysing this, you conclude on trends" (INT-Mkt2s)	Mkt	2	n/a	y
		PO	1		
Company formats	The Roadmap (p. 1) and PBC (p. 3-5) have pre-formatted areas for market potential and competitors.	DOC	2	n/a	y

Source: Author

Table K.5: Evidence of Practice E Within SEMO Case

Case SEMO: Practice E. Defining the Value Proposition					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To justify investments in development, production and marketing	"The business case needs to be approved by the management." (INT-Mkts2)	Mkt	2	n/a	y
		PO	3		
To establish a shared vision on the importance of the project	"For new features it is important to explain the idea very well. You need a good presentation so that you can create a common ground" (INT-RD1s)	RD	4	n/a	y
Activities		**Actor**	**#**		**y/n**
Defining customer value	"Various markets in which the product could offer customer value were identified, e.g. [summary of market segments]" (INT-PO1s);"We choose the one offering the highest amount of money" (INT-PO1s)	PO	3	n/a	y
Defining firm value	"As a firm you need to have your own view on what you want to offer. A customer acts only in its own short-term self-interest. You need to be aware of that" (INT-Mkt2s)	Mkt	2	n/a	y
Resources		**Actor**	**#**		**y/n**
Individual integration skills	"That is a lot of talking, and when the Sales Engineer says: 'This is not possible', you have to go back to your customer to check the alternative." (INT-PO1s).	PO	3	n/a	y
Sensemaking with customer	n/a	MAN	1	"We did have qualitative contact with the customer or prospect, but did not ask for financial input." (INT-MANs)	n
Collaborative internal sensemaking	n/a	MAN	1	The process was mostly done by the PO and the UCD manager was clearly not involved; "I don't know why, but we switched to another market and focused on that." (INT-MANs)	n
External legitimacy	n/a	MAN	1	The project was driven by InfoCo alone and did not involve external parties legitimizing the project; The value of SEMO was already determined; "at the start of the process [SEMO] was said to have potential" (INT-MANs)	n
Company formats	"When the PO drafts a proposal for a new product a business case is written" (INT-Mkt2s); "First you make a business case with initial ideas and you think about which segments could be interesting. That has to get approved […]" (INT-PO1s)	Mkt	1	n/a	y
		PO	1		

Source: Author

Table K.6: Evidence of Practice F Within SEMO Case

Case SEMO: Practice F. Managing DCI action					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Included**
Objectives		**Source**	**#**		**y/n**
To collect information in a conscious, efficient and impartial manner	"Formerly, we once in a while collected some information. Now the goal was to do this in a more conscious manner." (INT-MANs); "We needed some sort of planning to make sure we did not fall still" (INT-RD2s); "[…] we were conscious not always to ask the same people. You get self-fulfilling prophecies then" (INT-Mkt2s)	MAN	1	n/a	y
		RD	1		
		Mkt	1		
To make sure uncertainty decreases across the process	n/a	PO	2	"I would like to do it in a different, continuous manner" (INT-Mkt2s)	n
		Mkt	1		
Activities		**Actor**	**#**		**y/n**
Planning	"UCD plan" (UCDPLAN, p. 1 onward).	DOC	2	n/a	y
Developing methods	"These [the questions] are developed upfront, but there is freedom to let people talk." (INT-Mkt2s)	Mkt	1	n/a	y
		MAN	2		
Monitoring	"The UP feedback sessions were chosen to be one-phased (instead of two-phased) since the UCD team got a very comprehensive and extensive domain knowledge from a single session and were capable of assessing priorities based on it." (URD, p. 4)	DOC	2	n/a	y
Resources		**Actor**	**#**		**y/n**
Research method expertise	"UCP plan Addendum 1: overview of UCD methods" (UCDPLAN, p. 8); "User surveys are considered not feasible since there is no installed base … Affinity diagrams and ethnographic studies are considered not to provide added value in this products context "(UCDPLAN, p. 5)	DOC	2	n/a	y
		RD	1		
Reflectiveness	"The UP feedback sessions were chosen to be one-phased (instead of two-phased) since the UCD team got a very comprehensive and extensive domain knowledge from a single session and were capable of assessing priorities based on it." (URD, p. 4)	DOC	1	n/a	y
		RD	1		
A manager	"This was the first project in which we gave a central role to DCI. I, therefore, created the template, but, in my opinion, this was not enough. Every project calls for a dedicated approach and we need to have one person assigned to the team who follows up on the process." (INT-MANs)	MAN	2	n/a	y
		RD	1		
Company formats	The UCDPLAN (p. 2 onward) contains information about which people to contact, how information should be gathered and analysed.	DOC	3	n/a	y
Criteria for customer selection	"You should talk to the right people, not to anybody who coincidentally has some spare time" (INT-Mkt2s)	Mkt	4	n/a	y

Source: Author

Table K.7: Evidence of Practice G Within SEMO Case

Case SEMO: Practice G. Mobilizing Customer Sources					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To increase development capacity	n/a	Mkt	1	Development capacity is organized internally; "It [PBC] states the expected investment and development capacity […]" (INT-Mkt2s)	n
To find money for further development	n/a	PO	1	Customers are not asked to provide funding; "[…] and then [after the approval of management] a development team is set up and we develop the product" (INT-PO1s)	n
To prepare for sales & marketing	n/a	PO	2	"Then they [sales] say: I don't know but you should not intervene in the sales process." (INT-PO1s); "No, but they should have." [Did sales have a seat in the project group?] (INT-PO2s)	n
To get customer information	"You need to have customers that are willing to cooperate. It is not that such customers are not available, but they do not come in great numbers. Especially not if they need to sit with you regularly." (INT-Mkt2s)	Mkt	3	n/a	y
Activities		**Actor**	**#**		**y/n**
Defining customer criteria	"…we like to involve lead users, those engaged in ground breaking work" (INT-SLSs) "You need to take into account needs from foreign customers, and can not only approach Dutch customers" (INT-RD1s) "Par. 3.1. user panel" (UCDPLAN, p. 3)	SLS	1	n/a	y
		RD	2		
		DOC	1		
Identifying of customers	"It is easy to google on keywords and to find [customer segment1] and [customer segment2]" (INT-RD1s)	RD	2	n/a	y
Activating of customers	"In [customer segment1] you have to put more effort to get hold of them, they have less time." (INT-RD1s)	RD	2	n/a	y
Managing of expectations	"You need to stay in touch and tell them what the product can do at this moment and to tell them honestly what will be for the next release." (INT-SLSs)	SLS	3	n/a	y
Resources		**Actor**	**#**		**y/n**
Customer incentive	"You agree with launching customers they get a reduction and in return they provide feedback." (INT-PO1s)	PO	1	n/a	y
		SLS	1		
Internal incentive	n/a	Mkt	1	"The product is very new over here so we should have put more effort into selling it internally." (INT-RD1s); "…also to create a feeling of security. To present the first version internally and design it properly." (WS-RDs)	n
		PO	1		
		RD	2		
Marketing channels	n/a	RD	1	Communication with sales and marketing was slow; "We had to wait for a long time to get a list of names." (INT-RD2s)	n
Customer management skills	"Sometimes it is difficult to get hold of people. It takes time to find the right people" (INT-PO1s); "You build a relationship with them and then you can always come back with additional questions" (INT-RD1s)	PO	1	n/a	y
		RD	1		
		SLS	1		

Source: Author

Table K.8: Evidence of Practice H Within SEMO Case

Case SEMO: Practice H. Elaborating Customer Needs					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Included**
Objectives		**Source**	**#**		**y/n**
To support solution finding	n/a	MAN	2	"No, we did that after the idea generation period [So you could say idea generation was technically oriented]" (INT-MANs)	n
To define customer requirements	n/a	MAN	1	Requirements were already defined in an earlier stage by the PO; " […] the PO included the technical requirements in the business case. This is not something which he should focus on" (INT-MANs);	n
		SLS	1		
		RD	1		
To validate the scope of the project	"In the analysis we look for requirements that can be achieved now and others taking a bit longer" (INT-PO1s); "[…] the UCD team got a very comprehensive and extensive domain knowledge from a single session and were capable to assess priorities based on it "(URD, p. 4)	Mkt	1	n/a	y
		PO	1		
		DOC	1		
Activities		**Actor**	**#**		**y/n**
Preparing customer for efficient data collection	"Each of the UP feedback sessions was prepared by having the UP members fill out an input form" (URD, p. 13)	DOC	3	n/a	y
		MAN	2		
Visiting customers	"User visits were executed. The [customer group 1] were visited by [the PO] , and a [customer group 2] by the other UCD members" (URD, p. 4)	DOC	1	n/a	y
Watching movies	n/a	RD	1	The RD describes how a more personal approach was applied; "We contacted several potential users and we visited them, we interviewed them, looked at how they operate now […]" (INT-RD1s)	n
Conducting conversations	"These are open conversations. Not structured […]" (INT-RD1s)	RD	1	n/a	y
		PO	2		
		RD	3		
Analysing needs	"The analysis by the MRR UCD team have led to recommendations that on some points differ substantially from the original assignment in the draft PBC' (URD, p. 8)	DOC	4	n/a	y
Documenting needs	"They [the UCD team] came with a report" (INT-PO1s)	PO	1	n/a	y
		DOC	2		
Reflecting on assumptions and uncertainties	"Before jumping to these recommendations, a brief reflection on the core element of the draft PBC [x] is addressed " [URD, p. 8]	DOC	1	n/a	y
		RD	3		
Resources		**Actor**	**#**		**y/n**
Research method expertise	"Addendum 1: UCD methods" (UCDPLAN, p.11)	DOC	1	n/a	y
		RD	1		
Analytical skills	"We used user stories to understand who it concerned" (INT-RD2s) ; "At the end we developed a view on the customer workflow' (INT-RD2s)	RD	4	n/a	y
Interview skills	"These are open conversations. Not structured […]" (INT-RD1s) ; "We prepared the customers by sending them a questionnaire upfront" (INT-RD2s)	RD	2	n/a	y
		Mkt	1		
		PO	1		
Student support	n/a	PO	1	"Yes [So the student research is about the market structure and which parties are involved? Not about the needs... right?]" (INT-PO1s)	n

Table K.8: Continued

Readily available Internal sources	"I think, with my sales experience, you know better what type of customers they are" (INT-RD1s)	RD	3	n/a	y
Readily available customer sources	"We have identified several users [in market x] who may be willing to give their input" (PBC, p. 4)	DOC	3	n/a	y
		MAN	2		
Awareness of uncertainties	"The [SEMO] market is more pluriform and the UCD team sees higher uncertainty on shared requirements within this market" (URD, p. 4)	DOC	1	n/a	y
		RD	1		
Company formats	The URD (p. 14-20) contains several user stories and potential customer requirements; "We used user stories to understand who it concerned" (INT-RD2s)	DOC	1	n/a	y
		RD	1		

Source: Author

Table K.9: Evidence of Practice I Within SEMO Case

Case SEMO: Practice I. Collecting Customer Feedback					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To validate and refine customer requirements	n/a	MAN	2	Validation of ideas and refinement of requirements was done much earlier in the project; "The UCD analysis was executed before product development, in order to validate assumptions" (INT-MANs)	n
		PM	1		
To identify missing information	n/a	SLS	2	"We went to customers to identify problems they encounter with our current system, how we can improve it and which functionality is missing" (INT-SLSs)	n
		RD	2		
To check performance of the solution	"I collected a lot of feedback on what works and what doesn't work and this goes into the list for a next improvement on functionality" (INT-SLSs)	SLS	3	n/a	y
Activities		**Actor**	**#**		**y/n**
Surveying customers	n/a	DOC	1	"User surveys are considered not feasible since there is no installed base[…]" (UCDPLAN, p. 5); "But not with a panel that gives feedback about features on a quarterly or monthly basis" (WS-RDs)	n
		RD	1		
Conducting conversations	"This goes naturally, certainly for [SEMO] in which updates needed to be installed frequently" (INT-SLSs)	SLS	2	n/a	y
Watching movies of use	n/a	PO	1	The PO describes how a more personal approach was applied; "The past three years I went two times to visit [the launching customers]"	n
Analysing feedback	"You often see the same feedback coming back and that is very clear" (INT-RD1s)	RD	2	n/a	y
Documenting feedback	"7. UCD priorities" (URD, p. 13)	DOC	1	n/a	y
Reflecting on assumptions and uncertainties	'The [market segment 2] market is more pluriform and the UCD team sees higher uncertainty on shared requirements within this market." (URD, p. 4)	DOC	2	n/a	y
		MAN	2		
Resources		**Actor**	**#**		**y/n**
Minimum Viable Product	n/a	Mkt	1	"I think we should set up a minimum viable product at the customer earlier" (INT-Mkt2s)	n
		MAN	1		
Interview skills	n/a	SLS	1	This is done informally at various occasions and goes naturally: "This goes naturally" (INT-SLSs)	n
Analytical skills	n/a	MAN	1	After getting the feedback there appeared to be doubts in the analysis phase; "[…] questions from sales and other markets. The product was adjusted to them and there we lost some focus" (INT-MANs)	n
		RD	1		
Documentation system	"Visit reports go into the support database" (INT-SLSs); "These are formal channels" (INT-RD2s)	SLS	1	n/a	y
		RD	1		
		PO	1		
Readily available customer sources	"We had our launching customers. We asked them from feedback and we still ask them for feedback" (INT-PO1s); "3. MRR UCD PLAN" (UCDPLAN, p. 2-3)	PO	1	n/a	y
		DOC	1		
		SLS	1		

Source: Author

Table K.10: Evidence of Practice J Within SEMO Case

Case SEMO: Practice J. Defining Customer Requirements					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To achieve a shared understanding of requirements and priorities	"If you continue doing this you make the lives of the sales engineer, of the customer […] difficult, you are mixing functionalities."(INT-RD2s); "It is important that we come to one conclusion, otherwise everybody keeps thinking in his own interest. Therefore, we use formats like Personas. So that we all understand the motives of specific persons." (INTRD1s)	RD	3	n/a	y
To supervise the development process	"We discussed extensively about possible solutions. Then we had a discussion about priorities and opinions were divided" (INT-RD2s)	RD	3		n
To manage expectations of customers	n/a	SLS	2	Managing expectations mostly happens later during the actual sales process, not during development; "Be honest and tell them what the product can do currently and which functionality will be added in the future" (INT-SLSs)	n
		RD	1		
Activities		**Actor**	**#**		**y/n**
Listing user requirements	*"8. UCD User stories"* (URD, p. 14)	DOC	1	n/a	y
		PO1	2		
		MAN	1		
Setting priorities	"Setting the priorities is done by the PO. I advise, but final responsibility lies with him." (INT-RD1s).	RD	2	n/a	y
Refining requirements	"Some were redefined and in other cases priorities were changed" (INT-RD1s)	RD	1	n/a	y
		DOC	2		
Resources		**Actor**	**#**		**y/n**
Individual integration skills	"You are the voice of the customer within the team. This means lots of conversations and going back and forth between R&D and the customer" (INT-PO1s)	PO	1	n/a	y
Sensemaking with customers	n/a	PO	1	"With [SEMO] we did not do that [showing the requirements to the customer] because [SEMO] was the start of our innovation … we had to be careful to show our core activity" (INT-PO1s)	n
Collaborative internal sensemaking	n/a	PO	1	"We were developing the solution and then an internal stakeholder asked for different functionality. We lost 8 months of development". (INT-PO1s)	n
Company formats	"8. USER STORIES – [market segment]" (URD, p. 14-17) "9. USER STORIES – [market segment2]" (URD, p. 18-20)	DOC	2	n/a	y
		PO	2		

Source: Author

Table K.11: Evidence of Practice K Within SEMO Case

Case SEMO: Practice K. Mobilizing Internal Sources					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To learn about new customers and markets	n/a	SLS	2	Although SEMO was targeting new customer segments, the team sought information from existing customers. *"It is easier to involve sales in approaching existing customers"* (INT-SLSs)	n
		PO	1		
To validate findings	"Well, the PO got all information, but still we sit together to see what is missing and to decide on next steps" (INT-SLSs)	SLS	2	n/a	y
To get access to customer network	"At that time we wanted informing customers and I needed to involve sales" (INT-PO2s)	PO	2	n/a	y
		SLS	1		
Activities		**Actor**	**#**		**y/n**
Acquiring of sources holding relevant prior customer knowledge	"During one of these moments we asked for their [sales] opinion on the chosen terminology" (INT-PO2s)	PO	2	n/a	y
Sharing of information	"[…] there were several moments that we actively sat around the table with sales (INT-PO1s)	PO	2	n/a	y
Resources		**Actor**	**#**		**y/n**
Readily available relevant internal or partner sources	"I underestimated this. I thought it was easier to motivate Sales to sell SEMO. I thought they would be more eager." (INT-PO1s).	PO	1	n/a	y
		SLS	1		
Internal Incentive	n/a	RD	1	"You can tell them to sell on the [market segment], but why would you if it requires a lot more effort?" (INT-RD2s); "I overestimated the extent to which sales could embrace this" (WS-PO1s)	n
		PO	1		
Communication channels	"So, here you see all information shared with sales [summary of information]. And, all this [project information] is placed on a drive that is accessible to all" (INT-PO2s)	PO	1	n/a	y
		RD	1		

Source: Author

Table K.12: Evidence of Practice L Within SEMO Case

Case SEMO: Practice L. Developing the Product Concept					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Included**
Objectives		**Source**	**#**		**y/n**
To provide material for testing	"We talk with customers about the value proposition, after which we generated concepts […] a creative session […] after which we selected an idea and start development of a proto-type." (INT-MANs)	MAN	2	n/a	y
To prepare for sales and marketing	"This is a checklist for R&D, an internal document, specifying where we are and whether we fulfil conditions for release. Alongside comes the market-release plan" (INT-PO2s)	PO	1	n/a	y
		DOC	2		
Activities		**Actor**	**#**		**y/n**
Generating ideas for solutions	"So then you brainstorm, on how you will fulfil the demand" (INT-RD2s)	RD	2	n/a	y
Consensus and decision making	"We had extensive discussions on what should be brought to market and what could wait" (INT-RD2s)	RD	3	n/a	y
Developing the solution	"[…] we selected an idea and started development of a pilot version" (INT-MANs)	MAN	1	n/a	y
		PO	2		
		RD	1		
Resources		**Actor**	**#**		**y/n**
Experience with collective idea generation	"Some people do not have experience with creative techniques ... it is different to work in a different way, when you are used to do it in another way" (INT-MANs)	MAN	1	n/a	y
		RD	1		
Customer empathy in R&D team	n/a	SLS	1	"All that information [about the value proposition] comes from sales" (INT-SLSs); "If you look at the other products we developed, you see a very cluttered user interface […] R&D traditionally wants to show all the functionality as soon as possible" (INT-RD1s)	n
		RD	1		
Visual material supplied by the customer	n/a	SLS	1	Requests by customers are mostly communicated verbally to sales; "During the moments of contact they tell you what they need" (INT-SLSs)	n
Co-creating customer	n/a	Mkt	1	"We try to involve users but it is tough […] you need your own vision because the customer is worried about his short term problem" (INT-Mkt2s)	n
Student support	n/a	PO	2	Students are only used for market potential analysis, not for any other activities; "Yes [So the student research is about the market structure and the parties that are involved?]" (INT-PO1s)	n
Project management tool	"That is supported by a tool […] in which you define the user stories […] and in which you state when it is finished […] (INT-RD2s)	RD	3	n/a	y

Source: Author

Table K.13: Evidence of Practice M Within SEMO Case

Case SEMO: Practice M. Planning Sales & Marketing					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Included**
Objectives		**Source**	**#**		**y/n**
To start up the commercial process	"It appeared that our sales organisation wasn't familiar with this product." (INT-PO2s) "It took a long time before [SEMO] was sold to the right market in Europe." (INT-RD2s).	PO	2	n/a	y
		RD	2		
		MAN	1		
Activities		**Actor**	**#**		**y/n**
Re-using CI	"This is the market release plan. It says what is the objective, what do markets look like, what position do you take, what features are provided. I made it, it goes to sales" (INT-PO2s)	PO	3	n/a	y
		DOC	2		
Communicating insight	"This is a kind of sales presentation […]" (INT-PO2s)	PO	1	n/a	y
		DOC	2		
Resources		**Actor**	**#**		**y/n**
Individual integration skills	"I try to adapt this to the information needs of sales" (INT-PO2s)	PO	1	n/a	y
		SLS	1		
Collaborative sensemaking within team	n/a	PO	1	"No, but they should have [Did sales have a seat in the project group?]" (INT-PO2s)	n
Student support	n/a	PO	1	"Yes [So the student research is about the market structure and which parties are involved?]" (INT-PO1s)	n
Documentation system	"[…] this is the R&D drive. Here you find all relevant information of [SEMO]" (INT-PO2s) "This is the internal sales presentation […]" (INT-PO2s)	PO	2	n/a	y
		SLS	1		
		MAN	1		
		RD	1		
		Mkt	1		
Company formats	The UCDPLAN (p. 7-8) describes a commercialization phase containing: Product specification review, User documentation review, UCD release evaluation and Post-release evaluation.	DOC	1	n/a	y

Source: Author

APPENDIX L COUNT OF RESOURCES

Table L1: Count of resources by Resource Type

Resources by Resource Type	Thermo	ZKL	MZI	SEMO	SmartLight	FiberTop
Firm level assets						
Market reputation			1	1		
Vision of the future	1	1		1	1	1
Corporate decision making criteria	1		1	1	1	1
Strategic reflections	1	1		1	1	1
A sufficiently broad scope	1	2			1	2
Customer incentive		1		1	1	1
Internal incentive		1				
External legitimacy			1			
Company formats			2	5	1	1
Total	**4**	**6**	**5**	**10**	**6**	**7**
Carriers of information						
Documentation system				2		1
Readily available internal sources		2	4	3	2	3
Readily available customer sources	3	2	3	4	1	3
Readily available expert sources		1	2			2
Readily available secondary sources	1		2	1	1	2
Marketing channels	1				1	
Communication channels				1		
Minimum Viable Product	1	1			1	1
Visual material supplied by the customer			1			
Total	**6**	**6**	**12**	**11**	**6**	**12**
Skills & techniques						
Experience with collective idea generation	1		1	1	1	1
Experience with creative techniques	1	1				1
Research method expertise	1		1	3		
Customer management skills	1	1		1	1	1
Interview skills	2		1	2	1	2
Analytical skills	2	2	1	3		3
Awareness of uncertainties				1		
Customer empathy in R&D team	1		1			1
Overview of current products and capabilities	1			1	1	1
Individual integration skills	2	2		3		2
Sensemaking with customer			2			
Collaborative sensemaking team	3	1	2		2	2
Reflectiveness				1		1
Criteria for customer selection				1		1
Project management tool	1			1		
Total	**16**	**7**	**9**	**18**	**6**	**16**

Table L1: continued

Resources by Resource Type	Thermo	ZKL	MZI	SEMO	SmartLight	FiberTop
People and money						
Student support	3	1	3	1		1
Availability of grants			1			1
Customers willing to pay		1	1		1	1
A manager				1		1
Co-creating customer		1	1			1
Total	**3**	**3**	**6**	**2**	**1**	**5**

Source: Author

APPENDIX M CODING OF IMPROVEMENTS (RQ3)

Table M1: Coding of Improvements

Higher-order themes (improvement tactics)	Perceptions of improvement
Analytical tools	Accept uncertainty
	Extrapolate findings to other markets
Collaborative approach	Involve sales in development sales and marketing plans
	Take a collaborative approach to priority setting
	Take into account information needs sales
Creative skills	Have a training creative techniques
Culture	Have a culturally embedded process
Data collection techniques	Develop broad general domain knowledge by talking to people in the field
	Develop broad general domain knowledge by means of desk research
	Preserve completeness
	Preserve objectivity
	Take time to visit and observe customers
	Use advanced data collection techniques for latent needs
	Use techniques that focus on latent needs
Format synthesis	Document the value proposition in a complete, clear and relevant way
	Have a clear format for DCI
	Present the project convincingly to others (format and clarity)
	Put more structure in synthesis
Flexible processes	Have a fast and flexible approach
Management of learning	Document and structure DCI processes
	Have more intensive DCI management
	Have more continuous feedback from customers
Management of customer expectations	Manage expectations, create commitment
Market definition	Preserve focus on approved requirements
	Define the market in meaningful way
Order of doing things	Focus on problems not on technology
	Start the project with customer needs analysis
	Start validating early
Roles	Create a dedicated DCI management role
	Have a marketing expert on board
	Have a team that is both technical and receptive to customer-needs
	Have owners in the lead
	Include team-members that have customer insights
	Put more effort in marketing implementation
Sampling	Increase sample size
	Attract the right informants at the right time
	Make clever use of online channels for interviewing
	Include customers with different backgrounds
Timing	Get most out of limited time
	Plan more time for exploring problems
	Plan more time for market research
Test material	Put the right things in the proto-type
	Have something to show

Source: Author

APPENDIX N THE IMPACT OF THE IMPROVEMENTS

Table N1: Coding of Improvements and Impact

Higher-order themes (improvement tactics)	Perceptions of improvement	Impact
Analytical tools	Accept uncertainty	Timely
	Extrapolate findings to other markets	Comprehensive
Collaborative approach	Involve sales in development sales and marketing plans	Timely, Acceptable, Scope
	Take a collaborative approach to priority setting	Timely, Acceptable
	Take into account information needs sales	Timely, Inspiring, Acceptable
Creative skills	Have a training creative techniques	Novel
Culture	Have a culturally embedded process	Timely, Comprehensive, Novel, Consistent, Inspiring, Format, Accurate, Acceptable, Scope, Cost efficient
Data collection techniques	Develop broad general domain knowledge by talking to people in the field	Comprehensive
	Develop broad general domain knowledge by means of desk research	Comprehensive
	Preserve completeness	Comprehensive, accurate
	Preserve objectivity	Accurate
	Take time to visit and observe customers	Comprehensive, Novel
	Use advanced data collection techniques for latent needs	Novel, Accurate
	Use techniques that focus on latent needs	Novel, Accurate
Format synthesis	Document the value proposition in a complete, clear and relevant way	Format, Acceptable
	Have a clear format for DCI	Format
	Present the project convincingly to others (format and clarity)	Inspiring, Format, Acceptable
	Put more structure in synthesis	Format, Acceptable
Flexible processes	Have a fast and flexible approach	Timely, Cost efficient
Management of learning	Document and structure DCI processes	
	Have more intensive DCI management	Timely, Comprehensive, Novel, Consistent, Inspiring, Format, Accurate, Acceptable, Scope, Cost efficient
	Have more continuous feedback from customers	Timely, Comprehensive
Management of customer expectations	Manage expectations, create commitment	Comprehensive, Accurate, Acceptable
Market definition	Preserve focus on approved requirements	Timely, Comprehensive, Novel, Consistent, Inspiring, Format, Accurate, Acceptable, Scope, Cost efficient
	Define the market in meaningful way	Scope
Order of doing things	Focus on problems not on technology	Novel, Scope
	Start the project with customer needs analysis	Novel, Timely
	Start validating early	Cost Efficient
Test material	Put the right things in the proto-type	**Test material**
	Have something to show	

Table N1: Continued

Higher-order themes (improvement tactics)	Perceptions of improvement	Impact
Roles	Create a dedicated DCI management role	Timely, Comprehensive, Novel, Consistent, Inspiring, Format, Accurate, Acceptable, Scope, Cost efficient
	Have a marketing expert on board	Timely, Comprehensive, Novel, Consistent, Inspiring, Format, Accurate, Acceptable, Scope, Cost efficient
	Have a team that is both technical and receptive to customer-needs	Timely, Comprehensive, Novel, Consistent, Inspiring, Format, Accurate, Acceptable, Scope, Cost efficient
	Have owners in the lead	Timely, Comprehensive, Novel, Consistent, Inspiring, Format, Accurate, Acceptable, Scope, Cost efficient
	Include team-members that have customer insights	Timely, Comprehensive, Novel, Consistent, Inspiring, Format, Accurate, Acceptable, Scope, Cost efficient
	Put more effort in marketing implementation	Acceptable
Sampling	Increase sample size	Comprehensive, Accurate
	Attract the right informants at the right time	Timely, Accurate
	Make clever use of online channels for interviewing	Cost Efficient
	Include customers with different backgrounds	Comprehensive, Accurate
Timing	Get most out of limited time	Comprehensive, Cost efficient
	Plan more time for exploring problems	Comprehensive, Accurate
	Plan more time for market research	Comprehensive, Accurate
Test material	Put the right things in the proto-type	Novel, Accurate
	Have something to show	Timely, Acceptable

Source: Author

APPENDIX O CODING OF BARRIERS FOR IMPROVEMENT

Improvement tactic	Barrier
Collaborative approach	To include team-members that have customer insights
	Distance to sales
	Current structure and processes
Creative skills	Not everybody is creative
Culture	Have a culturally embedded process
Data collection techniques	Careful to present unfinished product
	What is market research?
	No measures to correct for biases
	Pros and cons of early testing
Format synthesis	What should be documented
	Disagreement on what to document
Management of learning	Formalizing would kill it
	No systematic approach
	Not explicit process
	Too much ideas
	Deviations of plan
	Lack of recognition of DCI management
Market definition	Focus on technical aspects
	Limited scope
	No focus
	Not clear on goals
	Preserve focus
Order of doing things	Limited scope
	Marketing comes after technical
	Order of doing things
	Start from solution
Roles	Sales responds to short term needs
	Too wide or too narrow role for the customer
	Owners' lack of trust in others
Sampling	Motivation of customers
	Geographical location customers
	Lack of method for customer selection
	Lack of attention for sample size
Time available	Opportunity assessment takes too much time
	Problem analysis takes too much time
	Sense of urgency
	Time frame of decision making
	Process takes too long
What to test	Should the product be a visible product

Source: Author

APPENDIX P IMPROVEMENT OPPORTUNITIES SEMO

Practices	Importance			Implementation			Opportunity
	% > 4	AVG	Std	% > 4	AVG	Std	Score
A. Exploring customer problem situations	100	5	0.00	100	4.3	0.58	10
B. Generating ideas	100	4.6	0.55	67	3.7	0.58	13.3
C. Securing innovation funds	100	4.6	0.55	33	3.3	0.58	16.7
D. Exploring the market opportunity	100	5	0.00	33	3.7	1.15	16.7
E. Defining the value proposition	100	4	0.00	50	3.0	1.41	15
F. Designing and managing CI action	100	4.2	0.45	0	2.0	0.00	20
G. Mobilising customer sources	100	4.4	0.55	0	3.0	0.00	20
H. Elaborating customer needs understanding	100	4.6	0.55	33	3.0	1.00	16.7
I. Collecting customer feedback	100	4.8	0.45	33	3.3	0.58	16.7
J. Defining customer requirements	80	4	0.71	50	3.5	0.71	11
K. Mobilising internal sources	40	3.2	0.84	67	3.7	0.58	1.3
L. Developing the product concept	100	4.4	0.55	50	3.5	2.12	15
M. Planning sales and marketing for launch	100	4.4	0.55	100	4.5	0.71	10
Total		4.4	0.44		3.4	0.77	

Source: Author

APPENDIX Q BARRIERS TO IMPLEMENTATION SEMO

Table Q1: Barriers to Implementation SEMO

Improvement Tactic	Barrier	Mentions	Exemplar Quote
Collaborative approach	Distance to sales	3	"If I am a salesperson, I know a lot about the customer. But I am not sales, I am sitting behind my desk. I need to pull this out of our CRM system." (INT-POs1)
	Current structure and processes	3	"In the ideal situation, you sit together with Sales. But, in practice, this is problematic […] They should have the courage and align sales targets. And as long as there is not a product, Sales is reluctant to share information […] Sales is too busy achieving their targets." (INT-PO1s)
Creative skills	Implementation of new skills requires attention (affecting Practice B and L)	2	"We had a training and then we think that everybody that was present is able to implement the learning. But, not everybody had the same background in using creative techniques […] we easily say we do not have the time to use what we have learned, but we also need to make this part of our daily work flow." (INT-MANs)
Data collection techniques	What is market research?	2	"Market research, that is simply verifying ideas that are on the table." (INT-SLSs); "Market needs, that is desk research, and checking with colleagues […] Product information is about giving customers a product and seeing how they react to it." (INT-PO1s)
	No measures to correct for biases	4	"Salespeople are opportunistic, they want to sell. So, they easily say everybody wants that feature, but you have to validate that, of course." (INT-SLSs)
Format synthesis	What should be documented (affecting Practice E, J and M)	6	"We had the PBC […] but that is not a very efficient way of working, requiring too much discussion and decision making. We now work in an agile, lean way." (INT-RD2s); "Currently, I am doing a usability test including 50 requirements. Our people easily complain that that is too much, but we know that this is a normal number of tasks" (WS-UTs)
Management of learning	Deviations of plan	3	"The User Panel (UP) formation was a slow process and formed a bottleneck in the UCD team analysis work. One of the reasons was that the project (technical) analysis work had already started before the first UP member was found. Whereas, in a normal UCD process, the UP is almost complete at start of analysis." (UCD, p4)
	Lack of recognition of DCI management	2	"Overall, the organisation thinks that once we have a plan or template everything will run smoothly, but that is not the case." (INT-MANs)
Market definition	No focus (affecting Practice B and C))	3	"I told him, this has nothing to do with the original […] If you continue doing this you make the lives of the sales engineer, of the customer […] difficult, you are mixing functionalities."(INT-RD2s)
	Preserve focus	2	"I don't know why, but we switched to another market and focused on that." (INT-MANs)

Table Q1: Continued

Improvement Tactic	Barrier	Mentions	Exemplar Quote
Order of doing things	Limited scope	1	"That shows that we were very product focused, We did not have a true focus on the market." (INT-MANs)"
	Order of doing things	4	"[…] the project (technical) analysis work had already started before the first UP member was found.
	Start from solution	4	"Well, there is still sufficient room [for exploration], only the direction is fixed: like this fits with our [segment names] […] We set the list of requirements" (INT-RD2s);
Roles	Sales responds to short term needs	3	"Not all sales people are capable to inquire customers about their needs […] They need to have a broader perspective on the market" (INT-SLS0
	Too wide or too narrow role for the customer	2	" That [customer involvement] has a high risk […] We don't like it if one of our customers points out a drawback of our new solutions. We are very careful with that [involving the customer]. SEMO is a strategic new product" (INT-PO1s)
Sampling	Motivation of customers	2	"You need to have customers that are willing to cooperate. It is not that such customers are not available, but they do not come in great numbers. Especially not if they need to sit with you regularly." (INT-Mkt2s)
	Geographical location customers	7	"It is very difficult to get useful feedback, for example, out of China. This culture is so different […] Sometimes when responses gets back, you find out that they didn't understand everything." (INT-Mkt2s)
	Lack of method for customer selection	4	"This is frequently part of internal discussions. Should we involve our closest relationships? But then we run the risk of self-fulfilling prophecies, or should we put effort in findings others?" (INT-Mkt2)
	Lack of attention for sample size (affecting Practice H and I)	4	"I have noticed that customers easily ask for specific features and that this is put on the agenda of R&D. But when you then ask the Sales Engineer about other customers having this need, it remains silent." (INT-RD1s)
Time available	Time frame of decision making	1	"We had the PBC as our corporate approach but that is not a very efficient way of working, requiring too much discussion and decision making. We now work in an agile, lean way." (INT-RD2s);
	Process takes too long	1	We had several discussions on it and this took a lot of time". (INT-RD2s)
Total	**26 Barriers**		

Source: Author

APPENDIX R CODING OF TRANSCRIPT INTERVIEW THERMO

PART OF TRANSCRIPT INT-Mktt

P. 1

Objective D.

INT-Mktt: So what I tried to help them with was with their question "we have our product now and we have so many application areas, but where do we start? And, how do we start? So, the question was what are the most appropriate customer groups for which we can add value? So, if they looked at that from their own perspective, they could only see their own strength and opportunities.
So, I could help them with my outsider and research perspective. Because you have to start with what you can offer to your customers and with how you can communicate your advantages.

D. Research Method Expertise

Researcher: What are the interesting market segments for [Thermo]?

Objective D. D. Desk Research

INT-Mktt: So, with all their application ideas, we identified suitable customer groups and asked ourselves what customer group would be most sensible to target and to get the product on the market. We made a kind of score-table and then we looked at different SBI codes and searched for amount of firms in different industries. And this gave us the scores and helped to determine the group of firms most to start with.

D. Secondary Information

D. Analyttical Skills

Researcher: And what was this group of firms?

INT-Mktt: This was in first instance [sub-segment industrial market segment].

Researcher: And do you remember why [Thermo] was important to them?

INT-Mktt: Because they regularly needed to [functionality1] and [functionality2] and they needed several solutions for doing this, while with the [SafetyCo] solution they could do this all in one.

Researcher: And how did you find out these needs as you just described?

INT-Mktt: I have done some qualitative interviews with those people

D. Talking to customers

Researcher: and how did you find these people?

INT-Mktt: Well, part of them were contacts of [SafetyCo] and further I googled them.

D. Some customer sources

APPENDIX S CODING OF ORIGINAL MARKETING RESEARCH REPORT (DUTCH VERSION)

5. Resultaten

D. Desk Research

D. Talking to customers

De resultaten zijn verkregen uit deskresearch en twee interviews met beslissers in de markt van [customer segment]. 5.1 Segmentatie naar sbi codes

SBI staat voor Standaard Bedrijfsindeling (voorheen BIK) en is opgesteld door het Centraal Bureau voor de Statistiek (CBS). Zij gebruiken dit om bedrijven in te delen op hoofdactiviteiten.

(KvK en CBS) Ieder bedrijf dat zich inschrijft in het Handelsregister krijgt een SBI-code. Deze code geeft aan wat de hoofdactiviteit van een bedrijf is. (KVK)

Naar aanleiding van de sbi-codes zijn er de volgende hoofdgroepen te onderscheiden die mogelijk te maken hebben met [basic functionality]. Hoofdgroep

D. Analysing the opportunity

D. Secondary Information

Hoofdgroep	Aantal bedrijven
Adviesbedrijven	10.357
Akkerbouw / tuinbouw	12.853
Computers en servers	11.577
Delfstoffen	806
Productie van / handel in Elektronica	8.881
Installatiebedrijven	12.441
Koeltechniek	6.971
Machinebouw	5.097
Farmacie	7.904
Productiebedrijven	4.839
Transportbedrijven	24.079
Uitvaartbedrijven	2.683
Vis / vleesverweking	890
Visserij	155

Bron: KVK, maart 2015, sbi versie 2008. Complete lijst in de bijlage.

5.2 Segmentatie naar bedrijfsgrootte Uit de informatie van de kvk is per bedrijf ook het aantal medewerkers te achterhalen. Dit kan als secundair kenmerk worden gebruikt om binnen een sbi segment verder te selecteren. Als primair selectiekenmerk is het niet bruikbaar. Een éénpersoons adviesbedrijf kan in sommige situaties meer betekenen dan een installatiebedrijf met 100 personen.

5.3 Segmentatie naar producttoepassingen Door [SafetyCo] (bijlage 4.) zijn bij de productontwikkeling mogelijke toepassingsgebieden beschreven. Vanuit de aard van het product zijn alle toepassingen gelijk: [list of functionalities. Niet geschikt als segmentatiekenmerk.

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APPENDIX T EVIDENCE OF PRACTICES THERMO

Table T.1: Evidence of Practice A Within Thermo Case

Case Thermo: Practice A. Exploring the Customer Problem Situation					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To define product market segments	"You have access to some customers, and then you learn what interesting segments are" (INT-RDt)	RD	3	n/a	y
To further develop first ideas	n/a	RD	2	Thermo does not start from needs, but rather from ideas: "I started with running up a flagpole on the website, and then with the response we got, we got in touch with certain markets and we then moved from there […] (INT-RDt)	n
To understand the opportunity of a customer idea	n/a	OM	2	"Customers do not have ideas, they do have needs, maybe, but it is us who should have to vision" (WS-OMt)	n
To build trust with potential customers	"This is about domain knowledge. You need it to bring products successfully to the market. This is about why they like you and why" (INT-RDt)	RD	2	n/a	y
Activities		**Source**	**#**		**y/n**
Identifying a problem area	"There were so many applications, that the basic questions was, how do we start, what are the right customer segments for who your product has added value?" (INT-Mkt1t)	Mkt	2	n/a	y
Conducting customer conversations	"I talked to those people, about what they wanted and why" (INT-RDt)	RD	1	n/a	y
		OM	1		
		Mkt1	1		
Analysing customer problems	n/a	RD	1	Thermo does not engage in explicit analytical activities; "I don't even remember exactly how I got to this [Thermo]." (INT-RDt). The owner speaks a lot about gut feeling.	n
		OM	2		
Reporting of customer problems	n/a	Mkt2	2	"You didn't really document things" (WS-Mkt2t) "No, but I still know exactly why we made our choices." (WS-OMt)	n
		OM	2		
Resources		**Source**	**#**		**y/n**
A broad scope	n/a	n/a		Thermo started working with customers reacting to their idea and did not explore needs across a number of segments first.	n
Readily available internal sources	n/a	OM	2	"[…] we really try to do this in a team, but we are having the experience, they don't know, they don't see things" (WS-OMt]	n
Readily available customer sources	"So, then we talked to customers in industrial markets […]"(INT-OMt)	OM	1	n/a	y
		RD	1		
Readily available expert sources	n/a	RD	1	The owner and the R&D Manager see themselves as the main actors in generating DCI: "It was just [RD Director] and me." (INT-OMt)	n
		OM	1		
Readily available secondary sources	n/a	n/a		Externally available external sources like from the Dutch Chamber of Commerce, were consulted later, on behalf of Practice D.	n
Interview skills	"And then I asked, why they wanted this and I tried to follow their line of reasoning" (INT-RDt)	RD	2	n/a	y
Analytical skills	"You learn how to detect bottlenecks in customer processes" (INT-RDt)	OM	1	n/a	y
		RD	2		

Source: Author

Table T.2: Evidence of Practice B Within Thermo Case

Case Thermo: Practice B. Idea Generation					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To define a project fitting into the strategic agenda	"So we developed a few platforms and from there we started technology-driven what we would take up" (INT-OMt)	OM	2	n/a	y
To define a solution for observed needs	n/a	n/a		Thermo started from an idea that set them apart from their competitors, not from needs	n
To define a project that can be funded	n/a	n/a		Thermo relied on their own strategic agenda for new projects	n
Activities		**Source**	**#**		**y/n**
Checking ideas of customers	n/a	OM	2	"Customers do not have ideas, they do have needs, maybe, but it is us who should have to vision" (WS-OMt)	n
Consensus and decision making	"[R&D Director] and I arrange for everything and own the company" (INT-OMt)	OM	2	n/a	y
Generating new ideas	"And, with that idea, [R&D Director] could think about how we could make life easier, cheaper or healthier" (INT-OMt)	OM	3	n/a	y
		RD	1		
Resources		**Source**	**#**		**y/n**
Vision of the future	"The product idea came first and with that we were able to establish grounds for broader technology platforms" (INT-OMt)	OM	2	n/a	y
		RD	5		
Overview of current products and capabilities	"And those platforms provided us the flexibility with which we could respond to the market. Also, we saw that from that one product all kinds of other stuff could be asked from it" (INT-OMt)	OM	4	n/a	y
Experience with creative techniques	"This is the core of our existence, if we didn't have this we could close the door" (WS-OMt)	OM	2	n/a	y
A sufficiently broad scope	"From there we started thinking, we already had [core functionality], also [other core functionality] and for this, we could have a broad functionality as well" (INT-RDt)	OM	1	n/a	y
		RD	1		
Market reputation	n/a	Mkt2	1	"I am not waiting for customers to come to us" (WS-Mkt2t) "Our reputation at that time was not very well-established" (WS-OMt)	n
		OM	2		

Source: Author

Table T.3: Evidence of Practice C Within Thermo Case

Case Thermo: Practice C. Securing Innovation Funds					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To get authorization from management	n/a	n/a		The R&D Director and Owner did not need approval from others to continue the project	n
To create means for next development step	"You need to be able to use all resources that are available within such a project" (INT-Mkt1t)	Mkt1	2	n/a	y
To create customer base	n/a	RD	2	If customers were not responding favourably to the idea of Thermo then investments for that particular market segment were stopped. Thermo did not invest heavily in marketing specific target segments; "Just see if someone picks it up and if not, so be it […]" WS-RDt)	n
Activities		**Source**	**#**		**y/n**
Finding funds for problem analysis	n/a	RD	2	Needs analysis is done highly informally, in between other tasks; there are ideas not given sufficient attention, but I can put my time only in one thing at the time […] (INT-RDt)	n
Finding funds for needs analysis	"We look of someone [customer] who expresses his interest, and if not, than we do not proceed" (INT-RDt)	OM	1	n/a	y
		RD	1		
Finding funds for testing	"Well, if you decide to work for 1.5 year on this product to develop it, you need to have some form of argument to be able to continue" (INT-OMt)	OM	2	n/a	y
Resources		**Source**	**#**		**y/n**
Corporate decision making criteria	"You have to spread the risk between developing you own product and doing customer specific implementations" (INT-OMt)	OM	3	n/a	y
		RD	3		
Strategic reflections	"We want to know the roadmap, our main objectives and strategy" (INT-OMt)	OM	4	n/a	y
		RD	2		
Availability of grants	n/a	OM	1	The project was solely funded by Owner and RD Director. "We can not afford an adventure like that anymore." (WS-OMt)	n
Customer willing to pay	n/a	n/a		Customers were not probed for their willingness to pay, or participating in the development of Thermo	n

Source: Author

Table T.4: Evidence of Practice D Within Thermo Case

Case Thermo: Practice D. Exploring the Market & Opportunity					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To make a business model	"So, the question was what are the most appropriate customer groups for which we can add value?" (INT-Mkt1t)	Mkt1	5	n/a	y
To estimate market potential	"He [Mkt1t] did a research project to check whether it would be feasible to enter that market" (INT-OMt)	OM	5	n/a	y
To understand the market forces affecting customer needs	n/a	RD	2	Market research was mostly confirmatory and did not result in new understanding for example of market forces: "that resulted in some insights, but not really in new things" (INT-RDt)	n
Activities		**Source**	**#**		**y/n**
Desk research	"Desk research done at [SYSTEMCO] is done and enriched with other material […] (Marketing Research, p. 16)	OM	3	n/a	y
		RD	1		
		Mkt1	1		
		DOC	1		
Visiting conferences	"We went to conferences […]" (INT-OMt)	OM	2	n/a	y
Interviewing	"I have done some qualitative interviews with those people [customers in target group]" (INT-Mkt1t)	OM	1	n/a	y
		Mkt1	2		
		DOC	1		
Analysing the opportunity	"Analysis , discussion and conclusions" (Marketing Research, p. 21)	OM	1	n/a	y
		DOC	1		
Documenting the opportunity	"Conclusions, […]" (Marketing Research, p. 24)	Mkt1	1	n/a	y
		DOC	2		
Resources		**Source**	**#**		**y/n**
Research method expertise	"So I thought about how to interview those people" (INT-Mkt1t)	Mkt	2	n/a	y
		DOC	4		
Interview skills	Interview protocol in (Market Research, p. 40)	Mkt	1	n/a	y
		DOC	1		
Analytical skills	Use of segmentation models in (Market research, p. 12	Mkt	2	n/a	y
		DOC	3		
Student support	"So that was part of my master project." (INT-Mkt1t)	OM	2	n/a	y
		Mkt1	1		
		DOC	1		
Readily available internal sources	n/a	DOC	1	The market research reports list the data sources. These consisted only of external sources (Marketing research, p. 16)	n
Readily available customer sources	"I spoke to five of those people [...] I googled them" (INT-Mkt1t)	Mkt1	1	n/a	y
		DOC	1		
Readily available expert sources	n/a	DOC	1	The market research reports list the data sources. These consisted only of external sources (Marketing research, p. 16)	n
Readily available secondary sources	"We looked at different SBI codes and searched for amount of firms in different industries" (INT-Mkt1t)	Mkt	1	n/a	y
		DOC	1		
Company formats	n/a	n/a		Other than the market research report there was nothing documented. Company formats were therefore not available	n

Source: Author

Table T.5: Evidence of Practice E Within Thermo Case

Case Thermo: Practice E. Defining the Value Proposition					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To justify investments in development, production and marketing	"You need to have an argument for developing the product. It has to be s academically sound, because you spend a lot of time on that" (INT-OMt)	OM	2	n/a	y
To establish a shared vision on the importance of the project	n/a	n/a		There was not need to establish a shared vision as the owner and research director were the sole persons involved and sharing important information continuously	n
Activities		**Source**	**#**		**y/n**
Defining customer value	"You need to start with the customer. What the advantage of your product is for him or her" (INT-Mkt1t)	OM	1	n/a	y
		Mkt1	1		
Defining firm value	"Chapter 7. The business case" (Market research, p. 27)	OM	1	n/a	y
		Mkt1	1		
		DOC	2		
Resources		**Source**	**#**		**y/n**
Individual integration skills	n/a	OM	1	The owner and research director frequently discussed findings between them or with others; "We continuously discuss what we hear and see" (WS-OM1) It was therefore much more a collaborative process. "That takes 2 years, and then you know it more or less" (WS-OMt)	n
		RD	1		
Sensemaking with customer	n/a	n/a		The customers was not involved in discussing the findings. Information processing was an internal affair	n
Collaborative internal sensemaking	"I held a brainstorm session […] about the business case and marketing activities for introduction […] it was for all employees that were present" (INT-Mkt1t)	OM	1	n/a	y
		Mkt1	1		
		DOC	1		
External legitimacy	n/a	n/a		Conclusions were not shared with outsiders. They therefore could not acknowledge Thermo as being an important innovation	n
Company formats	n/a	n/a		Other than the market research report there was nothing documented. Company formats were therefore not available.	n

Source: Author

Table T.6: Evidence of Practice F Within Thermo Case

Case Thermo: Practice F. Managing DCI action					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To collect information in a conscious, efficient and impartial manner	n/a	OM	2	This process was not systematically undertaken and monitored. "I am having difficulty seeing this as a systematic process […] Due to the circumstances it was very messy" (WS-OMt)	n
To make sure uncertainty decreases across the process	n/a				n

Source: Author

Table T.7: Evidence of Practice G Within Thermo Case

Case Thermo: Practice G. Mobilizing Customers					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To increase development capacity	n/a	n/a		Customers were not involved in development.	n
To find money for further development	n/a	n/a		Customers were not funding development.	n
To prepare for sales & marketing	"You also need sales channels […] so you need to find someone who says I understand the project and I want to do something with it' (INT-RDt)	OM	2	n/a	y
		RD	2		
To get customer information	"I wanted to have a full picture and I knew that person held specific ideas about that" (INT-OMt)	OM	4	n/a	y
Activities		**Source**	**#**		**y/n**
Defining customer criteria	"You need to be careful with whom you talk. Not everybody is capable of saying useful things" (INT-OMt); "Those were interesting markets, big markets" (INT-OMt)	OM	5	n/a	y
		RD	1		
		Mkt1	1		
Identifying of customers	n/a				n
Activating of customers	"We placed the products on our website, and in this way people found us" (INT-RDt)	OM	1	n/a	y
		RD	2		
Managing of expectations	" People like it when you define solutions for them" (INT-RDt)	RD	2	n/a	y
Resources		**Source**	**#**		**y/n**
Customer incentive	n/a	RD	2	Thermo did not invest heavily in attracting specific target customers; "Just see if someone picks it up and if not, so be it […]" WS-RDt)	n
Internal incentive	n/a	Mkt2	2	Thermo did not need to invest in internal marketing. The employees to just what they tell them: "There is one leader and he determines what we should do […] I was not involved in […] (WS-Mkt2t)	n
Marketing channels	"We just published it on the website, as a test case" (INT-RDt)	RD	3	n/a	y
Customer management skills	"You need to establish trust, to show that we know terminology and the domain" (INT-RDt)	RD	2	n/a	y

Source: Author

Table T.8: Evidence of Practice H Within Thermo Case

Case Thermo: Practice H. Elaborating Customer Needs					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To support solution finding	n/a	OM	1	Explorative research takes place in A, in order to understand problems. Once customers express interest in an idea, the product is developed and refined by means of feedback gathering. "Than we talk to ambassadors and test it." (INT-OMt)	n
To define customer requirements	n/a	RD	1		n
To validate the scope of the project	n/a				n

Source: Author

Table T.9: Evidence of Practice I Within Thermo Case

Case Thermo: Practice I. Collecting Customer Feedback					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To validate and refine customer requirements	"We listed all their requirements and then checked whether we could do it, feedback it to the customer, and this several times" (INT-OMt)	OM	2		y
To identify missing information	n/a	RD	2	"We asked the test persons what could be done better" (INT-RDt)	n
To check performance of the solution	"That is what we learned, from those people, that the product was ready for launch" (INT-RDt)	RD	2	n/a	y
Activities		**Source**	**#**		**y/n**
Surveying customers	n/a	RD	2	Feedback is collected informally, while working with customers. "We very pragmatically installed the product with [customer segment] and watched for them to get back to use. And in this way we adapted and improved Thermo" (INT-RDt)	n
Conducting conversations	"And, this is how you get in touch and you can start using , those ambassadors, those test persons so to say, and ask them, what do you want? Or, how can this be done better" (INT-RDt)	OM	3	n/a	y
		RD	2		
Watching movies of use	n/a	RD	2	"We very pragmatically installed the product with [customer segment] and watched for them to get back to use. And in this way we adapted and improved Thermo" (INT-RDt)	n
Analysing feedback	n/a				n
Documenting feedback	n/a				n
Reflecting on assumptions and uncertainties	n/a				n
Resources		**Source**	**#**		**y/n**
Minimum Viable Product	"We offered the basic product for testing" (INT-RDt)	OM	1	n/a	y
		RD	2		
Interview skills	n/a	RD	2	"We very pragmatically installed the product with [customer segment] and watched for them to get back to use. And in this way we adapted and improved Thermo" (INT-RDt)	n
Analytical skills	n/a				n
Documentation system	n/a				n
Readily available customer sources	"[Name of customer] was involved, he came back to me, asking to include this, and that […] (INT-OMt)	OM	2	n/a	y

Source: Author

Table T.10: Evidence of Practice J Within Thermo Case

Case Thermo: Practice J. Defining Customer Requirements					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To achieve a shared understanding of requirements and priorities	n/a	n/a		Insights were not documented and only shared between the owner and research director. Others were not involved.	n
To supervise the development process	"Than follows a specification process, in which you literally define what you have to do" (INT-OMt)	OM	2	n/a	y
To manage expectations of customers	n/a	OM	1	The list of requirement is not used during the development process to communicate with customers. SystemCo do uses it now in their marketing of SEMO. "This list is difficult to use for clients. Over the years we have improved our communication and we now use this in our marketing" (WS-OMt)	n
		Mkt2	1		
Activities		**Source**	**#**		**y/n**
Listing user requirements	"So we had a list of specifications for turning product A into B" (INT-OMt)	OM	5	n/a	y
Setting priorities	"[…] that also holds the priorities of the specifications" (INT-OMt)	OM	1	n/a	y
		RD	1		
Refining requirements	"We listed all their requirements and then checked whether we could do it, feedback it to the customer, and this several times" (INT-OMt)	OM	2	n/a	y
Resources		**Source**	**#**		**y/n**
Individual integration skills	"Everybody can contribute and say what they want to say"(INT-OMt)	OM	2	n/a	y
Sensemaking with customers	n/a	OM	1	The list of requirement is not used during the development process to communicate with customers. SystemCo do uses it now in their marketing of SEMO. "This list is difficult to use for clients. Over the years we have improved our communication and we now use this in our marketing" (WS-OMt)	n
		Mkt2	1		
Collaborative internal sensemaking	"I help him with that, you can not do this alone" (INT-OMt)	OM	1	n/a	y
		RD	1		
Company formats	n/a	n/a		Other than the market research report there was nothing documented. Company formats were therefore not available.	n

Source: Author

Table T.11: Evidence of Practice K Within Thermo Case

ase Thermo: Practice K. Mobilizing Internal Sources					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To learn about new customers and markets	n/a	OM	2	"Not everybody can do that [research], with all respect, that is the glasses you wear, the R&D manager and I we have a focus on the customer'… "not everybody has those glasses and that is perfectly fine." (INT-OMt)	n
To validate findings	n/a	Mkt	1	"if I had to improve my understanding of issues in these markets I would have needed to be much more active in the field." (WS-Mkt1t)	n
To get access to customer network	n/a	n/a		Thermo was targeted at new customers, so there was no customer network available	n

Source: Author

Table T.12: Evidence of Practice L Within Thermo Case

Case Thermo: Practice L. Developing the Product Concept					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To provide material for testing	"From there we looked at how we could adapt and make it producible" (INT-RDt)	RD	2	n/a	y
To prepare for sales and marketing	"We defined a few basic product products, put them in the market" (INT-OMt)	OM	2	n/a	y
Activities		**Source**	**#**		**y/n**
Generating ideas for solutions	"We said, it is nice, such a [THERMO] but we also want additional features...We literally defined products in a few hours" (INT-OMt)	OM	2	n/a	y
Consensus and decision making	"[…] that research confirmed our feelings, so we could safely continue" (INT-OMt)	OM	2	n/a	y
Developing the solution	"This is how we developed the product further, using our technology" (INT-OMt)	OM	2	n/a	y
Resources		**Source**	**#**		**y/n**
Experience with collective idea generation	"Everybody can contribute and say what they want to say" (INT-OMt)	OM	2	n/a	y
Customer empathy in R&D team	"It was vital to have customer empathy […] that you can think of solutions that help them in their true needs" (WS-RDT)	OM	1	n/a	y
		RD	1		
Visual material supplied by the customer	n/a	n/a		Customers were not involved in development.	n
Co-creating customer	n/a	n/a		Customers were not involved in development.	n
Student support	"I forgot to mention, the trainees, they were important support in development" (INT-OMt)	OM	2	n/a	y
Project management tool	"We call that the product change database, that also holds the priorities of the technical specifications" (INT-OMt)	OM	1	n/a	y
		RD	1		

Source: Author

Table T.13: Evidence of Practice M Within Thermo Case

Case Thermo: Practice M. Planning Sales and Marketing for Introduction					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To start up the commercial process	"We introduced [Thermo] rather quick" (INT-OMt)	OM	2	n/a	y
Activities		**Actor**	**#**		**y/n**
Re-using CI	"Section on the introduction campaign" (Market research, p. 3)	OM	3	n/a	y
		RD	2		
		DOC	1		
Communicate insight	"I made that report and also catered for a workshop. So that I could explain my recommendations" (INT-Mkt1t)	OM	1	n/a	y
		RD	1		
		Mkt	1		
		DOC	1		
Resources		**Source**	**#**		**y/n**
Individual integration skills	"Recommendations" (Market research, p. 25)	Mkt	2	n/a	y
		DOC	1		
Collaborative sensemaking within team	"I held a brainstorm session […] about the business case and marketing activities for introduction" (INT-Mktt); "[…] the technical people were also involved" (INT-Mktt)	Mkt	2	n/a	y
		DOC	1		
Student support	"This was for my master" (INT-Mktt)	RD	1	n/a	y
		OM	1		
Documentation system	n/a	n/a		At the time of Thermo, only technical specifications were captured. Insights were not documented	n
Company formats	n/a	n/a		Other than the market research report there was nothing documented. Company formats were therefore not available.	n

Source: Author

APPENDIX U EVIDENCE OF THE RELATIONSHIPS BETWEEN THE PRACTICES OF THERMO

Table U.1: Evidence of Relationships Between the Practices of Thermo

Practice / Output of Practices	Exploring the problem situation (A)	Generating ideas (B)	Exploring the market & opportunity (D)	Defining the value (E)	Securing innovation funds (C)	Managing DCI action (F)	Mobilising customer sources (G)	Exploring the user experience (H)	Collecting user feedback (I)	Defining /refining requirements (J)	Mobilising internal sources (K)	Developing the product concept (L)	Planning sales and marketing (M)	Representative Quotes
Customer problem understanding (A)			→				→							"We were speaking with [customers in customer segment] and then the marketeer came in and researched the size of the market" (INT-OMt) "I was able to build trust, by means of my domain knowledge and related terminology of that customers" (INT-RDt)
First idea concept (B)										→				"We had our core technology and from there we specified other products" (INT-RDt)
Market understanding (D)				→										"Summary, Benefits: the market potential will be around [amount]. With that amount [SafetyCo] will be able to have a payback period of [amount] on [investments]" (Marketing research, p. 3)
													→	"6.4 Recommendations, Execution of the strategy [describing, pricing, target groups, sales channels, promotion]" (Marketing research, p. 25)
Defined value (E)					→									"You want to know were you stand, will this be a meaningful project, should we invest in it" (INT-OMt)
Authorized means (C)							→							"That is literally innovation with the customer: It offered us the opportunity to realize part of the roadmap, without taking the risk of developing a product from scratch all by yourself" (INT-OMt)
Customer sources (G)	→			→					→					" [...] and we tried to think of customer groups and understand which one we should pick" (INT-Mktt) "That customer was a big customer, we thought we could get 2-3 order out of it" (INT-OMt) "And, this is how you get in touch and you can start using , those ambassadors, those test persons so to say, and ask them, what do you want? Or, how can this be done better" (INT-RDt)
													→	"With those best practices, you can show to others how it can be used" (INT-RDt)

Table U.1: Continued

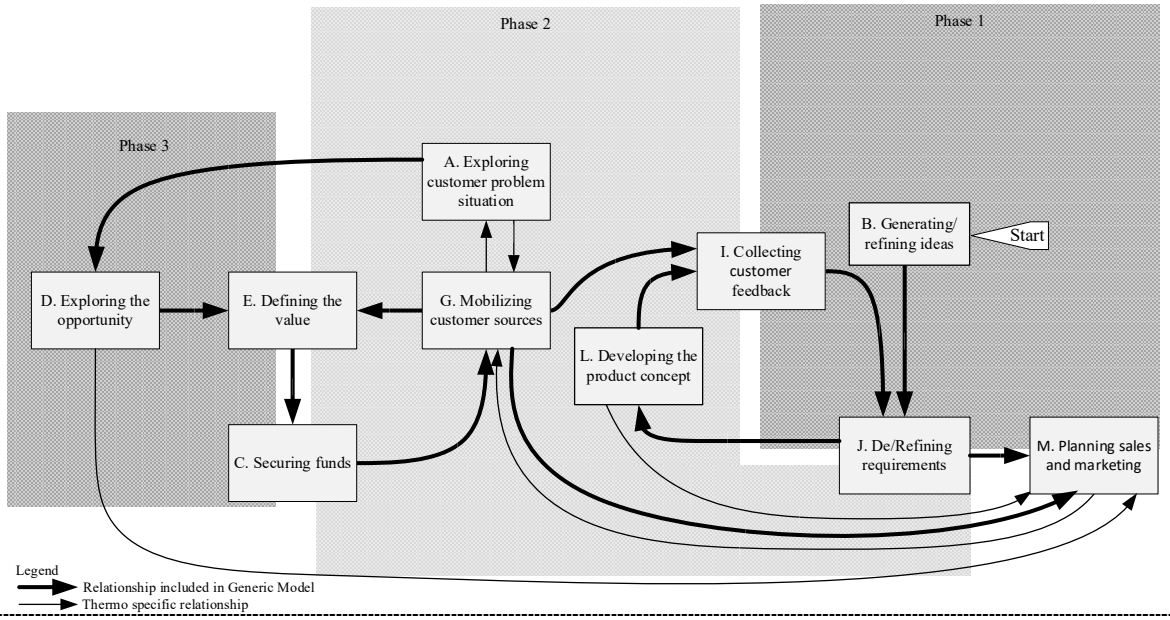
Practice / Output of Practices	Exploring the problem situation (A)	Generating ideas (B)	Exploring the market & opportunity (D)	Defining the value (E)	Securing innovation funds (C)	Managing DCI action (F)	Mobilising customer sources (G)	Exploring the user experience (H)	Collecting user feedback (I)	Defining /refining requirements (J)	Mobilising internal sources (K)	Developing the product concept (L)	Planning sales and marketing (M)	Representative Quotes
Feedback of customers (I)										→				"[…] and this [testing with customers] is how you proceed, developing and cooperating with you customers" (INT-RDt)
Prioritized requirements (J)												→		"[…] and so we get from one product a big list of requirements for a jump towards another product" *(*INT-OMt)
													→	" We literally defined products in a few hours […] and went looking for sales channels" (INT-OMt)
A first product concept (L)									→					"We have a rather long phase in which we send them the product and they come back to use with their requests for improvement [...]" (INT-RDt)
													→	"With that basic products we put up our sales channel and see what happens" (INT-OMt)
A plan for launch (M)							→							"We made sure your products could easily be found and this resulted in contacts in that market" (INT-RDt)

Source: Author

Table U.2: Key Characteristics of the Relationship model of Thermo

Thermo model and numerical features

10 practices, 17 relationships, 75% of common configuration of practices included (12 out of 16 generic relationships)



Central practices Thermo model

G. Mobilising customer sources (7)

M. Planning sales and marketing (5)

Characteristics Thermo model

- Starting point of the project is idea generation (B);
- The timing and focus is different than in the common configuration of practices;
- There is central role for mobilising customers (G) and marketing (M);
- M is done as soon as possible, in Phase 1 to attract potential customers (G) in Phase 2. An early product version (L) supports the process;
- A is done relatively late in Phase 2, and is limited to customers that expressed interest in the product;
- D is done in the latest phase and limited to selected markets. Findings are used in M;
- Apart from their role in A, customers validate the value proposition (E), test refined product versions (I) and support marketing (M).

Conclusions Thermo model

- Early marketing activities in Phase 1 enable to attract and select a customer group that matches best with commercial and informational objectives. This justifies further R&D investments;
- Dedicated customer and market research may then be postponed until phase 2 when more customers are mobilised. It is then limited in scope, and instrumental to the development of a refined product concept for a selected customer groups.

Source: Author

APPENDIX V ACTORS AND RESOURCES OF THERMO

Table V.1: Actors of the Practices of Thermo

Practice	Roles	Description of Role	Practice
R&D Director	Information processing	Collecting and analysing information	A, I
	Champion	Promoting the project internally, creating commitment	C
	Gatekeeper/synthesis	Synthesising all relevant knowledge into new models	E, J, M
	Creativity and Development	Develop ideas and concepts	L
	Boundary spanning	Recognising new externally located information	B
	Decision maker	Making go/no go decisions about the project	C
	Gatekeeper/quality control	Mitigate biases	A, I
Customer	Input source	Providing the raw data	A, I
Owner	Relationship manager	Promoting the project externally, creating commitment	A, G, M
	Information collection	Collecting information	A
	Gatekeeper/synthesis	Synthesising all relevant knowledge into new models	E, J, M
	Champion	Promoting the project internally, creating commitment	C
	Decision maker	Making go/no go decisions about the project	C
	Information source	Providing market ad/or customer data	D
External Marketeer	Information processing	Collecting and analysing information	D

Source: Author

Table V.2: Resources of the Practices of Thermo

Resource Group	# of Resources	%	Dominant Resource Type (# of Appearances in Practices)
FLA	4	14%	Strategic Thinking (3)
CoI	6	21%	Customer sources (3)
S&T	16	55%	Interview skills, integrative skills (7)
P&M	3	10%	Students (3)
Total	29	100%	

Source: Author

APPENDIX W PERCEPTIONS OF QUALITY CRITERIA OF THERMO

Quality	Mentions documents	Mentions interviews	Exemplar quote
Comprehensive	-	6	"You need to get a thorough understanding of specific business. For example, I know need all about cows. How they eat, the breeds, stables […] This goes very broad and helps you to gain trust from the client" (INT-OMt)
Novelty	-	6	" I look for unique features, compare with others via Google" (INT-OMt)
Accurate	-	6	"Once you decide to go for it, you need a more scientific approach, be more certain […] Suppose you find out you addressed the wrong market, or your specifications weren't correct" (INT-OMt)
Acceptable	-	3	"You need to combine technical and communicative aspects. The customer often does not tell what causes his problem. He needs to recognise the value of a technical feature […] Recognise that this is indeed a solution for his problem" (INT-RDt)
Scope	-	5	"It is very important we define whose needs were are looking at. [Customer-segment 1] finds the life-span of batteries important, whereas in [customer segment 2] this isn't important at all" (WS-RDt)
Cost efficient	-	3	"Of course, the big firms are able to buy reports and have more insights in size and number, but that cost a lot. We don't have that means […]" (INT-RDt)

Source: Author

APPENDIX X THE LEVEL OF INSIGHT OF THERMO

Criterion	Timely	Comprehensive		Novelty	Clear Consistency	Clear Inspiring	Clear Format	Extra case criterion Acceptance	Extra case criterion: Scope	Extra case criterion: Cost-Efficiency
Indicator	Document holding CI	Amount of needs insights	Missed needs insights	Attractive needs agreed upon by 50% of more of team	% of consistently formatted requirements	% of statements free of solution aspects	# of different formats			
Result	Brochure	26	Yes	6	53%	53%	2	yes	no	yes
Qualitative evaluation	At the time of Thermo, the R&D director and Owner developed the requirements for Thermo. This was done informally and not made available to others working on Thermo. Only later, when the product was beginning to sell to a wider group of customers requirements were listed in the brochure. "Many questions were still open and added in retrospective" (WS-OMt) . The insights were therefore not timely.	According to the R&D manager their insights at the beginning of the project were limited. as the project progressed they developed fairly complete understanding of the customer. They missed insights on buying processes and emotional needs and this especially complicated selling Thermo "We can improve on understanding decision making processes. This is for all our products. We don't know much about the buying situations" (INT-OMt) "In general we underestimated the effects of design […] our insights here are limited." (INT-RDt)		The team agrees on several attractive features, such as the logging and reporting functionality.	During the workshop the owner had to explain several times the meaning of certain requirements. This led to several discussions between the participants and illustrates the lack of clarity.			"In general the customers is very happy if I help them in formulating the problem. That builds trust." (INT-RDt)	During the workshop it became clear that requirements changed during the project. For some this was a problem, for others it was seen as an inevitable part of the process. At least it shows that the scope on target market and customers changed during the project. The R&D manager clearly sees this lack of scope as a major cause of the modest results of Thermo	"We tried to look for confirmation, if we heard that specific requirements were asked several times, we felt confident that we could move on." (INT-Mkt1t)

Source: Author

APPENDIX Y IMPROVEMENT OPPORTUNITIES THERMO

Table Y.1 Improvement opportunities

Practices	Importance			Implementation			Opportunity
	% > 4	AVG	Std	% > 4	AVG	Std	Score
A. Exploring customer problem situations	**100**	**5.00**	**0**	**100**	**4.25**	**0.5**	**10**
B. Generating ideas	75	4.25	0.96	100	4.33	0.58	5
C. Securing innovation funds	50	3.75	0.96	100	4.50	0.71	0
D. Exploring the market opportunity	75	4.25	0.96	66	3.67	0.58	8.3
E. Defining the value proposition	75	3.50	1	**100**	**4.00**	**0**	5
F. Managing DCI action	50	3.25	0.96	66	3.00	1.73	3.3
G. Mobilising customer sources	**100**	**4.50**	**0.58**	**100**	**4.25**	**0.5**	**10**
H. Elaborating customer needs understanding	75	4.25	0.96	**100**	**4.00**	**0**	5
I. Collecting customer feedback	**100**	**4.75**	**0.5**	100	4.67	0.58	**10**
J. Defining customer requirements	50	3.75	0.96	**100**	**4.00**	**0**	0
K. Mobilising internal sources	25	2.75	0.96	0	2.50	0.71	7
L. Developing the product concept	**100**	**4.25**	**0.5**	100	4.67	0.58	**10**
M. Planning sales and marketing for launch	75	4.00	0.82	25	3.50	1	**12.5**
Total		4.02	0.78		3.95	0.57	

Source: Author

Table Y.2 Improvement Tactics

Practice	# of Improvements	Dominant Tactic	# of Mentions	Exemplar Quotes
A	4	Data collection techniques	13	"At the beginning we acted more on feeling, more technology driven […] much was in our head. Many questions were still open and added in retrospective." Maybe we could have done this more systematically […] like we did with [other product]" (WS-OMt); "If I had to improve my understanding of issues in these markets I would have needed to be much more active in the field." (WS-Mkt1t)
G	1	Sampling	2	"Make a choice for a customer segment. This is a big thing for our company and it affects our marketing as well […] Who is this customer (WS-OMt)"
I	n/a	n/a	n/a	n/a
L	2	Roles	6	"We are not [big brand 1], or [big brand 2]. No, we are just a small Dutch Company and we need to be highly creative and special […] R&D we often say that in two words, but these are really to different things. You need to research before doing development, but not all our technological people can do this" (WS-OMt)
M	1	Roles	8	"This is our weak spot, strong marketing skills […]" (INT-OMt)
Total	8			

Source: Author

APPENDIX Z IMPLICATIONS OF THE IMPROVEMENTS THERMO

Improvements per Improvement Tactic	Implications for the Level of DCI									
	Timely	**Comprehensive**	**Novel**	**Consistent**	**Inspiring**	**Format**	**Accurate**	**Acceptable**	**Scope**	**Cost efficient**
Data collection techniques		✓	✓				✓			
Develop broad general domain knowledge by talking to people in the field		✓								
Preserve completeness		✓					✓			
Use techniques that focus on latent needs			✓				✓			
Format synthesis					✓	✓		✓		
Have a clear format for DCI					✓	✓		✓		
Roles	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Have a team that is both technical and receptive to customer-needs	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Have owners in the lead	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Put more effort in marketing implementation										✓
Sampling	✓		✓							
Attract the right informants at the right time	✓		✓							
Total impact (amount of improvements)	3	**4**	**4**	2	3	3	**4**	3	2	3

Source: Author

APPENDIX AA BARRIERS TO IMPLEMENTATION THERMO

Improvement Tactic	Barrier	Mentions	Exemplar Quote
Data collection techniques	What is market research?	2	"We requested lists from the chamber of commerce and identified the most interesting market segments […] just how market research should look like." (INT-OMt). Other times they used it to summarise different type of research: "I love doing market research, you go from inside to the outside, you google, you think about what makes you unique and talk to some people […]"(INT-OMt)
	Pros and cons of early testing	2	"I start with running up a flagpole on the website, and then with the response we get, we get in touch with certain markets and we then move from there […] Just see if someone picks it up and if not, so be it […]Your product has to look smart enough then, this is why I want to invest in 3D printing (INT-RDt)
Management of learning	No explicit process	4	"We are sitting next to each other and we do a lot of things from memory, we are working all day with those specs. But, indeed we didn't really have a system or process […] this is a oral process" (WS-OMt)
Market Definition	No Focus	3	"My insights are limited, I think. I have difficulty keeping track of everything and give priority to the right things" (INT-RDt)
Order of doing things	Start from solution	2	"But you can start from an idea. Combine this with market needs […] (WS-OMt) "Yes, at some point you are not really focuses customers, but you recognise how some technology can make you unique." (WS-RDt)
Roles	Too wide or too narrow role for the customer	2	"Customers do not have ideas, they do have needs, maybe, but it is us who should have to vision" (WS-OMt) "This is our struggle for many years, customers can not explain what functionalities they need […] so we develop these, from our experience with those markets" (WS-OMt)
	Trust of owner (affecting data collection and marketing)	8	"Well I have to say, [RD Director] and I, we are in the lead, maybe it is not fair, and I should not say this, we really try to do this in a team, but we are having the experience, they don't know, they don't see things" (WS-OMt]
Sampling	Geographical location customers	1	"In the Netherlands it is easy, but in other countries it is more difficult, because there are many things in the way to get to the right people" (INT-RDt)
	Lack of method for customer selection	8	"[…] isn't it perfect, talking to the [big national b-to-b customer]? Imagine! Well and then it turns out that noting useful comes out of these conversations… they appear to use their existing means creatively and are happy with that. They weren't able at all to think beyond that." (INT-OMt).
Total	**10 Barriers**		

Source: Author

APPENDIX BB CODING OF TRANSCRIPT INTERVIEW ZKL

PART OF TRANSCRIPT INT-OMz

P2

INT-OMz: I've done business in every country of Europe, and this brought me, well, let's say, understanding about the need behind the need. Every time they had to calculate cost, they saw that there were many man-hours involved. This is because they have to work together. But nobody dared to discuss this price of safety.

A. Identifying a problem idea

Also, everybody had to drive a big van or bus, because otherwise they couldn't bring in all the material. So we thought we had to develop something small. Secondly, people work quite a long time in the same location, so we thought we had to come up with something that could stay in place for some time. So we thought let's invent a solution for this and this is how we… how I started this enterprise

Objective C

B. Generate new ideas

C. Finding funds for problem analysis

We were developing for 2 - 3 years and that cost a lot of time, money and energy. I started very carefully and took the first [x] euro from the bank to develop the concept. Just, let's say the mock-up. And then I took another amount to learn whether there was interest for this. I went to conference, in Utrecht, and I developed survey cards.

C. Finding funds for needs analysis

P3

I. Surveying customers

So we started developing and all this was based on the 250 positive responses to the survey cards. We took an open approach and developed with our doors open. The big advantage is that with this process you can refine according to the needs...

Objective I..

L. A co-creating customer

APPENDIX CC CODING OF TRANSLATED TRANSCRIPT WORKSHOP ZKL

PART OF TRANSCRIPT WORKSHOP

P.23

WS-OMz: You know what, the product, you put it in the market and the finetuning, in my view, can only be achieved by this feedback of customer. You never should think that you are able to put this product 100% correct in the market. A. Vision on DCI

You have to incorporate the voice of the customer, as early as possible. So before you start developing your first simple model. Just like we did with the ZKL You continuously go out and test the solution. This is such a natural way of working,… Order of doing things

INT: So, if I try to summarize this, you say that it is very important to have a continuous dialogue with your customer.

WS-OMz: I tell you, you can not do I [collecting customer feedback], without having G [mobilizing customers]. Order of doing things

WS-Mktz: I was about to say so. I and G support each other. Order of doing things

WS-OMz: Another value we have is that we are a reliable partner. We develop with open doors. Immediately after we have secured our IP we invite the customer and take him along. Is that easy, no of course not. Sometimes you run into trouble for example when you missed a deadline. So you have to manage expectations. Openness Management of expectations

APPENDIX DD EVIDENCE OF PRACTICES ZKL

Table DD.1: Evidence of Practice A Within ZKL Case

Case ZKL: Practice A. Exploring the Customer Problem Situation					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To define product market segments	n/a	OM	1	From the early phase on the idea of ZKL targeted one specific product market segment. Now that the product is introduced, new product market segments might become relevant: "[SafetyCo] wont, I might, but [SafetyCo] wont [You won't take your concept to other market segments.]" (INT-OMz) "I want to grasp that. The difference. At that time we targeted rail" (INT-POz)	n
		PO	1		
To further develop first ideas	"[...] the process is always from A to Z and on what parts are there any customer frustrations and how can we solve these" (INT-OMz)	OM	2	n/a	y
To understand the opportunity of a customer idea	n/a	OM	1	The OM has enough experience in the market to have an idea of the opportunity; "The story I just told you about the playground … I knew that there was a problem" (INT-OMz)	n
To build trust with potential customers	n/a	OM	1	The OM tries to filter out potential customers that don't agree on his world view; "Seek your partners, seek the people that do see it and want to come along with you and sometimes nobody sees it, but in the meantime we build it anyway" (INT-OMz)	n
Activities		**Actor**	**#**		**y/n**
Identifying a problem area	"You hear where the problems are and that everything is too complex" (INT-OMz)	OM	8	n/a	y
		PO	8		
		Mkt	2		
Conducting customer conversations	"By talking to everybody, you are able to [understand the problem], they ask you the same thing every time, but in different ways" (INT-OMz)	OM	3	n/a	y
Analysing customer problems	n/a	OM	1	"Yes and I'm in a similar project now [Other people are a stakeholder too]. But with [ZKL] this wasn't the case. It came from me.]" (INT-OMz)	n
Reporting of customer problems	n/a	OM	1	At that time the OM did not document his findings; "No, I didn't document those things" (INT-OMz)	n
Resources		**Actor**	**#**		**y/n**
A broad scope	"[…] 10 years ago I already detected the problems with the rail. This is not about [specific problem], but more about how it is organized" (WS-OMz)	OM	2	n/a	y
		PO	1		
		Mkt	1		
Readily available internal sources	"This means that you have to have learned the specifics of a market before […]" (INT-OMz)	OM	2	n/a	y
		PO	3		
Readily available customer sources	"You need to get input from all your stakeholders, the customer is only one of them" (INT-POz)	OM	1	n/a	y
		PO	1		
Readily available expert sources	"You need to get input from all your stakeholders, the customer is only one of them" (INT-POz)	OM	1	n/a	y
		PO	1		

Table DD.1: Continued

Readily available secondary sources	n/a	OM	1	The OM either calls people or meets them in person; " I called my business partner eighty times and I try to gauge interest" (INT-OMz)	n
Interview skills	n/a	OM	1	The vision of the OM prevails in the organization; …I have to teach myself to leave behind the middle management. I have the tendency to try to convince people… (INT-OMz)	n
Analytical skills	"So, I speak thousands of people and this enables me to see what problems they have in common" (INT-OMz)	OM	2	n/a	y
		PO	2		

Source: Author

Table DD.2: Evidence of Practice B Within ZKL Case

Case ZKL: Practice B. Idea Generation					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To define a project fitting into the strategic agenda	n/a			SafetyCo now has a strategic agenda, but not at the time of ZKL	n
To define a solution for observed needs	"[...] so we base our development on our own vision and ideas […]" (INT-POz)	PO	2	n/a	y
To define a project that can be funded	n/a	OM	2	The OM follows his own vision; "We are not an organization of which an external party can tell what to develop" (INT-OMz);	n
Activities		**Actor**	**#**		**y/n**
Checking ideas of customers	n/a	PO	2	"So [OM] saw an opportunity […]" (INT-POz); "It wasn't so much the question whether customers wanted a product. You already had the idea yourself" (WS-Mktz)	n
		Mkt	1		
Consensus and decision making	n/a	PO	1	OM is the sole decision maker; "[OM] is responsible for the roadmap […]" (INT-POz)	n
Generating new ideas	"[…] so we thought let's invent a solution for this and this is how we, how I started [RailCo]" (INT-OMz)	OM	2	n/a	y
		PO	1		
Resources		**Actor**	**#**		**y/n**
Vision of the future	The question was, how can we solve that issue, but looking at the future […] And, I already understood that [influence] would become important (INT-OMz)	OM	3	n/a	y
		PO	1		
		Mkt	1		
Overview of current products and capabilities	n/a	OM	1	At the time of ZKL, they still had to develop core competencies;"[…] and [product] includes a technique, so we could use that and this is how we started" (INT-OMz)	n
Experience with creative techniques	"You need to have the skills to do a kind of back casting. Kind of like back into the future" (INT-OMz)	OM	2	n/a	y
A sufficiently broad scope	"[…]we made a picture of how our world would look like in a couple of years" (INT-OMz)	OM	2	n/a	y
Market reputation	n/a	OM	1	At the start of ZKL RailCo new in the market, without a solid reputation; "Two years ago I told a contractor 'forget that, focus on this and join in because this is the new world'. Then I got kicked out of the room so that was a bit too much" (INT-OMz)	n

Source: Author

Table DD.3: Evidence of Practice C Within ZKL Case

Case ZKL: Practice C. Securing Innovation Funds					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To get authorization from management	n/a	OM	1	OM was the sole decision maker and funder at the start of ZKL; "[…] I've never needed a bank to finance something directly or indirectly (INT-OMz)	n
To create means for next development step	"We were developing for 2 to 3 years and that cost a lot of time, money and energy" (INT-OMz)	OM	2	n/a	y
To create customer base	"Then we made a very good deal, and from that moment [the launching customers] took part in development. That was great, because I needed that money" (INT-OMz)	OM	2	n/a	y
Activities		**Actor**	**#**		**y/n**
Finding funds for problem analysis	"I started very carefully and took the first [x] euro from the bank […] to develop a mock-up" (INT-OMz)	OM	1	n/a	y
		PO	1		
Finding funds for needs analysis	"And then I took another amount to learn whether there was interest for [ZKL]" (INT-OMz)	OM	1	n/a	y
		PO	1		
Finding funds for testing	"Then we made a very good deal, and from that moment [the launching customers] took part in development. That was great, because I needed that money" (INT-OMz)	OM	2	n/a	y
		PO	2		
Resources		**Actor**	**#**		**y/n**
Corporate decision making criteria	n/a	OM	1	Most of the decisions were based on gut feeling; "This all went on the basis of gut feeling. I often say, these are the cost, we need to build this thing with trust and just do our work as efficient as possible" (INT-OMz)	n
Strategic reflections	"From ambition to revolution that is our vision 0" (INT-OMz)	OM	2	n/a	y
Availability of grants	n/a	OM	1	The OM indicates that no external funding was needed; "[…] I've never needed a bank to finance something directly or indirectly" (INT-OMz)	n
Customer willing to pay	"I was able to get [big customer], just by offering them a very good deal" (INT-OMz)	OM	4	n/a	y
		PO	1		

Source: Author

Table DD.4: Evidence of Practice D Within ZKL Case

Case ZKL: Practice D. Exploring the Market & Opportunity					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming information**	**Include**
Objectives		**Source**	**#**		**y/n**
To make a business model	n/a	OM	3	RailCo does not research the market in a traditional way. The previous experience and the instinct of OM is the driving factor; "I've never done anything with a business plan. Honestly, I don't believe in it. I prefer to act on my feelings […]"	n
To estimate market potential		Mkt	1		n
To understand the market forces affecting customer needs					n

Source: Author

Table DD.5: Evidence of Practice E Within ZKL Case

Case ZKL: Practice E. Defining the Value Proposition					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To justify investments in development, production and marketing	"This is the motivation. That is the plan from A to Z ... It shows what the added value will be, what it will look like, the requirements it has to meet" (INT-POz)	PO	2	n/a	y
To establish a shared vision on the importance of the project	n/a	OM	1	The owner accepts that not everybody shares his ideas and therefore does not put much effort in it; "[…] but if you start collaborating you notice that not everyone has that vision and that's all right" (INT-OMz)	n
Activities		**Actor**	**#**		**y/n**
Defining customer value	"This was the value we saw together with the customer and that we tried to quantify" (INT-POz)	OM	3	n/a	y
		PO	2		
Defining firm value	"I reasoned that if more than 250 people responded positively in a market of 3000 potential customers, it would be an ambitious plan that I needed to go for" (INT-OMz)	OM	3	n/a	y
		PO	1		
Resources		**Actor**	**#**		**y/n**
Individual integration skills	"It was up to me, with all my knowledge and expertise in this domain and all my experience with regard to the technical possibilities […]" (INT-OMz)	OM	2	n/a	y
Sensemaking with customer	n/a	OM	2	"We are so arrogant – I don't mean this negatively – that we are certain that we know the customers' need better than they do" (INT-OMz); "[…] we go for what we believe in […] where you go left, we go right […]" (WS-OMz)	n
Collaborative internal sensemaking	n/a	OM	1	"[…] it used to be easy because I was alone and I knew where I wanted to go […]" (INT-OMz)	n
External legitimacy	n/a	OM	1	"[…] we are confident enough to start with the priorities on the roadmap" (INT-OMz); "[…] it is very difficult, because the [core market] is a conservative world. Innovations aren't warmly welcomed" (INT-POz)	n
		PO	1		
Company formats	n/a	OM	2	(INT-OMz); "No, there was no business case [Is there documentation of this project? Something you put on paper, a description of the problem or a business case?]" (INT-OMz)	n

Source: Author

Table DD.6: Evidence of Practice F Within ZKL Case

Case ZKL: Practice F. Managing DCI Action					
Practice elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To collect information in a conscious, efficient and impartial manner	n/a	OM	1	The front end of innovation is not a structured process; "Let me put it like this, we recently have put more structure in the process from playground to a real product" (INT-OMz)	n
To make sure uncertainty decreases across the process	n/a	OM	1	SafetyCo heavily links gathering customer insights to mobilizing customers; " […] and mobilize the customer. That is most important and if you do that, you tackle all these facets" (WS-OMz)	n

Source: Author

Table DD.7: Evidence of Practice G Within ZKL Case

Case ZKL: Practice G. Mobilizing Customers					
Practice elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To increase development capacity	"When you are starting you look for a customer to sell your product to […]" (INT-OMz); "We want to build up a relationship with that customer" (WS-OMz)	OM	2	n/a	y
To find money for further development	"I started alone, but in the end they [customers and users] supported me in all kinds of work, like preparing the prototype for testing" (INT-OMz)	OM	3	n/a	y
To prepare for sales & marketing	"They got me access to the certifying group and this helped me to become an authority and get renowned" (INT-OMz)	OM	2	n/a	y
To get customer information	"We do this for two reasons. One is to get information, but the other is to get commitment" (WS-OMz)	OM	3	n/a	y
Activities		**Actor**	**#**		**y/n**
Defining customer criteria	"I thought, this person is far behind and his world is not matching mine, so this person will not be a good stakeholder" (WS-OMz)	OM	2	n/a	y
		PO	1		
Identifying of participants	"I knew all those guys" (INT-OMz)	OM	3	n/a	y
		PO	2		
Activating of participants	"I offered them the advantage to be the first working with this product" (INT-OMz)	OM	5	n/a	y
		PO	1		
Managing of expectations	"You need to tell them how the prototype is different from the final product" (INT-POz)	OM	3	n/a	y
		PO	3		
Resources		**Actor**	**#**		**y/n**
Customer incentive	"For them it didn't feel as an investment because we negotiated it as a discount" (INT-OMz)	OM	2	n/a	y
		PO	1		
Internal incentive	"It forces you to work in a service level agreement and you have to listen to what they need" (INT-OMz)	OM	2	n/a	y
Marketing channels	n/a	OM	1	The OM used a personal approach; "[…] I was 27 years old. You should try it sometime, going in there and telling them 'I'm going to change the world' "(INT-OMz)	n
Customer management skills	"This was a difficult period. I spent time convincing people, explaining, proving ourselves" (INT-POz)	PO	2	n/a	y

Source: Author

Table DD.8: Evidence of Practice H Within ZKL Case

Case ZKL: Practice H. Elaborating Customer Needs					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To support solution finding	n/a	OM	3	The OM is convinced of his vision through experience in the market. Instead of analysing the customers' needs further, a hands-on approach is used during the gathering of feedback; "Being present in the market. Understanding the developments in the market, specifically of the people who work in the field and CEOs [What are critical success factors to identify needs?]" (INT-OMz1)	n
To define customer requirements	n/a	OM	1	"You just need to understand the market and you don't need to understand the customer[…] (INT-OMz)	n
To validate the scope of the project	n/a	OM	1	"Yes [Yes, so you check the product, not the needs?]" (INT-OMz)	n

Source: Author

Table DD.9: Evidence of Practice I Within ZKL Case

Case ZKL: Practice I. Collecting Customer Feedback					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To validate and refine customer requirements	"The big advantage is that with this process you can refine according to the needs [...]" (INT-OMz)	OM	2	n/a	y
To identify missing information	n/a	PO	1	[SafetyCo] didn't think there would be a lot of missing information; […] someone probably asked around, but that wasn't as structured as it is right now" (INT-POz)	n
To check performance of the solution	n/a	Mkt	1	All the functionality was already in the product; "As soon as you have a prototype you go to the customer and present the idea […] the functionality is in it" (WS-Mktz)	n
Activities		**Actor**	**#**		**y/n**
Surveying customers	"Yes, [I had small survey cards], asking them: 'would you be willing to buy this product and what would you pay for it' "(WS-OMz).	OM	8	n/a	y
		PO	1		
Conducting conversations	"You immediately start asking questions, like ok, what should the maximum weight be " (WS-OMz)	OM	5	n/a	y
		PO	5		
Watching movies of use	n/a	PO	1	Feedback was gathered during conferences and in the field at a later stage. Videos of use were not used; "We went to conferences. There we showed [ZKL]" (WS-OMz)	n
Analysing feedback	"[...] you analyse this […] They say something and you are structuring it" (INT-POz)	OM	1	n/a	y
		PO	3		
Documenting feedback	"We write it down […] I call this an evaluation report" (INT-POz)	OM	1	n/a	y
		PO	6		

Table DD.9: Continued

Reflecting on assumptions and uncertainties	n/a	OM	1	[SafetyCo] accepts uncertainties and relies on customers to correct wrong assumptions during the process; "You shouldn't think that you can develop a 100% correct product for the market […[So you need to involve the customer in your development" (WS-OMz); "You develop a proof of concept and at the end of the development you show it […] we didn't do that in detail back then" (INT-POz)	n
		PO	1		
Resources		**Actor**	**#**		**y/n**
Minimum Viable Product	"We tried to present a world in which they recognized their needs" (INT-OMz)	OM	5	n/a	y
		PO	5		
Interview skills	n/a	PO	2	"Feedback isn't obtained through interviews but by letting users test [ZKL]. They come from the stakeholders […] they give feedback which you structure [Where do the things you evaluate come from?] (INT-POz); Yes […] you just get into a process with these people (INT-POz)	n
Analytical skills	They say something and you are structuring it (INT-POz)	PO	2	n/a	y
Documentation system	n/a	PO	1	The PO explains how there is currently a plan and evaluation form to document feedback. At the time of ZKL these were not present; "I don't think so [Do you know if there was such a plan for [ZKL]?]" (INT-POz)	n
Readily available customer sources	I could call him [user of the system] to do tests for me (INT-OMz)	OM	4	n/a	y
		PO	3		
		Mkt	1		

Source: Author

Table DD.10: Evidence of Practice J Within ZKL Case

Case ZKL: Practice J. Defining Customer Requirements					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To achieve a shared understanding of requirements and priorities	"You sit down with the shareholders and make a use case […] Describe what the solution functionally should do […] We base the system requirements on this (INT-POz)	PO	2	n/a	y
To supervise the development process	n/a	OM	1	The vision of [SafetyCo] appears to prevail; "We try to outline a world in which […] the customer can satisfy their needs" (INT-OMz)	n
To manage expectations of customers	n/a	Mkt	1	SafetyCo has difficulty influencing customers and keep them on board during the process; "That can be a problem for me. Sometimes the world is not ready yet and then they won't become my stakeholders" (INT-OMz); "We sometimes have difficulty explaining the advantages to certain customers" (WS-Mktz)	n
		PO	1		
Activities		**Actor**	**#**		**y/n**
Listing user requirements	"We made a list of requirements" (INT-POz)	PO	2	n/a	y
Setting priorities	n/a	OM	2	SafetyCo is prioritizing on a product level instead of on a feature level; Just write them down now, there weren't many [Could you reproduce a list of requirements for me?]" (INT-OMz)	n
Refining requirements	"And then we ask them […] to refine the list (INT-OMz)	OM	1	n/a	y
		PO	2		
Resources		**Actor**	**#**		**y/n**
Individual integration skills	n/a	OM	1	"We are looking for partners with the knowledge and expertise in that domain […] you need the user in the field […]" (INT-OMz); "Certainly, otherwise you don't know what to develop [Ok, so there was an idea of requirements…]" (INT-POz)	n
		PO	1		
Sensemaking with customers	"The use cases, you make them together [with the customers]" (INT-POz)	OM	2	n/a	y
		PO	3		
Collaborative internal sensemaking	"You need to interpret the information from the domain. Together with your partners" (INT-OMz)	OM	2	n/a	y
Company formats	n/a	OM	2	" […] the motivation is a bit more detailed than the one-liners which I put in the roadmap (INT-OMz); […] you can think about the requirement specification for three years. We avoid that (WS-OMz)	n

Source: Author

Table DD.11: Evidence of Practice K Within ZKL Case

Case ZKL: Practice K. Mobilizing Internal Sources					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To learn about new customers and markets	"You need to develop domain knowledge […] If you bring somebody along who has been CEO of [customer] then it is easier" (INT-OMz)	OM	2	n/a	y
To validate findings	n/a	OM	1	"[…] the company I worked for at that time had 200 of those machines so I knew what the problems were" (INT-OMz)	n
To get access to customer network	"Just try it, to get access to the right people, when you are young and inexperienced. That went much easier with [internal source] who was an old director in the rail world" (INT-OMz)	OM	2	n/a	y
Activities		**Actor**	**#**		**y/n**
Acquisition of sources holding relevant prior customer knowledge	"[...] you always have a mentor. I learned from [OM] […]" (INT-POz)	OM	2	n/a	y
		PO	1		
		Mkt	1		
Sharing of information	n/a	OM	1	"[…] back then you did everything by yourself. Now we have internal and external development and that has to come together" (INT-OMz)	n
Resources		**Actor**	**#**		**y/n**
Readily available relevant internal or partner sources	"[Internal source], he was my neighbour and had developed a solid expertise over the years" (INT-OMz)	OM	2	n/a	y
Internal Incentive	n/a	OM	1	"[…] an innovative organisation is run by one or two individuals (INT-OMz)	n
Communication channels	n/a	PO	1	Marketing or sales does not seem to be involved in delivering extra information; "They are informed, they are also a stakeholder, but they are for the implementation… [Marketing is not a part of them?]" (INT-POz)	n

Source: Author

Table DD.12: Evidence of Practice L Within ZKL Case

Case ZKL: Practice L. Developing the Product Concept					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To provide material for testing	"And then we almost had an end product, but it still wasn't quite there yet. You do another check so that you can meet expectations" (INT-POz)	PO	1	n/a	y
To prepare for sales and marketing	n/a	OM	1	"[…] you never knew if the product would enter the market and that is the political situation we have to deal with in our market" (INT-OMz)	n
Activities		**Actor**	**#**		**y/n**
Generating ideas for solutions	n/a	PO	1	"At this point the PO was only refining the current solution. Yes feel free to use it [You went there and said 'Here is the prototype, go ahead']" (INT-POz)	n
Consensus and decision making	"[...] we developed the prototype and discussed how to proceed" (INT-OMz)	OM	1	n/a	y
		PO	1		
Developing the solution	"They have already started using it, but it needs further development" (INT-POz)	OM	2	n/a	y
		PO	1		
Resources		**Actor**	**#**		**y/n**
Experience with collective idea generation	n/a	PO	1	Creative ideas all came from the Owner, and did not involve others in the process	n
Customer empathy in R&D team	n/a	PO	1	A significant part of the development team wasn't in contact with customers; "They were completely focused on development… [And who was involved externally? What were their positions?]" (INT-POz); "When you talk to a technician, they only want to build what is supposed to be in it […] (WS-OMz)	n
		OM	1		
Visual material supplied by the customer	n/a			There were not signs of visual material supplied by the customer	n
Co-creating customer	"It was fantastic, they started working for us and took over some of our work" (INT-OMz)	OM	2	n/a	y
Student support	"I was still studying when [Owner] asked me to support him […] I started with mechanical engineering" (INT-POz)	OM	1	n/a	y
		PO	2		
Project management tool	n/a	PO	1	SafetyCo had only a management approach, but not so much a tool; "At the time we used the V-model and we still use it nowadays […]" (INT-POz)	n

Source: Author

Table DD.13: Evidence of Practice M Within ZKL Case

Case ZKL: Practice M. Planning Sales and Marketing for Introduction					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To start up the commercial process	"This is making everything ready for marketing (WS-Mktz)	Mkt	1	n/a	y
		PO	2		
Activities		**Actor**	**#**		**y/n**
Re-using CI	"The second part was that we developed a subscription model" (INT-OMz)	OM	2	n/a	y
		PO	2		
		Mkt	3		
Communicate insight	"We don't make brochures, but the website needs content" (INT-OMz)	OM	2	n/a	y
		Mkt	1		
Resources		**Actor**	**#**		**y/n**
Individual integration skills	"Somewhere in the process, marketing is connected […]" (INT-OMz)	OM	2	n/a	y
		PO	2		
		Mkt	3		
Collaborative sensemaking within team	n/a	OM	1	All ideas for sales and marketing came from the Owner. Marketing was only involved in operational activities; "[…] it used to be easy because I was alone and I knew where I wanted to go and what had to be done" (INT-OMz); "To give you an idea, marketing is involved three months before pilot and implementation starts" (INT-POz)	n
		PO	1		
Student support					n
Documentation system	n/a	Mkt	1	At the time there was no documentation to support an introduction to the market; "We had a lot of trouble to explain it to customers, because they didn't see it yet […] "(WS-Mktz)	n
Company formats	n/a	OM	1	At the time of ZKL sales and marketing planning was not formalised yet; "Our sales people aren't 'hard sales' […] "But we do sales based on trust. Selling by not selling" (WS-OMz); "Well, a sales and marketing planning, and the innovation model are now included in the process." (WS-Mktz)	n
		Mkt	1		

Source: Author

APPENDIX EE EVIDENCE OF THE RELATIONSHIPS BETWEEN THE PRACTICES OF ZKL

Table EE.1: Evidence of Relationships Between the Practices of ZKL

Practice / Output of Practices	Exploring the problem situation (A)	Generating ideas (B)	Exploring the market & opportunity (D)	Defining the value (E)	Securing innovation funds (C)	Managing DCI action (F)	Mobilising customer sources (G)	Exploring the user experience (H)	Collecting user feedback (I)	Defining /refining requirements (J)	Mobilising internal sources (K)	Developing the product concept (L)	Planning sales and marketing (M)	Representative Quotes
Customer problem understanding (A)		→		→										"You have ideas, because you are active in the market, just like [owner] did with the ZKL" (INT-POz) "I reasoned that if more than 250 people responded positively in a market of 3000 potential customers, it would be an ambitious plan that I needed to go for" (INT-OMz)
First idea concept (B)										→				"The motivation is the one-liner idea. It includes some high level requirements" (INT-OMz)
Defined value (E)					→									"Well, I said, if 250 people responded positively….. that would be a go" (WS-OMz)
Authorized means (C)							→							"Our plan than was to mobilise the customer as soon as possible (WS-OMz)
Customer sources (G)				→	→				→			→	→	"I went to a conference and had survey cards in which people could fill in their names. I collected more than 250 positive responses" (INT-OMz) "I wanted to make them [customers] buy in early" (INT-OMz) "We asked them [customers] to react to the concept" (INT-POz) "I started alone, but in the end they [customers and users] supported me in all kinds of work, like preparing the proto-type for testing" (INT-OMz) "They got me access to the certifying group and this helped me to become an authority and get renowned" (INT-OMz)

Table EE.1: Continued

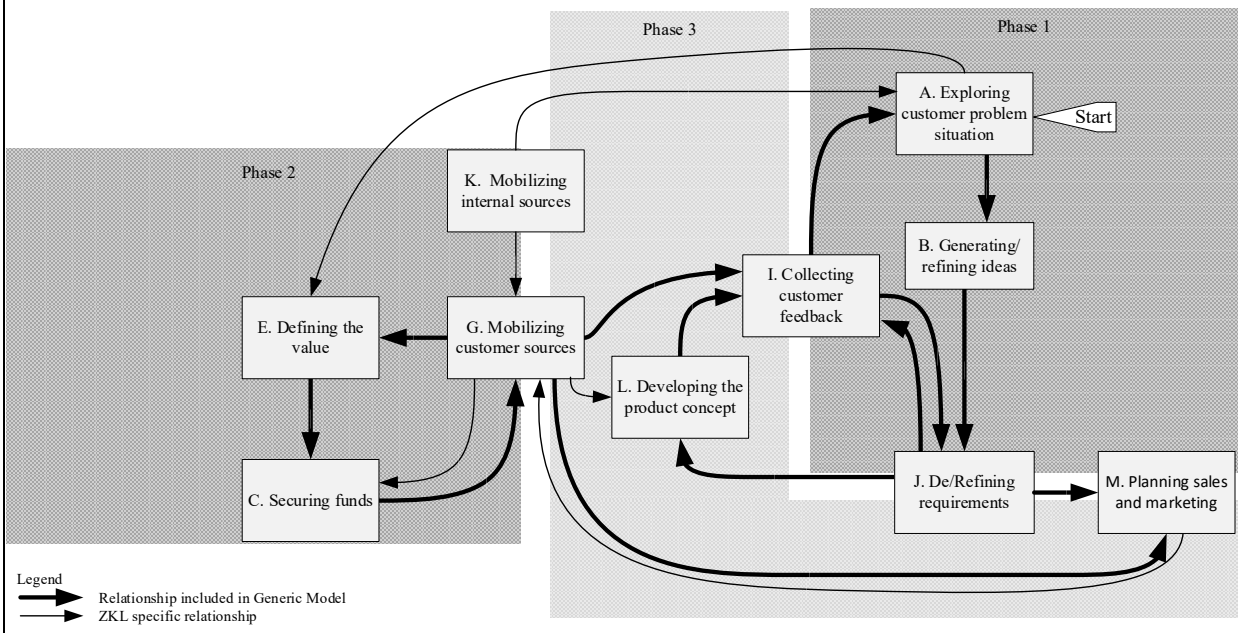
Practice / Output of Practices	Exploring the problem situation (A)	Generating ideas (B)	Exploring the market & opportunity (D)	Defining the value (E)	Securing innovation funds (C)	Managing DCI action (F)	Mobilising customer sources (G)	Exploring the user experience (H)	Collecting user feedback (I)	Defining /refining requirements (J)	Mobilising internal sources (K)	Developing the product concept (L)	Planning sales and marketing (M)	Representative Quotes
Feedback of customers (I)	→									→				"I started assessing and fine tuning needs early and then I also ran some ideas up the flagpole" (INT-OMz) "We used this [tests] to better define our requirements" (INT-POz)
Prioritized requirements (J)									→			→	→	"This list of high-level requirements are also send back and forth to the customers" (INT-OMz) "Once we had your requirements, we started development" (INT-POz) "Marketing makes the project ready for marketing at the same time as development starts" (INT-POz)
Internal sources (K)	→						→							"You need to develop domain knowledge ……...If you bring somebody along who has been CEO of [customer] than it is easier (INT-OMz)" "Just try it, to get access to the right people, when you are young and inexperienced, That went much easier with [internal source] who was an old director in the rail world" (INT-OMz)
A first product concept (L)									→					"That people were given a proof of concept to test" (INT-POz)
A plan for launch (M)							→							"We developed a subscription model. It forces you to work in a [SLA] agreement and to listen to what they need" (INT-OMz)

Source: Author

Table EE.2: Key Characteristics of the Relationship model of ZKL

ZKL model and numerical features

10 practices, 19 relationships, 80% of common configuration of practices included (13 out of 16 generic relationships)



Central practices ZKL model

G. Mobilising customer sources (8)
I. Collecting Customer Feedback (5)

Characteristics ZKL model

- This process incorporates the common configuration of practices to a large extent, but is less research-intensive in the second phase, with missing D;
- The mobilising of customer sources (G)) and customer involvement (I) are the most central practices;
- Starting point is the exploration of the customer problem situations (A), which is then followed by idea generation (B);
- Just like in the Thermo case, marketing models developed in M in Phase 1, support customer mobilisation at the end of Phase 2;
- Customer mobilisation, apart from supporting information gathering and marketing , supports funding (in C) and co-creation (in L) as well.

Conclusions ZKL model

- Extending the common configuration of practices with closer customer interaction in funding and product development, strengthens earlier generated customer insights.
- Internal sources replace market research and validate earlier generated customer insights

Source: Author

APPENDIX FF ACTORS AND RESOURCES ZKL

Table FF.1: Actors of the Practices of ZKL

Practice	Roles	Description of Role	Practice
Owner	Information processing	Collecting and analysing information	A, I
	Champion	Promoting the project internally, creating commitment	C
	Gatekeeper/synthesis	Synthesising all relevant knowledge into new models	E, J, M
	Relationship manager	Promoting the project externally, creating commitment	A, G, M
	Creativity and Development	Develop ideas and concepts	L
	Boundary spanning	Recognising new externally located information	B
	Decision maker	Making go/no go decisions about the project	C
	Gatekeeper/quality control	Mitigate biases	A, I
Customer	Input source	Providing the raw data	A, I
	Gatekeeper/synthesis	Synthesising all relevant knowledge into new models	E, J, M
R&D	Creativity and Development	Develop ideas and concepts	K, L

Source: Author

Table FF.2: Resources of the Practices of ZKL

Resource Group	# of Resources	%	Dominant Resource Type (# of Appearances in Practices)
FLA	6	27%	Scope (2)
CoI	6	27%	Customer sources (2)
S&T	7	32%	Integrative skills (2)
P&M	3	14%	Customers willing to pay or participate (2)
Total	22	100%	

Source: Author

APPENDIX GG PERCEPTIONS OF QUALITY CRITERIA OF ZKL

Quality	Mentions documents	Mentions interviews	Exemplar quote
Comprehensive	-	6	"You need to understand the customer, this process….. there are a lot of stakeholders, and you need to understand all of this, to get a good view of the final picture." (INT-POz)
Novelty	-	7	"Technicians, as a rule, they just include what is needed, we had this entire discussion about a sensor… well in the end, they had to put it back, if you want to sell it, it has to be attractive for the client." (WS-OMz)
Format		3	"We do this use-cased based, simply because that is more easy to comprehend" (INT-OMz)
Acceptable	-	12	"We put our use cases on the table and then we try to seduce them based on that…. we seek a way to connect with them" (INT-OMz)
Cost efficient	-	4	We have high level requirements, we are not in a perfect world, you can't plan for weeks of work, you need to start out some point." (INT-OMz)

Source: Author

APPENDIX HH THE LEVEL OF INSIGHT OF ZKL

Criterion	Timely	Comprehensive		Novelty	Clear Consistency	Clear Inspiring	Clear Format	Extra case criterion Acceptance	Extra case criterion: Cost-Efficiency
Indicator	Document holding CI	Amount of needs insights	Missed needs insights	Attractive needs agreed upon by 50% of more of team	% of consistently formatted requirements	% of statements free of solution aspects	# of different formats		
Result	Brochure	20	Yes	5	50%	85%	2	No	yes
Qualitative evaluation	"You need to have requirements to start. Otherwise you don't know what to develop. In the beginning this was less clear for us." (INT-POz)	Although the owner is convinced they have captured all needs, the PO indicates that they miss understanding of different cultures. "I think we do not capture important user differences in all the countries. Until now we are too specific for one country " (INT-POz)		The team agrees on several attractive features, such as the logging and reporting functionality, the size of the ZKL	The preferred format is the use case, but not all requirements statements were drafted in this way. They are generally drafted in a generic way, and this corresponds with the vision on requirements statements of the owner. "What you see here are epics, this is the highest level of a requirement. Anybody can understand this and use it." (WS-OMz)			Despite of RailCo's aim to develop customers' understanding and acceptance of ZKL, the team did not always succeed in this. "We had big problems selling ZKL, people didn't always understand the big picture." (WS-Mktz)	"We went as efficient as possible […] we developed the epics and went full speed ahead." (INT-OMz)

Source: Author

APPENDIX II IMPROVEMENT OPPORTUNITIES ZKL

Table II.1: Improvement opportunities

Practices	Importance			Implementation			Opportunity
	% > 4	AVG	Std	% > 4	AVG	Std	Score
A. Exploring customer problem situations	100	5.00	0	100	4.67	0.58	**10**
B. Generating ideas	100	5.00	0	100	5.00	0	**10**
C. Securing innovation funds	66	3.67	0.58	66	3.67	1.53	6.7
D. Exploring the market opportunity	66.	4.00	1	66	4.00	1	6.7
E. Defining the value proposition	100	4.67	0.58	100	4.33	0.58	**10**
F. Managing DCI action	0	2.67	0.58	0	2.33	0.58	0
G. Mobilising customer sources	66	3.67	1.53	66	3.67	1.53	6.7
H. Elaborating customer needs understanding	100	4.33	0.58	100	4.00	0	**10**
I. Collecting customer feedback	100	4.33	0.58	66	3.67	0.58	**13.3**
J. Defining customer requirements	66	3.67	1.53	33	2.67	1.15	**10.1**
K. Mobilising internal sources	33	3.33	1.53	33	3.00	1.73	3.3
L. Developing the product concept	100	4.33	0.58	66	4.00	1	**13.3**
M. Planning sales and marketing for launch	66	3.67	0.58	33	2.33	1.53	**10.1**
Total		4.03	0.74		3.64	0.91	

Source: Author

Table II.2: Improvement Tactics

Practice	# of Improvements	Dominant Tactic	# of Mentions	Exemplar Quotes
A/H	5	Data collection techniques	8	I would like to spend more time in this phase, the pressure to proceed is often too high […] you have to have a specific perspective. […] you are active in the market like OM was at that time and then you see certain opportunities (INT-POz)
B/L	1	Roles	2	"Finally now, as people are working for some time now with me, they are starting to understand what it is that this market needs. This is all about culture. Our pitfall is that it currently just me who has this strength" (INT-OMz)
E	1	Format	3	"We still do this mostly based on feeling (INT-OMz) We could use some more time to elaborate on the motivation." (INT-POz)
I	1	Sampling	3	"The cultural differences are enormous and we need to find a way to better capture these differences" (INT-POz)
M	1	Roles	4	"We sometimes have difficulty explaining the advantages to certain customers" (WS-Mktz)
Total	9			

Source: Author

APPENDIX JJ IMPLICATIONS OF THE IMPROVEMENTS ZKL

Improvements per Improvement Tactic	Implications for the Level of DCI									
	Timely	**Comprehensive**	**Novel**	**Consistent**	**Inspiring**	**Format**	**Accurate**	**Acceptable**	**Scope**	**Cost efficient**
Analytical tools		✓								
Extrapolate findings to other markets		✓								
Culture	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Have a culturally embedded process	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Data collection techniques		✓					✓			
Develop broad general domain knowledge by talking to people in the field		✓								
Format synthesis					✓	✓		✓		
Have a clear format for DCI					✓	✓		✓		
Order of doing things	✓		✓							
Focus on problems not on technology	✓		✓							
Roles	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Have a team that is both technical and receptive to customer-needs	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Put more effort in marketing implementation										✓
Sampling	✓		✓							
Include customers with different backgrounds	✓		✓							
Total impact (amount of improvements)	**4**	**4**	**4**	2	3	3	3	3	2	3

Source: Author

APPENDIX KK BARRIERS TO IMPLEMENTATION ZKL

Improvement Tactic	Barrier	Mentions	Exemplar Quote
Data collection techniques	Pros and cons of early testing	3	"[…] you don't spend something which you don't have yet (INT-OMz); "[…] then you can understand the customer, because you are talking about the same product since it is on the table. You have a sketch" (INT-POz)
Format synthesis	Disagreement on what to document	4	We could use some more time to elaborate on the motivation." (INT-POz) "I refuse to make business plans or whatever, we just need to trust the roadmap [strategy document]" (INT-OMz).
Order of doing things	Marketing comes after technical	2	"Marketing only comes in when we are making everything ready for production." (INT-POz).
	Start from solution	2	"I think that the need becomes clear once you show the product" (INT-POz)
Roles	Trust of owner	4	"People who do not see what you are telling, I've learned that, I am not going to put energy in them […] I seek my allies, those who go with you […] INT-OMz.
Total	**5 Barriers**		

Source: Author

APPENDIX LL EVIDENCE OF PRACTICES MZI

Table LL.1: Evidence of Practice A Within MZI Case

Case MZI: Practice A. Exploring the Customer Problem Situation					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To define product market segments	n/a	OM	1	"Just for the [target market] [Did you notice any opportunities in other market segments?]" (INT-OM1m); "I can't think of any other customers" (INT-RD1m)	n
		RD	1		
To further develop first ideas	"[owner] started thinking about the idea" (INT-RD1m) The question arose from new legislation and we all thought, if all [core market] are forced to use this new technique… (INT-RD1m)	RD	2	n/a	y
To understand the opportunity of a customer idea	n/a	OM	1	When the project started the team largely assumed that there would be market potential. Later in the project they started looking for confirmatory information for this assumption; "We had the same problem as [MZI], because the market was in decline (INT-OM2m)"	n
To build trust with potential customers	n/a			With a main customer on board there was not need to start building trust with other customers early in the project	n
Activities		**Actor**	**#**		**y/n**
Identifying a problem area	"How can we automate the [MZI] at the right distance from the main lines in such a way that we ergonomic circumstances for employees improve and the process becomes less labour intensive" (PPlan, p. 2)	Cst	2	n/a	y
		OM	2		
		RD	1		
		DOC	2		
Conducting customer conversations"	"With [owner] and [customer]" [we had one of the first meetings]" (INT-RD3m); "When [Customer] came in we explored what he exactly wanted" (INT-OM1m)	RD	2	n/a	y
		OM	1		
Analysing customer problems	n/a	OM	1	This was done much later in the process; "Yes, we mainly used photos and movies so we can show what is happening [Do you sit down after a customer visit and discuss it in the team?]" (INT-OM1m)	n
Reporting of customer problems	"The use of [MZI] and the long line system is particularly labour-intensive and inefficient" (MR report, p. 2); "A couple of focus areas for development were described in the [grant document], such as fuel use, ergonomic circumstances […]" (INT-RD2m)	DOC	1	n/a	y
		RD	1		
Resources		**Actor**	**#**		**y/n**
A broad scope	n/a	OM	1	"We are talking about the scope of the project, we focused on automating it too much" (INT-RD2m)	n
		RD	1		
Readily available internal sources	"Yes, Indeed [internal source] was our most important internal informant" (WS-OMm)	RD	3	n/a	y
		OM	1		
Readily available customer sources	"For us [customer] was the one holding market knowledge" (INT-OM1m)	OM	3	n/a	y
		Cst	2		
		RD	3		
		DOC	1		
Readily available expert sources	"I went to the conference to see what it's like and what the other developments were […]" (INT-OM1m)	OM	2	n/a	y
Readily available secondary sources	"[customer] had all kinds of figures" (INT-OM1m); "I checked the internet" (INT-OM1m)	OM	2	n/a	y

Table LL.1: Continued

Case MZI: Practice A. Exploring the Customer Problem Situation					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
Interview skills	n/a	OM	1	The OM talks about gathering information in a highly informal way; "You try to collect as much information as possible, regardless of whether it happens through YouTube or a conference" (INT-OM1m)	n
Analytical skills	n/a	OM	1	"[…] in fact if [Customer] had not asked the question, there would never have been a [MZI] (INT-OM1m)	n

Source: Author

Table LL.2: Evidence of Practice B Within MZI Case

Case MZI: Practice B. Idea Generation					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To define a project fitting into the strategic agenda	n/a	OM	1	The idea came from the customer; " Well I was dealing with a customer asking a question" (INT-OM1m)	n
		RD	1		
To define a solution for observed needs	n/a	OM	1	Potential solutions are linked to problems of already existing products; "Usually I see a customer problem which we can solve" (INT-OM2m)	n
To define a project that can be funded	"Project description,(GrantDoc, p. 2); "[OM] started thinking about the idea […] he saw that there was a grant available" (INT-RD1m)	DOC	1	n/a	y
		RD	1		
Activities		**Actor**	**#**		**y/n**
Checking ideas of customers	"Because at some point [customer] came up with his idea of the [MZI] (INT-OM1m);	OM	2	n/a	y
		Cst	1		
		RD	1		
Consensus and decision making	"Putting all this data together, we decided that we would like to build up the system in a different way [...]" (INT-RD1m)	OM	2	n/a	y
		Cst	1		
		RD	2		
Generating new ideas	"They had some ideas, we had some ideas. Then we discussed […]" (INT-Cst1m)	OM	2	n/a	y
		Cst	1		
Resources		**Actor**	**#**		**y/n**
Vision of the future	n/a	OM	1	Financial incentives heavily influenced the decision to develop the idea; "Also because there was a substantial subsidy available. We were advised to make use of it" (INT-OM1m)	n
Overview of current products and capabilities	n/a			There is no mention of comparing ideas with current products or technology of MachineCo	n
Experience with creative techniques	n/a			There are no mentions of creative techniques	n
A sufficiently broad scope	n/a	OM	2	"Our innovations are founded on customer demand" (INT-OM1m); The system was there, it just needed to be workable, less labour-intensive, energy […] (INT-OM2m)	n
Market reputation	"I went to [MachineCo] because I knew [owner] (INT-Cst1m)	OM	1	n/a	y
		Cst	2		

Source: Author

Table LL.3: Evidence of Practice C Within MZI Case

Case MZI: Practice C. Securing Innovation Funds					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To get authorization from management	n/a	OM	1	'It is an own investment […][How is it different?]" (INT-OM2m)	n
To create means for next development step	"[…] without subsidies we would never have started this project. We would never invest so much in it" (INT-RD2m)	RD	1	n/a	y
		OM	1		
To create customer base	n/a	OM	1	'It is something that you keep internal" (INT-OM2m)	n
Activities		**Actor**	**#**		**y/n**
Finding funds for problem analysis	"[...] a large part of the financing came from that investment (INT-RD1m); "Cost" (GrantDoc, p. 5); "Cost" (MRreport, p. 17)	OM	3	n/a	y
		Cst	1		
		RD	1		
		DOC	2		
Finding funds for needs analysis	n/a	DOC	1	The budget for needs analysis was included in the grant and therefore it was needed to find additional funds; "Cost" (GrantDoc, p. 5);	n
Finding funds for testing	"Now we wait for someone who wants to invest in it to continue this project so that revised versions can be developed" (INT-RD1m); "The reason for not continuing is that [customer] profits were not good that year, and part of the financing had to come from him" (INT-RD3m)	OM	1	n/a	y
		Cst	1		
		RD	2		
Resources		**Actor**	**#**		**y/n**
Corporate decision making criteria	"That [making use of the services of University] was a criterium from the Grant (WS-Cst1m); "1.4 Indicate how you will cooperate with a scientific or technical body" (GrantDoc, p. 2)	OM	2	n/a	y
		Cst	2		
		DOC	2		
Strategic reflections	n/a	OM	2	This project was and ad-hoc decision based on the customer's idea; "We never intended to invest so much […] (INT-OM2m)	n
Availability of grants	'We found out that there was a grant" (INT-OM1m)	OM	2	n/a	y
		Cst	2		
		RD	2		
		DOC	1		
Customer willing to pay	"I had invested quite some money in it, alongside the grant" (INT-Cst1m)	OM	2	n/a	y
		Cst	2		
		RD	1		
		DOC	1		

Source: Author

Table LL.4: Evidence of Practice D Within MZI Case

Case MZI: Practice D. Exploring the Market & Opportunity					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To make a business model	"By charting both the meso and macro environment, a conclusion can be drawn on the strengths and weaknesses. Because of this [...] the product can ultimately be positioned in the right way" (BriefMR, p. 2)	OM	2	n/a	y
To estimate market potential	"You also get a little insight into how much potential there is" (INT-OM1m)	DOC	2	n/a	y
To understand the market forces affecting customer needs	n/a	DOC	1	The MRreport (p. 8 – 15) describes market size and a SWOT analysis, but does not describe what influences demand	n
		OM	1		
Activities		**Actor**	**#**		**y/n**
Desk research	"During this research project we made use of secondary information. A full list of documents inspected is included in the literature list" (MRreport, p. 17)	OM	3	n/a	y
		RD	2		
		DOC	2		
Visiting conferences	"You go to a conference and similar events" (INT-OM1m)	OM	5	n/a	y
Interviewing	"Conducting interviews is a component of the project plan" (INT-RD3m)	OM	1	n/a	y
		Cst	1		
		RD	1		
		DOC	2		
Analysing the opportunity	"Use of five forces model and PESTEL analysis" (BriefMR, p. 2-3) Section 4.5. SWOT. In this section we describe the SWOT for the [MZI] (MRreport, p. 13)	OM	3	n/a	y
		Cst	1		
		RD	1		
		DOC	3		
Documenting the opportunity	"We also made it clear that there would be no more than 10 in the Netherlands (INT-Cst1m); The number of systems in the Netherlands (MRreport, p. 10)	OM	2	n/a	y
		Cst	1		
		DOC	2		
Resources		**Actor**	**#**		**y/n**
Research method expertise	"Chapter 3 Methods: This chapter describes how we collected data" (MRreport, p. 7)	DOC	3	n/a	y
Interview skills	"Field research was based on semi-structured interviews" (MRreport, p. 7)	DOC	3	n/a	y
Analytical skills	"4.5. SWOT. In this section the SWOT is explained. (MRreport, p. 13)	DOC	3	n/a	y
Student support	MRreport is written by students.	Cst	1	n/a	y
		DOC	1		
Readily available internal sources	"Interviews were held with Cst, OM and RD" (MRreport, p. 7)	OM	1	n/a	y
		Cst	1		
		RD	1		
		DOC	2		
Readily available customer sources		Cst	2	"To be honest, there is not a lot of time to talk to colleagues" (INT-Cst1m)	n
Readily available expert sources	"In addition, an interview was held with [expert] via a telephone conversation" (MRreport, p. 7)	DOC	2	n/a	y
Readily available secondary sources	"[…] secondary information was used (MRreport, p. 7)	DOC	2	n/a	y
Company formats	n/a	OM	2	The format of the MR report was clearly of the students and not based on MachineCo templates	n
		RD	1		

Source: Author

Table LL.5: Evidence of Practice E Within MZI Case

Case MZI: Practice E. Defining the Value Proposition					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To justify investments in development, production and marketing	Criteria for funding in GrantDoc: "Does the project lead to added value in [market segment]? Does the project lead to cost reductions in the [market segment2]?" (GrantDoc, p. 9)	DOC	3	n/a	y
To establish a shared vision on the importance of the project	n/a	OM	2	"We did this because the grant asked us to […] At the end of the day we are not doing anything with it [Did the market research change anything for you?]" (INT-OM2m)	n
Activities		**Actor**	**#**		**y/n**
Defining customer value	"The aim of this project is to develop an efficient [MZI]" (PPlan, p. 2) "Section 4.6.3 Customer perspective (MRreport, p. 17) The aim was to develop something that could make my work easier" (INT-Cst1m)	OM	5	n/a	y
		Cst	1		
		RD	3		
		DOC	3		
Defining firm value	n/a	OM	1	The OM seems to follow his gut feeling; "A possibility to build machines over a longer period of time […]" (INT-OM1m)	n
Resources		**Actor**	**#**		**y/n**
Individual integration skills	n/a	OM	2	The owner and customer worked together to determine the value; "[…] then I should be able to sell five to ten of them. That was the idea and [customer] confirmed this" (INT-OM2m); "	n
Sensemaking with customer	Actually these are the requirements of the customer […] you discuss them with the customer" (WS-OMm)	OM	1	n/a	y
		Cst	1		
Collaborative internal sensemaking	"[Customer] had all kinds of information: the amount of systems and all customers having the same problem. In this way we thought about [the value] [...] and together we concluded that it would be interesting for [target market]" (INT-OM2m)	OM	1	n/a	y
		RD	1		
External legitimacy	"Maybe we got too enthusiastic because of the subsidy" (INT-OM2m)	OM	1	n/a	y
		RD	1		
Company formats	Format of the GrantDoc.	Cst	1	n/a	y
		RD	1		
		DOC	1		

Source: Author

Table LL.6: Evidence of Practice F Within MZI Case

Case MZI: Practice F Managing DCI action					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To collect information in a conscious, efficient and impartial manner	n/a	OM	2	"We did not have time to do market research […] we only had two years to develop the product so we started building" (INT-OM2m)	n
To make sure uncertainty decreases	n/a	OM	2	It is unfortunate that we had to start so quickly. [customer] came in and we had started immediately (INT-OM1m)	n

Source: Author

Table LL.7: Evidence of Practice G Within MZI Case

Case MZI: Practice G. Mobilizing Customers					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To increase development capacity	n/a	OM	1	[MachineCo] does not take an active role in reaching out to customers for increasing the development capacity; "[…] we just have to wait. First we want to get funding before we continue (INT-OM1m); "Now we have to wait for an investor to continue the project […] (INT-RD1m)	n
		RD	1		
To find money for further development	n/a	OM	2	MachineCo has just started looking for other potential customers; "we have two interested parties to continue the project" (INT-OM1m)	n
To prepare for sales & marketing	n/a	OM	2	There was no time for marketing and sales; "You build something and get little time to test it. It takes time from the customer and they also need to secure their income (INT-OM1m)	n
To get customer information	n/a	Cst	1	It was clear who potential customers were, because of contacts of the customer. No effort was made to collect additional information about them; "Yes, obviously our customers were [target market] and we didn't really focus on them" (WS-Cstm)	n

Source: Author

Table LL.8: Evidence of Practice H Within MZI Case

Case MZI: Practice H. Elaborating Customer needs					
Practice elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To support solution finding	"So, we undertook this to really understand the present activities, and this knowledge helped us to think about how this could be done more effectively" (INT-RD1m)	RD	1	n/a	y
To define customer requirements	"The result of the analysis phase were requirements […]" (INT-RD2m)	RD	1	n/a	y
To validate the scope of the project	n/a	Cst	1	The scope was not really a question. After the exploration done by the owner the problem definition of the customer was accepted: "But that was derived from the information that we got from [customer]" (INT-RD2m)	n
		RD	1		
Activities		**Actor**	**#**		**y/n**
Preparing customers for efficient data collection	n/a			At this stage, the customers was already deeply involved and did not need to be prepared.	n
Visiting customers	"We went on the boat to understand bottlenecks" (INT-RD1m)	OM	6	n/a	y
		Cst	1		
		RD	5		
Watching movies	"We got the video footage from [customer] and we found some more on YouTube ourselves" (INT-RD1m)	OM	5	n/a	y
		RD	4		

Table LL.8: Continued

Case MZI: Practice H. Elaborating Customer needs					
Practice elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Activities		**Source**	**#**		**y/n**
Conducting conversations	"Then, for example, we asked [customer] how big the raft should be" (INT-RD1m)	OM	3	n/a	y
		Cst	2		
		RD	1		
Analysing needs	"Section 3: Answers to research questions: How does [target market] work? What materials are used […]" (AReport, p. 4-5)	RD	6	n/a	y
		DOC	2		
Documenting needs	"Process tree customer process" (AReport, p. 7); "On the websites of both involved applicants and [university] the scientific publication will be available for download" (GrantDoc, p. 3)	OM	1	n/a	y
		Cst	3		
		RD	2		
		DOC	2		
Reflecting on assumptions and uncertainties	n/a	OM	2	[MachineCo] did not take action to verify uncertainties with the customer; "[Customer] wanted the [MZI]. Eventually it became a different machine" (INT-OM2m); "I feel that he didn't feel comfortable with the end result" (INT-RD2m)	n
		RD	2		
Resources		**Actor**	**#**		**y/n**
Research method expertise	n/a	RD	2	"It is such a specific target market that you can't get the information from the internet […]" (INT-RD1m); "as a contractor you have to develop the skills to get that into the open and I didn't completely do that in this project" (INT-RD3m)	n
Analytical skills	n/a	OM	1	"Not directly [Did you return to your choice matrix and reflect on earlier decisions?]" (INT-OM2m)	n
Interviewing skills	n/a	Cst	1	"[…] nobody else thought of a similar product, we talked to big players in the market and they didn't think of it either" (INT-Cst1m); "we didn't prepare [interviews] beforehand" (WS-OMm)	n
		OM	1		
Student support	AReport is written by students; "Students supported the analysis phase" (INT-RD3m)	RD	3	n/a	y
		DOC	1		
Internal sources of needs knowledge	"[Internal source] was our most important internal source. He provided a lot of information" (WS-OMm)	OM	2	n/a	y
		RD	2		
Readily available customer sources	"And then [customer] went to see if that was what he had in mind, whether it is applicable and whether there is still room for improvement' (INT-RD1m)	RD	7	n/a	y
Awareness of uncertainties	n/a	OM	1	The team did not test assumptions or identify uncertainties; "Later I discovered that the design should have had a certain shape or solution" (INT-RD3m)	n
		RD	1		
Company formats	Format of the AReport; "We used formats of the Delft Design Method" (WS-RD3m)	DOC	1	n/a	y
		RD	5		

Source: Author

Table LL.9: Evidence of Practice I Within MZI Case

Case MZI: Practice I. Collecting Customer Feedback					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To validate and refine customer requirements	n/a	RD	1	Feedback served to refine the technology and was not focused on new insights into needs; "Yes, [...The photos were used for the technical aspect while the customer visit was used to generate ideas, right?] (INT-RD1m)	n
		Cst	1		
To identify missing information	n/a	Cst	1	Adjustments were made based on testing; "When you perform tests in the field you make adaptions to keep it feasible" (INT-Cst1m)	n
To check performance of the solution	"And then [customer] went to see if that was what he had in mind, whether it is applicable and whether there is still room for improvement" (INT-RD1m)	RD	1	n/a	y
Activities		**Actor**	**#**		**y/n**
Surveying customers	n/a	RD	1	Feedback was retrieved from customer visits; "We [development team] went on board to understand working conditions and weather conditions […]"(INT-RD1m)	n
Conducting conversations	"[…] and then [customer] with his experience went to see if it was workable or not (INT-RD2m); "[…] we annoyed [customer] constantly, with questions like, is this what you mean? How do you like this?" (WS-RD3m)	OM	1	n/a	y
		Cst	3		
		RD	4		
Watching movies of use	"We tested the solutions and put cameras to see what happened on the boat" (INT-OM1m)	OM	3	n/a	y
		RD	2		
Analysing feedback	"[…] and that [Delft Design Method] also has an authorized method that allows things to be grouped and made clearer"(INT-RD2m); "[...] we evaluated the two test days: [followed by 8 bullets summarizing findings]" (MeetReport, p. 1)	OM	1	n/a	y
		RD	1		
		DOC	1		
Documenting feedback	"We evaluated based on the reporting of [internal source]" (MeetReport, p. 1)	Cst	2	n/a	y
		DOC	1		
Reflecting on assumptions and uncertainties	n/a	RD	1	"[MZI] wasn't what [customer] dreamed of […] I haven't been able to figure that out" (INT-RD3m)	n
Resources		**Actor**	**#**		**y/n**
Minimum Viable Product	n/a			MachineCo did not use a minimum viable product to get feedback. They were merely testing proto-types	n
Interview skills	n/a	RD	1	[customer] often processed the information of the previous week or received inspiration from colleagues and had ideas about how to make changes (INT-RD1m)	n
Analytical skills	n/a	RD	1	"I'm uncertain […]" [Do you know what underlying latent needs were present?] (INT-RD3m)	n
Documentation system	n/a			All though this project was documented well, with several reports, individual findings were not captured	y
Readily available customer sources	"[customer] will test the system in collaboration with [MachineCo], both on the quay and in open water. The test data will be reported to make a final design of the system" (GrantDoc, p. 6)	OM	1	n/a	y
		RD	3		
		DOC	2		

Source: Author

Table LL.10: Evidence of Practice J Within MZI Case

Case MZI: Practice J. Defining Customer Requirements					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To achieve a shared understanding of requirements and priorities	"We made the [matrix], put all ideas on one pile and decided this is how we go forward. We cannot keep developing ideas forever" (INT-RD2m)	RD	1	n/a	y
To supervise the development process	"The quality of the solution is evaluated regularly based on the program of requirement" (PPlan, p. 8)	DOC	1	n/a	y
To manage expectations of customers	n/a	OM	1	"[…] the willingness to invest has changed" (INT-OM1m)	n
Activities		**Actor**	**#**		**y/n**
Listing user requirements	"Yes [And those morphological maps are actually those criteria and possible solutions and the scores of those solutions on those criteria.]" (INT-RD2m)	OM	3	n/a	y
		RD	6		
		DOC	2		
Setting priorities	"In the first phase we were mostly busy with basic functionalities. Attractives, such as [feature] came later" (WS-OMm)	OM	2	n/a	y
		RD	1		
Refining requirements	n/a	RD	1	"Then we […] decided the direction which we evaluated with [customer]. Here we froze the design and ideas and now we are making a machine" (INT-RD2m)	n
Resources		**Actor**	**#**		**y/n**
Individual integration skills	n/a	RD	1	Interpretation of findings was done together; "Then we asked [customer] how big the raft should be and he says this big, but you could also look at how these people did it" (INT-RD1m)	n
Sensemaking with customers	"The requirements were defined based on the descriptions of what [MZI] should be able to do according to [customer]" (INT-OM2m)	OM	2	n/a	y
		Cst	1		
		RD	1		
Collaborative internal sensemaking	"We did that together [And did you sit together to decide what the requirements and solutions were?]" (INT-OM2m)	OM	3	n/a	y
		RD	5		
Company formats	n/a	n/a		The requirements were listed in a choice matrix, but there was not an agreed upon format for requirements.	n

Source: Author

Table LL.11: Evidence of Practice K Within MZI Case

Case MZI: Practice K. Mobilizing Internal Sources					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To learn about new customers and markets	"It was difficult to get a grip on the needs. I didn't have experience with this mussel industry and then we had this more experienced colleague […] he knew about fishery and boats" (INT RD2m)	RD	1	n/a	y
To validate findings	n/a	OM	1	"Right, we did not account for that big of a change [Nobody could have foreseen this would become a problem.]" (INT-OM2m)	n
		Cst	1		
To get access to customer network	n/a	Cst	1	"I think we could have included one or two additional colleagues to create more possibilities for testing and feedback" (WS-Cstm)	n
Activities		**Actor**	**#**		**y/n**
Acquisition of sources holding relevant prior customer knowledge	"[…] so every time something came into the picture that had to be connected, he was asked for information […]" (WS-RD1m)	OM	1	n/a	y
		RD	4		
Sharing of information	"Yes, indeed [we asked him very specific things and we invited him at certain moments to our meeting and to share some more information]" (WS-RD1m)	OM	2	n/a	y
		RD	2		
Resources		**Actor**	**#**		**y/n**
Readily available relevant internal or partner sources	"Yes, Indeed [internal source] was our most important internal informant" (WS-OMm)	OM	2	n/a	y
		RD	2		
Internal Incentive	n/a	Cst	1	"The students were thinking along with us […] we didn't have to explain much to them" (WS-Cstm)	n
Communication channels	n/a	OM	1	"[internal source] had a lot of knowledge about [test location], so when something new came up, [internal source] was asked for information" (WS-OMm)	n

Source: Author

Table LL.12: Evidence of Practice L Within MZI Case

Case MZI: Practice L. Developing the Product Concept					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To provide material for testing	"[…] we realized very well that we could come up with something, but if it wasn't working at sea on the boat, it would not help [customer]" (INT-RD2m)	RD	1	n/a	y
To prepare for sales and marketing	"For us, the most important thing was to get the machine working […] After that it was nice to think about how to market it" (INT-RD2m)	RD	1	n/a	y
Activities		**Actor**	**#**		**y/n**
Generating ideas for solutions	"[…] and it happened very often that [customer] was here almost every day to discuss ideas" (INT-RD2m)	OM	2	n/a	y
		RD	5		
		DOC	2		
Consensus and decision making	"We decided in a meeting how to proceed together" (INT-OM2m)	OM	3	n/a	y
		RD	4		
		DOC	2		
Developing the solution	"3. Building the prototype. Based on the design by [MachineCo] the solution will be designed" (GrantDoc, p. 5)	OM	1	n/a	y
		RD	2		
		DOC	2		
Resources		**Actor**	**#**		**y/n**
Experience with collective idea generation	"Our students were involved and they are trained to hold brainstorm sessions" (INT-RD3m)	OM	3	n/a	y
		RD	4		
		DOC	2		
Customer empathy in R&D team	"We really tried to develop from the perspective of the user" (INT-RD2m)	Cst	1	n/a	y
		RD	3		
Visual material supplied by the customer	"[…] when we watched the video material of the boat later, we could see where it went wrong" (INT-OM2m)	OM	2	n/a	y
		RD	2		
Co-creating customer	"[customer] regularly participated in brainstorming sessions […]" (INT-RD2m)	RD	2	n/a	y
		DOC	1		
Student support	"The student worked very effectively and always knew how to find practical solutions for problems" (INT-Cst1m)	OM	1	n/a	y
		Cst	1		
		DOC	2		
Project management tool	n/a	RD	1	"No, we had a general approach [Project management tool. I didn't see those in our interviews]" (WS-Cstm)	n
		Cst	1		

Source: Author

Table LL.13: Evidence of Practice M Within MZI Case

Case MZI: Practice M. Planning Sales and Marketing for Introduction					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To start up the commercial process	n/a	Cst	3	There is ample evidence that the commercial introduction of [MZI] was not considered as long as there was no proof of the technical feasibility; "For us it was relevant to get the machine in working order. It is good to know how to bring it to the market once it works […]" (INT-RD2m);	n
		RD	2		
		OM	1		

Source: Author

APPENDIX MM EVIDENCE OF THE RELATIONSHIPS BETWEEN THE PRACTICES OF MZI

Table MM1: Evidence of the Relationships Between the Practices of MZI

Practice / Output of Practices	Exploring the problem situation (A)	Generating ideas (B)	Exploring the market & opportunity (D)	Defining the value (E)	Securing innovation funds (C)	Managing DCI action (F)	Mobilising customer sources (G)	Exploring the user experience (H)	Collecting user feedback (I)	Defining /refining requirements (J)	Mobilising internal sources (K)	Developing the product concept (L)	Planning sales and marketing (M)	Representative Quotes
Customer problem understanding (A)		→	→											"And then I started exploring what [customer] wanted and how we could solve this" (INT-OM2m) "When [customer] came to us with his ideas, of course we also went looking whether this would fit the market" (WS-OMm)
A first idea concept (B)	→													"[customer] came to us with an idea and then you start exploring: what is it exactly that you want?" (INT-OM1m)
Market understanding (D)				→								→		"Market research is needed to understand the fishery market" (BriefMR, p. 2) "Initial request: Answering the following questions will enable to meet the request; In what way, will [MachineCo] be able to generate sufficient value from the[MZI]" (MRreport, p. 6)
Defined value (E)					→									"We had only 13 days to apply for the grant. We quickly took a look at some figures and other material before applying" (INT-OM2m)
Authorized means (C)								→						"1. Prestudy. In this study the University and other project parties will work together to further define the idea and execute suitable market research to develop technical and financial criteria" (GrandDoc, p. 6)
Understanding of needs (H)										→		→		"Requirements were developed on the basis of the descriptions of [customer] about what the system should do" (INT-OM2m) "The result of the analysis phase were requirements and a vision on design" (INT-D3m)
Feedback of customers (I)												→		Then, [In the field test] you see what the problems are and then we tried to address the problems (INT-RD2m)

Table MM1: Continued

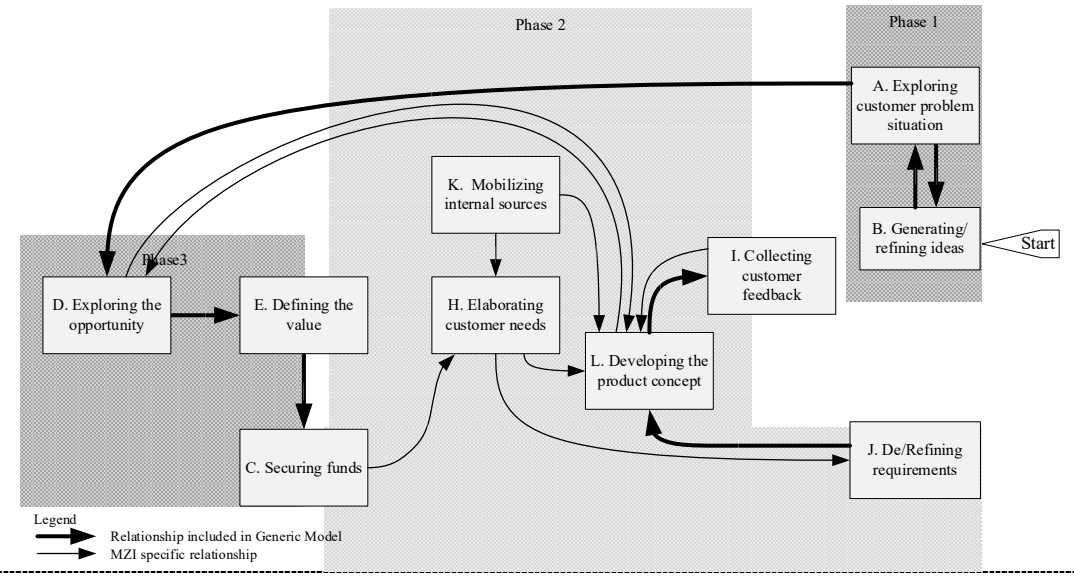
Practice / Output of Practices	Exploring the problem situation (A)	Generating ideas (B)	Exploring the market & opportunity (D)	Defining the value (E)	Securing innovation funds (C)	Managing DCI action (F)	Mobilising customer sources (G)	Exploring the user experience (H)	Collecting user feedback (I)	Defining /refining requirements (J)	Mobilising internal sources (K)	Developing the product concept (L)	Planning sales and marketing (M)	Representative Quotes
Prioritized requirements (J)												→		"Based on the [choice matrix] we froze ideas and decided this is it, now let's make a machine out of it" (INT-RD2m)
Internal sources (K)								→				→		"It was difficult to get a grip on the needs. I didn't have experience with this mussel industry and then we had this more experienced colleague […] he knew about fishery and boats (INT RD2m) "While developing we regularly checked [internal sources]" (WS-RD1m)
A first product concept (L)			→						→					"While we were developing and testing, we started research on the fishery market" (INT-OM1m)) "[Customer] checked whether the new concept was applicable" (INT-RD1m)

Source: Author

Table MM.2: Key Characteristics of the Relationship model of MZI

MZI Model and numerical features

10 practices, 15 relationships, 44% of common configuration of practices included (7 out of 16 generic relationships)



Central practices MZI model

L. Developing the product concept (7)

Characteristics MZI model

- The front-end of this project is smaller than in the common configuration of practices and does not contain requirements listing;
- Starting point is the idea brought in by a customer (B), which is then briefly explored on matching needs (A) and market potential (D);
- A formal start in project Phase 2 follows once means are secured (C);
- In this second phase, concept development is put central (L);
- This includes more intensive customer research (H);
- Customers are not separately mobilised as the customer was part of the team.
- J is not updated with customer feedback (I);
- Once a more final product version is ready, more intensive market research (D) is undertaken in Phase 3. Findings are not used.

Conclusions MZI model

- In addition to insights accrued from early exploration of customer problems, customer insights result from more intensive explorative customer research once the project has formally started and more means are available.
- An additional phase of dedicated market research leads to an update of the value definition.

Source: Author

APPENDIX NN ACTORS AND RESOURCES MZI

Table NN.1: Actors of the Practices of MZI

Practice	Roles	Description of Role	Practice
Owner	Information processing	Collecting and analysing information	A, H
	Champion	Promoting the project internally, creating commitment	C, K
	Decision maker	Making go/no go decisions about the project	C
	Gatekeeper/synthesis	Synthesising all relevant knowledge into new models	E, J
	Creativity and Development	Develop ideas and concepts	B, L
Customer	Input source	Providing the raw data	A, H, I
	Relationship manager	Promoting the project externally, creating commitment	A, H
	Information processing	Collecting and analysing information	A, H, I
	Boundary spanning	Recognising new externally located information	B
	Champion	Promoting the project internally, creating commitment	C
	Decision maker	Making go/no go decisions about the project	C
	Creativity and Development	Develop ideas and concepts	B, L
	Gatekeeper/synthesis	Synthesising all relevant knowledge into new models	E, J
R&D	Creativity and Development	Develop ideas and concepts	B, L
	Information processing	Collecting and analysing information	A, H, I
	Input source	Providing the raw data	A, H, I
	Gatekeeper/quality control	Mitigate biases	H
Students/External	Information processing	Collecting and analysing information	D

Source: Author

Table NN.2: Resources of the Practices of MZI

Resource Group	# of Resources	%	Dominant Resource Type (# of Appearances in Practices)
FLA	5	15%	Company formats (2)
CoI	12	38%	Internal sources (4)
S&T	9	28%	Collaborative sensemaking (4)
P&M	6	19%	Students (3)
Total	32	100%	

Source: Author

APPENDIX OO PERCEPTIONS OF QUALITY CRITERIA OF MZI

Quality	Mentions documents	Mentions interviews	Exemplar quote
Timely		8	"We started focusing on the must-be's. We had to develop a proto-type first. It was only after that that we started looking at the broader market." (WS-Cust1m)
Comprehensive	4	10	"We went on the boat and that enabled us to develop a good feeling of how things go during harvesting. You see it happen" (INT-RD1m)
Novelty	2	6	"Please describe the innovativeness of the project." "how will this improve the fishery industry/" (GrantDoc, p. 9)
Accurate	1	3	"In the end our conclusions were not correct. You need to have the skills to identify the hidden stuff" (INT-RD3m)
Acceptable	-	12	Why we didn't include [functionality x] isn't clear to me until today. I think we dropped it because [customer] didn't feel comfortable with that. (INT-RD3m)
Scope		3	"It turned out that every farm has his own system. I am not optimistic that our solutions will meet requirements of every farmer." (INT-RD1m)
Cost efficient	-	9	Sometimes they suggested to look into specific problems, or topics and then I said that it had to be useful, we can't explore the whole world." (INT-RD3m)

Source: Author

APPENDIX PP THE LEVEL OF INSIGHT OF MZI

Criterion	Timely	Comprehensive		Novelty	Clear Consistency	Clear Inspiring	Clear Format	Extra case criterion Acceptance	Extra case criterion: Cost-Efficiency
Indicator	Document holding CI	Amount of needs insights	Missed needs insights	Attractive needs agreed upon by 50% of more of team	% of consistently formatted requirements	% of statements free of solution aspects	# of different formats		
Result	List of requirements	10	Yes	0	100%	70%	1	No	No
Qualitative evaluation	The Choice matrix shows how the team listed the basic requirements and used these to evaluate solutions. Economic and emotional needs were not included, because the team decided to give priority on the most essential, must-be, requirements.	The owner and engineers all indicate they missed certain insights, especially insights explaining economic and emotional needs. "We focused on making a working proto-type. Marketing aspects came later." (WS-Custm) "Because we had to do everything very fast, we skipped certain things…." (INT-RD3m)		The team agrees that attractive needs were not addressed.	The team used a format called choice matrix, which was based on Delft Design Method; "We used formats of the Delft Design Method" (WS-RD3m)			The team concentrated above all on developing acceptable insights. Despite of the efforts, the final solution was not accepted by the customer involved. Even more, the team doubts that other customers would have accepted it. "I doubt[…] that others would have bought it. Just because of a lack of goodwill. I think you would have said, well this isn't mine solutions, it is [customer's] solution, so I don't need that" (INT-RD3m)	"At that time we wanted to build something relevant for the entire market, but as I look at it know, I don't think it is possible. Farmers have different boats and use such systems in different ways" (INT-RD1m)

Source: Author

APPENDIX QQ IMPROVEMENT OPPORTUNITIES MZI

Table QQ.1: Improvement opportunities

Practices	Importance			Implementation			Opportunity
	% > 4	AVG	Std	% > 4	AVG	Std	Score
A. Exploring customer problem situations	100	4.4	0.548	100	4.2	0.447	**10**
B. Generating ideas	80	4.4	0.894	60	4	1.000	**10**
C. Securing innovation funds	80	4.4	0.894	80	3.8	1.095	8
D. Exploring the market opportunity	40	3.2	0.837	60	3.6	0.548	2
E. Defining the value proposition	80	4.2	0.837	60	3.4	0.894	**10**
F. Managing DCI action	40	2.8	1.304	20	2.6	1.14	6
G. Mobilising customer sources	80	3.8	1.095	40	3	1.000	**12**
H. Elaborating customer needs understanding	80	3.8	0.447	60	3.6	0.548	**10**
I. Collecting customer feedback	100	4.4	0.548	80	3.8	1.095	**12**
J. Defining customer requirements	80	4.4	0.894	100	4.25	0.500	6
K. Mobilising internal sources	100	4.4	0.548	75	4	0.816	**12.5**
L. Developing the product concept	100	4.2	0.447	80	4.2	0.837	**12**
M. Planning sales and marketing for launch	80	3.8	0.447	0	2.6	0.548	**16**
Total		4.02	0.750		3.62	0.810	

Source: Author

Table QQ.2: Improvement Tactics

Practice	# of Improvements	Dominant Tactic	# of Mentions	Exemplar Quotes
A	3	Data Collection	2	“I would say that the next time we should take a little more time and first research the market better before taking action” (INT-Custm); "You can't design something without understanding very well what takes place deep down at that customer level" (INT-RD3m)
B	n/a	n/a	n/a	
G	n/a	n/a	n/a	
H	n/a	n/a	n/a	
I	1	Sampling	5	“I am now talking to other fisheries as well and this is very insightful, I see how they all have invented their own solutions” (WS-OMm)
K	1	Roles	2	“I think we could have included one or two additional colleagues to create more possibilities for testing and feedback” (WS-Cstm)
L	1	Market Definition	2	“We are talking about the scope of the project, we focused on automating it too much” (INT-RD2m)
M	1	Roles	4	“[customer] was our marketing person”. I trusted him. Next time we need to do this differently, have a dedicated person for this” WS-OMm)
Total	7			

Source: Author

APPENDIX RR IMPLICATIONS OF THE IMPROVEMENTS MZI

Improvements per Improvement Tactic	Implications for the Level of DCI									
	Timely	Comprehensive	Novel	Consistent	Inspiring	Format	Accurate	Acceptable	Scope	Cost efficient
Data collection techniques		✓	✓				✓			
Take time to visit and observe customers		✓	✓							
Market definition									✓	
Define the market in a meaningful way									✓	
Order of doing things	✓	✓								
Start the project with customer needs analysis	✓	✓								
Roles	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Have a marketing expert on board	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Include team members that have customer insight	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Sampling		✓					✓			
Increase sampling size		✓					✓			
Timing		✓					✓			
Plan more time for market research		✓					✓			
Total impact (amount of improvements)	3	**6**	3	2	2	2	4	2	3	2

Source: Author

APPENDIX SS BARRIERS TO IMPLEMENTATION MZI

Improvement Tactic	Barrier	Mentions	Exemplar Quote
Collaborative approach	Include team members that have customer insight	2	"But then again, this is a such a specific target group, very few people have useful information about it" (INT-RD1m)
Data collection techniques	Careful to present unfinished product	3	"We were very careful to discuss [MZI] with others. We still wanted to protect our IP" (WS-OMm)
	What is market research? (affecting A and H)	3	"I would make a survey and ask my colleagues to fill it in […] ask their needs, what they would pay for a solution for [specific problem], how much time they would expect to save with it." (INT-Cust1m)
Management of learning	No systematic approach	1	"It was really difficult to put some structure in it, especially since I did not known anything about this industry […] it was difficult to make everybody work in the same way" (INT_RD2m)
	Too much ideas	2	"At some point we had to decide, otherwise we could have generated ideas for ever. At some point [customer] came in every day to discuss new ideas" (INT-RD2m)
Market definition	Focus on technical aspects	3	"Technically, the final draft is a fine interpretation the problem as formulated at the start of the project" (INT-RD3m)
	Limited scope	2	"[…] we did look at some examples abroad, but then we ran back quickly to the Netherlands, because we felt that this went a step too far" (WS-OMm)
	Not clear on goals	4	"[…] this project did not start out as a commercial enterprise. That idea grew later on (INT-Cst1m)"
Order of doing things	Marketing comes after technical	3	"To us, it was important to get things up and running. It is nice to think ahead on how to market things once we have a working machine, but to me that wasn't really relevant" (INT-RD1m)
Roles	Too wide or too narrow role for the customer (A, M)	8	"[…] but of course, we were customer-focused, the client was at our table, working with us, what else would you need in terms of customer involvement? I can't imagine anything better than that" (WS-RD3m)
Sampling	Lack of method for customer selection	2	"At that time we wanted to build something relevant for the entire market, but as I look at it know, I don't think it is possible. Farmers have different boats and use such systems in different ways" (INT-RD1m)
	Lack of attention for sample size (affecting Practice H and I)	3	So, [customer] represented 20% of the entire group of customers, so that is not nothing, I would say (WS-RD3)
Time available	Research takes too much time (E, A, L)	4	"[…] if you have to do a six months market research first, there is not much time left to develop the solution" (INT-OM1)
Total	**19 barriers**		

Source: Author

APPENDIX TT EVIDENCE OF PRACTICES SMARTLIGHT

Table TT1: Evidence of Practice A Within SmartLight Case

Case SmartLight: Practice A. Exploring the Customer Problem Situation					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To define product market segments	n/a	OM	3	The idea to target SmartLight to industrial clients was introduced by the Business Developer and not the result of problem exploration; "[Business Developer] came to us and already had quite some knowledge […] this how we got in this market segment" (INT-OM2sl)	n
		SLS	2		
To further develop first ideas	n/a	OM	1	"As a sales person you don't have time to extensively research what might drive a potential customers" (INT-OM2sl)	n
To understand the opportunity of a customer idea	n/a	OM	2	The opportunity was checked in Practice D. That information was available in early in the project. "[Business Developer] had already done some research into that market." (INT-OM2sl)	n
		SLS	2		
To build trust with potential customers	n/a	OM	2	This was done during testing of the idea; "[…] by trail and error we try to develop applications that matter. Sometimes this is supported by needs" (INT-OM2sl)	n

Source: Author

Table TT2: Evidence of Practice B Within SmartLight Case

Case SmartLight: Practice B. Idea Generation					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To define a project fitting into the strategic agenda	"Once and a while you need to renew your product, so that was the reason we started thinking about it (INT-RDsl); "We wanted to be unique, and that is what we became" (INT-OM2sl)	OM	2	n/a	y
		RD	1		
To define a solution for observed needs	n/a	OM	2	The basic idea for SmartLight was the result of strategic thinking, not of information collection; "[…] we were thinking what makes our technology better than any other for those markets" (INT-OM2sl)	n
To define a project that can be funded	n/a	SLS	2	The project idea came first, funds followed the results; "They gave me a year playground. To test and try" (INT-SLSsl)	n
Activities		**Actor**	**#**		**y/n**
Checking ideas of customers	n/a	OM	2	Ideas of customers were not checked because customers are not perceived to be innovative in this market segment; "[…] they don't think about that, they just use the old systems" (INT-OM2sl)	n
		RD	2		

Table TT2: Continued

Case SmartLight: Practice B. Idea Generation					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Activities		**Source**	**#**		**y/n**
Consensus and decision making	"We saw an option to integrate [basic SmartLight functionality] and decided to go for that option" (INT-RDsl)	OM	1	n/a	y
		RD	2		
Generate new ideas	"We took one step back and then we saw a much bigger thing" (INT-OM1sl).	OM	1	n/a	y
		RD	2		
Resources		**Actor**	**#**		**y/n**
Vision of the future	"We always wanted to take the opportunity to build in [functionality]" (INT-RDsl)	OM	3	n/a	y
		RD	5		
Overview of current products and capabilities	"We are good in advanced solutions, integrating things. And with [SmartLight] we strengthened our position" (INT-RDsl)	OM	1	n/a	y
		RD	1		
Experience with creative techniques	n/a	RD	2	"Everybody can give his input, but most of it comes from R&D of course (INT-RDsl)"	n
A sufficiently broad scope	"If you ask at a more abstract level, the customer gets back with a vision on their future" (INT-OM2sl)	OM	1	n/a	y
		RD	1		
Market reputation	n/a	OM	1	Market reputation of LigthCo was non existing because before SmartLight. LigthCo worked only for the Petrol industry; "We could not go immediately to [big consumer brand]. They don't have the time to talk to us" (INT-SLSsl)	n
		SLS	1		

Source: Author

Table TT.3: Evidence of Practice C Within SmartLight Case

Case SmartLight: Practice C. Securing Innovation Funds					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To get authorization from management	n/a	RD	2	"[…] this is a company were we can easily develop things" (INT-RDsl)	n
To create means for next development step	"Go/no-go decisions were made when a lot of money or time was involved" (INT-OM2sl)	OM	2	n/a	y
		RD	1		
To create customer base	n/a	OM	2	Potential customers were attracted during the innovation activities and did not require funding during the project: "by doing it, testing it, collecting positive customer experiences, we developed the product […]" (INT-OM2sl)	n
Activities		**Actor**	**#**		**y/n**
Finding funds for problem analysis	n/a	OM	2	This project did not include problem and needs analysis. Most of the work involved testing: "by trail and error we try to develop applications that matter. Sometimes this is supported by needs" (INT-OM2sl)	n
Finding funds for needs analysis	n/a				n
Finding funds for testing	"They gave me a year playground. To test and try" (INT-SLSsl)	OM	2	n/a	y
		SLS	1		

Source: Author

Table TT.3: Continued

Resources		Actor	#		y/n
Corporate decision making criteria	"Decisions were based on the amount of money involved" (INT-OM2sl)	OM	4	n/a	y
		SLS	3		
Strategic reflections	"We like to follow a niche strategy, in which we can offer specific distinctive advantages" (INT-OM2sl)	OM	4	n/a	y
		RD	2		
Availability of grants	n/a	n/a		There were no mentions of other than company funds	n
Customer willing to pay	n/a	OM	4	Customers only paid when the liked the product and once it was fully developed: "[…] they didn't have to pay" (INT-OM2sl)	n
		SLS	3		

Source: Author

Table TT.4: Evidence of Practice D Within SmartLight Case

Case SmartLight: Practice D. Exploring the Market & Opportunity					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To make a business model	n/a	OM	2	"If it is not commercially attractive I wait a while before making a proposal for [market segment]" (INT-OM2sl)	n
To estimate market potential	"You always try to take a look beyond a single customer" (INT-RDsl)	RD	2	n/a	y
		SLS	1		
To understand the market forces affecting customer needs	n/a	SLS	2	The main driver for market understanding is to understand the market or technical requirements, not necessarily needs; "I checked the HACCP rules for toxic components (INT-SLSsl)	
Activities		**Actor**	**#**		**y/n**
Desk research	"I did some desk research to see whether certain markets had specific legislation […] I try to follow competitor activity, look at trends"(INT-SLSsl)	OM	1	n/a	y
		RD	1		
		SLS	2		
Visiting conferences	n/a	OM	2	There were no mentions of going to conferences, other than for selling SmartLight; "[…] you go to a fair, a conference […] these are the things you do" (INT-OM2sl)	n
Interviewing	n/a			Main activities to understand the opportunity in a market segment are related to desk research. There were no mentions of interviewing	n
Analysing the opportunity	"I checked the market potential" (INT-OM2sl); "He had analysed 100 [types of customers]" (INT-OM2sl)	OM	1	n/a	y
		RD	1		
		SLS	1		
Documenting the opportunity	n/a	SLS	2	The findings were not put on paper, but shared with R&D or the direction when needed; "I then went for a quick check to R&D […] . When I wasn't sure I involved management (INT-SLSsl)	n
Resources		**Actor**	**#**		**y/n**
Research method expertise	n/a	n/a		Desk research evolved naturally and was not designed and planned in advance. There were not mentions of other methods	n

Table TT.4: Continued

Interview skills	n/a	RD	2	Main activities were based on desk research; "[…] customers are not working with light on that level, they do not see the bigger picture of possibilities" (INT-RDsl)	n
Analytical skills	n/a	n/a		It is unclear how exactly the market was analysed as this was not documented	n
Student support	n/a	n/a		All of the work was done by the business developer and R&D	n
Readily available internal sources	"Also, from our internal R&D and sales sources. Not everything can be found on the internet" (INT-RDsl)	RD	1		y
		SLS	1		
Readily available customer sources	n/a	n/a		Main activities were desk research	n
Readily available expert sources	n/a	n/a		Main activities were desk research	n
Readily available secondary sources	"That is a database. We bought it" (INT-SLSsl)	RD	1	n/a	y
		SLS	1		
Company formats	n/a	n/a		The findings were not documented	n

Source: Author

Table TT.5: Evidence of Practice E Within SmartLight Case

Case SmartLight: Practice E. Defining the Value Proposition					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To justify investments in development, production and marketing	"And then you have to make the business case and if it doesn't pay off, forget it" (INT-OM1sl);	OM	3	n/a	y
		SLS	1		
To establish a shared vision on the importance of the project	n/a	OM	2	The team was small and all actors were closely involved in development of the project. Dedicated activities to create a shared vision were not needed; "We go together that makes it super quick" (INT-OM2sl)	n
Activities		**Actor**	**#**		**y/n**
Defining customer value	"Here [in the industry], [SmartLight] has a much bigger added value than in the Petrol" (INT-OM1sl)	OM	4	n/a	y
Defining firm value	"We calculated to have [x] margin" (INT-OM1sl)	SLS	3	n/a	y
Resources		**Actor**	**#**		**y/n**
Individual integration skills	n/a	OM	2	Conclusions on the value of the innovation were the result of a collaborative process: "We involved several people. You get different perspectives then" (INT-OM2sl)	n
Sensemaking with customer	n/a	OM	2	"[customers] drove the innovation, but they were not involved" (INT-OM1sl)	n
Collaborative internal sensemaking	"We involved several people. You get different perspectives then" (INT-OM2sl)	OM	1	n/a	y
		RD	1		
External legitimacy	n/a			LightCo relied fully on its own judgements: "Some people like it, others, never understanding it" (INT-OM2sl)	n
Company formats	n/a	n/a		The findings were not put on paper.	n

Source: Author

Table TT.6: Evidence of Practice F Within SmartLight Case

Case SmartLight: Practice F. Managing DCI action					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To collect information in a conscious, efficient and impartial manner	n/a	n/a		"[…] that was not really a managed process […] this is a natural process (INT-OM2sl)	n
To make sure uncertainty decreases across the process	n/a				n

Source: Author

Table TT.7: Evidence of Practice G Within SmartLight Case

Case SmartLight: Practice G. Mobilizing Customer Sources					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To increase development capacity	n/a	RD	2	Customers did not participate in development; "We have to present it to them, otherwise they simply can not comprehend it" (INT-RDsl)	n
To find money for further development	n/a	OM	2	Customers did not pay until the product fully developed; […] they didn't have to pay" (INT-OM2sl)	n
		RD	2		
To prepare for sales & marketing	"The more projects you have done, the better. Than you can say, 'go there and see it working'" (INT-RDsl)	OM	1	n/a	y
		RD	1		
To get customer information	"You look for customers who are open to try it […]it provides you with a lot of information" (INT-RDsl)	OM	2	n/a	y
		SLS	3		
Activities		**Actor**	**#**		**y/n**
Defining customer criteria	n/a	OM	2	In the beginning LightCo was not critical on the customers involved: "[…] we tested it in our street" (INT-OM2sl); I think so [would SmartLight be a different product, I you had test it with other customers?]" (INT-RDsl)	n
		RD	1		
Identifying of customers	"We had a database with addresses of customers who were interesting to get in touch with" (INT-SLSsl)	SLS	2	n/a	y
Activating of participants	"You have to use examples to illustrate what it could mean to them" (INT-SLSsl)	OM	1	n/a	y
		SLS	1		
Managing of expectations	"You have to explain this well […] It might very well be that the test fails […] (INT-RDsl)	RD	1	n/a	y
		SLS	3		
Resources		**Actor**	**#**		**y/n**
Customer incentive	"Customers easily say yes, when it is for free" (INT-RDsl)	RD	1	n/a	y
		SLS	3		
Internal incentive	n/a	OM	2	Innovation drives activities and therefore internal incentives are not needed; "We are just a bunch of people who like technical stuff […] this is what our business is 'innovate' […]" (INT-OM2sl)	n
Marketing channels	"[…] but now we also test propositions via LinkedIn and the socials" (INT-OM2sl)	OM	2	n/a	y
Customer management skills	"You need to bridge what they want today and what is possible in the future" (INT-OM2sl)	OM	4	n/a	y
		SLS	1		

Source: Author

Table TT.8: Evidence of Practice H Within SmartLight Case

Case SmartLight: Practice H. Elaborating Customer Needs					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To support solution finding	n/a	OM	3	"As a sales person you don't have time to extensively research what might drive a potential customers […] We take our ideas with us to the customer and then talk about it with them […] This is what we do […] We run up the flagpole and then see how people react to that (INT-OM2sl)	n
To define customer requirements	n/a	RD	2	"We had some requirements when we started working on the idea, like that it had to work with standard equipment [...] but most requirements came later" (INT-RDsl)	n
To validate the scope of the project	n/a	OM	2	Validation was done during the test; "All projects of LigthCo started with a test […] that helped to understand the meaning of the innovation" (INT-OM2sl)	n
		RD	3		

Source: Author

Table TT.9: Evidence of Practice I Within SmartLight Case

Case SmartLight: Practice I. Collecting Customer Feedback					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To validate and refine customer requirements	"By trial and error we gradually developed this" (INT-OM2sl);	OM	8	n/a	y
		SLS	4		
		RD	2		
To identify missing information	n/a	OM	8	The focus was not on generating information, but on developing the product; "There was nothing, when I started, we step by step developed it" (INT-SLSsl)	n
		SLS	4		
To check performance of the solution	n/a	SLS	1	"Bottom line you check if it all works technically as it is supposed to and when the client says it is fantastic we start producing it" (INT-SLSsl)	n
Activities		**Actor**	**#**		**y/n**
Surveying customers	n/a	SLS	3	All questioning was done in a qualitative way, not by predefined questions; "Very pragmatically, I checked with customers" (INT-SLSsl)	n
Conducting conversations	"I visited their location and then I asked specific questions, like 'what is it that you pay attention to'" (INT-SLSsl)	OM	1	n/a	y
		SLS	5		
Watching movies of use	n/a	OM	4	Observation was done in real life: "I walked along [specific facilities] to check the temperature, the conditions" (INT-SLSsl)	n
Analysing feedback	"And then I knew what was important for them" (INT-SLSsl)	SLS	2	n/a	y

Table TT.9: Continued

Documenting feedback	n/a	OM	2	At the time of SmartLight, there was no documentation system available. Results were shared orally, or everybody who had an interest in speaking or observing the customer joined in when visiting the customer. "We go together that makes it super quick" (INT-OM2sl); We go there together […] as a technician I see other things […]" INT-RDsl)	n
		RD	2		
Reflecting on assumptions and uncertainties	n/a	n/a		There are no signs that the team of LightCo formulated assumptions, questions or uncertainties that they wanted to solve with the test.	n
Resources		**Actor**	**#**		**y/n**
Minimum Viable Product	"We were quickly to have a something for testing" (INT-RDsl)	OM	1	n/a	y
		RD	1		
		SLS	1		
Interview skills	"I went carefully asking questions, not steering them towards certain answers" (INT-SLSsl)	SLS	2	n/a	y
Analytical skills	n/a	RD	1	The findings were collected on a customers per customer basis and therefore did not require comparisons or tabulations. Once we finished working on that customer in [specific facility] number one, we moved to customer in [specific facility] number 2" (INT-SLSsl)	n
		SLS	1		
Documentation system	n/a	OM	2	At the time of SmartLight, there was no documentation system available. Results were shared orally, or everybody who had an interest in speaking or observing the customer joined in when visiting the customer. "we go together that makes it super quick" (INT-OM2sl)	n
Readily available customer sources	"We first tried to sell it, but they didn't want it, and then we asked whether they wanted to participate in the test" (INT-OM2sl)	OM	2	n/a	y

Source: Author

Table TT.10: Evidence of Practice J Within SmartLight Case

Case SmartLight: Practice J. Defining Customer Requirements					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To achieve a shared understanding of requirements and priorities	"You put everything together and then communicate what we think is best to do" (INT-SLSsl)	SLS	2	n/a	y
To supervise the development process	n/a	RD	2	"We do this always pragmatically, step by step, and if we have one thing ready, we move over to another " (INT-RDsl)	n
To manage expectations of customers	n/a	n/a		Requirements were not shared with the customer; the customer had to be convinced of the innovation step by step	n
Activities		**Actor**	**#**		**y/n**
Listing user requirements	"Yes, for this project we certainly had a list of requirements" (INT-RDsl)	OM	1	n/a	y
		RD	1		
		SLS	1		
Setting priorities	"We do this always pragmatically, step by step, and if we have one thing ready, we move over to another " (INT-RDsl)	RD	2	n/a	y
Refining requirements	"And the test resulted in some new requirements" (INT-RDsl)	RD	2	n/a	y
		OM	1		
Resources		**Actor**	**#**		**y/n**
Individual integration skills	n/a	OM	2	Most of the sensemaking was done together; "I have my glasses, they have theirs and when we add that we know more" (INT-OM2sl)	n
Sensemaking with customers	n/a	SLS	2	Customers were only questioned, not performing active roles in validating and discussing conclusions. The customer had to be convinced step-by-step of the added value because they were very conservative. They therefore lacked the abilities for more active roles: "If I would have showed them [functionality] they would have run away, instead, I just put it on 50% and then gradually I increased it every week" (INT-SLSsl)	n
		RD	2		
Collaborative internal sensemaking	"We did this together, deciding shall we go this way or that. Most requirements were from R&D but Sales added to that as well" (INT-RDsl)	OM	1		y
		RD	2		
Company formats	n/a	SLS	1	Things were not documented and most progress and findings were shared orally; "When we needed some input are had some questions we just got together, had a quick brainstorm" (INT-SLSsl)	n

Source: Author

Table TT.11: Evidence of Practice K Within SmartLight Case

Case SmartLight: Practice K. Mobilizing Internal Sources					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To learn about new customers and markets	"He brought in the entire project" (INT-OM2sl)	RD	1	n/a	y
		SLS	2		
To validate findings	n/a	SLS	2	"The business developer started from scratch: "There was an idea, but that was not suited for the industry […]" (INT-SLSsl)	n
To get access to customer network	n/a	SLS	2	"I started at the end of this street, we did not have any customers yet" (INT-SLSsl)	n
Activities		**Actor**	**#**		**y/n**
Acquiring of sources holding relevant prior customer knowledge	"He already had evaluated projects and done some research. He came to us and offered to sell that kind of products" (INT-OM2sl); I had experience in the some industrial market before I started, but not with products like SmartLight (INT-SLSsl)	OM	2	n/a	y
		RD	1		
		SLS	2		
Sharing of information	n/a	n/a		The Business Developer became part of the team and integrated his knowledge while working on SmartLight	n
Resources		**Actor**	**#**		**y/n**
Readily available relevant internal or partner sources	"[Business Developer] came to us" (INT-OM2sl)	OM	1	n/a	y
		RD	1		
Internal Incentive	"They said, 'you go and play around, with those products'" (INT-SLSsl)	OM	1	n/a	y
		SLS	2		
Communication channels	n/a	n/a		The Business Developer became part of the team and shared his information during team meetings. This did not require dedicated communication channels	n

Source: Author

Table TT.12: Evidence of Practice L Within SmartLight Case

Case SmartLight: Practice L. Developing the Product Concept					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To provide material for testing	"We installed the products and tested and asked customer their response. Then we went back to R&D again" (INT-SLSsl)	SLS	2	n/a	y
To prepare for sales and marketing	"We developed marketing around the findings of the test" (INT-OM2sl)	OM	2	n/a	y
Activities		**Actor**	**#**		**y/n**
Generating ideas for solutions	"It is nice that he comes up with solutions and then I think you can do it in this way as well, and he starts thinking that maybe we can do it in a totally different way" (INT-OM2sl)	OM	1	n/a	y
		RD	1		
		SLS	2		
Consensus and decision making	n/a	SLS	3	"The process did not require extensive decision making; "we worked very pragmatically, we are not a company that is very formal, I just easily went and asked for things" (INT-SLSsl)	n
Developing the solution	"In this way we gradually developed and improved the concept" (INT-SLSsl)	OM	2	n/a	y
		RD	1		
		SLS	1		
Resources		**Actor**	**#**		**y/n**
Experience with collective idea generation	"We had a lot of contact with R&D to understand what it was we needed" (INT-OM2sl); "It is interesting they have information we don't have and the other way around […] we try to work this out together" (INT-RDsl)	OM	1	n/a	y
		SLS	1		
		RD	2		
Customer empathy in R&D team	"Our R&D is very commercial. We do everything from a customer perspective" (INT-OM2sl); "I regularly go with [sales] to the customer" (INT-RD1sl)	OM	2	n/a	y
		RD	1		
Visual material supplied by the customer	n/a	n/a		The test results were collected at the premises of the customer and did not require additional visual material of the customer.	n
Co-creating customer	n/a	n/a		Customers were not involved in development	n
Student support	n/a	n/a		There were no mentions of students involved in the process	n
Project management tool	n/a	SLS	1	At the time of SmartLight, the current tool was not available yet; "We worked from a sheet" (INT-SLSsl)	n

Source: Author

Table TT.13: Evidence of Practice M Within SmartLight Case

Case SmartLight: Practice M. Planning Sales & Marketing					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To start up the commercial process	"When the first customer were satisfied we made an article number and the product was there, ready to be sold" (INT-SLSsl)	OM	1	n/a	y
		RD	1		
		SLS	1		
Activities		**Actor**	**#**		**y/n**
Re-using CI	"I used that information for developing my sales process" (INT-OM2sl)	OM	2	n/a	y
		SLS	1		
Communicating insight	"We are now having first conversations with big customers" (INT-OM1sl)	OM	2	n/a	y
		SLS	1		
Resources		**Actor**	**#**		**y/n**
Individual integration skills	n/a	SLS	2	Sales and marketing material was created based on test findings and did not require a lot of transformation or adaptation; "This is just a pitch, a data sheet and some article number, very straightforward" (INT-SLSsl)	n
Collaborative sensemaking within team	n/a				n
Student support	n/a	n/a		There were no mentions of students involved in the process	n
Documentation system	n/a	SLS	2	At the time of SmartLight, there was no documentation system available. "This is just a pitch, a data sheet and some article number, very straightforward" (INT-SLSsl)	n
Company formats	"We give [department that installs] directions and they further take care of [making the product ready for launch]. I am not doing that anymore" (INT-SLSsl);	OM	1	n/a	y
		RD	1		
		DOC	1		

Source: Author

APPENDIX UU EVIDENCE OF THE RELATIONSHIPS BETWEEN THE PRACTICES OF SMARTLIGHT

Table UU1: Evidence of the Relationships Between the Practices of SmartLight

Practice / Output of Practices	Exploring the problem situation (A)	Generating ideas (B)	Exploring the market & opportunity (D)	Defining the value (E)	Securing innovation funds (C)	Managing DCI action (F)	Mobilising customer sources (G)	Exploring the user experience (H)	Collecting user feedback (I)	Defining /refining requirements (J)	Mobilising internal sources (K)	Developing the product concept (L)	Planning sales and marketing (M)	Representative Quotes
A first idea concept (B)			→							→				"In this way you screen whether the idea fits the observations in the market" (INT-RDsl) "We had some requirements when we started working on the idea, like that it had to work with standard equipment [...] but most requirements came later" (INT-RDsl)
Market understanding (D)		→		→										"We saw the trends and needed to translate this to our products" (INT-RDsl) "Our idea fitted the needs we assumed to be there and we developed out proposition around it" (INT-OM2sl
Defined value (E)					→									"We said ok, we will decide whether we will do this or not. What is the potential ?" (INT-OM2sl
Authorized means (C)							→							"And once we decided to go for it, when we thought we had something, we went all the way and went out for customers to test it" (INT-OM2sl)
Customer sources (G)									→				→	"I just asked them whether we could test it. I also approached [specific customer]" (INT-OM2sl) "[…] they ([participating customers] provided us with success cases" (IN-RDsl)

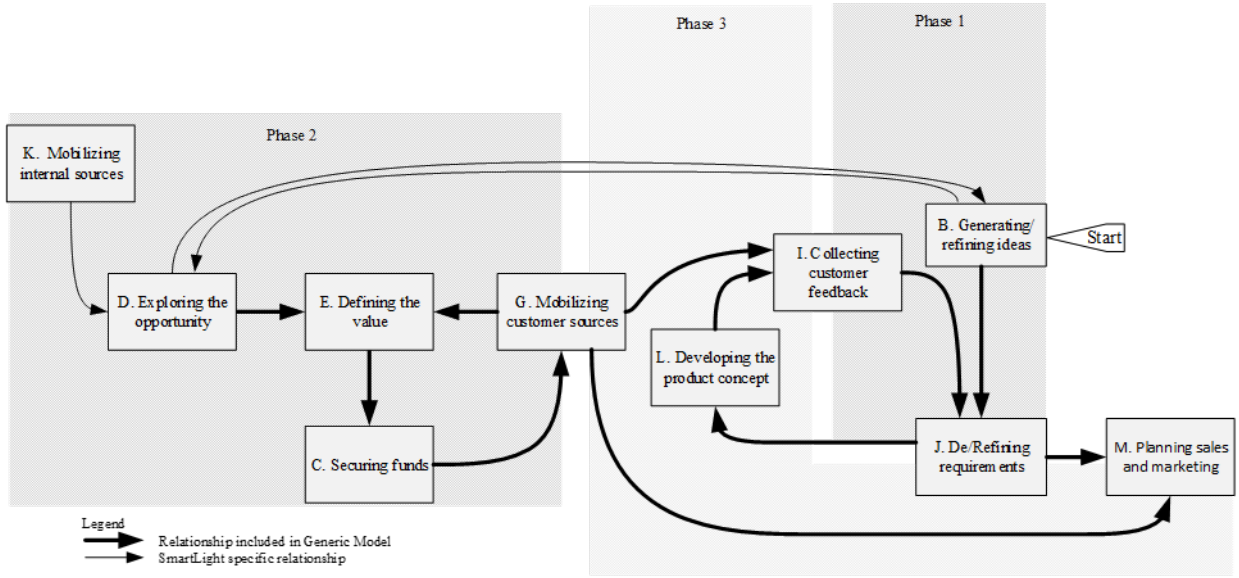
Table UU.1: Continued

Practice / Output of Practices	Exploring the problem situation (A)	Generating ideas (B)	Exploring the market & opportunity (D)	Defining the value (E)	Securing innovation funds (C)	Managing DCI action (F)	Mobilising customer sources (G)	Exploring the user experience (H)	Collecting user feedback (I)	Defining /refining requirements (J)	Mobilising internal sources (K)	Developing the product concept (L)	Planning sales and marketing (M)	Representative Quotes
Feedback of customers (I)										→				"The products were installed and from there we learned what it was what customers wanted" (INT-SLS2sl)
Prioritized requirements (J)												→	→	"And then you know what they want and you further develop the product" (INT-Sl2sl) "We thought about what [requirements] we needed to change and then the customer said that it was ok, we made an article number and the product was made, ready to sell (INT-SLsl)
Internal sources (K)			→											" He [Business Developer] had 15 years of experience and said to him go and see what is possible in this market" (INT-OM2sl)
A first product concept (L)									→					"And then we went back testing again" (INT-SLSsl)

Source: Author

Table UU.2: Key Characteristics of the Relationship model of SmartLight

SmartLight model and numerical features
10 practices, 14 relations, 69% of the common configuration of practices is included (11 out of 16 generic relationships)



Central practices SmartLight model
D. Exploring the opportunity

Characteristics SmartLight model
- This process is less intensive than the common configuration of practices. A is not included and most central is Practice D;
- D is driven mainly by internal sources holding relevant prior information;
- The customer is mobilised to perform a limited role (G) and provides feedback on product versions (I).

Conclusions SmartLight Model
- Internal sources holding prior market knowledge are important to explore the opportunity and to develop the value proposition.

Source: Author

APPENDIX VV ACTORS AND RESOURCES SMARTLIGHT

Table VV.1: Actors of the Practices of SmartLight

Practice	Roles	Description of Role	Practice
Owner	Decision maker	Making go/no go decisions about the project	C
	Gatekeeper/synthesis	Synthesising all relevant knowledge into new models	E, J
Customer	Input source	Providing the raw data	I
R&D	Creativity and Development	Develop ideas and concepts	B, L
	Boundary spanning	Recognising new externally located information	B
	Gatekeeper/synthesis	Synthesising all relevant knowledge into new models	E, J
Sales	Information processing	Collecting and analysing information	D
	Relationship manager	Promoting the project externally, creating commitment	A, H
	Gatekeeper/synthesis	Synthesising all relevant knowledge into new models	E, J
	Boundary spanning	Recognising new externally located information	B
	Champion	Promoting the project internally, creating commitment	C
	Decision maker	Making go/no go decisions about the project	C
	Gatekeeper/quality control	Mitigate biases	I

Source: Author

Table VV.2: Resources of the Practices of SmartLight

Resource Group	# of Resources	%	Dominant Resource Type (# of Appearances in Practices)
FLA	6	32%	Strategic considerations (3)
CoI	6	32%	Internal sources (2)
S&T	6	32%	Collaborative sensemaking (2)
P&M	1	1%	Customers willing to pay (1)
Total	19	100%	

Source: Author

APPENDIX WW EVIDENCE OF PRACTICES FIBERTOP

Table WW1: Evidence of Practice A Within FiberTop case

Case FiberTop: Practice A. Exploring the Customer Problem Situation					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To define product market segments	"So that is what we did: to find a market combination in which we can make a difference. (INT-OMf)"	OM	3	n/a	y
		PO	2		
To further develop first ideas	"To try to look which of these applications can have traction and should be developed further" (INT-RDf)	RD	2	n/a	y
To understand the opportunity of a customer idea	n/a			This was done later on behalf of Practice D.	n
To build trust with potential customers	n/a			This was done after the idea got more refined	n
Activities		**Source**	**#**		**y/n**
Identifying a problem area	"We analysed a few problems that troubled them and checked if there could be a solution." (INT-OMf)	OM	3	n/a	y
		PO	1		
		RD	1		
		SLS	1		
Conducting customer conversations	"In these first conversations were kind of developing hypothesis. They touched upon all sorts of things" (INT-POf)	OM	3	n/a	y
		PO	3		
		SLS	2		
Analysing customer problems	We analysed a few problems that troubled them and checked if there could be a solution." (INT-OMf)	OM	2	n/a	y
		PO	1		
Reporting of customer problems	n/a	DOC	2	Problems were not extensively reported on, only later when the technology was further developed some references to problems were found; "the [FiberTop functionality] will reduce the complexity of existing designs" (BP, p. 1)	n
Resources		**Source**	**#**		**y/n**
A broad scope	"We looked very broad. We had something with which we could measure. But we didn't know what" (INT-POf)	OM	1	n/a	y
		PO	2		
		SLS	4		
Readily available internal sources	"I had seen these guys in America, printing organs, so I knew a bit of the life sciences market" (INT-OMf)	OM	2	n/a	y
		RD	1		
Readily available customer sources	"It's not like I sought out the machine beforehand and commissioned it. However, when I heard of it, it became clear to me that I could use it" (INT-Cstf))	OM	1	n/a	y
		Cst	2		
		PO	2		
		SLS	2		
Readily available expert sources	"We started to go around talking to different colleagues and asking them: how would you use it?"(INT-RDf)	OM	1	n/a	y
		PO	2		
		RD	1		
Readily available secondary sources	"A lot of what people do and where they work is publicly available" (INT-SLSf)	SLS	2	n/a	y
Interview skills	"So you try to use a structured approach […]" (INT-SLSf)	RD	1	n/a	y
		SLS	1		
Analytical skills	[Product Owner] came on board. And he is very analytical and keen on reducing uncertainty by certain parameters (INT-SLSf)	OM	1	n/a	y
		SLS	2		

Source: Author

Table WW.2: Evidence of Practice B Within FiberTop Case

Case FiberTop: Practice B. Idea Generation					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To define a project fitting into the strategic agenda	n/a	OM	2	FiberTop was a start-up case and did not have very definite strategic agenda, just technology; "We start from our technology" (INT-OMf)	n
		RD	2		
To define a solution for observed needs	"I know very well that people want to make indentation, so I knew wonderful starting the company" (INT-RDf);	OM	3		y
		RD	2		
To define a project that can be funded	n/a	OM	2	FiberTop was a start-up case and did not have very definite strategic agenda, just technology; "We start from our technology" (INT-OMf)	n
		RD	2		
Activities		**Actor**	**#**		**y/n**
Checking ideas of customers	"We had an idea. We gave multiple presentations. Afterwards people approach you, could this be an idea or a solution?" (INT-OMf)	OM	2	n/a	y
		Cst	1		
		RD	1		
Consensus and decision making	"When everybody agrees, this has to be the right solution because the market is positive then we proceed" (INT-SLSf)	SLS	2	n/a	y
Generating new ideas	"Then we went back to the drawing board… These are notes of such a brainstorm" (INT-SLSf)	PO	1	n/a	y
		SLS	2		
Resources		**Actor**	**#**		**y/n**
Vision of the future	"[...] I had an issue and to solve the problem I've invented this new sensor and then I realized that this sensor could have had application in many different other fields. So, I started to work on that market process with no experience and no knowledge (INT-RDf)	OM	3	n/a	y
		PO	3		
		RD	1		
Overview of current products and capabilities	"Then, we also look at our technological capabilities, so what is it that we are good at" (INT-SLSf)	PO	1	n/a	y
		SLS	3		
		DOC	1		
Experience with creative techniques	"But clearly you had the creative capacity to develop the ideas" (WS-OMf)	OM	1	n/a	y
		RD	1		
A sufficiently broad scope	"Well, in the beginning we were very open, as in it's a very broad technology […]" (INT-POf); "Indeed, they [customers] have 100.000 interests and you have to distill what you can do." (INT-POf)	OM	1	n/a	y
		PO	2		
		RD	1		
		SLS	1		
Market reputation	n/a	OM	1	When FiberTop started its market reputation still had to be established and they gave presentation to attract customers: "We had an idea. We gave multiple presentations. Afterwards people approach you, could this be an idea or a solution?" (INT-OMf)	n
		PO	3		

Source: Author

Table WW.3: Evidence of Practice C Within FiberTop Case

Case FiberTop: Practice C. Securing Innovation Funds					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To get authorization from management	n/a	n/a		When FiberTop started out the management was closely involved and driving the activities.	n
To create means for next development step	"This allowed us to test the market and to get some revenue" (INT-RDf)	PO	1	n/a	y
		RD	1		
To create customer base	"I think you need to validate needs by means of customers' commitment, this is the most powerful way to understand what they want, find out their willingness to pay." (INT-POf).	PO	2	n/a	y
		SLS	2		
Activities		**Actor**	**#**		**y/n**
Finding funds for problem analysis	"Then I started to collect grants to bring the technology to maturity" (INT-RDf)	OM	3	n/a	y
		RD	1		
		SLS	1		
Finding funds for needs analysis	"When we learned it was technically feasible we decided we needed more feedback from the market" (INT-POf)	PO	2	n/a	y
		SLS	1		
Finding funds for testing	"[...] we try to connect a customer who is willing to commit so we can get some cash" (INT-POf)	OM	1	n/a	y
		PO	2		
		RD	2		
Resources		**Actor**	**#**		**y/n**
Corporate decision making criteria	"The rule was that if three prospects would buy our concept, we would continue" (INT-POf)	SLS	2	n/a	y
Strategic reflections	"Yes, but the alternative is that you need to have money in the bank. That portrays the type of company you are. In the beginning we were very bootstrap, as in we grew on that kind of revenue" (INT-POf)	PO	2	n/a	y
		RD	2		
		SLS	1		
Availability of grants	"So, I had these grants and part of these grants I wanted to develop an indenter" (INT-RDf)	OM	1	n/a	y
		Cst	1		
		PO	2		
		RD	1		
Customer willing to pay	"[…] that is the most powerful [...] to do […] that what people are willing to pay for" (INT-POf)	OM	2	n/a	y
		Cst	2		
		PO	1		
		RD	1		

Source: Author

Table WW4: Evidence of Practice D Within FiberTop Case

Case FiberTop: Practice D. Exploring the Market & Opportunity					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To make a business model	n/a	OM	3	Focus was on market potential, not on needs; "What is the expected market size?" (S&H, p. 2)	n
		DOC	2		
To estimate market potential	"That market for measuring vibrations, how big is it? How important is it?" (IN-OMf)	OM	2	n/a	y
		DOC	2		
To understand the market forces affecting needs	n/a	OM	3	Focus was on market potential, not on needs; "What is the expected market size?" (S&H, p. 2)	n
		DOC	2		
Activities		**Actor**	**#**		**y/n**
Desk research	"You take a look in general. What is the market for that technology or for AFM [...] (INT-OMf); "Finding publications [...]" (INT-POf); "Markets" (BP, page 1)	OM	5	n/a	y
		PO	2		
		DOC	2		
Visiting conferences	" Partially I knew already what opportunities could be, from going to conferences […]" (INT-RDf)	OM	1	n/a	y
		PO	1		
		RD	1		
Interviewing	"Look if you speak to leaders in the field you have a higher chance to capture what's occurring in their field." (INT-POf)	OM	1	n/a	y
		RD	1		
Analysing the opportunity	"In your head, you connect the dots. You see developments, you know what the size of the market is, you know what is technically feasible" (INT-OMf)	OM	1	n/a	y
		PO	1		
		DOC	2		
Documenting the opportunity	"What is the expected market size?" (S&H, p. 2)	OM	2	n/a	y
		DOC	2		
Resources		**Actor**	**#**		**y/n**
Research method expertise	n/a	DOC	2	There are no signs that particular methods were considered.	n
Interview skills	n/a	DOC	2	There are not signs that much thought was given to how interviews were conducted.	n
Analytical skills	"What is the expected market size" (S&H, p. 2); "I made something to structure market assessments" (INT-POf)	OM	1	n/a	y
		PO	2		
		DOC	2		
Student support	n/a	n/a		There are no signs that students were involved.	n
Readily available internal sources	"I had been in touch before with people active in [market segment] This helped in defining the business case and deciding to put some money in it" (INT-OMf)	OM	1	n/a	y
		RD	1		
		DOC	2		
Readily available customer sources	"[Owner] also spoke about needs amongst other things to [Customer]" (INT-SLSf)	PO	1	n/a	y
		SLS	1		
Readily available expert sources	"You talk to leaders in the field, you talk to all kinds of persons" (INT-POf)	OM	1	n/a	y
		PO	1		
		RD	1		
Readily available secondary sources	"Well, knowing the literature a little bit helps. You see which properties contribute to life sciences, knowing the current technologies and you see opportunity because you see all the things coming together in the right direction […]" (INT-RDf)	OM	1		y
		RD	1		
		SLS	1		
		DOC	1		
Company formats	n/a	DOC	5	The different formats of the documents show that there was not a dedicated format available at the time of FiberTop	n

Source: Author

Table WW.5: Evidence of Practice E Within FiberTop Case

Case FiberTop: Practice E. Defining the Value Proposition					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To justify investments in development, production and marketing	"So this means that there is potentially a lot of growth and will offer us the chance to develop an instrument with high added value and a good margin for us" (INT-POf)	OM	2	n/a	y
		PO	3		
To establish a shared vision on the importance of the project	"Then we discuss it [new customer information] and usually these are longer sessions because these are the things that shape the future of the company" (INT-SLSf)	SLS	2	n/a	y
Activities		**Actor**	**#**		**y/n**
Defining customer value	"The customer value proposition of [FiberTop] hinges on one single concept:[FiberTop] offers [Value proposition statement] (STARTDOC, page 1)	OM	1	n/a	y
		PO	1		
		RD	1		
		DOC	2		
Defining firm value	"We did some market research and wrote some business plans" (INT-OMf)	OM	2	n/a	y
		PO	2		
		RD	1		
		DOC	3		
Resources		**Actor**	**#**		**y/n**
Individual integration skills	"In your head, you connect the dots. You see developments, you know what the size of the market is, you know what is technically feasible" (INT-OMf)	OM	2	n/a	y
Sensemaking with customer	n/a			The customer was not involved in determining the value proposition. He was involved in testing and sensemaking of test result.	n
Collaborative internal sensemaking	""There's not a single person who knows everything. So it requires multiple heads together" (INT-SLSf)	OM	1	n/a	y
		RD	1		
External legitimacy	n/a			FiberCo relied fully on its own judgements.	n
Company formats	n/a	DOC	5	The different formats of the documents show that there was not a dedicated format available at the time of FiberTop	n

Source: Author

Table WW.6: Evidence of Practice F Within FiberTop Case

Case FiberTop: Practice F. Managing DCI action					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Included**
Objectives		**Source**	**#**		**y/n**
To collect information in a conscious, efficient and impartial manner	"I am responsible for the hypothesis and development of guidelines. We can build all kinds of things, but we don't do this we run the risk that we lose track en develop something that nobody needs" (INT-SLSf)	SLS	2	n/a	y
To make sure uncertainty decreases across the process	"It is difficult, if you talk to two or three customers, the fourth may have totally different requirements. This is why we seek feedback from a variation of customers across segments and customers, but then, we need to proceed fast. We need to draw a line" (INT-SLSf)	SLS	2	n/a	y
Activities		**Actor**	**#**		**y/n**
Planning	"It is important to have some kind of systematic approach. You do think about what comes first" (INT-SLSf)	PO	1	n/a	y
		RD	1		
		SLS	5		
Developing methods	"List of questions" (Questions, p. 1); "Yes [we had a structured approach]. We developed some hypotheses, which we then tested" (INT-POf)	SLS	1	n/a	y
		DOC	1		
Monitoring	"It stays in my head and when we get together a week later we get back to it […] (INT-SLSf); "When somebody has new input, we get together again" (INT-SLSf)	SLS	2	n/a	y
		DOC	4		
Resources		**Actor**	**#**		**y/n**
Research method expertise	n/a	RD	1	"Although the team frequently refers to their research background, there is no hard evidence that they used their skill in designing methods: "Well, there is a lot of personal skills that you have to put in" (INT-RDf);	n
Reflectiveness	"This is a difficult moment. When do you have enough information to freeze the requirements" (INT-SLSf)	SLS	2	n/a	y
A manager	"I am responsible for the hypothesis and development of guidelines. We can build all kinds of things, but if we don't do this we run the risk that we lose track en develop something that nobody needs" (INT-SLSf)	SLS	2	n/a	y
Company formats	n/a	DOC	5	The different formats of the documents show that there was not a dedicated format available at the time of FiberTop	n
Criteria for customer selection	"So we look at who could be the top candidates for this concept. Usually we look at who is publishing, it's fairly easy with academics." (INT-SLSf)	PO	1	n/a	y
		SLS	2		

Source: Author

Table WW.7: Evidence of Practice G Within FiberTop Case

Case FiberTop: Practice G. Mobilizing Customer Sources					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To increase development capacity	n/a	Cst	1	Customers were involved to get access to information, development remained the responsibility of the FiberTop team: [FiberTop was standing in our lab, I could try out some things" (INT-Cstf)	n
To find money for further development	"This allowed us to test the market and to get some revenue" (INT-RDf)	RD	2	n/a	y
To prepare for sales & marketing	n/a	n/a		At this point of development sales and marketing strategies were not considered yet.	n
To get customer information	"[...] but at a certain point you can convince people to give commitment, to make sure that during the development or before the development you have support for what you're building" (INT-POf)	PO	6	n/a	y
Activities		**Actor**	**#**		**y/n**
Defining customer criteria	"Potential (lead) customers [core functional job]" (PRES, p.14); "Then we looked up a few leaders in the field, a few professors, because it is an academic field (INT-POf)	OM	4	n/a	y
		PO	1		
		RD	1		
		SLS	5		
		DOC	2		
Identifying of customers	"All our customers were kind of friends quote unquote and then we started to expand from there" (INT-RDf)	RD	2	n/a	y
Activating of customers	"It offered me the possibility to start measuring things at very accuracy […] that were revolutionary (INT-Cstf)	PO	3	n/a	y
		Cst	1		
		RD	1		
Managing of expectations	"We call this customer intimacy, we closely collaborated with our customers" (INT-OMf)	OM	2	n/a	y
		PO	1		
		SLS	2		
Resources		**Actor**	**#**		**y/n**
Customer incentive	"You can make real scientific progress with it. This causes users like me to think along with the company [FiberCo]." (INT-Cstf))	Cst	2	n/a	y
		RD	1		
		DOC	1		
Internal incentive	n/a	SLS	2	The team was highly motivated to work on FiberTop and did not need incentives to mobilise customers; "I was really attracted to do something new and develop my skills" (INT-SLSf)	n
Marketing channels	n/a	n/a		At this point of development sales and marketing strategies were not considered yet.	n
Customer management skills	"But mostly I think it's important that we create a feeling of partnership, we are a supplier but we are interested in what you [customers] want to do" (INT-SLSf)	PO	1	n/a	y
		RD	2		
		SLS	1		

Source: Author

Table WW.8: Evidence of Practice H Within FiberTop Case

Case FiberTop: Practice H. Elaborating Customer Needs					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To support solution finding	n/a	OM	2	Needs were identified and refined by capturing customers' response to the first concepts of FiberTop; "We made this machine, with which people could play" (INT-OMf); "They [users] see it and try it out on different tissue and I think that's been innovative" (INT-Cstf)	n
		Cst	2		
		PO	4		
		RD	4		
		SLS	4		
To define customer requirements		DOC	4		
To validate the scope of the project					

Source: Author

Table WW.9: Evidence of Practice I Within FiberTop Case

Case FiberTop: Practice I. Collecting Customer Feedback					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To validate and refine customer requirements	"We make a decision based on the feedback and we transition towards a concept or not" (INT-SLSf)	SLS	6	n/a	y
		DOC	2		
To identify missing information	"So, iteratively we learned from the experiments. We had much room to do so" (INT-SLSf)	PO	2	n/a	y
		SLS	3		
To check performance of the solution	n/a	n/a		Main aim of the test was to generate information	n
Activities		**Actor**	**#**		**y/n**
Surveying customers	"Questions to users (QUESTIONS, pp 1 – 2)	RD	1	n/a	y
		SLS	1		
		DOC	1		
Conducting conversations	"I have conversations with them, to test the hypothesis we developed earlier" (INT-SLSf)	PO	1	n/a	y
		SLS	1		
		DOC	1		
Watching movies of use	n/a	n/a		There are not mentions of videos of use	n
Analysing feedback	"[…] then we discussed it [feedback] and rather we exchanged the essence" (INT-SLSf)	SLS	1	n/a	y
		DOC	1		
Documenting feedback	"We captured the essence in a powerpoint" (INT-SLSf)	SLS	2	n/a	y
		DOC	1		
Reflecting on assumptions and uncertainties	"Do we know sufficiently to develop or do we need to go back for more information?" (INT-SLSf)	SLS	2	n/a	y
Resources		**Actor**	**#**		**y/n**
Minimum Viable Product	"We made this machine, with which people could play" (INT-OMf)	OM	2	n/a	y
		Cst	1		
		RD	1		
		SLS	1		
Interview skills	"You see, [shows notes from an interview], this is how I do it. I start with a main topic, and then for each I probe deeper asking 'why are you doing this, 'why are you doing that', and in this way I learn what hypothesis are behind each main topic" (INT-SLSf)	SLS	2	n/a	y
Analytical skills	"[...] I know [Product Owner], I also know the way he thinks, what he does, he looks at all the uncertain variables very analytically to verify them." (INT-SLSf)	SLS	2	n/a	y
Documentation system	n/a	PO	2	"When you document things, you are doing the wrong things. We don't have time for that" (INT-POf).	n
Readily available customer sources	"Then when we developed the instrument, the first customer was [Customer]. So, [Product Owner] interacted with him to create first full proof instrument" (INT-RDf)	OM	1	n/a	y
		PO	3		
		RD	2		

Source: Author

Table WW.10: Evidence of Practice J Within FiberTop Case

Case FiberTop: Practice J. Defining Customer Requirements					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To achieve a shared understanding of requirements and priorities	"Then we make a sort of blueprint with specifications which a broader audience can identify" (INT-SLSf)	SLS	4	n/a	y
To supervise the development process	"From there [list of requirements] we made it a bit better and better and better" (INT-RDf)	RD	2	n/a	y
To manage expectations of customers	n/a	n/a		There are no mentions that the requirements were shared with the customers in order to manage his expectations	n
Activities		**Actor**	**#**		**y/n**
Listing user requirements	"SPECS" (S&H, p. 3)	OM	1	n/a	y
		RD	2		
		SLS	4		
		DOC	2		
Setting priorities	"[...] I have the job to test all hypotheses and giving some kind of guidelines […] (INT-SLSf)	SLS	2	n/a	y
Refining requirements	"[...] I send that list to a broader group of customers asking whether this is indeed the list of requirements" (INT-SLSf)	PO	2	n/a	y
		SLS	2		
Resources		**Actor**	**#**		**y/n**
Individual integration skills	n/a	n/a		Conclusions were the result of a collaborative process and did rely to a much lesser extent on individual integration skills	n
Sensemaking with customers	"[...] I send that list to a broader group of customers asking whether this is indeed the list of requirements" (INT-SLSf)	SLS	2	n/a	y
Collaborative internal sensemaking	"There's not a single person who knows everything. So it requires multiple heads together" (INT-SLSf)	PO	1	n/a	y
		SLS	5		
Company formats	n/a	PO	2	"When you document things, you are doing the wrong things. We don't have time for that" (INT-POf).	n

Source: Author

Table WW.11: Evidence of Practice K Within FiberTop Case

Case FiberTop: Practice K. Mobilizing Internal Sources					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To learn about new customers and markets	"[Owner] on the other hand had experience in making things like instruments" (INT-RDf)	OM	2	n/a	y
		RD	2		
To validate findings	n/a	RD	1	Owner and Research Director started FiberTop together. At that time their were no findings yet; […] we decided to start a company together, only the two of us" (INT-RDf	n
To get access to customer network	n/a	RD	1	Owner and Research Director started FiberTop together. Owner had experience in other markets and his network seemed less of a value; "We liked each other, and we decided to start a company together […] (INT-RDf)	n
Activities		**Actor**	**#**		**y/n**
Acquiring of sources holding relevant prior customer knowledge	"Then eventually in 2010 I was introduced by a technology transfer office to [Owner]. He is a senior entrepreneur, so he started other companies, many other companies and he brought a lot of high-tech products to the market. We liked each other, and we decided to start a company together, only the two of us" (INT-RDf	OM	1	n/a	y
		RD	1		
		DOC	2		
Sharing of information	n/a	n/a		The Owner became part of the team and integrated his knowledge while working on FiberTop.	n
Resources		**Actor**	**#**		**y/n**
Readily available relevant internal or partner sources	"Then eventually in 2010 I was introduced by a technology transfer office to [Owner] (INT-RDf)	OM	1	n/a	y
		RD	1		
Internal Incentive	n/a	n/a		What the main incentive was for Owner to join FiberTop is not communicated.	n
Communication channels	n/a	n/a		The Owner became part of the team and shared his information during team meetings. This did not require dedicated communication channels	n

Source: Author

Table WW.12: Evidence of Practice L Within FiberTop Case

Case FiberTop: Practice L. Developing the Product Concept					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To provide material for testing	"So what are we doing, we have an idea and we want to make something with added value, but in the most simple way, so that we can learn how to improve and do iterations" (INT-POf)	PO	2	n/a	y
To prepare for sales and marketing	" […] then we make the final iteration in which we determine the final specs and I make a definitive set of marketing materials." (INT-SLSf)	SLS	2	n/a	n
Activities		**Actor**	**#**		**y/n**
Generating ideas for solutions	"We had some brainstorms" (INT-OMf)	OM	2	n/a	y
		RD	1		
		SLS	2		
Consensus and decision making	"So formulating new hypotheses like: we know this so we have to test that, or we know this and that's sufficient and now we can make a technical design'" (INT-SLSf)	SLS	3	n/a	y
Developing the solution	"Because when we find something, we fully develop and sell it […] (INT-POf)	RD	1	n/a	y
		SLS	1		
Resources		**Actor**	**#**		**y/n**
Experience with collective idea generation	"Well, these are notes of a brainstorm" (INT-SLSf)	OM	1	n/a	y
		RD	1		
		SLS	2		
Customer empathy in R&D team	"But it was really the fact that we had the right people also that are [...] that were receptive to the issues of the customer (WS-RDf)	RD	1	n/a	y
		SLS	1		
Visual material supplied by the customer	n/a	n/a		The are not mentions of additional visual material of the customer.	n
Co-creating customer	n/a	n/a		Customers were involved but not actively developing the solution	n
Student support	"[...] and two or three part-time employees, they were students from the university who studied in a field related to the work we had for them" (INT-SLSf)	SLS	2	n/a	y
Project management tool	n/a	PO	2	"When you document things, you are doing the wrong things. We don't have time for that" (INT-POf).	n

Source: Author

Table WW.13: Evidence of Practice M Within FiberTop Case

Case FiberTop: Practice M. Planning Sales and Marketing for Introduction					
Practice Elements	**Exemplar Evidence**	**Mentions**		**Disconfirming Information**	**Include**
Objectives		**Source**	**#**		**y/n**
To start up the commercial process	"Then we made a brochure […] we included a computer drawing of the product and we hit the streets with it (INT-SLSf)	PO	1	n/a	y
		SLS	2		
Activities		**Actor**	**#**		**y/n**
Re-using CI	" […] then we make the final iteration in which we determine the final specs and I make a definitive set of marketing materials." (INT-SLSf)	RD	1	n/a	y
		SLS	2		
		DOC	1		
Communicate insight	"[...] for example once we have such an instrument, we can show it to the rest of the sales team so they can work with it and they can get to know the software […]" (INT-SLSf)	SLS	2	n/a	y
Resources		**Actor**	**#**		**y/n**
Individual integration skills	" […] then we make the final iteration in which we determine the final specs and I make a definitive set of marketing materials." (INT-SLSf)	SLS	2	n/a	y
Collaborative sensemaking within team	"At this point of time the instrument wasn't fully developed, but we already had set-up the brochure" (INT-SLf)	SLS	2	n/a	y
Student support	n/a	n/a		Students were not involved in sales and marketing. That was done by the Sales Director	n
Documentation system	n/a	PO	2	"When you document things, you are doing the wrong things. We don't have time for that" (INT-POf).	n
Company formats	"[Product Owner] made a quick 3D visual and I made a brochure out of it. We did this all in one day" (INT-SLSf)	SLS	2	n/a	y

Source: Author

APPENDIX XX EVIDENCE OF THE RELATIONSHIPS BETWEEN THE PRACTICES OF FIBERTOP

Table XX1: Evidence of the Relationships Between the Practices of FiberTop

Practice / Output of Practices	Exploring the problem situation (A)	Generating ideas (B)	Exploring the market & opportunity (D)	Defining the value (E)	Securing innovation funds (C)	Managing DCI action (F)	Mobilising customer sources (G)	Exploring the user experience (H)	Collecting user feedback (I)	Defining /refining requirements (J)	Mobilising internal sources (K)	Developing the product concept (L)	Planning sales and marketing (M)	Representative Quotes
Customer problem understanding (A)		→	→			→								" We looked at different markets […] we then developed the idea to work in the market of [segment]" (INT-OMf) "When [customer] came to us with his ideas, of course we also went looking whether this would fit the market" (WS-OMm) "So, as soon as I have spoken to 2-3 people in the market, then we get back together to decide how to proceed further… We really try to decide: 'are we going to test more?' or ' do we know enough and can we start developing a concept?"" (INT-SLSf)
A first idea concept (B)	→									→				"We thought this idea has value for someone, so we started researching a customer group having this need" (INT-POf) "So we know the different solutions [...] we know that we can solve this problem but we didn't know exactly what the problem was" (WS-RDf)
Market understanding (D)				→								→		"And then you check cost prices and alternatives in the market and you can calculate return" (INT-SLSf) "Initial request: Answering the following questions will enable to meet the request; In what way, will [MachineCo] be able to generate sufficient value from the[MZI]" (MRreport, p. 6)
Defined value (E)					→									"We used this [business case] to conclude on whether it is interesting to proceed" (INT-OMf)
Authorized means (C)							→							"We got a grant for proofing the concept and then we searched for leaders of the field. We asked feedback and searched for their commitment"(INT-POf)
A managed approach (F)	→													" We really try to decide, 'are we going to test more?' or ' do we know enough and can we start developing a concept?' […] We had 6 – 7 of these kinds of iterations (INT-SLSf)

Table XX1: Continued

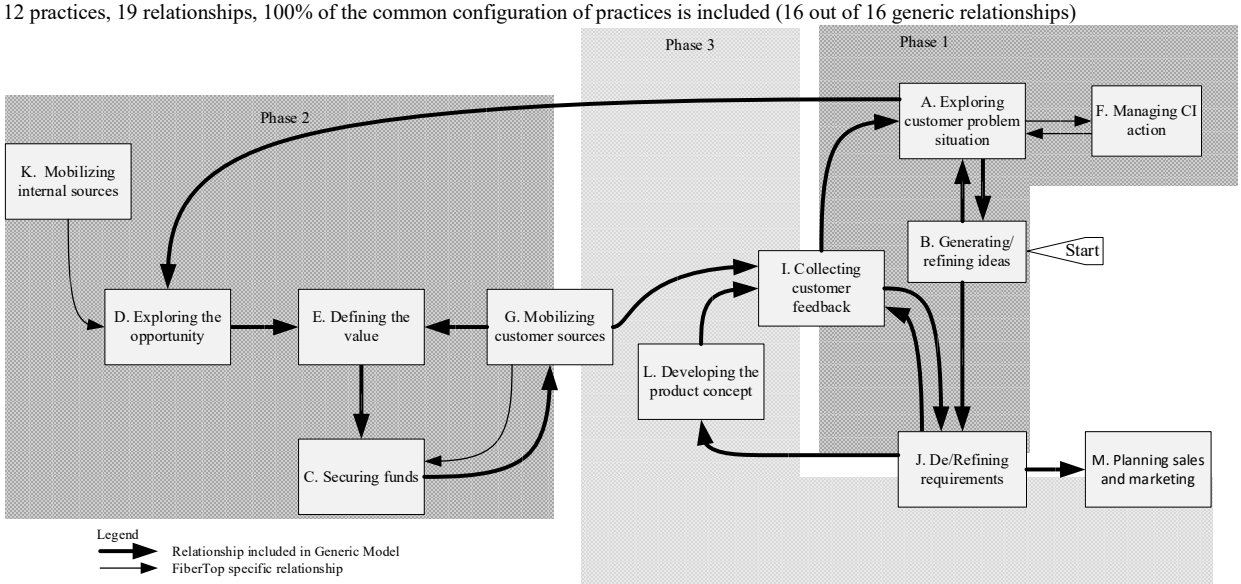
Practice / Output of Practices	Exploring the problem situation (A)	Generating ideas (B)	Exploring the market & opportunity (D)	Defining the value (E)	Securing innovation funds (C)	Managing DCI action (F)	Mobilising customer sources (G)	Exploring the user experience (H)	Collecting user feedback (I)	Defining /refining requirements (J)	Mobilising internal sources (K)	Developing the product concept (L)	Planning sales and marketing (M)	Representative Quotes
Understanding of needs (H)				→	→				→					"The rule was that if three prospects would buy are concept, we would continue [...] and if the perspective is 100 + instruments and three can commit, we are sure this will bring sufficient money" (INT-POf) "With early commitment we were able to collect money. From the start we were a bootstrap company" (INT-POf) "So the people I had approached earlier were asked to validate our hypothesis" (INT-SLSf)
Feedback of customers (I)	→									→				"There was one minimum viable product that was sent to various markets to learn how they would apply it" (INT-RDf) "I send them the powerpoint to check the powerpoint with specifications. And then we found out whether we need to go back to the drawing board "(INT-SLSf)
Prioritized requirements (J)									→			→	→	"I send them the powerpoint to check the powerpoint with specifications" (INT-SLSf) "[FiberCo] makes sure that it knows the needs of the users, and it steers development in this direction. (CASE, p. 4) "Once we decided on the final list of requirements, we start developing the marketing materials" (INT-SLSf)
Internal sources (K)			→											"I had been in touch before with people active in [market segment] This helped in defining the business case and deciding to put some money in it" (INT-OMf)
A first product concept (L)										→				"When it doesn't work well we adapt the concept. These are iterations lasting 2 – 3 months" (INT-SLSf)

Source: Author

Table XX.2: Key Characteristics of the Relationship model of FiberTop

FiberTop model and numerical features

12 practices, 19 relationships, 100% of the common configuration of practices is included (16 out of 16 generic relationships)



Central practices FiberTop model

A. Customer problem exploration (6)
I. Collecting Customer Feedback (5)

Characteristics FiberTop model

- This model follows the common configuration of practices completely, but adds more control and intensity from the early phase of customer research on;
- The exploration of customer problems (A) in Phase 1 is the most addressed practice;
- Like in the ZKL case, mobilised customers are not only providing information, but also become a close partner due to their funding.

Conclusions FiberTop Model

- By adding a more managed approach from the early explorative research activities on, a second phase of explorative customer research can be avoided.

Source: Author

APPENDIX YY ACTORS AND RESOURCES FIBERTOP

Table YY.1: Actors of the Practices of FiberTop

Practice	Roles	Description of Role	Practice
Owner	Champion	Promoting the project internally, creating commitment	A, C
	Decision maker	Making go/no go decisions about the project	C
	Input source	Providing the raw data	K
Customer	Input source	Providing the raw data	A, I
	Gatekeeper/synthesis	Synthesising all relevant knowledge into new models	J
Sales	Relationship manager	Promoting the project externally, creating commitment	A, G, I,
	Gatekeeper/quality control	Mitigate biases	F
Team	Information processing	Collecting and analysing information	A, I, D
	Boundary spanning	Recognising new externally located information	B
	Gatekeeper/synthesis	Synthesising all relevant knowledge into new models	E, J, M
	Champion	Promoting the project internally, creating commitment	C, K
	Decision maker	Making go/no go decisions about the project	C
R&D	Creativity and Development	Develop ideas and concepts	B, L

Source: Author

Table YY.2: Resources of the Practices of FiberTop

Resource Group	# of Resources	%	Dominant Resource Type (# of Appearances in Practices)
FLA	7	17%	Broad Scope (2)
CoI	12	30%	Customers sources/ Internal sources (4)
S&T	16	40%	Research skills (5)
P&M	5	13%	Money (grant and customers co-financing) (2)
Total	40	100%	

Source: Author

APPENDIX ZZ PERCEPTIONS OF QUALITY CRITERIA FIBERTOP

Quality	Mentions documents	Mentions interviews	Exemplar quote
Timely	-	5	"[…] it is something that evolves, you should not regard this as some definite thing that you have to stick to. You have to have some flexibility to let it evolve while you are active and learning about what it means to customers to work with your product. Especially at the early phase […]" (WS-POf).
Comprehensive	2	12	"You need to have many sources […] A good overview of developments in a market […] so that you can connect the dots […] that you can pick up the weak signals" (INT-OMf)
Novelty	-	7	"There is so many different features and defining the value proposition is picking out that feature that is the most relevant and the most unique and attractive to a specific customer" (WS-POf)
Accurate	-	7	"But isn't there a bias here. I mean because how many times do you think there is a need when it is actually isn't?". (WS-RDt)
Acceptable	-	12	"I think you need to validate needs by means of customers' commitment, this is the most powerful way to understand what they want, find out their willingness to pay" (INT-POf). "I believe strongly that the most important thing is to create commitment of customers, while still keeping your independence […]. Preserve your uniqueness ." (INT-POz)
Cost-efficient	-	7	"I send that list to a broader group of customers asking whether this is indeed the list of requirements. And you never can catch it for the full 100%. We understand that, we also want to proceed fast […] so if you have to wait three weeks. We want to minimalize the risk but at some point you just go on." (INT-SLSf)

Source: Author

APPENDIX AAA THE LEVEL OF INSIGHT OF FIBERTOP

Criterion	Timely	Comprehensive		Novelty	Clear Consistency	Clear Inspiring	Clear Format	Extra case criterion Acceptance	Extra case criterion: Cost-Efficiency
Indicator	Document holding CI	Amount of needs insights	Missed needs insights	Attractive needs agreed upon by 50% of more of team	% of consistently formatted requirements	% of statements free of solution aspects	# of different formats		
Result	List of requirements	43	No	7	60%	23%	3	yes	yes
Qualitative evaluation	The list of requirements was the result of the many conversations. Every time new information came in the team discussed the consequences of it for the product concepts. It wasn't a static document; "[…] it is something that evolves […]" (WS-POf).	"We knew [...] we did not have to calibrate it, but to most [customers] that is not a real problem, calibration. But we found then [sub-group], they find it a very big problem and for them it is very high value that you do not have to calibrate the system" (WS-Mktf)		"Due to FiberTop things can be measured that weren't measurable before" (WS-POf)	The team did not pay much attention to how they documented insights; "When you document things, you are doing the wrong things. We don't have time for that" (INT-POf).			"I believe we had a confirmation of the customer" (WS-RDf)	"So, we went really lean, without much documentation" (WS-OMf)

Source: Author

APPENDIX BBB IMPROVEMENT OPPORTUNITIES FIBERTOP

Table BBB.1: Improvement opportunities

Practices	Importance			Implementation			Opportunity
	% > 4	AVG	Std	% > 4	AVG	Std	Score
A. Exploring customer problem situations	100	4.50	0.58	50	3.75	0.96	**15**
B. Generating ideas	50	3.80	0.96	100	4.50	0.58	0
C. Securing innovation funds	75	4.00	0.82	75	4.25	0.96	7.5
D. Exploring the market opportunity	50	3.50	1.29	0	2.75	0.5	**10**
E. Defining the value proposition	100	4.00	0	100	4.50	0.58	**10**
F. Designing and managing CI action	75	3.80	0.5	50	3.25	0.96	**10**
G. Mobilising customer sources	75	4.30	1.5	75	4.00	1.41	7.5
H. Elaborating customer needs understanding	75	4.30	0.96	50	3.75	0.96	**10**
I. Collecting customer feedback	100	5.00	0	100	4.75	0.5	**10**
J. Defining customer requirements	50	3.80	0.96	100	4.25	0.5	0
K. Mobilising internal sources	50	3.50	0.58	50	3.75	0.96	5
L. Developing the product concept	100	4.50	0.58	100	4.75	0.5	**10**
M. Planning sales and marketing for launch	0	2.30	0.96	0	2.00	0.82	0
Total		3.9	0.74		3.9	0.78	

Source: Author

Table BBB.2: Improvement Tactics

Practice	# of Improvements	Dominant Tactic	# of Mentions	Exemplar Quotes
A	1	Management of learning	4	
	1	What to test	7	"[…] I wouldn't put too much emphasis on the designing because otherwise it almost look like, okay, […] nobody can" (WS-RDf)
D	n/a	n/a	n/a	n/a
E	1	Format Synthesis	11	"[the value proposition] is such a complex concept that I think we don't completely embrace it (WS-RDf); "Always the value proposition is about getting structured" (WS-POf)
F	n/a	n/a	n/a	n/a
H/I	1	Data collection techniques	9	"So what you present is a rather clumsy thing, that is not obvious what it is, hopefully. You want to trigger their imagination and you hope that they. Quite often they see things that are not there […]" (WS-Mktf)
L	n/a	n/a	n/a	n/a
Total	4			

Source: Author

APPENDIX CCC IMPLICATIONS OF THE IMPROVEMENTS FIBERTOP

Improvements per Improvement Tactic	Implications for the Level of DCI									
	Timely	Comprehensive	Novel	Consistent	Inspiring	Format	Accurate	Acceptable	Scope	Cost efficient
Data collection techniques			✓				✓			
Used advanced data collection techniques			✓				✓			
Format Synthesis					✓	✓				
Put more structure in synthesis					✓	✓				
Management of learning	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Document and structure DCI processes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
What to test			✓				✓			
Put the right things in the proto-type			✓				✓			
Total impact (amount of improvements)	**1**	**1**	**3**	**1**	**3**	**2**	**3**	**1**	**1**	**1**

Source: Author

APPENDIX DDD BARRIERS TO IMPLEMENTATION FIBERTOP

Improvement Tactic	Barrier	Mentions	Exemplar Quote
Data collection techniques	The pros and cons of early testing	7	"[…] so that is the big risk I think if you start talking to people without having your own technology or without having your own idea of (WS-POf) "[…] but you don't have to overdesign it" (WS-RDf)
Management of learning	Formalising would kill it	1	"For me […] it is the structural element in my mind to go through this whole process from the first technology to selling products in the market "If you would formalize this, you would kill it" (WS-Mktf)
Format synthesis	What should be documented	1	"It is not a static thing, I think that is true what you are saying. It is evolving […]" (WS-Mktf)
What to test	Should the product version presented to the customer be a physical product	4	"You also need a physical product (WS-Mktf); "No, we proved that you don't need that" (WS-POf) "If you start from scratch I think you need something" (WS-RDf)
Total	**4 barriers**		

Source: Author

APPENDIX EEE THE RELATIONSHIPS BETWEEN THE PRACTICES

Table EEE1: Count of relationships between practices

	A	B	C	D	E	F	G	H	I	J	K	L	M	Total
A		4		4		1	1							11
B	3			1						5				9
C				1		1	4	1		1				8
D		1			5							1	1	8
E			6			1								7
F	1						1	1						3
G	1		2		3			1	4			1	3	15
H						1				2		1		4
I	3							1		5		1		10
J			1						3			6	5	15
K	2			2	1			2				1		8
L				1					6	0			1	8
M							2							2
Total amount of relationships														108

Source: Author

APPENDIX FFFCROSS CASE OVERVIEW OF ACTORS

Table FFF1.: Cross Case Overview of Actors and Roles

Practice	Roles	Thermo	ZKL	MZI	SEMO	SmartLight	FiberTop
PO (Business)	Information processing				✓		
	Champion				✓		
	Gatekeeper/synthesis				✓		
Customer	Input source	✓	✓	✓	✓	✓	✓
	Gatekeeper/synthesis		✓	✓			✓
	Relationship manager			✓			
	Information processing			✓			
	Boundary spanning			✓			
	Champion			✓			
	Decision maker			✓			
	Creativity and Development			✓			
Sales	Relationship manager				✓	✓	✓
	Information processing				✓	✓	
	Boundary spanning				✓	✓	
	Champion				✓	✓	
	Decision maker				✓	✓	
	Information source				✓		
	Gatekeeper/quality control					✓	✓
	Gatekeeper/synthesis					✓	
R&D	Information processing	✓		✓	✓		
	Champion	✓					
	Gatekeeper/synthesis	✓				✓	
	Creativity and Development	✓	✓	✓	✓	✓	✓
	Boundary spanning	✓				✓	
	Decision maker	✓					
	Gatekeeper/quality control	✓		✓			
	Input source			✓			

Table FFF1.: Continued

Owner	Boundary spanning		✓		✓		
	Decision maker	✓	✓	✓	✓	✓	✓
	Relationship manager	✓	✓				
	Information processing	✓	✓	✓			
	Gatekeeper/synthesis	✓	✓	✓		✓	
	Champion	✓	✓	✓			✓
	Information source	✓					✓
	Creativity and Development		✓	✓			
	Gatekeeper/quality control		✓				
Students/ external	Information processing	✓		✓	✓		
Research specialist	Gatekeeper/quality control				✓		
Team	Information processing						✓
	Boundary spanning						✓
	Gatekeeper/synthesis						✓
	Champion						✓
	Decision maker						✓

Source: Author

APPENDIX GGG OVERVIEW OF RECOMMENDATIONS

Number	Topic	Empirical results	Practical recommendations
1	13 distinct practices	• CI is created through 13 different, interconnected, practices; • Each is a bundle of objectives and related activities and resources performed by different actors; • The 13 practices perform five main functionalities: mobilizing of information sources collection of information, synthesising findings, managing the processes, utilizing customer insights	• Develop a vision about DCI and use this to make sure that all project partners and firm-members are aware of the full CI value chain; • This vision should include what is being done, when it is being done and why it is being done; • Develop a clear view on who should be involved, as each of the practices draws upon different actors holding different skills.
A	Exploring customer problem situations	• This is a core, and centrally placed qualitative research practice; • Processes input from customers and other sources to understand customers' problems; • Findings are used for idea refinement, selection of target segments, building trust • Often done together with Practice I as the cases feel they should show something to get access to unmet needs; • Owners are less active on analysis and rely on domain knowledge for interpretation. They gather input by immersing themselves into the context; • The context is mostly defined narrowly and in close relation with the product idea; • Methodological knowledge generally lacks, and cases feel this should be improved; • Bias reduction appears an important improvement theme; • Timing may be early or late in the project; • Findings on the problem situations are not explicated until later in the project.	• Define the scope of the project by keeping in mind the customer, and how he/she will use this product-class; • Assign people that are able to systematically collect and analyse qualitative data from customer sources; • Alternatively, intelligent immersion into the user context will provide input on customer problems. Do this as much as possible in duo's or teams and use a wide variety of sources; • Use a format for describing problem situations, so that it can easily explained to others and can steer information collection; • Do not introduce the idea in the conversation until the problem situation is well understood; • Instead of outlining the idea, *projector concepts* may be used to stimulate creativity and out of the box thinking. Try to keep an open mindset.
B	Generating innovation ideas	• This is a CI utilization practice supporting refinement of ideas; • Ideas are often the starting point and fuels other CI practices as well; • Ideas are often the result of a strategic agenda and defined by technological capabilities;	• Generate various alternative ideas and keep options open until customer problems are more fully explored; • Involve other people and use techniques to stimulate creativity.
C	Securing innovation funds	• This is a practice that both utilizes CI and provides input to other practices; • It is mostly done in a rational manner; • Funds for first phase practices A, D and E are not always available; • CI is funded by customers, grants, and owners.	• Use a variety of funding sources; • Be aware of large customer funders taking up important information processing roles. This may lead to a strong customer dependence and compromise the level of CI; • Provide funds for the early phase practices A, D and E as well.
D	Exploring the market opportunity	• This is a research practice, aiming for understanding of the market potential; • It generally follows upon idea generation; • Approaches vary: some cases rely on gut feeling, others seeking more certainty and take a systematic approach, updating understanding several times during the project; • It is done by means of desk research and largely concentrates on market size; • Despite different views on the importance, most firms would like to have a better understanding of the amount of customers having unmet needs; • Firms seeking more certainty, feel that the qualitative approach taken for D, falls short.	• Continue exploring the market potential across the entire project; • Intelligent desk research may be used for getting some idea of market size early in the project; • Choose a format to capture findings and keep it up-to-date during the project; • Vary methods according to the innovation phase and means available; • Explore the added value of quantitative methods when more certainty is needed.
E	Defining the value proposition	• This is a synthesizing practice, it provides input for decision making, but also has a *symbolic value* and communicates what the project is about; • Cases explicating their research findings excel in producing new insights; • It is based on inputs from A and D and supports in keeping focus across the project; • Teams have an important role in making sense of the findings; • Formats need to be efficient and be limited to the essence.	• Develop the value proposition collaboratively with the team; • Do not short-cut on this practice, as it keeps you focused on the right things; • Develop a format or tool that is efficient and effective for sharing and updating learnings during and after the project.

Number	Topic	Empirical results	Practical recommendations
F	Designing and managing customer insight action	• Takes care of design and control of the CI value chain; • Cases performing this practice excel in producing new insights; • It requires methodological understanding and reflective skills.	• Assign somebody that oversees the CI activities across the entire project; • Make sure this person has had some training in design and research methods and can take responsibility for the tasks.
G	Mobilizing customer sources	• This is a core practice for most cases; • Mobilized customers provide information, fund the process and become ambassadors; • Only a limited amount of customers is mobilized; • Its timing impacts importantly the efficiency of other activities; • It is mostly done by owners and sales teams; • Less complete researchers put more efforts in organizing sources; • Intensive co-creation is only found in the innovation failure case. In this case the customer performed information processing tasks as well; • Strategies for mobilizing customers may be more or less pro-active; • In concentrated markets and start-up cases commercial criteria overrule the other criteria.	• Decrease dependence on a limited amount of customers and widen the group of customers involved, including representatives of different cultures; • By using literal and theoretical replication (based on results of D) accuracy can be increased (in Practice H and I) • Take a pro-active approach and design channels and strategies to get in touch with the right customers at the right time; • Use incentives creatively to motivate customers to participate; • Apply explicit selection criteria and make sure that lead-users are involved; • Prevent co-creating customers to take a leading role in information processing.
H	Elaborating customer needs	• This a second phase customer research practice; • It is used to validate and supplement findings of practice A; • Findings form input for the construction of customer requirements; • More methodological resources are put to this practice; • Actors of this practice feel they lack time and can improve in data-collection methods; • Not all cases do this and efficiency is major concern.	• Include a second phase of customer research once more funds are available; • Plan for sufficient time and explore available methods; • A suitable format for capturing results supports you in efficiently finding the right information; • Bear in mind the limiting effect of presenting the project idea early in the conversation.
I	Collecting customer feedback	• This is a core, continual research practice to most cases; • It is often done early in the project; • Most efforts are put in organizing sources, conversations are ill-prepared; • Methodological expertise is lacking, quantitative methods are not used; • High new insights producing cases systematically test hypothesis; • Cases want to spend more time on selecting the right and sufficient amount of customers.	• Define learning objectives, hypothesis, and interview protocols upfront; • Be critical on who to involve; • Explore the added value of quantitative methods when more certainty is needed.
J	Defining customer requirements	• This is a core, and central synthesizing practice; • Customer requirements transform the research findings and explicate customer insights; • Some cases do this before utilization to preserve focus on the most important insights; • Others define insights afterwards when needed for marketing and communication; • In general the requirements are poorly formatted; • Teams using corporate formats are relatively good insight creators.	• Involve other organization members in developing requirements; • Decide upfront how a good requirement should look like; • Make sure requirements are consistently formatted and leave sufficient degrees of freedom for idea generation; • Develop a format or tool so that most important learnings can be shared and updated during and after the project.
K	Mobilizing internal sources	• This is a mobilizing of source practice and concerns often sales sources; • Internal sources are consulted at various moments in the project; • Inconsistent thoughts exist on the value of prior knowledge; • Used to validate research findings, ideas and concepts, and to get access to customers.	• Do not rely exclusively on internal sources; • Define upfront the value of information held by the sales force; • Inclusion of internal sources into the project team leads to deeper and more acceptable insights.
L	Developing the product concept	• This is a practice that both utilizes CI and provides input to other practices; • The minimum viable product (MVP) is important input for further CI generation; • The cases are especially concerned with doing this as early as possible in the project; • Cases that are weak in syntheses, keep focus through intense team collaboration • More complete research practices coincide with more complete concept development.	• Make sure that team-members involved in CI research, are also involved in CI utilization.
M	Planning sales and marketing for introduction	• Usually done at the end and largely based on direct input from customers; • Sometimes done early to ensure appeal to a sufficient large target group; • Mostly undertaken by individuals, but some take a collaborative approach; • Some fail in communicating the added-value of the project to a wider audience.	• Integrate sales and marketing perspectives as early as possible in the project to ensure appeal to a sufficient large target group; • Integrate sales and marketing perspectives as early as possible to make sure there is sufficient time to develop effective sales and marketing strategy.

Number	Topic	Empirical results	Practical recommendations
1	The outcomes	• New insights can be measured by using the requirements and by applying the KANO technique.	• Use the amount of new insights to follow up on your innovation objectives.
2	Resources	• CI is not just a matter of having skills and techniques and information sources, but also of having firm level assets, such as strategic considerations and a vision on CI; • In some instances this CI vision this leads to formats for synthesis; • Some CI activities are done deliberately and in a systematic way, they are however hardly formalized in explicit rules and guidelines; • A fourth resource group is dedicated people and money. Some firms are very creative in finding and funding experts supporting the CI process.	• Build on your vision on what CI is and how it should be developed to create formats and learning tools supporting synthesis and sharing of knowledge; • Explore subsidies and grants to fund experts in research and development; • Define upfront the tasks that the expert will fulfil.
3	Team roles	• Owners are often closely involved in research; • Cases relying solely on expert entrepreneurs create less insights than those in which owner closely collaborate with young, multi-skilled design scientist; • References to customers as 'partners' does not mean they are co-creators; • Customers do participate in sensemaking, but have a negative impact on news insights when also performing other information processing tasks, such as gate-keeping and decision making;	• Employ a participative leadership style by means of which experience can be complemented with recent marketing and design science understanding; • Make sure the team is composed of multi-skilled people.
4	Timing and nature	• Systematic front-end research is an important prerequisite for the creation of insights; • Insights are deliberately created across the entire project and do not stop after the front-end; • Considering their iterative, continual yet planned approach, they are mostly *reflective* by nature, and is mindful on allowing cognitive and relational flexibility.	• Plan for CI creation from the earliest project phase on.
5	Dimensions underlying small firm approaches	• Approaches differ by level of research, level of collaboration and direct – indirect approach for insight construction; • Information driven and analytical cases build on their research capabilities and produce higher levels of insight. These are not necessarily older firms, neither expert entrepreneurs. Rather they are cross-functional or even T-shaped professionals.	• Use the framework to understand the main mechanism underlying the CI approach, with customer collaboration – internal collaboration on one dimension and indirect insight construction and direct insight construction on the other hand.
6	Development paths	• Generally, all cases look for better research practices and earlier validation; • Also the want to decrease dependence on a small number of customers and apply more rational to customer selection; • Intuitive case want to involve a larger team and to establish a CI culture; • Information-driven approaches look for more structure, without giving up on efficiency; • Analytical approaches seek a more flexible, and team-based approach.	• Increase performance on research and select customers more carefully; • Define improvements that fit the development phase instead, of mirroring best practices.

Source: Author