CRANFIELD UNIVERSITY

SATI FEHAID ALOTAIBI

A DECISION-MAKING FRAMEWORK FOR PURCHASING PRODUCT-SERVICE SYSTEMS

SCHOOL OF AEROSPACE, TRANSPORT AND MANUFACTURING

PhD
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JANUARY 2016

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ABSTRACT

As technologies become more complex and competition becomes tougher than ever before, manufacturers in the developed world acknowledge the significance of a competitive strategy in increasing sales to their customers. These strategies not only include offering the products, but also offering service contracts and integrated bundles of products and services, where the supplier is responsible for the required engineering services, typically for a relatively long period of time. This is also known as Product-Service Systems (PSS).

For many commercial and governmental organisations, purchasing PSS remains challenging. Despite the considerable work that has been conducted to investigate and improve the methodological applications of the concept of PSS from PSS providers' perspective, purchasing PSS positions the PSS customers halfway between PSS providers' strategies and the PSS customer traditional strategies. Little effort in the literature describing how to assist PSS customers in the selection and evaluation of the PSS offerings has been observed. Consequently, this research attempts to satisfy the gap in the body of knowledge by proposing a decision-making framework to enable PSS customer to evaluate and select from the various PSS offers.

The research began by reviewing the state-of-art of PSS, followed by the identification of the most likely characteristics exhibited by PSS customers. Then, the research investigates the existing PSS frameworks and analyses it to identify its appropriateness for use by PSS customers. The basis of the PSS framework is initially structured on the findings from the literature review, then modified by the result obtained from the field study in Saudi Arabia. The PSS framework is refined through expert feedback. Then, a computerised software tool was developed for the purpose of validation. Finally, the proposed PSS framework is validated by conducting five case studies.

The proposed framework can guide purchasing practitioners through a step by step process, from evaluation to selection the most suitable PSS offers, by considering the degree of fitness between the PSS offerings and customer's characteristics. This research has satisfied the industrial need and filled the gap in the literature, and has made a significant contribution to the knowledge on PSS customers to overcome the challenge of purchasing PSS.

ACKNOWLEDGMENTS

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PUBLICATIONS

Al-Otaibi, S. and Tjahjono, B. (2012), “PSS decision-making framework from the customers' viewpoint”, *Proceedings of the 2012 International Conference of Manufacturing Research*, Birmingham, 11-13 September 2012.

Al-Otaibi, S. and Tjahjono, B. (2015),” Assisting Customers to Acquire Product-Service Systems: towards a decision-making framework”, International Journal of Production Research. (submitted)

1 INTRODUCTION

1.1 Research Background

Sustained economic growth in the world led to the increase of the rate of trade exchange and thus increased spending to improve the economic level. Many organisations have embarked on the implementation of the development plans to support their infrastructure, in areas such as education, health service, transport and industries. This naturally led to reliance on the acquisition of equipment, complex systems, heavy machineries and services through local and foreign suppliers. Suppliers turned their attention to seize the opportunities to sell their products/services.

Therefore, manufacturers focus more on such strategies to satisfy the increased demands from the global markets. One potential approach is the shift from a product- to a service-based economy. In a service-based economy, satisfying individualised customer needs play a vital role rather than focusing on mass-production and consumption (Vasantha *et al.*, 2012). Customers are more interested in availability or capability rather than purchasing physical products.

The concept of Product Service Systems is conceivably valuable to manufacturers based in developed economies. Manufacturing industries worldwide continue to experience massive change. As a result, manufacturers have shifted their business from selling their products traditionally, to a new concept which is a combination of product and service (PSS). On the other hand, PSS customers face the new trend when acquiring PSS

Product-Service System (PSS) is an emerging paradigm, whereby, manufacturing companies shift their business focus, from the sale of their product only, to offering an integrated product and service (Baines *et al.*, 2013; Gaiardelli *et al.*, 2014). PSS has originated from the Scandinavian research community and the first publication was by Goedkoop *et al* in 1999 (Baines *et al.*, 2007). Most of the publication in the area of PSS cited Goedkoop et al. (1999), who defines it as a combination of products and services in a system that provides functionality for consumers and reduces environmental impact

(Beuren *et al.*, 2013). The notion of PSS has been considered as a special case of servitisation and described in various disciplines under different related concepts, such as functional sales, performance/outcome-based contracting, product bundling, industrial product-service system, and integrated solutions (Brax and Jonsson, 2009). Rolls-Royce's Power-by-the-Hour and Xerox's Document Management Solution business models are exemplars of PSS that deliver the required tasks to the customer.

As a result, decision makers in purchasing departments across governmental and industrial organisations face ever increasing challenges in dealing with PSS, especially knowing that most of the organisations have so far applied the traditional purchasing scheme. Al-Otaibi and Tjahjono (2012) argue that purchasing a PSS is difficult and more challenging. They identified number of customers' characteristics that need to be considered in order to purchase a PSS. There is an urgent need to assist PSS customers in evaluating and selecting the most suitable PSS to meet their requirements. Much of the existing research in PSS concentrated on the PSS providers, in order to plan, develop and deliver PSS. A number of frameworks and methodologies have been developed to support PSS providers. PSS customers on the other hand have not received sufficient attention to enable them in the selection and purchase of a PSS.

Since the evolution of the PSS, significant efforts have been made to help manufacturers to develop their strategies to offer a combinations pf product and services to satisfy customers; need (Reim *et al.*, 2014). Purchasing PSS answers the questions of: how PSS customers evaluate the offered PSS's and then select the appropriate PSS.

1.2 Research Motivation

In today business, products and services are becoming increasingly intertwined and the competition become more in the domain of PSS. Since the appearance of PSS, substantial efforts also appeared to support the shift toward PSS orientation. Manufacturers and service providers realised the importance of the adoption of new strategies in order to deliver PSS. In spite of the role of the

customers' in the development of PSS, few attempts considered to help PSS customers to purchase a PSS. Therefore, an influential motivation of this research relates to its ambition to support the customer to purchase PSS.

Moreover, most of the previous research focused on the improvement of the manufacturing and production strategies by developing frameworks, methodologies and tools to support the delivery of PSS (Kumar and Kumar, 2004; Datta and Roy, 2011; Ng and Nudurupati, 2010). Products are developed to satisfy customer demand and are customisable to include services. The example of a car- sharing system, document management solutions and leasing (Mont, 2000; Kang and Wimmer, 2008) provide a clear role of the customer in the succeed of PSS. However, Little effort made to emphasise how PSS customer purchase a PSS. By considering the combinations of products and services, the customer would find it difficult to evaluate the PSS and thus deciding which PSS package suites him.

Another motivation for conducting this research was the researcher experience in a purchasing and contracting department in a large organisation. The role of the researcher in his organisation requires a deep investigation to evaluate the PSS offering in order to avoid any possible risk. In fact, due to the lack of a proper strategy to deal with PSS offerings, undesirable results occurred. Given these motivations, it became necessary to conduct this research to develop a decision-making framework for purchasing PSS.

1.3 Overview of Research Aim and Objectives

The aim of this research has been formulated as:

"To develop a decision-making framework to assist PSS customers in assessing, selecting and acquiring PSS offerings"

To satisfy the aim of the research, five objectives have been set to:

1. Identify typical characteristics exhibited by customers who have adopted or are likely to adopt PSS.

2. Capture and analyse the most relevant PSS frameworks and methodologies from the literature that can be used as a basis in the development of the framework.
3. Develop the customer-driven PSS framework.
4. Develop a tool to assess the PSS offerings.
5. Validate the PSS customer's framework.

1.4 Thesis Structure

The thesis starts with the background of the research, followed by an overview of the aim and objectives. The concept of Product Service Systems is investigated, based on the existing knowledge to build a solid basis for the researcher. The research aim, objectives and programme are then identified, to guide the research to reach to the targeted results. PSS's customer's characteristics have been presented afterward. The development of the required framework is initiated by the investigation of the existing frameworks in the literature. A refinement of the framework is conducted, based on the collected data from five PSS customers' organisations. A validation of the proposed framework is achieved by conducting five case studies from various industries. The thesis is structured on ten chapters as illustrated in Figure 1-1.

Chapter 1: This chapter reports the background of this research and motivations, to define and create the industrial context and the need for PSS framework to assist the customers of PSS in the purchase of PSS. The research question was identified. Then, aim and objectives are clearly stated in this chapter.

Chapter 2: This chapter represents the review of the critical literature related to the concept of PSS to provide a better understanding of the investigated areas. Also, the chapter identifies the key findings related to the PSS customers. PSS customers' characteristics have been defined. This is to support the development of the PSS customers' framework The research gap consequently is analysed.

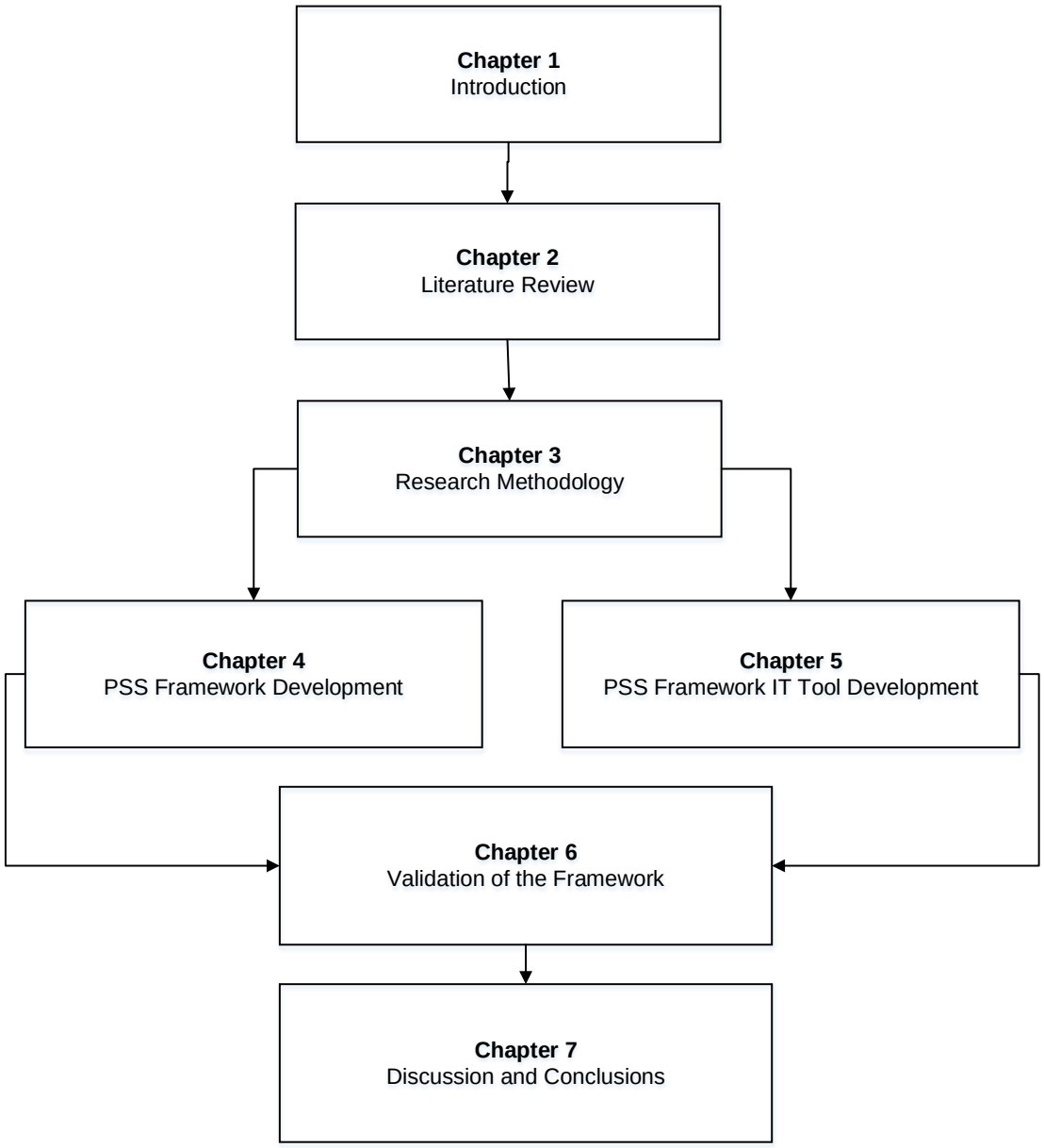


Figure 1-1: Thesis Structure

Chapter 3: In this chapter, a description of the research strategy is provided. The chapter presents the research methodology that has been followed to ensure that its design is appropriate to provide the answer to the research question and achieve its aim and objectives

Chapter 4: This chapter presents the development of the conceptual framework by reviewing a number of relevant PSS frameworks and methodologies. The initial framework is developed. Additionally, the

purchasing processes are reviewed to enhance the development of the framework. Then, the initial framework is modified based on the data collected in collaboration with five organisations. The selection of the organisation is described and justified based on a number of criteria. The collected data are analysed following a robust procedure which includes data processing, transcribing and coding,

Chapter 5: This chapter focuses on the development of an IT support tool to help to validate the developed framework. The developed framework in this stage is refined based on the emergent concepts, particularly, the concept of FIT. A PSS supplier-customer fit process is introduced to help designing the framework tool. The developed IT tool consists of four phases explained in details.

Chapter 6: This chapter presents the validation of the PSS customer's framework in collaboration with five organisations. The validation involves the implementation of the developed tool and the calculations of the customer's characteristics as well as the perceived values of the PSS.

Chapter 7: This chapter summarises the key findings of the research and highlights the contributions to knowledge of this thesis. The achievement of the aim and objectives of this research is explained. The limitations of this research are described and recommendations are made for future work.

1.5 Chapter Summary

This chapter has presented a brief background about the concept of Product-Service Systems and appointed the research issues. The research motivations and drivers for conducting this research are also discussed. Consequently, the research aim, objectives and question were identified. An explained overview of the thesis structure was provided.

2 LITERATURE REVIEW

2.1 Introduction

This chapter appoints the industrial problem in context of academic research by providing an overview of Product-Service Systems (PSS) and the exploration of related concepts, as well as the its current challenges. In addition, this chapter investigates the existing strategies of PSS, in order to design, develop and implement the necessary mechanisms. Accordingly, PSS customers' strategy in the adoption of the PSS is investigated to gain understanding in the development of the PSS framework for PSS customers. Additionally, PSS customers' characteristics were investigated and extracted to gain deep understanding of the behaviour of customers when acquiring PSS.

Conducting a literature review has been considered the essential first step to carry out a research project, to allow the researcher to "distinguish what has been done from what needs to be done" (Baker, 2000). On the other hand, Rowley and Slack (2004) argue that the role of the literature review is to identify a research topic and build a comprehension of theoretical concepts and terminologies.

2.2 The Concept of Product-Service Systems (PSS)

With the revolution of industrial production and the increase in the competitive market, influenced by the rapid demand of consumers, manufacturers and service providers have turned their attention into an emerging manufacturing paradigm known as Product-Service Systems (PSS) (Baines et al., 2007), and have since captured the attention of many researchers.

The attention of earlier manufacturers was aimed at the transformation of raw materials into products, through the process of design, to then sell these products to the customers. Since then, customer demand has changed to delivering accompanied services, such as engineering services, and training and upgrading, alongside the assets sold (Aurich et al., 2009).

2.3 Product vs. Service

Distinguishing between product and service is significant to identify the concept of PSS. Earlier studies in the area made efforts to identify the different characteristics of products and services. The differences were centred on the nature of products and services in terms of the tangibility, heterogeneity, simultaneity, perishability and ownership (Meier *et al.*, 2010). These characteristics are illustrated on Table 2-1 (Durugbo *et al.*, 2010; Valk and Rozemeijer, 2009; Vasantha *et al.*, 2012; Spring and Araujo, 2009)

Table 2-1: Difference between product and service

Characteristics	Product	Service
Intangibility	• Can be physically seen and touched • Easy to examine • Objective measures can be applied	• Cannot be seen • Difficult to examine in advance
Heterogeneity	• More standardised • Mass produced	• More customised • Uniquely produced for a certain customer
Simultaneity	• Consumption depends on the customer requirements • No or slightly interaction in the creation of the product	• Consumed at the same location where they are produced • Closer interaction in the creation of the service
perishability	• Can be stored to be used another time	• Cannot be stored
Ownership	• Ownership can be transferred	• Ownership cannot be transferred

The notion of PSS is not novel in itself; what is novel, however, is the realisation that these systems have the potential characteristics to convey changes in production and consumption forms that would accelerate the shift into more sustainable societies (Mont, 2000).

To understand the concept of PSS, it is sensible to define the key elements of a PSS. According to Goedkoop et al. (1999), the key elements of a PSS are defined as follows:

- *Product*: “a tangible commodity manufactured to be sold. It is capable of ‘falling on your toes’ and of fulfilling a user’s needs”.
- *Service*: “an activity (work) done for others with an economic value and often done on a commercial basis”.
- *System*: “a collection of elements including their relations”.

According to UNEP (2001), the main thought behind PSS is that clients are not exactly looking for products, but are actually seeking the functions of these products. PSS is an economical system of products with a service that includes the provision of maintenance, recycling and spare parts that meet consumers’ requirements and potentially reduce the environmental impact over the product life cycle (UNEP, 2001). Tukker (2004) sees PSS as a function-oriented business model and defined it as “tangible products and intangible services, designed and combined so that they jointly are capable of fulfilling specific customer needs”. Some commonly cited definitions of PSS from academic papers are listed in Table 2-2.

Table 2-2: Common definitions of Product-Service Systems and related concepts

Author (date)	PSS definition
Goedkoop et al., (1999)	"A marketable set of products and services capable of jointly fulfilling a user's need.
Vandermerwe and Rada (1988)	"Modern corporations are offering fuller market packages or 'bundles' of customer-focused combinations of goods, services, support, self-service, and knowledge. But services are beginning to dominate"
Baines et al., (2007)	"A PSS is an integrated product and service offering that delivers value in use"
Manzini (2003)	"An innovation strategy, shifting the business focus from designing (and selling) physical products only, to designing (and selling) a system of products and services which are jointly capable of fulfilling specific client demands"
Mcaloone and Andreasen (2002)	"A move from focusing on the design and development of the simple artefact to the innovation of a whole product service system (PSS), in which the traditional manufacturer-vendor-user relationship is rearranged, to enable the delivery of environmental and (for the company) economic benefits"
Paiola et al. (2012)	''Innovative combinations of products and services leading to high-value unified responses to customers' needs''
Lee and Park (2010)	"A system of products, services, supporting networks and infrastructure that is designed to be: competitive, satisfy customer needs and have a lower environmental impact than traditional business models"
Tukker (2004)	"Tangible products and intangible services designed and combined so that they jointly are capable of fulfilling specific customer needs"
Colen and Lambrecht (2013)	"Integrated solutions to enhance the product offering with services to increase the total value proposition"

2.4 PSS: Configurations and Applications

As a combination of products and services that provide the desired consumer functionality, PSS has become a field of competitive propositions, influenced by

customer satisfaction and economic sustainability. Three fundamental entities are considered in the PSS configuration: product structure, product life cycle and service structure (Aurich et al., 2009).

Durugbo et al. (2010) demonstrated that regarding configurations in traditional businesses, production and services are seen as independent, unconnected thoughts. In a PSS, however, the case differs. The production process relies on product characteristics, such as dimensions and mechanical aspects, and stakeholder interaction. Product characteristics involve physical and functional elements (operational components, assemblies and transformations). It is argued that the level of intangibility for some products is higher than others in terms of technology (Durugbo *et al.*, 2010).

Baines et al. (2007) show three types of PSS, whilst bearing in mind that different authors may use diverse labels. These types are:

- Product-oriented PSS: traditional way of selling a product, where the customer owns the product with promoted responsibility by the manufacturer/supplier (repair, maintenance, recycle and re-use).
- Result-oriented PSS: in this case, the results from using a product are sold, instead of the product. For example, selling washed clothes instead of laundry appliances.
- Use-oriented PSS: this type relies on the availability of the product and not ownership by the customers. For example, leasing equipment or sharing a service.

Additionally, by considering the economic and environmental characteristics of products and services, Tukker (2004) identified eight different business models of PSS. Figure 2-1 illustrates these types.

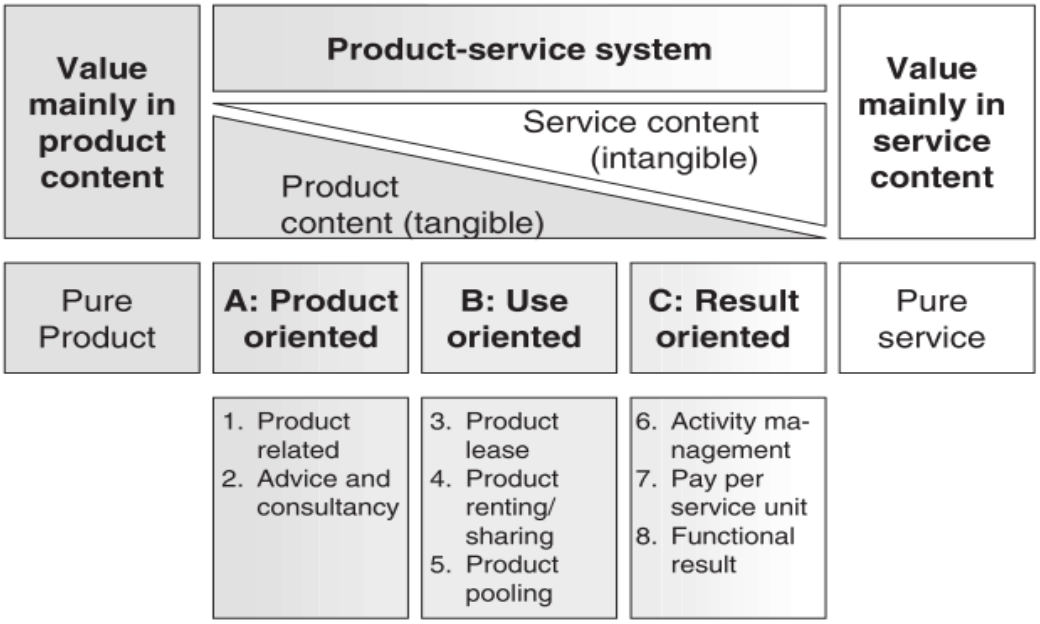


Figure 2-1: Main categories and subcategories of PSS (Tukker, 2004)

Based on Tukker (2004), the three main categories are classified into subcategories as follows:

1. Product-oriented services. In this model the company tends to sell a product with some additional services. The subcategories of this model are product-related service and advice and consultancy.
2. Use-oriented services. In this model, the provider owns the product and makes it available for users in various ways. The subcategories of this model are product lease, product sharing/renting, and product pooling.
3. Result-oriented services. In this model, the customer and provider agree on a result.

In the literature, many applications have been illustrated as examples of PSS. One of the popular examples of a PSS is the sale of a photocopier, as shown in Figure 2-2 and Figure 2-3. Traditionally the equipment is sold separately to the service, where the customer owns the photocopier first and then the seller provides the required maintenance, spare parts, and additional services based on the agreement.

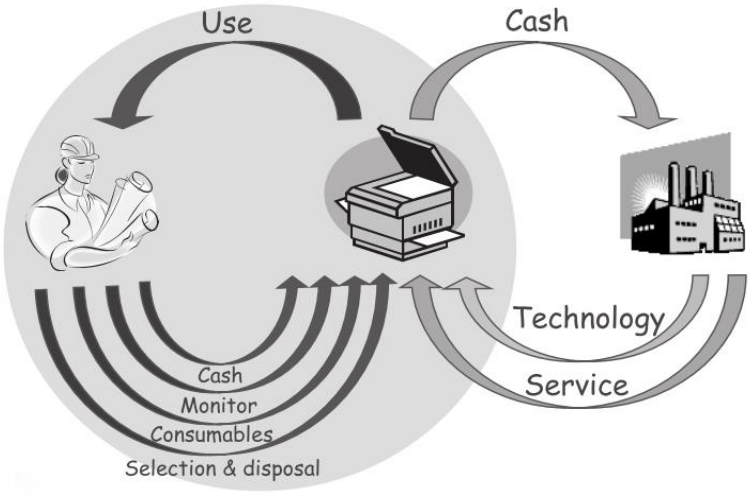


Figure 2-2: Product-oriented PSS (Baines et al., 2007)

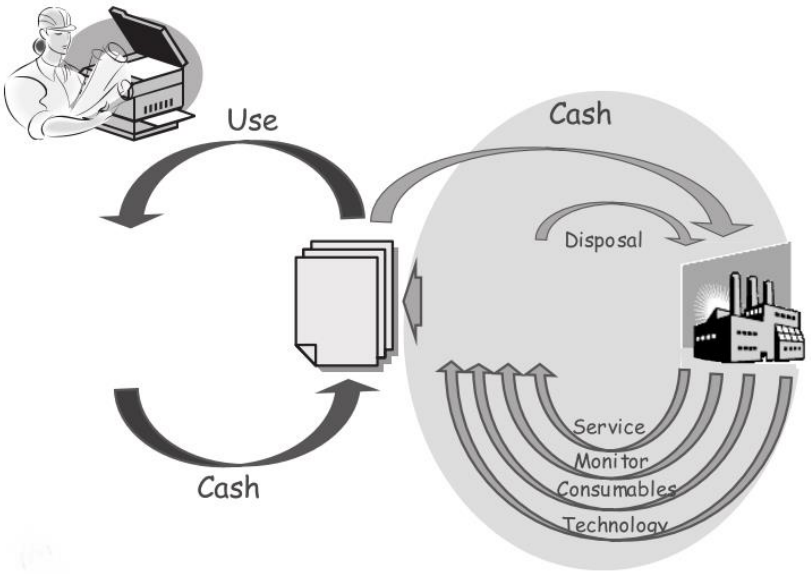


Figure 2-3: Use-oriented PSS (Baines et al., 2007)

Alternatively, when the customer is not interested in owning the photocopier and seeks to find a solution for document management, the provider in this case is responsible for providing the equipment and the related services (spare parts, maintenance, performance monitoring and disposal) as shown in Figure 2-3. This type of PSS is known as *use-oriented PSS* (Baines et al., 2007).

Other applications have been highlighted: selling cars with a service agreement and car rental. Result-oriented PSS can be clarified by using the example of a

transportation payment function, by which a customer guarantees a result (Rexfelt and Ornäs, 2009).

2.4.1 Servitization

The term *Servitisation* was coined by Vandermerwe and Rada in 1988. Since then it has captured the attention of many researchers. Servitisation is acknowledged as the course of action that creates value by adding services to products (Baines *et al.*, 2009). Desmet, Van Dierdonck and Van Looy, (2003) defined servitisation as “a trend in which manufacturing firms adopt more and more service components in their offerings”.

Definitions of servitisation indicate a close similarity between PSS and servitisation. The variation in name is due to the incentives and geographical derivations of the research societies (Baines et al., 2009). Baines et al. (2007) see that PSS is a particular example of servitisation, while Meier et al. (2010) consider servitisation as an alternative term for PSS.

2.4.2 Industrial Product-Service System (IPS²)

As the competition becomes more intense, another aspect of PSS, the Industrial Product-Service System (IPS²), has come into play. IPS² can be defined as “a marketable set of products and services, capable of jointly fulfilling a user’s need” (Rese et al., 2009). The reasoning behind the IPS² is that industrial countries acknowledge the threat from their competitors, especially in developing countries and new low cost economies. Initially, the main threat was the imitation of products, which is actually damaging the investment opportunities in developing countries. However, over time, companies from the industrial countries faced another threat, which is the development of capability and skills and low labour cost within the companies in developing countries (Rese et al., 2009).

Meier et al. (2010) showed that IPS² has an interdependent relationship between products and services in production, and can be applied to Business-to-Business applications. A given example of IPS² by Meier et al. (2010) is the SiTec GmbH’s solution for industrial technology manufacturing. The company is

located in Germany. SiTec manufacturing, involves the design, delivery, and the operation of ECM-lines assembly, and offers a wide range of product services, such as operation systems, construction, leasing of plants and maintenance.

2.5 PSS: Benefits and Challenges

The global adoption of PSS has led to the rise of potential benefits and challenges. Table 2-3 clarifies the benefits and challenges described by a number of authors.

Table 2-3: Common benefits and challenges

Author (year)	Benefits	Challenges
UNEP (2001)	Environmental benefits, resources reduction, less waste, economy sustainability, innovative market opportunities, and lower responsibility.	Cultural shift, lack of experience and know-how.
Lockett et al. (2011)	Income enhancing, Value-enhancing benefits, sustainable competitive	Risk transfer and complexity in customer relationships.
Baines et al. (2007)	Improvement in total value for the customer, product responsibility and environmental benefits	Countries with a low-cost labour and cultural shift.
Durugbo et al. (2010)	Less environmental load, efficiency enhancement, operational improvement and resources sustainability	Design and delivery of PSS across industries and industry sectors

Durugbo et al. (2010) demonstrated the benefits of adopting PSS in different industries. Delivering product-service systems to consumers (industry, organisation or individual customers) as a package, depends on the needs of the consumers. The combination of products and services is an important aspect in designing the delivered package. Here, the product is identified physically, to be either tangible or intangible.

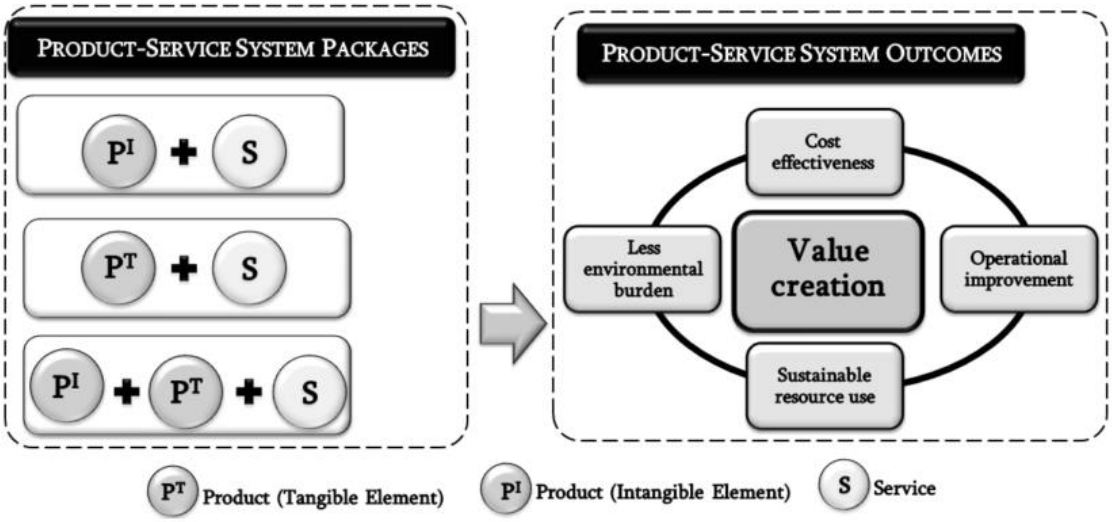


Figure 2-4: Product-Service System Packages and Outcomes. (Durugbo et al., 2010)

2.6 PSS: Delivery to customers

After the brief introduction to PSS, as the aim of this research is to find a strategy to allow developing countries to benefit from PSS, it is essential to address the agreement mechanism between manufacturers/providers and consumers in the obtainment of PSS.

2.6.1 Contracting

Manufacturing strategies have changed since the last decade. Customer satisfaction plays a significant role in shaping these strategies. However, the traditional scheme of industrial firms that provide customers with a purely physical product has changed to one that offers total need fulfilment to customers (Stremersch et al., 2001).

Kumar et al. (2004) discussed the relationship between providers and customers in terms of service delivery, and found that for a successful agreement between both parties to deliver product/service, several elements need to be considered. These elements are:

- Aims of work
- Payment conditions

- Product reliability
- Training and documentation
- Maintenance and overhaul
- Spare parts
- Cost
- Operational requirements

These elements influence the negotiation process and are shared by most firms. The negotiation process of service delivery must be performed before the sale of a system (Kumar et al., 2004). Additionally, customer requirements need to be applied during the initial phases, as PSS is a long-term contract (Ericson *et al.*, 2009).

2.6.2 Outcome-based contracting

Outcome-based contracting (OBC) is defined by Ng et al. (2009) as “a contracting mechanism that allows the customer to pay only when the firm has delivered outcomes, rather than merely for activities and tasks”. In traditional engineering services contracts or maintenance, repair and overhaul (MRO) contracts, providers usually gain significant profits as they only provide the required services when a system or equipment is defective or service is required by the user. This could lead to unprofessional service from the contractor. The design of OBC, guarantees that the service quality of the service provider is professional, as the customer will only pay for the delivery of the performance, i.e. the outcome.

Hypko et al. (2010a) and Ng et al. (2009) both state that outcome-based contracting is also known as performance-based contracting (PBC). Manufacturers shifted to the strategy of offering integrated solutions by offering services with their product/equipment and then establishing long-term contracts with customers (Brax and Jonsson, 2009).

Lay et al. (2009) describe the concept of PBC as transformation in ownership, responsibility of maintenance, and payment. Hence, it can be said that the customer purchase is a result of the product/asset being used (service or

performance outcomes) and not a result of purchase/ownership of the product/asset (Ng and Ding, 2010).

The persistent shift from product-oriented towards the service-oriented, has somehow resulted in an unclear distinction between service providing and manufacturing. Thus, industries have become more interested in performance-based contracting (PBC) (Hypko et al., 2010a). Nonetheless, Ng et al. (2009) clarified the potential benefits that OBC can offer to consumers and service providers.

For consumers:

- Payment to service providers is based on delivering measurable outcomes and reduced service/contract cost
- Reduced operation and supervision cost
- Motivation of service providers to provide high quality outcomes

For service providers:

- Staff effectiveness
- Controlling outcome performance through close relationship between the contractor and the customer
- Opportunities for innovation
- Guarantee of competitive benefit

Ng and Nudurupati (2010) conducted research, based on a case study, to find the challenges and risks related to the implementation of outcome-based contracts (OBCs) in provided services; specifically, maintenance, repair and overhaul (MRO) in the defence industry. They researched two contracts between Ministry of Defence (MoD) and contractors. Both contractors granted a through-life MRO service contract for the equipment. By applying in-depth interviews with a qualitative approach, the associated risks and challenges of the implementation of OBCs were identified. These were cost unpredictability, cultural change, dependence on the customer in providing the service, and complexity. Additionally, the results indicated that outcome-based service capability, can potentially make a meaningful contribution to the sustainability

strategy and by maintaining the assets and thus enabling longer and more proficient working, one can reduce the necessity of producing and consuming new equipment.

Despite the challenges of OBC, such as complexity and unpredictability, outcome-based contracting is seen as the future of business-to-business relationships. Such contracts have captured the interest of manufacturers of aerospace and defence systems and equipment (Ng et al., 2009).

Ng and Ding (2010) give an example of the concept of OBC. Rolls-Royce, as one of the biggest manufacturers providing integrated power systems for aerospace, defence and energy, adopted an OBC approach, which they called “Power by the Hour”. In this case, Rolls-Royce provided continuous maintenance and engine services, based on the number of hours the customer obtains power from the engine.

With OBC, both service providers and customers benefit. However, it requires interchangeable involvement between contracted parties, and the necessity to deal with several challenges, such as specifying outcome target definition and clarifying and evaluating value-in-use (Ng et al., 2009).

2.6.3 Contracting for availability

In the defence sector, outcome-based contracting was used by the U.S. government during 1960 as a technique to control military expenditures (Ng et al., 2009). The U.S. Department of Defence (DoD) identified OBC as a tool for performance-based logistics, and defines it by stating that “the essence of Performance Based Logistics is buying performance outcomes, not the individual parts and repair actions… instead of buying set levels of spares, repairs, tools, and data, the new focus is on buying a predetermined level of availability to meet the (customer’s) objectives” (Ng et al., 2009).

Since then, outcome-based contracting has become a new trend in the defence industry. The military sector in the UK has adopted OBC in a different way, referred to as “contracting for availability” (CfA). Contracting for Availability (CfA) is defined by Ng et al. (2009) as “a commercial process which seeks to

sustain a system or capability at an agreed level of readiness over an extended period of time, by building a partnering arrangement between the Ministry of Defence and industry".

This transformation to a comprehensive service orientation was performed especially by manufacturers in the defence and aerospace sectors. In 2008, the UK MoD signed a full availability contract with Rolls-Royce. The purpose of this contract was to provide full maintenance, repair and overhaul (MRO) for the Gnome turboshaft engines for the Royal Air Force and the Royal Navy. This agreement guarantees a 24/7 service to the MoD. In addition, the British Royal Navy operates patrol vessels owned by the shipbuilder, VT. VT is fully responsible for the availability of these vessels, including technical support, repair, spare parts and comprehensive maintenance, even aboard these vessels (Cushway, 2006).

The House Defence Committee (2006) argues that a long-term contract has potential advantages that provide the private sector a degree of certainty to realise the requirements and potential business, subsequently reducing the cost and ensuring efficiency. Although customers in such contracts receive guaranteed services and hence, ensure assets/equipment reach their operational capability, customers enter into a dependence relationship (Hypko et al., 2010b).

Leasing agreements are another aspect of product/service contracting strategies. In such contracts, the leasee has the right to use the leased product/asset within a clearly described period (McConnnell and Schallheim, 1983). Usually, payment of the leasing contract is due at periodic dates. The leasor still owns the product/asset and is responsible for the associated services (maintenance, repair) during the lease contract and afterwards (Tukker, 2004; Hypko et al., 2010a).

According to Yang et al. (2009), the leasing approach is a typical example of use-oriented PSS, where the leasor owns and provides a product/asset and the user uses its function. In some cases, the option to purchase the product/asset is available as the long-term leasing contract becomes more expensive (Mont,

2000). However, leasing a product/asset may increase environmental impact if customer behaviour is less responsible (Tukker, 2004).

2.7 PSS Customer-Supplier Relationship

The relationship between PSS providers and customers makes a significant contribution to the success of PSS deals. Prior involvement between PSS parties (provider and customer) ensures the delivery of the required product/service, as well as the flow of the product functionality and the associated services (Kumar and Kumar, 2004). Ng and Nudurupati (2010) see that this relationship is important to define the required work from the stance of the customer, particularly in the contractual arrangement. Lettice, Wyatt and Evans (2010) explored the notion of partnership between buyer and supplier in the global market and argue that in the early phase of the relationship, and there needs to be an acute awareness of expectation to achieve the desired benefits. However, partnerships can strengthen the presence of competitive benefits, market share and investment for the buyer and the supplier (Saccani and Perona, 2007).

2.8 PSS Frameworks and Strategies

As the research is concerned with improving customer ability in the selection of a PSS, it is essential to examine the availability frameworks that could help PSS customer when purchasing a PSS. In fact, a considerable number of frameworks/methodologies have been developed since the concept of PSS evolved. Kumar and Kumar (2004), developed a framework for the service delivery to ensure the delivery of services, based on customer requirement. Datta and Roy (2011) identified the key operational strategy to effectively deliver a performance-based contract (PBC). Stremersch et al. (2001) investigated the factors and conditions that trigger the purchase of a full-service contract. They highlight the way in which these frameworks are viewed from both business and engineering perspectives.

Horenbeek, Ostaeyen and Pintelon (2010) investigated the influencing factors and attributes regarding the service strategy for both supplier and customer.

They developed a framework for maintenance service contract management. Moreover, One of the most common methodologies in the area of PSS is the Methodology for Product-Service Systems (MEPSS); which supports industry by providing a methodology and tools to create new product-service offerings (Van Halen *et al.*, 2005). Valk and Rozemeijer (2009) proposed a purchasing process to enable organisations to overcome difficulties associated with buying services. Relevant frameworks and methodologies will be discussed in deep details in Chapter 4.

2.9 PSS Customers' Characteristics

As mentioned previously, PSS has been categorised into three main groups, based on the characteristics of the PSS offering and PSS customer needs (Tukker, 2004). The purchasing process of PSS tends to vary from customer to customer, and therefore, the customer characteristics, either at the organisational or the individual level, need to be considered. PSS customers would need to be profiled, based on their characteristics and attitudes towards purchasing PSS.

Although PSS characteristics have been mentioned in the literature, the characteristics of the PSS customers have not been discussed in great detail. A possible reason for this is the nature of individual researchers and their tendency to enrich their area of research to support the PSS providers rather than customers. Goedkoop (1999) stated that "each customer has its own characteristic, wishes and needs". This actually supports the argument considering customer capabilities and willingness in the adoption of a PSS. However, as noted in the reviewed articles, the majority of the studies, focus on planning, designing and implementation of the PSS, and how to successfully deliver the required PSS to the customer. PSS itself is a complex combination of products and services. Therefore, PSS providers often pay attention to the needs of their customers, as well as the factors that encourage the acceptance of the PSS.

2.9.1 Customer culture

Traditionally, product ownership is part of customer culture. When a product is bought, there is a desire to own the product or at least part of it (Mont and Plepys, 2003). Neely (2008) agreed that customers tend to buy a product (rather than to rent it) due to 'emotional' reasons of ownership. Consequently, cultural and emotional issues are critical to understanding product ownership (Rexfelt and Ornäs, 2009), especially in the case of buying an integrated product and service. The fact is that in PSS customers are paying for the package of the product and service whilst not necessarily owning the physical product.

In an Outcome-Based Contract (OBC) or a Performance Based Contract (PBC), for instance, the customers pay for the use or operation of a product (e.g. excavation, material delivery), and for obtaining the required outcomes. Often, the ownership of the products remains with the provider, removing direct responsibility to maintain the products from the customer, keeping the stock of spare parts, and other common consequences that would come with ownership of the products (Ng and Ding, 2010; Hypko et al. 2010b). Phumbua and Tjahjono (2011) and Mont (2002) also advocated that PSS customers also benefit from a better variety of choice in the market, maintenance and repair services. Despite the various advantages, (Rexfelt and Ornäs, 2009) remain assertive that one of the factors in customer acceptance of PSS is due to the ownership of the products.

2.9.2 Environmental awareness

Environmental sustainability has been seen as one of the reasons behind manufacturers adoption of PSS, and they are typically influenced by governmental regulations (e.g. the Dutch government) (Goedkoop *et al.*, 1999). Some authors argue that PSS can be a route to environmental sustainability, and to be so, environmental impacts need to be considered, regarding the process of manufacturing strategies (e.g. using, recycling and re-manufacturing products) (Mont, 2000). A number of companies have practiced these and achieved economic benefits (UNEP, 2001). For PSS customers, adopting PSS

is seen as an effort to save the environment, as the customers are now buying the service or the capability of the equipment, rather than the equipment itself and its associated responsibilities (maintenance, recycling, disposal, etc.) which increase environmental impact (Morey and Pacheco, 2003).

For instance, Xerox, in addition to offering document management solutions, also offers a comprehensive responsibility of their photocopiers and their ownership (Baines *et al.*, 2007). Xerox's customers consider this service provided by Xerox as a way to reduce the environmental impact of the product. Xerox takes responsibility for maintenance, repair and disposal of the product at the end of life. Likewise, the washing machine, as an example of result-oriented case, shows the concern that PSS customers have for the environmental impact.

2.9.3 Competence availability

According to Mont and Plepys (2003), competence can be defined as "possession of required skills (i.e. organisational and personal) and knowledge to perform the service". As PSS is a combination of products and services, service is seen as any executed work (maintenance, repair, service spare, technical support, etc.) to a product with a functional value (Baines et al. 2007), which requires a specific capability and advanced knowledge, especially for products which are complex, critical and high-tech (Markeset and Kumar 2005). Customers (especially in developing countries) who lack product support capabilities, particularly in the field of maintenance, repair and spares services (Kumar and Kumar 2004), take into account that many products necessitate specific knowledge of the product/equipment and its technology (Oliva and Kallenberg, 2003), thus prefer to rent PSS. Defence and aerospace equipment are typical examples of such equipment that require specialised knowledge and facilities, as well as complex engineering systems (Neely *et al.*, 2011). PSS customers are less reliant on their own competencies for the engineering services, as the PSS providers supply all the essential maintenance, including the provision of spares and maintenance workforce (Hypko *et al.*, 2010a)

2.9.4 Operation ability

Customer requirements in the operation of a product may vary, but in general, the customers seek to reduce their operational costs because their ability to perform the required operation is limited. In PBC, customer interest is in the performance of the product/equipment rather than ownership, therefore, the performance provider may also take responsibility for the operation of the product/equipment (Hypko *et al.*, 2010b; Hypko *et al.*, 2010a). Such a case is likely to be adopted by industrial customers, who need to operate complex machinery for production purposes, such as oil and mining companies. Buying PSS packages may also require advanced training to ensure the product/equipment is operated efficiently and effectively (Markeset and Kumar, 2005), and the operational capacity and readiness of critical equipment or complex machinery would require greater involvement from the PSS providers. This may include skilled personnel to operate such equipment/machinery (Ng and Nudurupati, 2010)

2.9.5 Customer's resources

Consideration of the customer's resources plays a significant role in the adoption of PSS. These resources include facilities, materials, liquid funds, complementary skills, knowledge and information, and this adoption can be seen as cooperation between the provider and the customer (Ng and Nudurupati, 2010). However, the customer's access to resources would contribute to lowering the contract cost, and helping the service provider to ensure the efficiency and effectiveness of the service, as well as business permanence; this is obvious in OBC. Nevertheless, not all customers would appreciate sharing their own resources (Ng *et al.*, 2009). A number of manufacturers/service providers, moved toward product-centric services to deliver the required product/service, which will probably require sharing/using customer resources, such as facilities, which are known as facility practices. Evidence of such a tendency is apparent in Alstom, a train solutions provider. Virgin operates the Pendolino class trains on the West Coast mainline and Alstom takes responsibility for the advanced service across the rail network

using the existing repair and maintenance facilities belonging to the customer (T. S. Baines *et al.*, 2011; Kumar *et al.*, 2004). Exploitation of customer resources (in some cases the resources of third parties) could be seen as an exchangeable advantage between the customer and the product/service provider in B2B strategies (Helander and Moller, 2007). In OBC, accessing/sharing customer resources gives the service provider the opportunity to predict the required product/service and its cost, to ensure the availability of an efficient outcome (Ng and Nudurupati, 2010).

2.9.6 Affordability

Purchasing a product or a service relies mainly on the financial ability of the customer. The term 'customer affordability' is usually applied to indicate something at a reasonable cost or at a low price. Customer affordability is frequently associated with the purchase of a product, service or a PSS at a price that the customer is willing to pay (Opeyemi *et al.*, 2012). However, Kroshl and Pandolfini (2000) define the customer affordability as "the ability to procure a system within a budget when the need arises; operate at a required performance level; maintain and support it within an allocated life cycle budget'.

According to this definition, the customer gives great consideration of the associated costs, such as the operation and maintenance cost during the execution of the service and the life cycle of the product. Therefore, customer affordability can be seen as an essential characteristic of a PSS customer. Moreover, customer affordability can influence the purchasing decision, in terms of the type of PSS a customer may select. For instance, renting, as an option under the use-oriented PSS, can be an affordable option for the customer, and it can be seen as a reduction of the total cost of the purchase, rather than owning the PSS (product-oriented PSS) (Mont, 2001).

Table 2-4: Summary of PSS customers' characteristics

	Characteristics					
Author (date)	Customer culture	Environmental concern	Operational ability	Customer resources	Competence	Affordability
Baines et al, (2007	√	√	√	√	√	√
Baines et al, (2011)	√			√		
Datta and Roy (2011)		√	√		√	
Goedkoop et al., (1999)	√	√				√
Hypko et al, (2010a)	√				√	
Hypko et al., (2010b)		√	√			
Kumar and Kumar, (2004)			√	√	√	
Kumar et a, (2004)			√	√	√	
Markeset and Kumar, (2005)			√		√	
Mont and Plepys, (2003)	√				√	
Mont, O. (2000)	√	√				
Mont, O. (2002)	√	√				√
Morey and Pacheco, (2003)		√				
Neely, A. (2008)	√	√				√
Neely et al., (2011)					√	
Ng and Nudurupati, (2010)			√	√		
Ng et al., (2009)				√		
Ng and Ding, (2010)	√				√	

Oliva and Kallenberg, (2003)					√	
Phumbua and Tjahjono, (2011)	√					
Rese et al. (2009)				√		
Tan and McAloone, (2006)	√					
UNEP, (2001)	√	√				
Opeyemi et al. (2012)						√
Kroshl and Pandolfini (2000)						√

2.10 The influential factors on the adoption of PSS

Several authors, e.g. Mont (2000) and UNEP (2001), believe that a cultural shift is needed for PSS to be adopted. They found that the success of a PSS solution is extremely reliant on the sensitivity to the culture where it operates, and it is noted, that within certain societies in some European countries (Scandinavia, the Netherlands and Switzerland), PSS solutions have been more willingly accepted. In addition, the relationship between the customer and the PSS provider, plays a significant role in the design of a successful PSS to provide the optimal solution for customer needs (Baines *et al.*, 2007). Kumar and Kumar (2004) stressed the importance of the consideration of PSS customer operational aspects, as well as the organisational futures for a successful service delivery, which actually reflect customer capability.

Environmental impact of production or product consumption is one of the factors that may encourage a customer to buy a PSS package rather than buy the product (Mont, 2000). In addition to cost saving, the PSS business model is believed to be able to reduce environmental impacts (Tukker, 2004). System complexity is also an important factor. Although some customers have the ability to operate and maintain complex systems, they may be unwilling to take the risk or prefer to avoid the associated risk of the operation and maintenance consequences, especially throughout the long life cycle of the system. Other types of customer may only have the choice to adopt PSS due to limited

resources and competencies (Markeset and Kumar, 2005). Moreover, purchasing a PSS is a form of long-term relationship between the customer and the supplier, especially in the delivery of service performance. Such a relationship plays a role to encourage the customer to adopt the concept of PSS, as it requires early involvement from the customer side to achieve the targeted outcome during and after the execution of the contract (Baines et al. 2007; Vining and Globerman, 1999).

Product/service characteristics play an essential role in the acceptance of PSS from the customer perspective (Kumar *et al.*, 2004). These characteristics include reliability, maintainability and supportability and affect the value of the product (Horenbeek *et al.*, 2010). Moreover, operational requirements and operating environments, customers' capabilities/resources and preferences, infrastructure and available competence are also essential factors that affect the customer strategy in adopting PSS. Customers who have the choice between adopting PSS and purchasing the product can assess the situation and consider the costs incurred for production, service and spare parts, administrative and any other hidden costs.

The Rolls-Royce's TotalCare® offers airlines, a 'power-by-the-hour' package for aero engines, based on a lease out contract; where the ownership remains with Rolls-Royce with a guaranteed service and performance (Baines *et al.*, 2007). This PSS package enables the airlines to focus more on their core businesses to 'fly people', which ultimately helps to ensure a sustained business.

Product/service price also influences the decision for PSS adoption. A customer analyses the packages offered and compares them with the traditional purchasing of a product and/or the associated services, especially if there are alternative offers from multiple PSS providers. Moreover, geographical location, operational requirements and operating environment, customers' capabilities/resources and preferences, infrastructure and available competence, play essential parts in the customer strategy, in order to successfully adopt PSS (Kumar and Kumar, 2004; Kumar et al. 2004).

2.11 Research Gap Analysis

The previous sections in this chapter provided a better understanding regarding the concept of PSS. PSS terminologies, applications and PSS delivery strategies were also reviewed. As a result, it can be observed that the attention of the research in the area of PSS is in the focus of the PSS suppliers. The emergent of the PSS as a business model, was supported by the need of the manufacturers and suppliers to shift towards sustainable business. Moreover, the common definitions of the PSS mentioned in this chapter provide evidence of the tendency of the authors to support the suppliers. For example, Mcaloone and Andreasen, (2002) described the concept of PSS as “a move from focusing on the design and development of the simple artefact, to the innovation of a whole product service system”. It is obvious that this definition emphasises the need of the suppliers to move into a new business models. Similarly, Baines et al. (2007) defined the PSS by stressing the need for suppliers to develop PSS offerings by integrating products and services.

Moreover, the applications of PSS focus primarily on the configuration of products and services, which actually support the suppliers’ position. Research in servitisation focuses on manufacturers firms by the adoption of more service component in the PSS offerings. Literature suggested variant delivery strategies helping PSS suppliers to cope with the new trends. Contracting for availability and outcome-based contacting, represent a delivery mechanism of the PSS. The main focus of these mechanisms is on the supplier side, although the customer is involved in the delivery strategies. The PSS frameworks and methodologies are developed mostly to support the PSS suppliers.

The complexity of the content of the PSS is an obstacle for the customer to apply traditional purchasing approaches. Also, purchasing a PSS involves a lengthy relationship between the supplier and the customer to be maintained properly. Despite the fact that the majority of the literature concentrates on the supplier side, there are very few attempts to help PSS customers in the purchase of a PSS. However, all attempts are limited by a specific aspect of the

PSS. Therefore, there is an urgent need to expand the research scope by supporting PSS customers when evaluating and purchasing a PSS.

The evidence drawn by the literature review clearly indicates that PSS customers lack strategies to acquire PSS offers. There are considerable studies that support the PSS provider to design, plan and market their PSS. PSS frameworks in literature are developed to support the PSS provider by highlighting a number of factors related to PSS customers. This research should take the opportunity by using the available knowledge to develop PSS customers' frameworks

2.12 Chapter Summary

This chapter has presented a literature review on product service systems. The chapter began by investigating the concept of PSS and the related terminologies that are used in this thesis; then, the benefits and challenges have been reviewed, followed by forms of delivering PSS to customers. The relationship as the core of the PSS has been presented and the current strategies and frameworks have been explored. In addition, this chapter set out the characteristics that could be recognised for PSS customers. Factors that affect the adoption of PSS from customers' perspective have been reviewed. The key findings from the literature analysis suggest that much research has given attention to the concept of PSS from suppliers' perspectives; however, there little research work has been conducted to help PSS customers to evaluate and select the appropriate PSS. From the literature search, no existing research work considers the position of purchasing practitioners to deal with the PSS offerings. Therefore, developing a decision-making framework to purchase a PSS is a valuable topic for a focused research effort. The next chapter will establish the research methodology that has been used to conduct this research.

3 RESEARCH METHODOLOGY

3.1 Introduction

In the introductory chapter, the fundamental research issues have been outlined, along with a general overview of the research question, aim and objectives. The relevant literature has been examined in Chapter 2. Therefore, the aim of this chapter is to explain how this research has been conducted by providing an overview of the research strategy, purpose and approach. An overview of the research purpose is provided as it helps to decide which research strategy is the most appropriate for the nature of the research. has been provided, this includes an overview of research philosophy and the different paradigms. Research purpose, approaches, strategies and choices are presented in details in the upcoming sections with the the rational of the selection of the research methodology.

3.2 Overview of Research methods

3.2.1 Philosophical Paradigms of Research

Saunders *et al*, (2007) defined Research philosophy is an over-arching term relating to the development of knowledge and the nature of that knowledge. According to Easterby-Smith et al., (2012), the main philosophical positions underlie the designs of research. In other words, the philosophical factors affect the overall arrangements which enable satisfactory outcomes from research. The term paradigm is defined as a way of examining social phenomena from which particular understandings of these phenomena can be gained and explanations attempted (Saunders *et al.*, 2007). William and Mays (2002) stated that research is based on philosophical values which define various disciplines. These philosophies are mainly divided into ontology, epistemology and axiology.

According to (Saunders *et al.*, 2007), there are three major ways of thinking about research philosophy: epistemology, ontology and axiology. Each contains important differences which will influence the way in which the researcher thinks

about the research process. Ontology is a branch of philosophy which is concerned with the nature of social phenomena as entities, whereas Epistemology concerns what constitutes acceptable knowledge in a field of study. Chia (2002) describes epistemology as 'how and what it is possible to know' and the need to reflect on methods and standards through which reliable and verifiable knowledge is produced. Axiology is a branch of philosophy that studies judgements about the role of values. Axiology aim is to explain what researcher values go into the research and the assumptions made by the researcher that are concerned with the value systems (Miles and Huberman, 1994).

Saunders *et al*, (2007) introduced the research onion as a way of depicting the issues underlying your choice of data collection method or methods and peeled away the outer two layers – research philosophies and research approaches as illustrated in Figure 3-1.

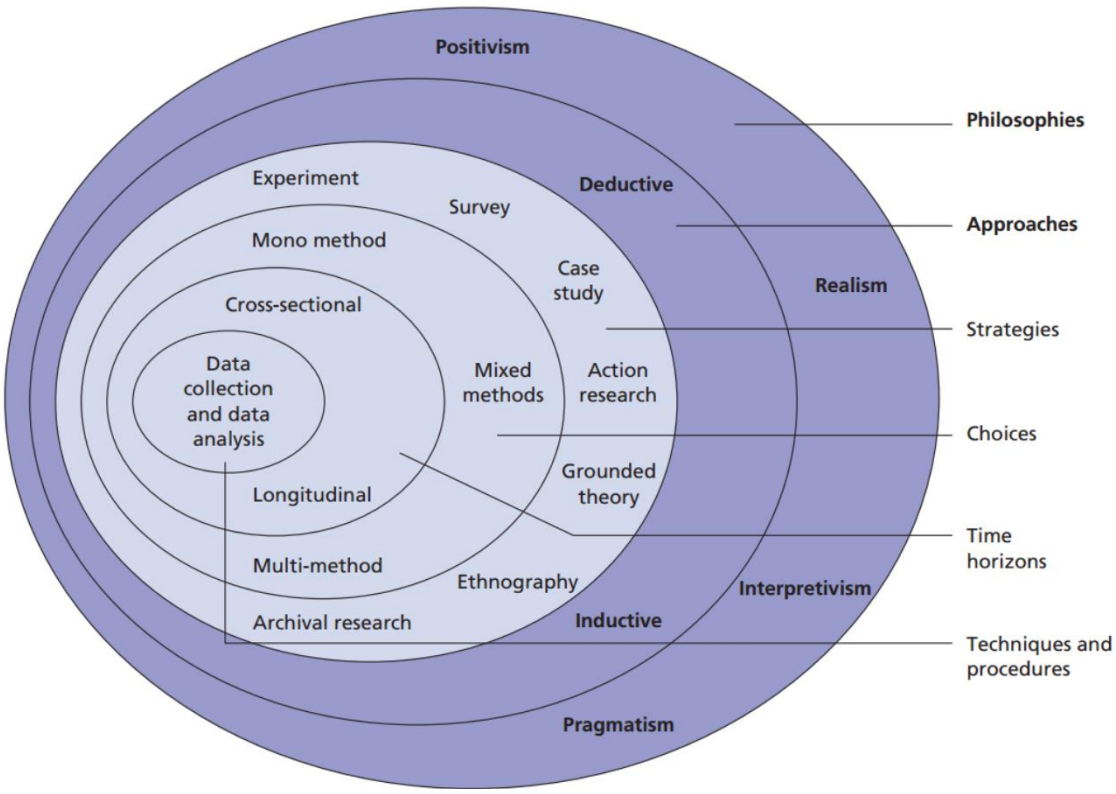


Figure 3-1: Research onion (Saunders *et al*, 2007)

The way the researcher chooses to answer the research question will be influenced by the research philosophy and approach. The research question, aim and objectives will subsequently inform the choice of research strategy, the choices of collection techniques and analysis procedures. Therefore, these layers can be thought of as focusing on the process of research design, that is, turning the research question into a research project (Robson 2011). Based on the research onion, the main philosophical perspectives for the research paradigm are positivism, realism, pragmatism and interpretivism. Saunders *et al.* (2009) identified four research philosophies in management research as shown in Table 3-1. This categorisation of social science paradigms which can be used in management and business research to generate fresh insights into real-life issues and problems.

Burrell & Morgan (1982) summarised the purposes of the four paradigms are:

- to help researchers clarify their assumptions about their view of the nature of science and society;
- to offer a useful way of understanding the way in which other researchers approach their work;
- to help researchers plot their own route through their research; to understand where it is possible to go and where they are going.

Saunders *et al.* (2009) identified four research philosophies in management research as shown in Table 3-1.

Table 3-1: Comparison of four research philosophies in management research

	Positivism	**Realism**	**Interpretivism**	**Pragmatism**
Ontology: the researcher's view of the nature of reality or being	External, objective and independent of social actors	Is objective. Exists independently of human thoughts and beliefs or knowledge of their existence	Socially constructed, subjective, may change, multiple	External, multiple, view chosen to best enable answering of research question
Epistemology: the researcher's view regarding what constitutes acceptable knowledge	Only observable phenomena can provide credible data, facts. Focus on causality and law like generalisations	Observable phenomena provide credible data, facts. Insufficient data means inaccuracies in sensations	Subjective meanings and social phenomena. Focus upon the details of situation, a reality behind these details, subjective meanings motivating actions	Either or both observable phenomena and subjective meanings can provide acceptable knowledge dependent upon the research question.
Axiology: the researcher's view of the role of values in research	Research is undertaken in a value-free way, the researcher is independent of the data and maintains an objective stance	Research is undertaken in a value-free way, the researcher is independent of the data and maintains an objective stance	Research is value bound, the researcher is part of what is being researched, cannot be separated and so will be subjective	Values play a large role in interpreting results, the researcher adopting both objective and subjective points of view
Data collection techniques most often used	Highly structured, large samples, measurement, quantitative, but can use qualitative	Highly structured, large samples, measurement, quantitative, but can use qualitative	Small samples, in-depth investigations, qualitative	Mixed or multiple method designs, quantitative and qualitative

3.2.2 Research purpose

Conducting a research task necessitates the development of an appropriate research approach and the adoption of data collection techniques. The quality of the findings depends on the quality of the collected data. In order to select a particular methodology, the research aim, objectives, purpose, population need to be determined. In addition, the resources available to the researcher need to be determined (Gill and Johnson, 1997).

According to Yin (2013), the purpose of a research can be exploratory, descriptive or explanatory. A research however, may depend on a single or a combination of these categorises. The research question can be both descriptive and explanatory, so the research may have more than one purpose. Indeed, as Robson (2011) points out, the purpose of your enquiry may change over time.

Exploratory research is a valuable means of finding out 'what is happening; to seek new insights; to ask questions and to assess phenomena in a new light (Robson, 2011) and most appropriate when very little is known about a particular subject and can begin with a literature search, a focus group discussion, or case studies (Sue and Ritter, 2012). The aim is to formulate problems and clarify concepts. Exploratory research typically pursues to build hypotheses rather than test them. However, to conduct exploratory research, data is likely to be qualitative (Saunders *et al.*, 2007).

(Saunders *et al.*, 2009) argues that there are three principal ways of conducting exploratory research:

- a search of the literature;
- interviewing 'experts' in the subject;
- conducting focus group interviews.

Descriptive research involves more guidelines. This research tends to describe events, persons, and situations. Usually descriptive research is guided by one or more research questions but not propelled by structured research hypotheses. Data from descriptive research can be qualitative or quantitative

(Sue and Ritter, 2012). Descriptive research involves gathering data that describe events and then organizes, tabulates, depicts, and describes the data collection.

Explanatory research primarily aims to explain why phenomena occur and to predict their occurrences in future. According to Sue and Ritter (2012), explanatory research is driven by research hypotheses that define the manner and direction of the relationships between or among variables. Quantitative data are required in explanatory research, as it always the use of a statistical test to establish the validity of the relationships (Saunders et al., 2007).

3.2.3 Research approach

The two main research approaches as illustrated in the research onion are inductive and deductive approaches. Taking the fact that the research will involve the use of theory, that theory may or may not be made explicit in the design of the research, although it will usually be made explicit in the presentation of the findings and conclusions. The extent to which the researcher is clear about the theory at the beginning of the research raises an important question concerning the design of the research. This is whether the research should use the deductive approach, in which you develop a theory and hypothesis (or hypotheses) and design a research strategy to test the hypothesis, or the inductive approach, in which you would collect data and develop theory as a result of your data analysis (Saunders *et al.*, 2009). Inductive approaches are commonly associated with qualitative researches, whilst deductive approaches are more likely associated with quantitative researches. Table 3-2 shows the main differences between the two approaches.

Table 3-2: The main differences between inductive and deductive approach

Deduction emphasises	Induction emphasises
• scientific principles	• gaining an understanding of the meanings humans attach to events
• moving from theory to data	• a close understanding of the research context
• the collection of quantitative data	• the collection of qualitative data
• researcher independence of what is being researched	• a realisation that the researcher is part of the research process
• the necessity to select samples of sufficient size in order to generalise conclusions	• less concern with the need to generalise

Undertaking a research can seem broadly falls into two distinctive approaches that each have their own characteristics: qualitative and quantitative research (Gill and Johnson, 2010). By considering the differences between the two approaches (Table 3-3), Quantitative approach is conductive in nature where the researcher deals with numerical facts, prediction, and testing. Quantitative more extensive review that covers the full range of relevant literature guided very much by the content of the review. It is rare for new literature to be brought in to any discussion (Gratton and Jones, 2010).

On the other hand, in qualitative research, the approach is inductive in nature. Qualitative a briefer overview of the literature and to allow the relevant literature to emerge from the theme developed from the data. The researcher deals with qualitative data and acts as instrument for data collection. The nature of data in qualitative approach are non-numerical and mostly are words, actions and behaviour.

Table 3-3: Differences between Qualitative and Quantitative approaches (Zikmund *et al.*, 2012)

Research aspect	Quantitative	Qualitative
Common purpose	Test hypotheses or specific research question	Discover idea, used in Exploratory research with general research objects
Approach	Measure and test	Observe and interpret
Data collection approach	Structured response, categories provided	Unstructured, frww-form
Research independence	Researcher is uninvolved observer. Results are objective	Researcher is intimately involved. Results are subjective
Samples	Large sample to produce generalizable results	Small sample – often in natural settings
Most often used	Descriptive and causal research design	Exploratory research design

3.2.4 Research strategy

Once the researcher is clear about the research topic, approach and purpose, it is essential to choose the most appropriate research strategy and data collection and analysis techniques. Each strategy can be used for exploratory, descriptive and explanatory research. Creswell also suggests that the research problems and questions should be considered for the selection. (Saunders *et al.*, 2009). Some of these strategies clearly belong to the deductive approach, others to the inductive approach. The research onion model as shown in Figure 3-1 points out number of research strategies:

- experiment;
- survey;

- case study;
- action research;
- grounded theory;
- ethnography;
- archival research.

The researcher adopted the inductive approach to conduct this research. Therefore, the nature of the researcher is likely to be qualitative. Robson (2011) categorised the acceptable strategies for qualitative inquiries into case study, ethnographic study, and grounded theory study. Table 3-4 illustrates Robson's three categories.

Table 3-4: The three qualitative research strategies

Qualitative Research Strategies	Definition	Typical features
Case study	Detailed, intensive knowledge development about a single case, or a small number of related cases	• Single case selection • Study of the case within its context • Use of various data collection techniques, such as observation and interviews.
Ethnographic study	Aims to capture, analyse, and explain how a group, organisation or community live and experience the world.	• Selection of a group, organisation and community • Researcher involvement in the setting • Use of observation
Grounded theory study	Aims to generate theory based on the data collected from the study.	• Applicable to a broad range of phenomena • Mainly interview based • Provides comprehensive recommendations for data analysis and theory generation

Yin (2013) argues that to specify a research method, there are three factors need to considered.

1. Type of research questions
2. Requires control of behavioural events
3. Focus on contemporary events

Yin (2013) identified relevant situations for different research strategies as illustrated in Table 3-5. These strategies are: experiment; survey; archival analysis; history; and case study. For each of these research strategies, different methods are considered to collect and analyse empirical evidence with advantages and disadvantages. All these five strategies can be combined with the three research approaches discussed previously. However, experiment, survey and case study are the three most common strategies.

Table 3-5: Relevant situations for different research methods

Methods	Type of research questions	Requires Control of Behavioural Events	Focuses on Contemporary Events
Experiment	how, why?	Yes	Yes
Survey	who, what, where, how many, how much?	No	Yes
Archival analysis	who, what, where, how many, how much?	No	Yes/No
History	how, why?	No	No
Case study	how, why?	No	Yes

An experiment strategy is conducted when the purpose is to study causal links, whether a change in one variable will cause a change in another dependent variable (Hakim, 2000). More complex experiment researches may also consider the change of variable of two or more independent variables (Saunders et al., 2007). They further argue that experiment strategies are more likely to suit both exploratory and explanatory research, however, this is something that Yin (2009) disagrees. A survey strategy, in contrast to

experiment, is more common in business and management research. They are popular as they allow data collection from a large population, often obtained by using questionnaires, which could be analysed quantitatively. Finally, case study as a research strategy is useful when studying a real life phenomena and when the gain of more in depth knowledge of a phenomenon is vital. According to Yin (2013), case study is particularly useful when studying a phenomenon that cannot be taken out of its context.

3.2.4.1 The Case study as a research strategy

According to Robson (2011), case study is defined as “a strategy for doing research which involves an empirical investigation of a particular contemporary phenomenon within its real life context using multiple sources of evidence”. Eisenhardt (1989) asserted that the case study is a research strategy which focuses on understanding the dynamics present within single settings. Case study research is not restricted to a single source of data, as in the use of questionnaires for carrying out a survey. In fact, successful case studies benefit from having multiple sources of evidence.

Case study research is not restricted to a single source of data, as in the use of questionnaires for carrying out a survey. In fact, successful case studies benefit from having multiple sources of evidence. There are Six common sources of evidence as pointed out by Yin (2013). In fact, it is possible to combinations of any of the available sources. The six common sources in doing case studies are:

1. Direct observations (e.g., human actions or a physical environment)
2. Interviews (e.g., open-ended conversations with key participants)
3. Archival records (e.g., student records).
4. Documents (e.g., newspaper articles, letters and e-mails, reports).
5. Participant-observation (e.g., being identified as a researcher but also filling a real-life role in the scene being studied).
6. Physical artifacts (e.g., computer downloads of employees’ work)

Benbasat *et al.,* (1987) summarised a list of eleven characteristics of case studies as follows:

Key Characteristics of case studies

1. Phenomenon is examined in a natural setting.
2. Data are collected by multiple means.
3. One or few entities (person, group, or organisation) are examined.
4. The complexity of the unit is studied intensively.
5. Case studies are more suitable for the exploration, classification and hypothesis development stages of the knowledge building process; the investigator should have a receptive attitude towards exploration.
6. No experimental controls or manipulation are involved.
7. The investigator may not specify the set of independent and dependent variables in advance.
8. The results derived depend heavily on the integrative powers of the investigator.
9. Changes in site selection and data collection methods could take place as the investigator develops new hypotheses.
10. Case research is useful in the study of "why" and "how" questions because these deal with operational links to be traced over time rather than with frequency or incidence.
11. The focus is on contemporary events.

A single case is often used where it represents a critical case or, alternatively, an extreme or unique case. In addition, a single case study allows to investigate phenomena in depth to provide rich description and understanding. an important aspect of using a single case is defining the actual case. A case study strategy can also incorporate multiple cases, that is, more than one case. The

rationale for using multiple cases focuses upon the need to establish whether the findings of the first case occur in other cases and, as a consequence, the need to generalise from these findings (Saunders *et al.*, 2009). Eisenhardt (1989) argue that both single and multiple case designs can be adopted for exploratory research and allow for cross-case analysis and the extension of theory as they can be used to compare the similarities and differences between cases.

Multiple-case designs allow for cross-case analysis and the extension of theory as they can be used to compare the similarities and differences between cases. Multiple-case studies follow replication logic, meaning that cases are selected for theoretical not statistical reasons (Eisenhardt, 1989). An important step in all replication procedures is the development of a rich, theoretical framework. The framework needs to state the conditions under which a particular phenomenon is likely to be found (a literal replication) as well as the conditions when it is not likely to be found (a theoretical replication) (see Figure 3-2).

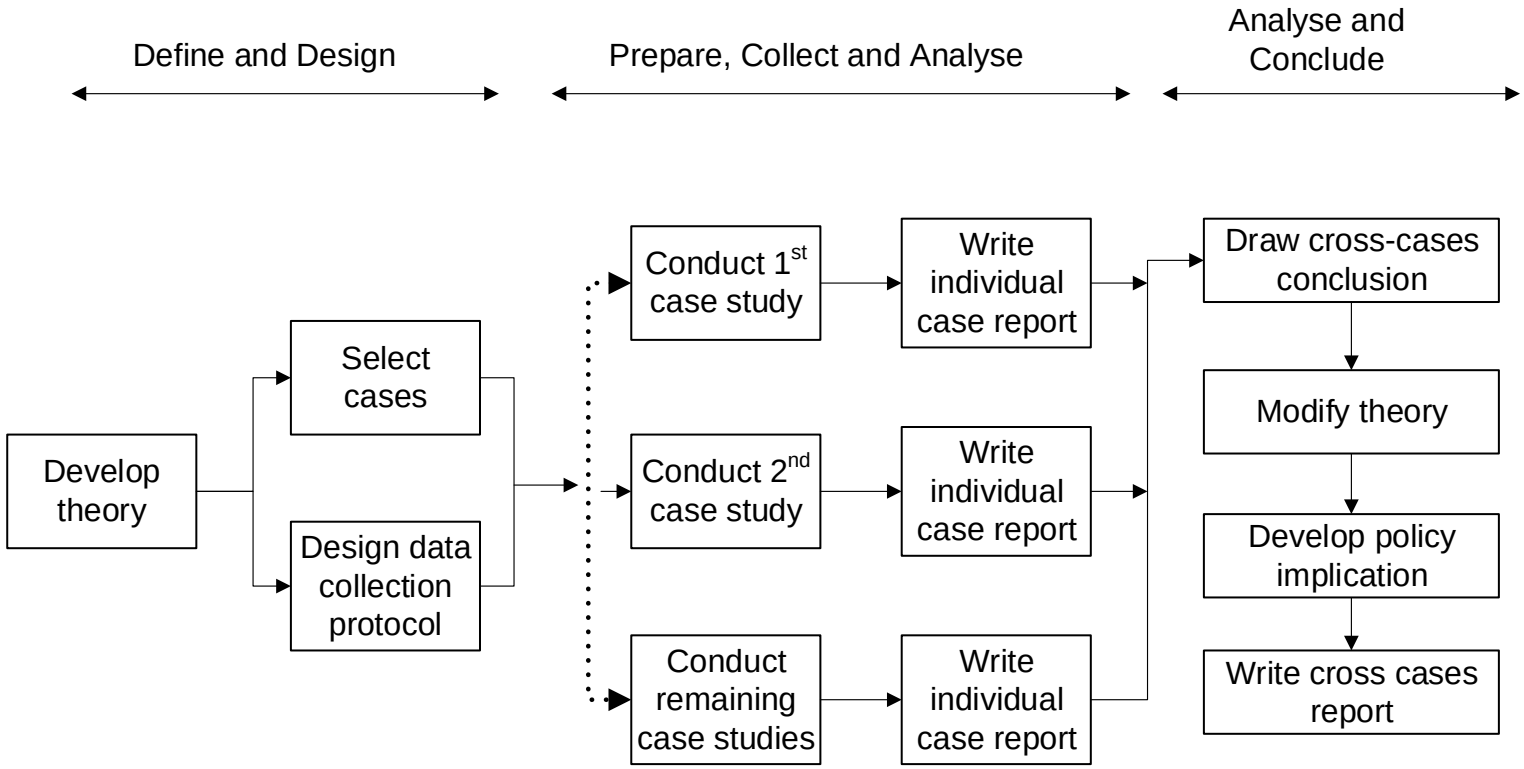


Figure 3-2: Case study method (Yin, 2013)

3.2.5 Research choice

The terms quantitative and qualitative are used widely in business and management research to differentiate both data collection techniques and data analysis procedures. Research choice refers to the way in which the researcher chooses to combine quantitative and qualitative techniques and procedures. According to Saunders *et al.* (2009), the research choice involves the selection of the requires data. Therefore, the research choice would be either mono method or multiple methods (Figure 3-3).

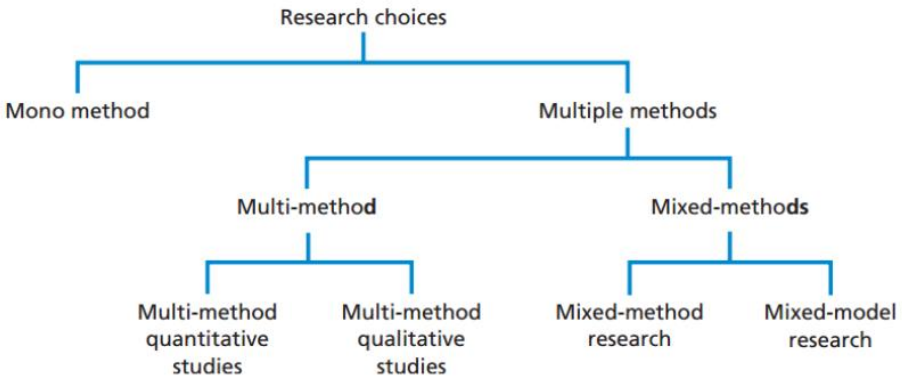


Figure 3-3: Research choices (Saunders *et al.,* 2009)

The mono method refers to the use of a single data collection technique and corresponding analysis procedure or procedures to answer the research question. In such choice, the researcher combines either a single quantitative data collection technique, such as questionnaires, with quantitative data analysis procedures; or a single qualitative data collection technique, such as in-depth interviews, with qualitative data analysis procedures.

On the other hand, in multiple methods more than one data collection technique and analysis procedures can be used. According to Saunders *et al.* (2009), there are four possible choices:

- Multi-method quantitative studies: combinations where more than one data collection technique is used with associated analysis techniques, but this is restricted within either a quantitative or qualitative world view.

The researcher might choose to collect quantitative data using, for example, both questionnaires and structured observation analysing these data using statistical (quantitative) procedures.

- Multi-method qualitative studies: the researcher might choose to collect qualitative data using, for example, in-depth interviews and review of documents and analyse these data using non-numerical (qualitative) procedures.
- Mixed-method research: in this case, both quantitative and qualitative data collection techniques and analysis procedures are used in a research design. It is possible in mixed-method research to use quantitative and qualitative data collection techniques and analysis procedures either at the same time (parallel) or one after the other (sequential) but does not combine them.
- Mixed-method model: this choice involves combinations of quantitative and qualitative data collection techniques and analysis procedures as well as combination of quantitative and qualitative approaches at other phases of the research. In other word, the researcher can collect quantitative data and convert it into qualitative form such as a narrative form or convert a qualitative data into quantitative form.

3.2.6 Data collection techniques

A research choice signifies the choice between a combination of quantitative and/or qualitative data collection techniques. in case study research strategy, Multiple data collection methods are typically employed in case research studies. Ideally, evidence from two or more sources will converge to support the research findings (Benbasat et al., 1987).

Data can be divided into two types: primary data and secondary data (Saunders et al., 2009). Primary data is data collected by the researcher for the purpose of his study. It can be collected by observations or query techniques. Query techniques can be divided into three different approaches: surveys, personal interviews, and telephone interviews. Secondary data is data collected by someone else for a different purpose. The collection of secondary data is often

cheaper and less time consuming than the collection of primary data, but the quality might be slightly lower since it is not as well adjusted for the purpose and it can be out of date.

Yin (2013) argued that the common data source in doing case study are: Direct observations, Interviews, Archival records, Documents, Participant-observation and Physical artefacts. The most popular qualitative data collection techniques tend to be interviews, group discussions/focus groups and observation. Table 3-6 illustrates comparisons between the main qualitative data collection techniques.

Table 3-6: Comparisons between the main qualitative data collection

Interviews	**observations**	**Focus group/group discussion**
Allows researcher to gain insight into attitudes, thought process and behaviour of social actors	Allows researcher to gain insight into the 'bigger picture'	Size enables a range of discussions to be represented
provides in-depth, detailed descriptions of the phenomenon	Enable the researcher to see activities unfold first hand	Generally take place in a central/mutual locations
Allows interviewee to voice opinions of a sensitive nature openly to interviewer	Enable activities to be viewed from the social actors perspectives in its nature	Researcher needs to be able to establish differences between the participants
Conducted in sites specifically arranged for the research	Conducted in field situations of participants	Facilitates views becoming influenced by others

An interview is a purposeful discussion between two or more people and can help to gather valid and reliable data that are relevant to your research question(s) and objectives. Interviews are considered as one of the most important sources of case study data collection. The primary aim of qualitative interviews is to gain an understanding of the research topic from the interviewee's perspective (Robson, 2011). By considering the qualitative

approach adopted by the researcher in this study, interviews are the primary data sources in this study.

Interviews may be highly formalised and structured, using standardised questions for each research participant (often called a respondent), or they may be informal and unstructured conversations. In between there are intermediate positions (Saunders *et al.*, 2009). Robson (2011) categorised the interviews into three types: structured, semi-structured and unstructured interviews. Structured interviews use questionnaires based on a predetermined set of questions. Semi-structured interviews allow the researcher to use a list of themes and questions to be covered. The order of questions may also be varied depending on the flow of the conversation. Unstructured interviews are informal and allow the researcher to explore in depth a general area in which he is interested.

3.3 Research Methods Selection and Justification

3.3.1 The Rationale of the Interpretivism Paradigm

Having explored the different philosophical paradigms and considered the nature of the current research as dealing with the purchasing of product-service systems. The investigation of this research is based on a phenomenon that is rooted in live-work experience. This suggests that knowledge is socially constructed through the interpretations of the major participants in the practices of purchasing product-service systems. Thus the interpretivism epistemological position is adopted to gain an in-depth understanding of social reality through studying people's interpretations and attitudes in purchasing product-service systems. In addition, Saunders *et al.* (2009) stated that interpretivism "emphasises the difference between conducting research among people rather than objects".

3.3.2 The Rationale of the Inductive Approach

This research aims to investigate a human behaviour; which is the purchasing of PSS in real-life, therefore, the researcher adopted the inductive approach which is associated with qualitative methods of data collection and data analysis. The overall topic calls for further exploration, in order to create ideas

and meet the research objectives. In addition, Inductive approach is based on learning from experience. Therefore, the experience of purchasing practitioners best to be investigated in depth based on qualitative data.

Inductive approach starts with the observations and theories are formulated towards the end of the research and as a result of observations. The researcher is interested to understand the behaviour of such organisations that purchase PSS and that can be achieved by observing people actions, events, processes (Goddard and Melville, 2004). Therefore, the inductive approach has been adopted as it fit the aim and objectives of this research.

3.3.3 The rationale of exploratory study

An exploratory study is a valuable means of finding out 'what is happening; to seek new insights; to ask questions and to assess phenomena in a new light' (Robson, 2011). Its great advantage is that it is flexible and adaptable to change. After reviewing the three main categories of research purposes, and recalling the aim and objectives of this research, the research purpose needs to be defined. Basically, very little is known about the purchasing behaviours in the context of Product Serviced Systems (PSS); particularly from a PSS customer perspective. The research begins by reviewing the existing theories in the context of PSS to clarify the concept of purchasing a PSS. As a result, we can see that the exploratory study is most appropriate for the aim and objectives of the research.

3.3.4 The rationale of case study as a research strategy

In order to select an adequate research strategy, the purpose of the study must be taken into consideration. In this research, the research purpose is defined to be exploratory. Therefore, the case study strategy will be of particular interest as the researcher wish to gain a rich understanding of the context of the research and the processes being enacted. The case study strategy also has considerable ability to generate answers to the question 'why?' as well as the 'what?' and 'how?' questions (Yin, 2013). Saunders *et al.* (2009) argues that a case study strategy can be a very worthwhile way of exploring existing theory.

In addition, a well-constructed case study strategy can enable the researcher to challenge an existing theory and also provide a source of new research questions. For this reason, the case study strategy is most often used in exploratory research.

Moreover, this research aims to help PSS customer determine ‘how’ purchasing practitioners behave in practice. The research methods to answer the ‘how’ questions include experiment, history and case study. To achieve the aim of the research, the development of the framework needs to be conducted in an industrial setting. Thus, there is no control of behavioural events. Therefore, the use of Experiment as a research method is eliminated. Additionally, the development requires investigating the phenomenon in a real-life situation. Therefore, history is also eliminated as an appropriate method. A case study is the most appropriate method to be selected to conduct this research. The case study based research will guide the progress of the research to achieve the required objectives.

In the case study strategy, a multiple case studies are adopted. A single case is often adopted where it represents a critical case or, alternatively, an extreme or unique case. A single case may be selected because it is typical or because it provides the researcher with an opportunity to observe and analyse a phenomenon that few have considered before. A case study strategy can also incorporate multiple cases, that is, more than one case. The rationale for using multiple cases focuses upon the need to establish whether the findings of the first case occur in other cases (Saunders *et al.*, 2009).

3.3.5 The rationale of Multi-method as a research choice

By considering the inductive approach adopted in this research as well as the research purpose and strategy, it is essential to decide the way in which the researcher chooses to combine quantitative and qualitative techniques and procedures. The researcher is interested to investigate the purchasing of product-service systems in its real-life, therefore, the required data tend to be qualitative (non-numerical) and combines more than one technique. Multi-method qualitative study uses more than one quantitative data collection

technique and corresponding quantitative analysis procedure or procedures. For these reasons, the multi-method qualitative study is selected.

3.3.6 The Rationale of the Interview Technique

The interview technique argued to be used most often in exploratory studies, particularly in case study strategy. This study uses semi-structured interviews as the primary data collection technique. In inductive approach, interviews are powerful technique to help to generate insights into how respondents see the studied phenomenon (Easterby-Smith et al., 2012).

Gathering data from PSS customers requires deep inquiry to understand how they would deal with such purchasing. Therefore, face-to-face interviews assist the exploration of important occurrences (events, incidents, processes or issues) pinpointed by the interviewee. Saunders *et al.* (2009) confirmed that additional questions may be required to explore the research question and objectives given the nature of events within particular organisations. The nature of the questions and the ensuing discussion mean that data will be recorded by audio-recording the conversation or perhaps note taking.

3.3.7 Research Trustworthiness

Due to the involvement of the researcher and the nature of the subject, there are number of potential issues need to be discussed.

- reliability;
- forms of bias;
- validity and generalisability.

(Patton, 2002) states that validity and reliability are two factors which any qualitative researcher should be concerned about while designing a study, analysing results and judging the quality of the study. Reliability, within a qualitative research context, is concerned with the reliability of the methods and practices used; the data collection methods should be structured and consistent, as well as the research strategy. In addition, reliability is concerned

with whether alternative researchers would reveal similar information and results (Saunders *et al.*, 2009).

Easterby-Smith *et al.* (2012) pointed out that the reliability can be assessed by posing the following three questions:

1. Will the measures yield the same results on other occasions?
2. Will similar observations be reached by other observers?
3. Is there transparency in how sense was made from the raw data?

In this study, the primary data was collected based on interviews. The concern about reliability in these of interview is also related to issues of bias. According to Saunders *et al.,* (2009), there are various types of bias to consider. The first of these is related to interviewer bias. This is where the comments, tone or non-verbal behaviour of the interviewer generate bias in the way that interviewees react to the questions being asked. This may be where the researcher attempts to impose his own beliefs and frame of reference through the questions that he asks. The second to this is interviewee or response bias. This type of bias may be caused by perceptions about the interviewer or in relation to perceived interviewer bias. The interviewee may, in principle, be willing to take part but may nevertheless be sensitive to the unstructured exploration of certain questions. Interviewees may therefore choose not to reveal and discuss an aspect of the topic that you wish to explore, because this would lead to probing questions that would intrude on sensitive information that they do not wish, or are not empowered, to discuss with you(Saunders *et al.*, 2009).

A research study is valid when it is reliable (Robson, 2011). Validity is concerned with whether the findings are really about what they appear to be about (Saunders *et al.* 2009). Robson (2011) also argued that validity of qualitative research concerns its accuracy, correctness or trustworthiness. Robson (2011) has also charted the threats to validity, which provides a useful way of thinking about this important topic. The role of the researcher in conducting a qualitative research has been seen always threats to the research validity and reliability. These threats include the researcher bias, interviewees

bias as discussed above. Therefore, in order to overcome the appearance of such threats, Robson (2011) suggested a number of strategies to deal with these threats as the following:

- Prolonged involvement: refers to the time that the researcher spends within the research setting and participants to understand the situation and trying to create relationships with the participants. In this case the researcher bias may appear.

- Triangulation: refers to the use of different data collection techniques within one study in order to improve the research rigour.

- Peer debriefing and support: involves debriefing sessions with other researchers which leads reduce researcher bias.

- Member checking: involves presenting results and analysis to participants in order to get feedback.

- Audit trail involves keeping a full track and record of all the activities carried out during the research including the collected data and the process of data analysis and results.

- Purposive sampling: offers researchers a degree of control rather than being at the mercy of any selection bias inherent in pre-existing groups.

- Negative case analysis: refining an analysis until it can explain a majority of cases.

The generalisability of a research argued to be a concern particularly when conducting a case study research. The term generalisation is sometimes referred to as external validity. Generalisation in a research concerns whether your findings may be equally applicable to other research settings, such as other organisations (Saunders *et al.*, 2009).

3.4 Research Methodology Adopted

The researcher described the rational of the selection of the research design, approach and methods taking into account the widely accepted approaches that can be found in the literature. The proposed research methodology is represented in Figure 3-4. The research methodology is divided into four phases as the following:

- Research context;
- Research strategy development;
- Data collection and framework development; and
- Validation

3.4.1 Research context

The first phase concerns the understanding of the area of Product-Service Systems and its related concepts. This is to establish the starting point of the research supported by the available data source such as Emerald, Elsevier, Springer Link, Science Direct, and EBSCO. Then, the research problem was identified leading to the identification of the research gap. Therefore, the research aim and objectives were developed. After that, a systematic literature review was conducted to establish the basis of the research. Number of PSS customers' characteristics were captured to help achieving the aim of the research. Then, after reviewing relevant frameworks, the researcher proposed an initial framework.

3.4.2 Research strategy development

After defining the research problem and then developing the research aim and objectives, the researcher was deciding the appropriate researcher strategy to be adopted. By considering the nature of the research and the research question, the researcher investigated the potential research strategies in the literature. Therefore, the research tends to be an exploratory in nature. The research followed an inductive approach which relies on qualitative data collection techniques. The case study was as the most suitable research strategy.

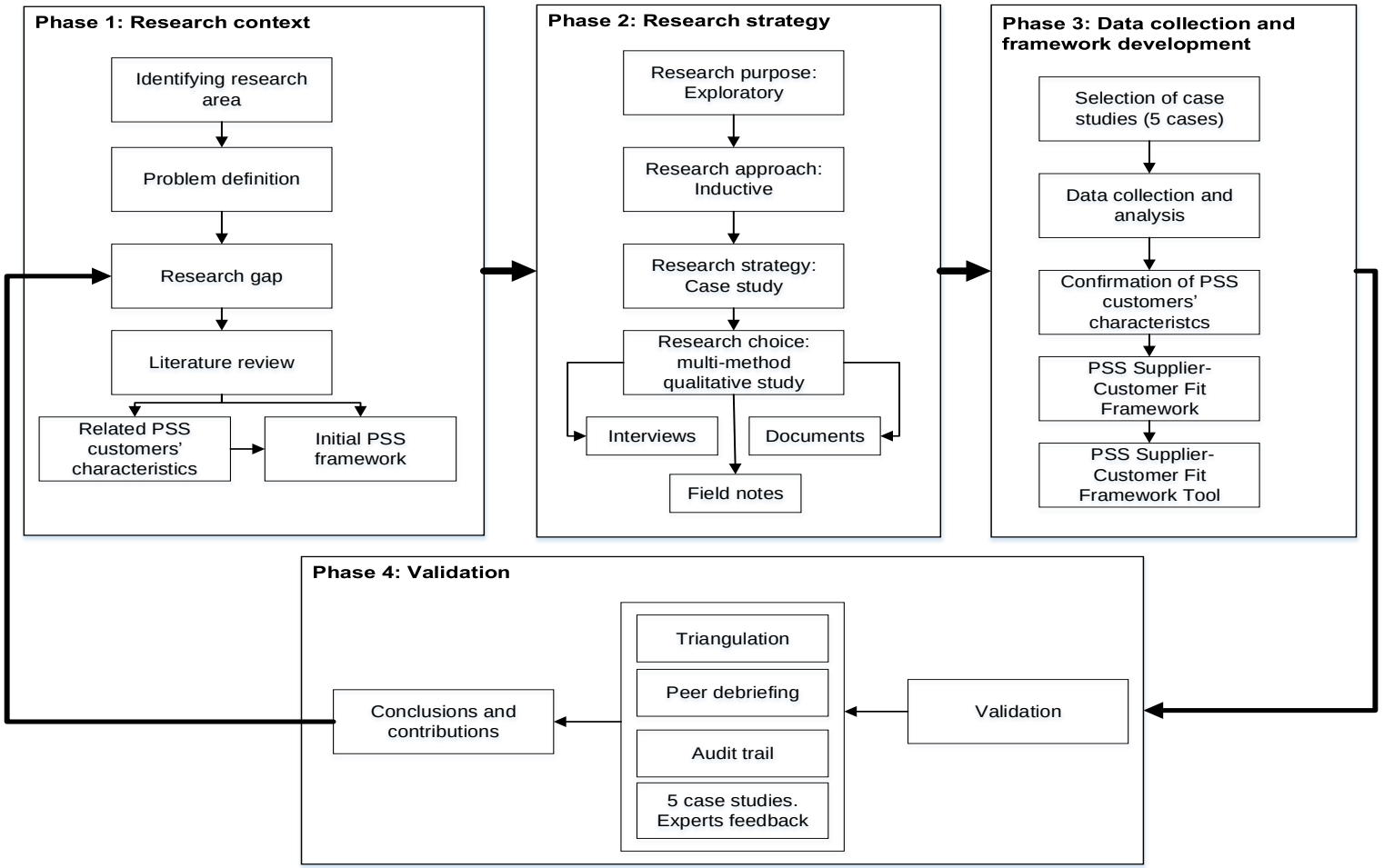


Figure 3-4: Research Methodology Adopted

3.4.3 Data collection and framework development

This phase involves the collection of data from selected organisations. The selection of the organisations was based on specific criteria which represents PSS customers. semi-structured interviews were held with number of key persons in the selected organisations. The researcher also considered other information sources such as the provided documents and the notes taken during the interviews.

The researcher followed a systematic data analysis process, the data analysis involves several steps including data transcribing, translation and coding. The outcome of the data analysis revealed number of decision parameters these organisations considered to purchase PSS. These parameters include the PSS customers; characteristics for each organisation. Those characterises have been reviewed with key persons in each organisation.

As a result, the initial PSS framework was modified to accommodate the emerging findings to present the final PSS framework. Additionally, a framework tool was developed which surrogates the developed framework to be used for the purpose of validation.

3.4.4 Validation

The fourth phase concerns the validation of the final results. This was done by means of qualitative and quantitative assessment. The final PSS framework was validated using common validation strategies such as Triangulation, Peer debriefing and support, Audit trail and Purposive sampling. To ensure the usefulness of the developed framework, the research validated the final results with the collaboration of the five organisations which represent PSS customers. The researcher used the developed framework tool to insure the validity of the framework. The implementation of the tool was based on semi-structured interviews with purchasing practitioners from five PSS customers.

3.5 Chapter Summary

This chapter has set out the research methodology that has been adopted to guide the research to achieve the developed aim and objectives. The available research methods and data collection techniques were reviewed. Then, the rational of the selected research methods and strategy were justified.

4 PSS CUSTOMER CONCEPTUAL FRAMEWORK DEVELOPMENT

4.1 Introduction

This chapter deals with the objective of Phase 2 in the research programme to explore the available frameworks and methodologies that can be useful to help PSS customers in the purchase of a PSS. The development of such framework from scratch would be difficult and costly in terms of time and effort (Becker et al. 2009). In fact, it is not reasonable to develop a framework if it already exists in the literature; that is actually the reason behind identifying the gap in this research in the early stage of this research. The development of the framework was based two stages, first by reviewing the relevant PSS frameworks and methodologies in previous studies to gain a clear insight of the development of the required framework. moreover, purchasing processes were reviewed to support the development of the framework. The second stage was the excision of case studies. This stage was achieved by selecting five organisations and conducting interviews with key persons in the purchasing of PSS.

4.2 The Development of PSS Conceptual Framework

The term “conceptual framework” has been widely used by researchers; therefore, it would be necessary and useful to identify the definition of conceptual framework. Miles and Huberman (1994) stated that “A conceptual framework explains, either graphically or in narrative form [diagrams are much preferred], the primary things to be studied - the key factors, constructs or variables - and the presumed relationships among them”.

On the other hand, Jabareen (2009) defines a conceptual framework as ‘a network, or a plane, of interlinked concepts that together provide a comprehensive understanding of a phenomenon or phenomena’. A conceptual framework hence, is illustration of linked and interactive concepts, for a purpose to achieve a goal. Mapping of concepts as a part of a conceptual framework, and typically takes two general forms:

- Process framework; and
- Content framework

Process framework form involves an action flowing through stages, from the starting point to the final output. On the other hand, content framework form, links variables with relationships. Examples of these forms are: an abstract framework, a flowchart, a causal network of variables, and a treelike diagram, and possibly a combination of two types or more (Maxwell, 2008).

The purpose of this chapter is to explore, investigate and understand the state of art of product service systems frameworks. Consequently, it has to better explore existing PSS frameworks and methodologies in the literature as guideline, as well as the findings of the characteristics of PSS in the literature, in order to develop the required framework. Moreover, purchasing processes have been investigated to find out their applicability of purchasing a PSS. Therefore, Phase 2 seeks to answer the following question:

> *What PSS frameworks, methodologies, and strategies exist to help customers adopt PSS?*

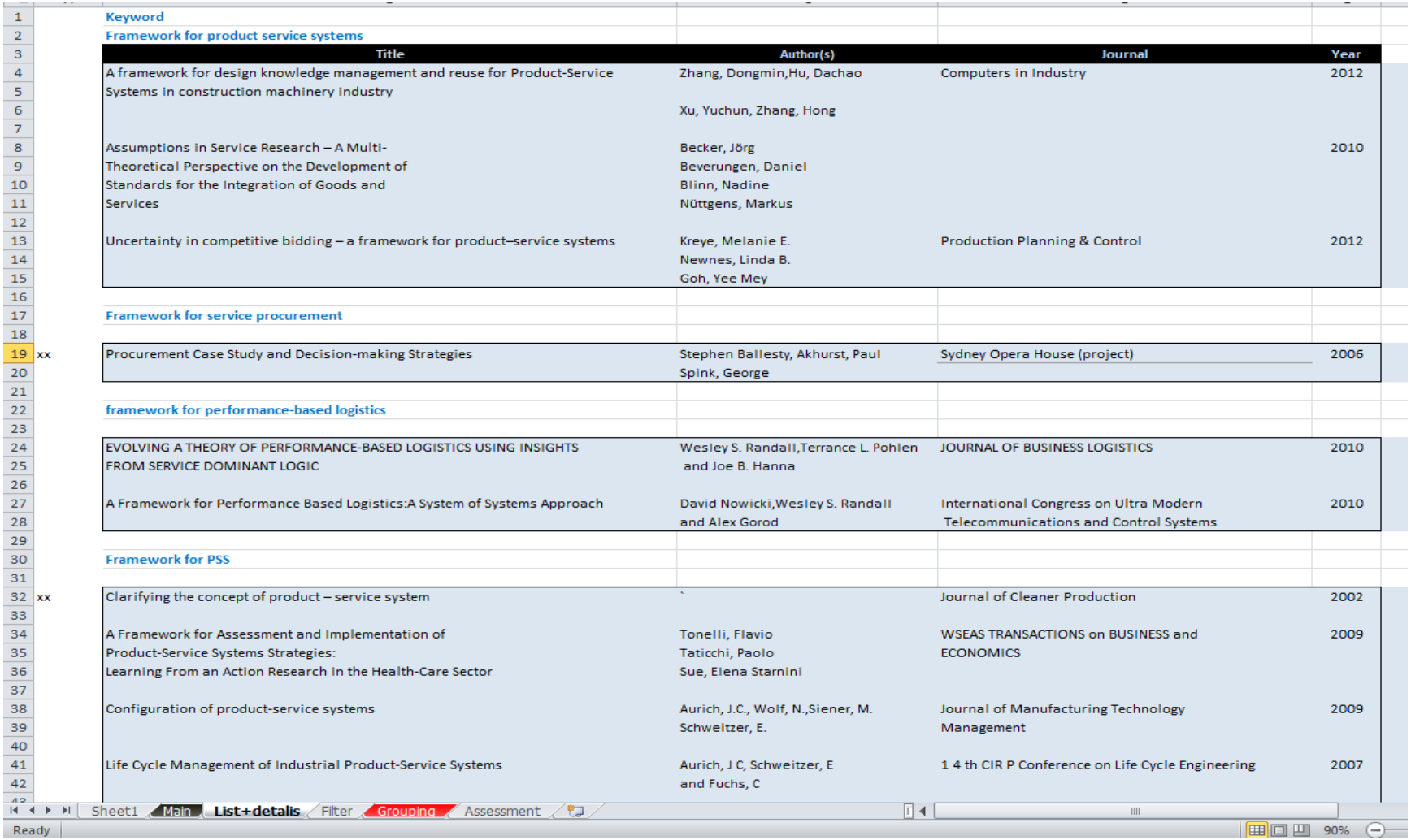
The literature will be investigated to explore the existence of product service systems frameworks or their related concepts and who and what has been studied and what has been considered. It is better to conduct the search based on a search methodology in order to reach tolerable results.

The search strategy was developed by identifying relevant databases of scientific publications, including journals, books and conference proceedings. The search engines used were Web of Knowledge, Scopus, IEEE Xplore, ABI/Inform and Emerald. These were accessed electronically through the university library and Information Services, which redirected the search to a large number of data resources. In addition, a manual search was also conducted, to retrieve papers indexed by Google Scholar. The search did not specify a defined time frame so, in theory, it provided a better coverage of the publications being retrieved.

Several relevant keywords were used to retrieve the relevant papers. The term ‘product service systems’ and its related concepts, such as ‘servitisation’, ‘functional sale’, ‘product bundling’, and ‘industrial product-service system’ have been considered to check the availability of the papers that could provide answers to the questions. Moreover, within the context of the proposed terms, other terms usually associated with PSS, such as ‘Outcome Based Contracting (OBC)’, ‘Performance Based Contracting (PBC)’ and ‘full service contracting’ were also considered.

The search has been limited to cover the concept of PSS within the context of B2B articles, focusing on the PSS as a manufacturing and business strategy. Articles not in English, not serving the aim of this research, and not considering customer perspectives, have been excluded. On the other hand, several articles published by key authors in the field (e.g. Baines, Mont, Neely and Tukker), have been considered and added to the final result of the search. Those selected were reviewed by focusing on the title, the abstract and the keywords.

The first round of results showed a large number of articles (thousands) (See Figure 4-1). The items were then cross-checked to exclude papers irrelevant to the aim of the research, time-frame sorted, and filtered to remove redundancy, bringing down the number of papers to 236. By carefully reading the abstracts, the scope and relevance of each paper was checked, leaving 61 papers for further analysis. The papers published from the time the term Product Service Systems first emerged, were examined carefully. The review then focused on PSS frameworks, strategies or models from the point of view of the customers. Eventually, 16 papers directly concerned with PSS frameworks, were deemed key to the research, and subsequently reviewed in great detail as illustrated in Table 4-1.



		Keyword			
		Framework for product service systems			
		Title	Author(s)	Journal	Year
		A framework for design knowledge management and reuse for Product-Service Systems in construction machinery industry	Zhang, Dongmin,Hu, Dachao Xu, Yuchun, Zhang, Hong	Computers in Industry	2012
		Assumptions in Service Research – A Multi-Theoretical Perspective on the Development of Standards for the Integration of Goods and Services	Becker, Jörg Beverungen, Daniel Blinn, Nadine Nüttgens, Markus		2010
		Uncertainty in competitive bidding – a framework for product–service systems	Kreye, Melanie E. Newnes, Linda B. Goh, Yee Mey	Production Planning & Control	2012
		Framework for service procurement			
xx		Procurement Case Study and Decision-making Strategies	Stephen Ballesty, Akhurst, Paul Spink, George	Sydney Opera House (project)	2006
		framework for performance-based logistics			
		EVOLVING A THEORY OF PERFORMANCE-BASED LOGISTICS USING INSIGHTS FROM SERVICE DOMINANT LOGIC	Wesley S. Randall,Terrance L. Pohlen and Joe B. Hanna	JOURNAL OF BUSINESS LOGISTICS	2010
		A Framework for Performance Based Logistics:A System of Systems Approach	David Nowicki,Wesley S. Randall and Alex Gorod	International Congress on Ultra Modern Telecommunications and Control Systems	2010
		Framework for PSS			
xx		Clarifying the concept of product – service system		Journal of Cleaner Production	2002
		A Framework for Assessment and Implementation of Product-Service Systems Strategies: Learning From an Action Research in the Health-Care Sector	Tonelli, Flavio Taticchi, Paolo Sue, Elena Starnini	WSEAS TRANSACTIONS on BUSINESS and ECONOMICS	2009
		Configuration of product-service systems	Aurich, J.C., Wolf, N.,Siener, M. Schweitzer, E.	Journal of Manufacturing Technology Management	2009
		Life Cycle Management of Industrial Product-Service Systems	Aurich, J C, Schweitzer, E and Fuchs, C	1 4 th CIR P Conference on Life Cycle Engineering	2007

Sheet1 | Main | List+detalis | Filter | Grouping | Assessment

Ready 90%

Figure 4-1: Screenshot of search results

Table 4-1: Key publications reviewed

Author	Purpose of paper	Key findings	Source
Datta and Roy (2011)	Supporting PSS manufacturers to configure their operations to deliver effective PSS offering	A set of elements of operation strategies guiding the development of a conceptual framework, a set of operating principles and support processes	International Journal of Operations & Production Management
Horenbeek et al. (2010)	Reviewing maintenance service contracts and business models for better understanding of the important parameters for service contract configuration between service provider and customer.	Framework for maintenance service contract management. The influencing factors and attributes regarding the service strategy for both partners.	Proceedings of the 17th International Working Seminar on Production Economics
Kumar et al. (2004)	Investigating the process of negotiation of a service delivery agreement for a supplier and a customer.	Factors influencing the negotiation process. A conceptual framework for service delivery negotiation process.	International Journal of Service Industry Management.
Kumar and Kumar (2004)	Focusing on performance enhancement through the use of service delivery strategies; critical factors in the marketing of product support and service-related contracts.	Various factors that must be considered when developing the most suitable service delivery strategy for (industrial) customer. A conceptual framework for service delivery strategy development and implementation that considers product characteristics and customer operational/organisational features.	Journal of Business & Industrial Marketing
Stremersch et al. (2001)	An exploratory vision of the factors and conditions that trigger the purchase of a full-service contract, as well as DMU members' roles in this type of purchase.	Most relevant factors that are used by mangers in evaluation of maintenance and service contracts. A theoretical framework for a full service contract that focuses on purchasing services contracts, rather than service delivery performance.	Industrial Marketing Management.
Aurich et al. (2009)	Addressing the integration of physical and non-physical PSS components to conduct a	A configuration model describes the process of PSS configuration (four steps). Framework for	Journal of Manufacturing

	systematic configuration of PSS.	PSS-configuration consists of seven elements.	Technology Management
Meier et al. (2010)	Investigating the integration of products and services for industrial customers	Various aspects and dependencies of the IPS^2 delivery and use phase. IPS2 delivery and use framework.	CIRP Annals - Manufacturing Technology
Roy and Cheruvu (2009)	Studying the competitive opportunities for better offering of IPS^2 in business to business context.	Various factors to offer IPS^2. A competitive IPS2 framework.	International Journal of Internet Manufacturing and Services
Van Halen et al. (2005)	Formulating a systematic strategy towards a successful and sustainable new PSS for companies.	A handbook for companies provides guidance and practical assistance to plan a PSS innovation project. Methodology for Product Service System Innovation (MEPSS) and toolkit for a successful implementation for a new PSS.	Royal Van Gorcum .Supported by the European Commission under the Fifth Framework Programme
Maxwell and Van der Vorst (2003)	Focusing on a more sustainable approach to product design and manufacturing.	Practical guidance to businesses on how to develop sustainable products and services. Proposed a method for effective sustainable product and/or service development (SPSD) in industry.	Journal of Cleaner Production
Luiten et al. (2001)	Investigating new visions of the future for companies to develop new sustainable businesses.	A five-step approach using Kathalys method to propose a sustainable product-service methodology.	Proceedings of the Second International Symposium on Environmentally conscious design and inverse manufacturing,
Brezet et al. (2001)	Focusing on how to support organisations in innovating, with a sustainable improvement in eco-efficiency.	The design of eco-efficient services (DES) methodology was proposed, which involves the exploration, policy formulation, idea finding, strict development, realisation, and evaluation. They	TU Delft for the Dutch Ministry of Environment, Delft.

		also proposed appropriate tools for each step, from scenario planning tool to blue-printing	
Aurich et al. (2006)	Aiming to study the technical contents of PSS and its significant impact on the entire product lifecycle.	Suggested a lifecycle oriented method for a systematic design for a PSS. They stressed the importance of the content of the technical PSS (such as maintenance, retrofitting, refurbishing and user training) as type of PSS, and argue that these technical contents have a significant impact on the entire product lifecycle and must be considered in the design process	Journal of Cleaner Production
Mont (2001)	Studying and analysing opportunities, drivers and barriers in companies for introducing and developing innovative and marketable product-service systems.	Development of a PSS depends on the product characteristics, organisational structure, chain actors, network support and infrastructure in place. Step-by-step methodology based on the Deming cycle was proposed.	IIIEE, Lund University
Tukker and Halen (2003)	Helping companies to discover the added value of PSS business models.	A manual for PSS innovation scan for industry. Six steps in the innovation scan were proposed with tools for each step.	Manual. TNO- STB, Delft, Utrecht, Netherlands.
Maussang et al. (2009)	Providing engineering designers with technical engineering specifications in relation to the whole system's requirements, as precise as possible for the development of the physical objects involved in those systems.	Various elements can influence the design and the development of PSS (benefits for customers and providers, elements of solutions, environmental and social consideration). A methodology to support engineering designers during the development process was proposed.	Journal of Engineering Design

4.2.1 PSS Frameworks and Methodologies

Products and services are two intrinsic components in a PSS offering (Davies et al. 2006; Oliva and Kallenberg, 2003). Therefore, the adoption of PSS has been seen as a challenge, as companies need to identify the required changes in their business (Meier and Massberg 2004). For a successful shift towards a PSS, providers need to make significant changes in their organisations at all levels; to move from product thinking to system thinking (Baines *et al.*, 2007). However, this transition could not be done successfully, unless consideration is given to a well-designed PSS to encourage the customers considering the PSS offerings. As a result, industries need assistance in terms of approach and tools to be adopted by the manufacturers.

Distinguishing the importance of PSS design, as the design stage determines the characteristics and the quality of the PSS (Hara *et al.*, 2009), a number of methodologies developed to support PSS industries, have prompted a shift towards the new business model. These methodologies may differ in the scope, but share the same target. In the process of transformation towards PSS, industries require support, in terms of tools, techniques and methods. (Manzini, 1999) is one of those scholars who claimed to adopt a strategic design for sustainability, by applying a design perspective on how firms can move from a traditional product-oriented approach, to a new product-service.

The concept of PSS has been argued to be a methodology for designing a model from economic, social and environmental perspectives (Komoto and Tomiyama, 2009). Maussang et al. (2009) claim that the number of elements influencing the development and design of a PSS need to be considered; these include organisation stakeholders, the obtained benefits for the PSS supplier and customer, elements for solutions, and environmental and social aspects. Therefore, to avoid insufficient consideration of the mutual influences of the products and services, the development of PSS requires that services and products must be developed in one coordinated development process (Wang *et al.*, 2011). In order to design a PSS, it is necessary to have full and clear knowledge of the product and its life cycle, providing customers with the ability

to link the technologies to the cultural dimensions (Tan and Mcaloone 2006; Manzini 2003).

In comparison to the development of physical products, the development of PSS actually differs, as the components of the service in the PSS characterise the PSS offering, especially when considering components such as social behaviour, communications, culture and time (Morelli, 2006). One of the development methodologies for PSS is the Methodology for Product Service Systems (MEPSS), which is the deliverable of a European Commission funded programme, which supports industry by providing a methodology and tools, to create new product-service offerings (Van Halen *et al.*, 2005). MEPSS is a general methodology which has its structure based on five steps (namely; strategic analysis, exploring opportunities, PSS idea generation, PSS concept design; and development and implementation of PSS project), which cover the new service development process phases and involves various techniques and tools (Bandinelli and Gamberi 2012). Aurora and Roche (2013), however, argue that the MEPSS focus mainly on generating a new PSS idea, and therefore, the development of the existing PSS needs to be considered. As a result, the Transition along the PSS Continuum (TraPSS) methodology was subsequently proposed by Aurora and Roche (2013). TraPSS is similar to MEPSS but with the addition of three components.

In the automotive and the computer industry, Maxwell and Van der Vorst (2003) proposed a methodology for effective implementation of a sustainable product and/or service development (SPSD) that delivers practical guidance to businesses on how to develop sustainable products and services. Brezet et al. (2001) proposed the design of eco-efficient services (DES) methodology which involves the exploration, policy formulation, idea finding, strict development, realisation, and evaluation. They also proposed appropriate tools for each step, from a scenario planning tool to blue-printing. Luiten et al (2001) used Kathaly's method to formulate a five-step approach to propose a sustainable product-service methodology. Arguably, these steps can assist PSS manufacturers to achieve their PSS strategy. The proposed approach consists of five project

steps: future exploration, system design, product/service specification, drawing in detail and testing, and implementation (Luiten *et al.*, 2001).

Aurich et al. (2006a, 2006b) suggested a lifecycle oriented method for a systematic design of a PSS. They stressed the importance of the content of the technical PSS (such as maintenance, retrofitting, refurbishing and user training) as a type of PSS, and argue that these technical contents have a significant impact on the entire product lifecycle, and must be considered in the design process. Moreover, Mont, (2001) suggested that a PSS may be developed in a step-by-step approach, based on the Deming cycle. The innovation scan for PSS has been proposed by (Tukker and Halen, 2003). They introduced a detailed step-by-step approach to identify a new concept in PSS and to help find added value. Maussang et al. (2009) developed a design methodology for PSS that can help engineers create additional added values, by stressing the joint development of physical objects with service components.

A number of frameworks exist to support product/service providers to achieve their goals in the marketplace. Such frameworks have been noted by several scholars, which highlight the way in which these frameworks are viewed from the business and engineering perspectives. The frameworks were developed to serve different focuses, e.g. product development, service engineering, engineering processes and technology. The focus of these frameworks is influenced by the area and the purpose of the research.

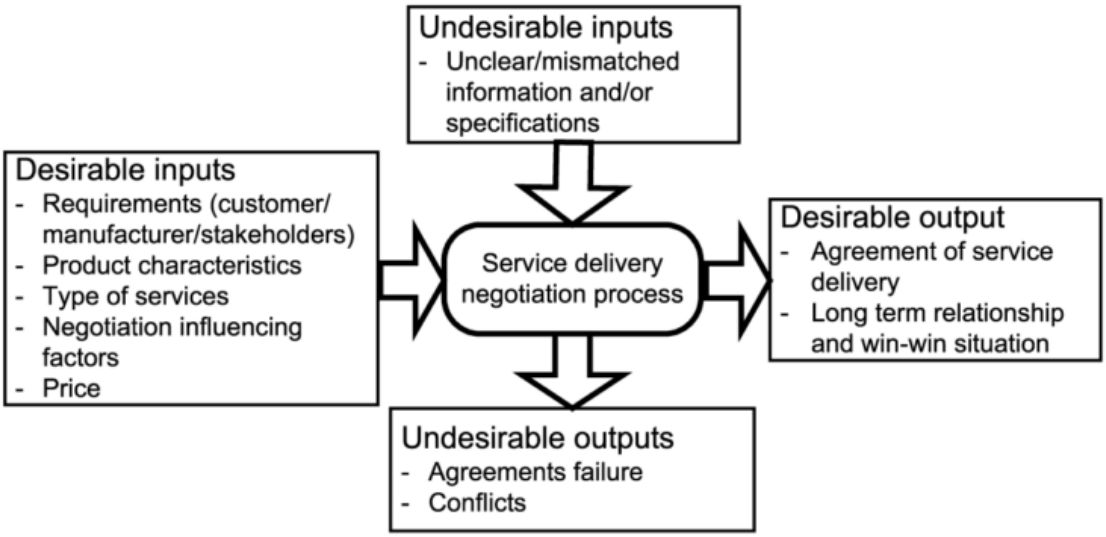


Figure 4-2: A conceptual framework for service delivery negotiation process (Kumar et al., 2004)

Kumar et al. (2004) developed a conceptual framework for the service delivery negotiation process, to ensure delivery of the services, based on the customer requirements. The proposed framework as shown in Figure 4-2 is based on the negotiation process between the PSS provider and the customer that delivers a service agreement and required customer cooperation. The negotiation process helps both parties to define the service specifications, such as, what service is to be delivered and how. The key enablers for the negotiation process include scope of work, price, operational requirements, training, payment methods, product reliability and spare parts and maintenance tasks. During the design of the package, customers need to evaluate this package, so that any undesirable output can be avoided (Kimita *et al.*, 2009).

Progressively, product/service providers are turning their attention to full-service contract. In cases where customers seek to purchase a complete system, full-service contracts offered by PSS providers, need to be to be considered. Purchasing full-service contract requires decision makers ability to evaluate the full-service contract, to ensure the suitability of the contract to their needs (Stremersch *et al.*, 2001). In addition, Datta and Roy (2011) identified the key operational strategy to effectively deliver PBC. This strategy includes four major

dimensions: contract definition, service provider operations strategy, service delivery strategy, and customer operations strategy. Their proposed framework links these four dimensions with their elements, which are defined as: incentives, performance measures, organisational readiness, co-production and information (Figure 4-3). Additionally, the external environment has been identified as a significant element in the success of the operational strategy.

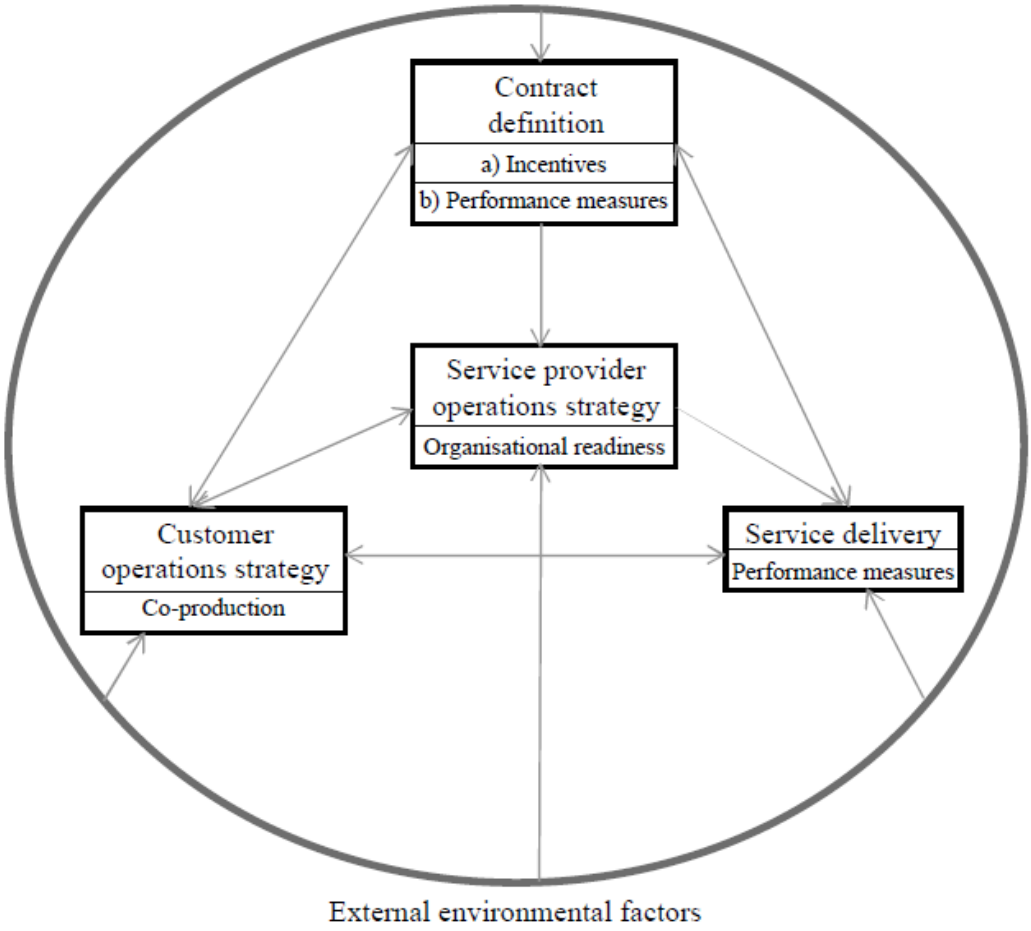


Figure 4-3: Performance-based contract operations strategy conceptual framework (Datta and Roy, 2011)

Horenbeek et al. (2010) proposed a maintenance service contract to configure the relationship between customer and service provider, by identifying the significant parameters in the service contract. Three main parts have been defined, as well as a number of factors and attributes to link the relationship steps between the service provider and service buyer (Figure 4-4). In their

proposed framework, the process of the service contract starts by defining the strategies of service delivery and service reception from both sides, and ends with the delivered service and payment. Based on the previously mentioned attributes of both parties, a number of criteria, such as reliability and maintainability are defined to help reach a decision between both parties, regarding the delivery of the service. The step involving the maintenance service contract analysis, has been constructed to provide an opportunity to service buyers to decide whether a service is required or not, and the best service strategy to select. For the service provider, this step helps to explore the advantages of adding service to the product, as well as the strategy to gain the greatest benefit.

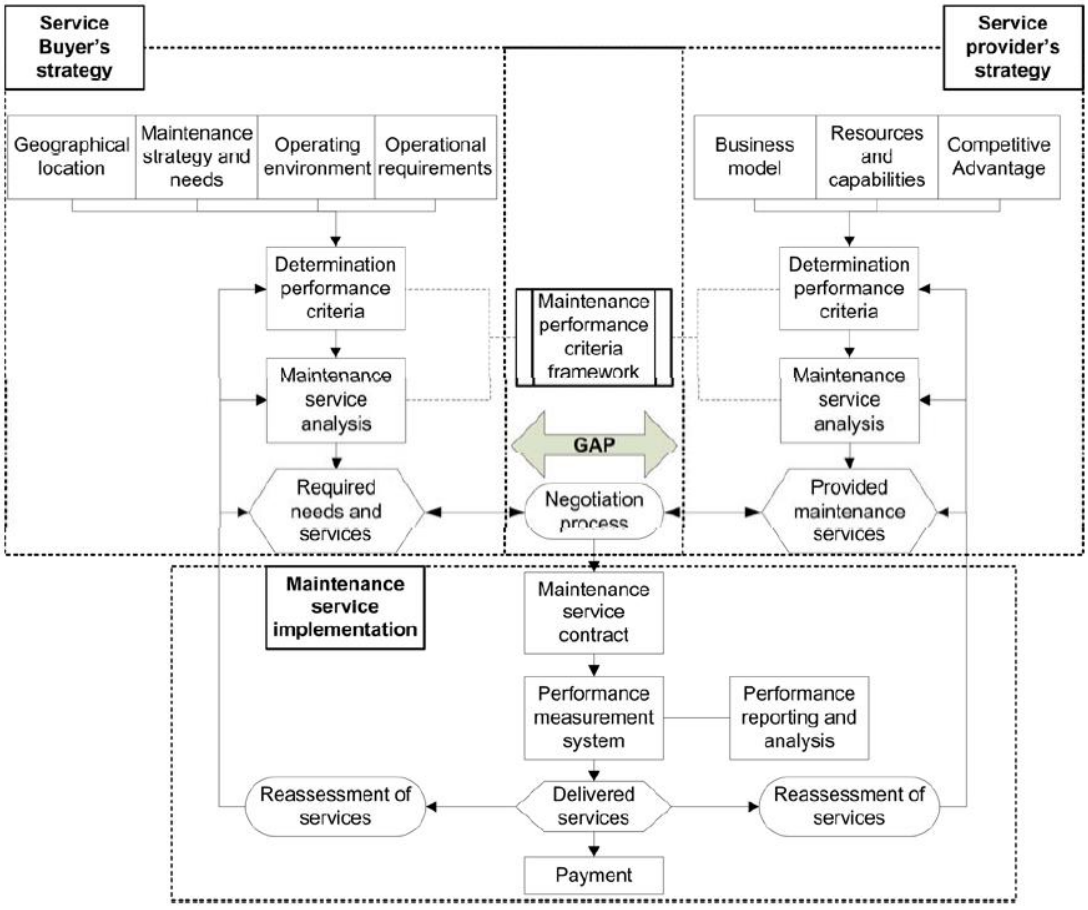


Figure 4-4: A framework for maintenance service contract management (Horenbeek et al. 2012).

PSS customers seek an effective performance, reduction in risk and achievement of their organisational targets, especially when purchasing industrial services to support their systems. Kumar and Kumar (2004) developed a conceptual framework for the development and implementation of service delivery strategy as illustrated in Figure 4-5. They stressed the importance to consider the integration of product characteristics and customer operational futures. They argue that the service reception strategy is influenced by different attributes, such as operational requirements, maintenance strategy and needs, operating environment, and geographical location.

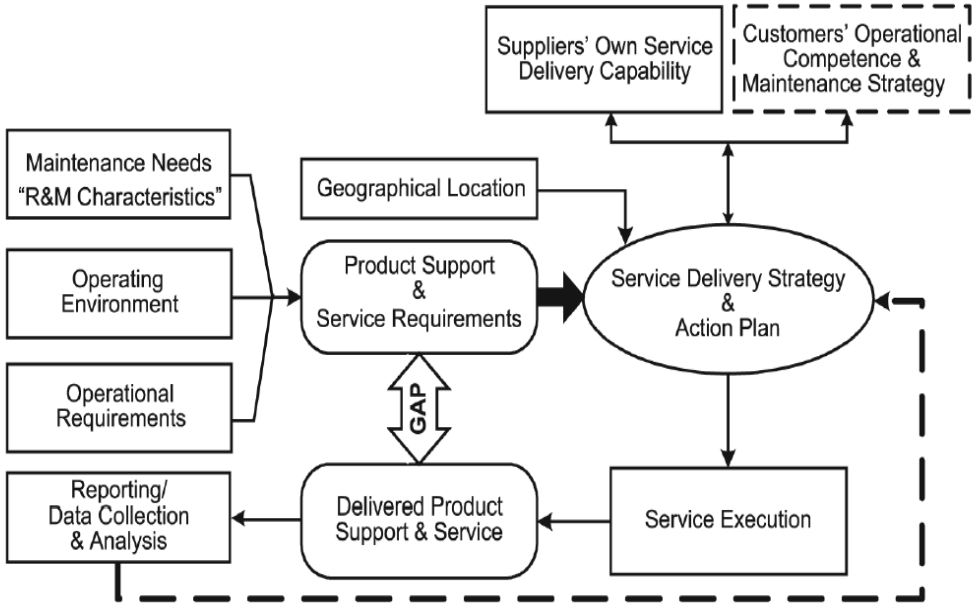


Figure 4-5: A conceptual framework for development of a service delivery strategy (Kumar and Kumar, 2004)

Meier et al. (2010) proposed the framework for the Industrial PSS (IPS^2), by demonstrating various characteristics and needs for the delivery and use phase (Figure 4-6). They argue that integrated PSS requires dynamic adaption to cope with changing customer demands and provider capabilities. They argue that the delivery and use phase of IPS^2 is influenced by the PSS model, contracts, customers and knowledge.

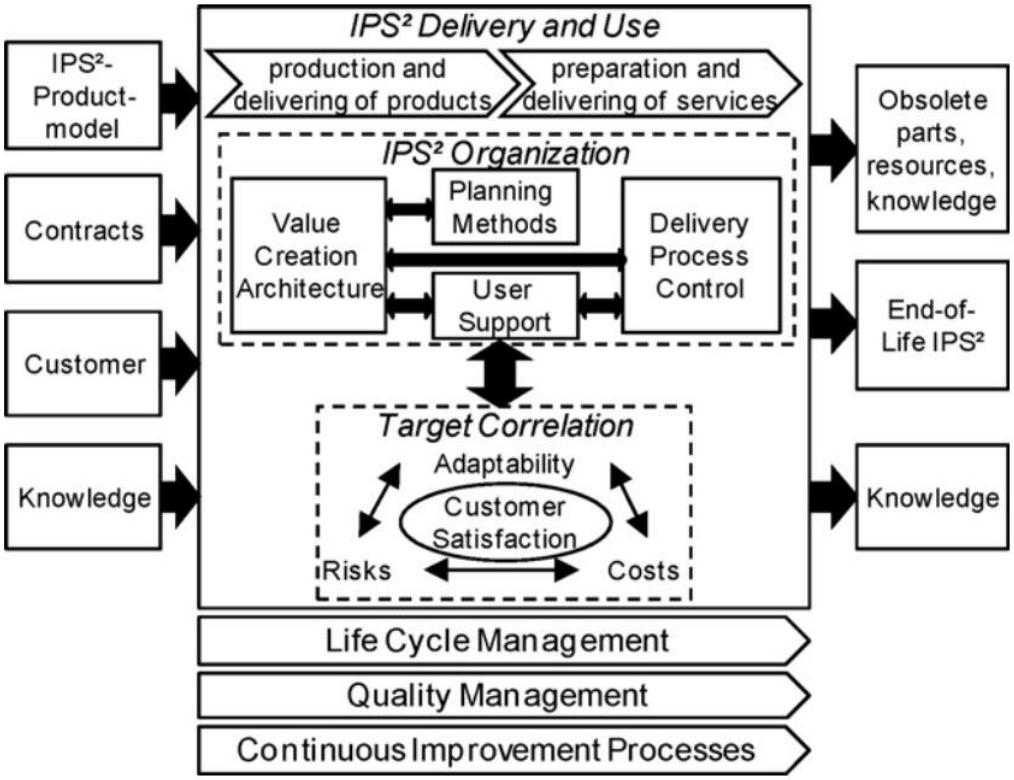


Figure 4-6: IPS2 delivery and use framework (Meier et al, 2010)

Furthermore, Roy and Cheruvu (2009) proposed a framework for PSS to sustain customer value. They looked at various drivers to design competitive industrial product service offerings. These drivers are identified as: customer affordability, revenue generation opportunity, global competition, technology development and environmental sustainability. Aurich et al. (2009) proposed a framework for a systematic configuration of PSS, comprising seven elements collated into three groups as shown in Figure 4-7. The first group involves the analysis of the physical product and service and life cycle. The influence of the product life cycle on physical products, as well as the impact of service on physical products is then determined. The last group of elements involves the formation of the technical configuration and the service configuration together, to produce a tailor-made PSS for specific needs.

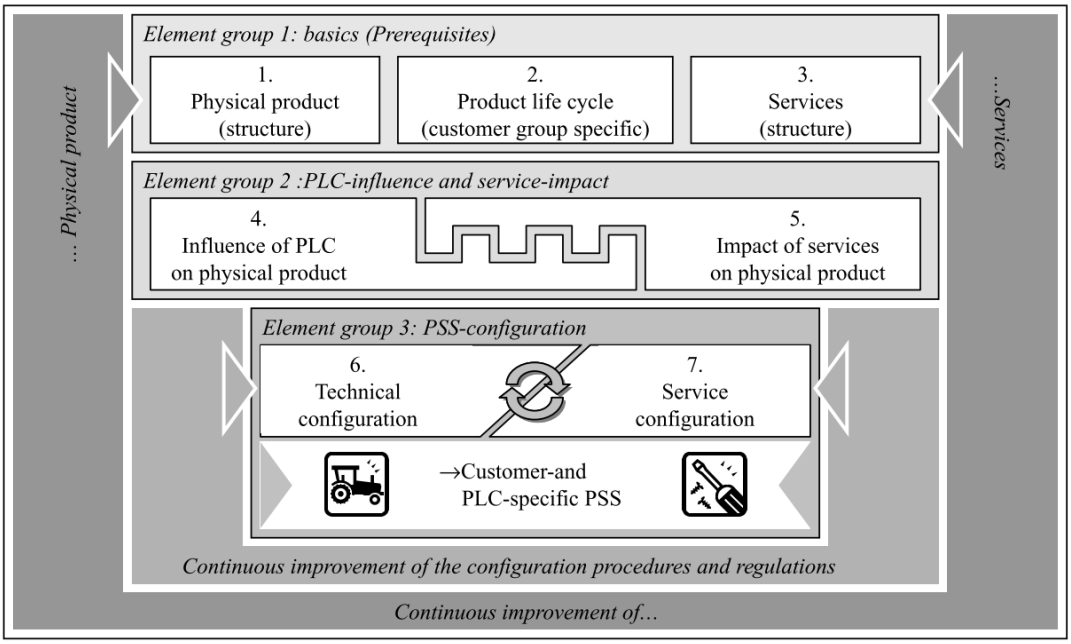


Figure 4-7: Framework for PSS-configuration (Aurich et al, 2009)

There exist numerous methodologies and frameworks for developing PSS. The majority of the frameworks were developed primarily to support the needs of PSS providers along their 'servitisation' journey, for instance, to plan, design and execute a PSS contract. However, those frameworks are not ready to use, hence unsuitable for the customers of PSS. As customer is a key stakeholder in PSS, the availability of PSS frameworks that assist the customers of PSS to select, configure or even negotiate with their PSS providers, is imperative.

4.3 Purchasing Processes

In this section, as this research concerns the purchasing of PSS, it is worth investigating the concept of purchasing. The purchasing activities involve different and related processes, such as need determination, supplier selection, order, and evaluation (Van Weele, 2005). Though, the purchase process differs from one organisation to another in terms of the steps and action; this is duo to the influences of several factors, such as the buying situation, organisation size, type of product Wind and Thomas (1980). Robinson et al. (1967) argue that the importance of purchase, as well as the experience of the buying centre members, plays a significant role in the complexity of the purchase process.

One of the original purchasing models has been introduced by Robinson et al. (1967). They proposed a sequence of actions frequently performed by an organisation for the buying process in B2B market. Although these buying decision phases are ordered sequentially, it is difficult to be operationally differentiated. The involvement of buying centre might be present in more than phases.

Similarly, Webster and Wind (1972) investigated the organisational buying behaviour and how it is affected by several influencers. They identified four classes of variables that influence the organisational buying behaviour at which: environmental influencers, organisational influencers, social influencers, and individual influencers. However, the presented buying process consists of five sequential phases. These phases are:

1. Identification of need
2. Establishment of specifications
3. Identification of alternatives
4. Evaluation of alternatives
5. Selection of suppliers

According to Van weele (2005), the process of purchasing involves number of interrelated activities; this includes requirement planning, inventory management, and purchasing operation. The purchasing function however covers number of linked activities, which are responsible for:

- Determining the specification of the goods and services (quality and quantity)
- Supplier selection
- Purchasing contract
- Placing orders
- Expedite
- Follow up and evaluation (update, supplier rating and ranking)

Van Weele (2005) argues that the illustrated activities are interrelated and within the purchasing function, and considered to be operational, tactical and strategic activities. On the other hand, Kakouris, Polychronopoulos and Binioris (2006) proposed five phases in the purchasing process for a successful

purchasing and outsourcing decision for a firm. These phases methodologically grouped into five key documents (Feasibility study, Decision criteria, Service definition, Service level agreement contract, and Review procedure).

- Initiation phase: includes the firm's identification for its requirement in terms of products and services.
- Planning phase: involves the determination of the purchasing criteria that must be considered to assess the requirements against the potential suppliers.
- Qualification phase: involves the process of assessing the qualified suppliers identified in the planning phase. This process starts with the definition of a set of suppliers.
- Winning phase: after completing the previous phases, a contract is given regarding the future supplier. The supplier must validate the performance level that is required.
- Monitoring and review phase: this phase involves the regular performance review of the supplier against the agreed performance level.

Purchasing of capital equipment and services has been studied by Johnston and Bonoma (1981), who identified five dimensions of the buying centre in an organisation. These dimensions respectively were: lateral and vertical involvement, extensively, connectedness, and the centrality of the purchasing manager. They demonstrated how the functions/people involved in interactions with suppliers vary with the novelty, complexity and importance of a purchase. However, the purchasing process identified by Johnston and Bonoma (1981) as:

- Need recognition
- Specification
- Approval of purchase
- Supplier search and proposal evaluation
- Selection of supplier
- Formalisation (negotiation and contracting); and
- Evaluation of performance

Choffray and Lilien, (1980) present a methodology for segmenting industrial markets on the basis of functional involvement in phases of the purchasing decision process. The industrial purchasing process is complex and requires involvement from the decision making unit with different responsibilities. However, they identified five major phases in the purchasing process for industrial cooling systems:

- Needs evaluation and requirement specification
- Budget approval
- Alternative search/bid list
- Product and supplier evaluation
- Product and supplier selection

From service perceptions, Van der Valk and Rozemeijer, (2009) proposed a purchasing decision process by extending the traditional process of Van Weele (2005). They explored the differentiation between buying goods and services. Consequently, they argue that determining service specifications is more difficult that goods specifications. This is due to service characteristics such as intangibility. The purchasing service requires greater collaboration between the buyer and the supplier. However, the proposed process is similar to the proposed process by Van Weele (2005), but with the addition of two more steps; request for information and detailed specification.

Although the purchasing processes involves several practices, it shares similar segmentations. During the purchasing process, the buyer measurement identifications vary with regard to the attitude of the buyer (Miemczyk et al, 2012). Obviously, the purchasing processes mentioned above from different aspects were inspired by the original model of Robinson et al. (1967). Table 4-2 summarises all steps of the purchasing process that are covered in this section. The Table shows many similarities in the purchasing processes. Although several authors proposed their processes in different manner, some steps are integrated in some way.

Table 4-2: Summary of purchasing processes

Author (date)	Identification of problem and needs	Identification of specifications	Description of specifications and quantity	Detailed specifications	identification of decision criteria	Budget approval	Search for sources/alternatives	Obtain of proposals	Evaluations of alternatives	Product evaluation	Negotiation and contracting	Selection	Order	Expediting	Monitoring, feedback and evaluation
Robinson et al, (1967)	X	X	X				X	X	X			X	X		X
Webster and Wind, (1972)	X	X					X		X			X			
Van Weele (2005),		X							X		X	X	X	X	X
Kakouris et al., (2006)	X				X				X			X			X
Johnston and Bonoma (1981)	X	X				X	X				X	X			X
Choffray and Lilien, (1980)	X	X				X	X		X	X		X			
Van der Valk and Rozemeijer , (2009)		X	X	X			X		X		X	X	X	X	X

4.4 Decision Parameters for Selecting PSS Offers

Given the context of PSS, selecting the appropriate purchase means selecting the right supplier, as the customer evaluates the performance of the supplier as well as the offered values of the purchasing (Pressey *et al.*, 2009). PSS as a combination of tangible and intangible components, could make it difficult to evaluate and select the best purchase. These components actually define the features of the offerings to be seen by the customer as measurable attributes (Hallikas *et al.*, 2014). PSS customers draw careful attention to the parameters they rely on to make the appropriate decisions and such parameters play a major part to determine the success of the purchasing results. It should be noted that decision parameters for buying PSS are not explicitly mentioned in the literature. The sensible approach taken in this case is by deducing information from various papers, especially those describing the adoption of PSS or possible PSS purchasing scenarios. Practitioners attach great significance to the procurement practice for several reasons. In the globalisation of the competitive market, the decision-making process has been seen as a way to mitigate the supply risk (Micheli, 2008).

Manufacturers offer high quality products and services, and therefore customers require the appropriate strategy to select the suppliers that are attentive to the customer's needs and competencies (Ordoobadi and Wang 2011). In selecting a supplier, operational and strategic factors such as delivery, reliability, quality, etc., must be taken into account to ensure a balanced satisfaction between the buyer and the seller (Sarkis and Talluri 2002). Several industrial firms, however, prefer to work together with a particular supplier in a single source relationship (Stremersch *et al.*, 2001). At a time when a customer seeks to acquire a specific product and/or service, a supplier selection process is typically carried out to select the PSS providers. This process requires the assessment of the PSS offers (Ng *et al.*, 2009). Purchasing activity has been discussed widely in the literature and many purchasing phases have been proposed (Robinson et al. 1967; Webster and Wind 1972; Valk and Rozemeijer 2009).

Kotteaku et al. (1995) focused on product complexity and its influence on purchasing behaviour, and identified that the purchasing process is carried out through four phases. The first phase is *initiation*, which starts with purchase planning, the required specifications and estimated price. The second phase is *search*, which involves the investigation of possible suppliers and sources. The third phase is *selection*, which is the process of selecting the appropriate supplier, based on a number of criteria (supplier evaluation, price, etc.). The fourth phase is *completion* and this includes ordering, delivering and inspection of the product. The final phase could be in a form of *contractual* signing.

However, from the customer perspective, the customer decision-making process, involves several factors which motivate and influence the purchasing decision (Mont and Plepys 2003). Stremersch et al. (2001) suggest a number of parameters and factors in purchasing a full-service contract that shape such long-term agreements. These parameters include depth of the contract, detail of information, supplier reputation, total costs and supplier performance. However, in the development of a service delivery strategy for industrial systems and products, Kumar and Kumar (2004) assert that product support and customer support, are essential factors in the delivery process. Furthermore, the negotiation process described by Kumar et al. (2004) is one of the successful keys to reach an agreement between the customer and the provider. Good communication between both parties is required, to manage the negotiation phase, prior to the final agreement.

4.5 Analysis and Discussion of Results

The objective of this section is to provide an analysis of the obtained results from the investigation of PSS framework and methodologies, and purchasing process. The analysis focuses on the relationship between the PSS framework and customers' characteristics. Also, the applicability of the existing purchasing process is presented. As the aim of this research is to develop a framework to help customers in the purchase of a PSS, an initial framework is developed as a basis of the ultimate PSS framework.

4.5.1 The relationship between customer characteristics and PSS framework

Customer characteristics have been identified in Chapter 4 to understand the behaviour of the customer when purchasing a PSS. Customer characteristics play a key role in the process of the adoption of PSS from the customer's perspective, as well as the development of a PSS framework. This is because customer characteristics determine the current and future requirements of the customer. With respect to PSS providers, product and service modelling is one of the major tasks for a successful PSS offering, and this offering is usually oriented to the global market demand, and in some cases to fulfil a specific customer requirement. For instance, oil and mining industries, seek to acquire advanced machineries to execute their production and exploration tasks. In such cases, the product/service provider realises the limited customer ability to operate and/or maintain such machinery, and therefore, customers prefer to purchase the function or capability of the product, rather than own it.

Existing PSS frameworks are often developed by the manufacturers themselves and not by the customers. PSS providers look at this business model from a different angle, which aims to deliver their product and acquire service contracts. Therefore, in terms of the PSS framework developed for the negotiation process of the service delivery, one of the main drivers in this framework is the customer requirement. Customer requirements determine the needs, due to e.g. lack of manpower, resources and know-how. PSS providers use these customer characteristics to develop PSS frameworks to achieve their benefits. However, customer characteristics determine the shape of the suitable PSS from several aspects. For instance, with the example of photocopying machines provided by Xerox, the customer found it more appropriate, not to own the machines, but rather, to just have use of it.

4.5.2 Findings on purchasing process

The purchasing process starts commonly with the recognition of the problem and the identification of needs for product or service; this could be derived from the demand of the organisation or a solution to a problem and requires an

extensive flow and exchange of information among the involved members, as well as adequate communications (Kakouris et al., 2006). This step is influenced by the members of the buying centre and may involve several of its roles (McWilliams et al. 1992; and Robinson et. al. (1967). The type of situation (straight rebuy, modified rebuy, new buy) significantly impacts the identification of needs (Robinson et al., 1967). Webster and Wind (1972) argue that the purchasing process is a form of a problem solving, which starts with the recognition of the problem.

Likewise, Kakouris et al. (2006) consider the identification of needs as the preliminary step in the purchasing process for products or service. They argue that the requirement of good communication within the buying centre is extensive. Additionally, a feasibility study plays a key role to identify the probable benefits and costs, as well as the expected risks.

Johnston and Bonoma (1981) studied the purchasing process for capital equipment and services and defined the initiation phase as the trigger in the purchasing process. They found that the firm must recognise the need by investigating the reason behind that; this could be machinery replacement, production capability expansion, emergency replacement, environmental governing requirements or new requirements (equipment or service). On the other hand, Choffray and Lilien, (1980) see that the initial step in the purchasing process regarding the evaluation of needs, and involves the largest number of buying centre members (decision participants), as well as external participants from the product manufacturer.

Specification of the desired product or service is an essential part of the purchasing process. In fact, service specifications are very difficult design, due to their intangible nature, and the content of the service needs to be identified before it is acquired (Valk and Rozemeijer, 2009). Van Weele (2005) considers the first step in the purchasing process as the determination of specifications; this includes the functional specifications and the detailed technical specifications. Additionally, he argues that the purchase requirements are defined in this step. Choffray and Lilien (1980) and Johnston and Bonoma

(1981) identified the importance of the agreement within the organisation for the purchase, as it can occasionally take more than six months and involve internal negotiation between members of the organisation and the suppliers.

Webster and Wind (1972) recognised the identification of the specifications step as the second step in the purchasing process and argued that it is influenced by individual, social, organisational, and environmental factors. However, the type od purchasing situation as well as the buying centre members play an essential role in the identification of specification for the purchase. For instance, the identification of specification for the new buy, requires greater involvement and consumes more time (Robinson et al., 1967).

Valk and Rozemeijer, (2009) proposed a purchasing process for the buying service, based on a traditional purchasing process. They argue that the firm involved in the buying, needs to define the specifications of services as more difficult than goods, consequently, more requests for information and detailed specifications are required to ensure that the buying firm develops comprehensive and correct specifications. Similarly, Robinson et al. (1967) see that the determination and description of characteristics and quantity of the product or service requires consideration in the early stage of the purchasing process.

According to Kakouris et al. (2006), the second step in the purchasing process involves the identification and formulation of the decision criteria. This main focus of this step is on the definition of assessment criteria against the possible suppliers. However, this requires bid standards preparation and detailed specification of the requirement. However, regarding the purchasing process, specifications of service are complex to identify and subject to change over the time and need to be developed with the supplier (Valk and Rozemeijer, 2009).

Choffray and Lilien (1980); and Johnston and Bonoma (1981) see that it is necessary to obtain preliminary approval for the purchase budget in the early stage of the purchasing process. In the purchase of capital equipment, a budget request must be sent, which may take more than six months. The approval of

the budget involves a series of negotiations within the firm (Johnston and Bonoma, 1981).

According to Webster and Wind (1972), the identification of alternatives needs to accomplished, in order to evaluate the alternatives steps. This actually involves the available products or services in the market, compared with those in the firm Sources and alternatives search is considered to be one of the most important and common steps in the purchasing process. Webster and Wind (1972) argue that all participants in the purchasing process are responsible for identifying, evaluating and selecting the required product and supplier. Searching for a particular product among many alternatives, may lead the firm to depend on sources of expertise outside (Choffray and Lilien, 1980).

Van Weele (2005) sees that the selection of suppliers is one of the most significant steps in the purchasing process. This step includes several tasks such as: preparation of bidding list, subcontracting method, quotation request, quotation analysis, and the final selection. On the other hand, Valk and Rozemeijer, (2009) argue that to purchase service, the selection of the supplier becomes more complicated. According to (Johnston and Bonoma, 1981), after the development of the specifications of the required equipment or service, all bidders are invited to quote their bids, then a list of suppliers is prepared to select the actual supplier.

However, in the case of purchasing service, it is very important to involve supplier selection criteria, such as trust and openness, rather than price and quality (Valk and Rozemeijer, 2009). Robinson et al. (1967) consider obtaining and analysing the proposals as a separate step in the purchasing steps, the process to evaluate and select the right purchase and supplier is significant. On the other hand, other authors (Choffray and Lilien, 1980; and Johnston and Bonoma, 198) consider the obtaining and analysis of the proposals, combined with the alternative search step.

The step of contracting is usually identified after the selection of the supplier, and the contract will cover all legal agreements, the terms and conditions, the agreed required product or service (Van Weele 2005). Placing the order is

considered as one of the purchasing processes (Robinson et al., 1967; Van Weele 2005; and, Valk and Rozemeijer, 2009). Placing the order takes place after the final agreement with the supplier and usually contains important information regarding the order, such as product description, delivery date and time, and quantity (Van Weele 2005).

The evaluation of performance plays an essential role in a successful purchase. After delivering the agreed purchase, the evaluation of the delivery, well as the supplier engagement is necessary (Johnston and Bonoma, 1981). Monitoring and evaluating the performance from the side of the buyer becomes more important after acquiring the product, especially regarding the required maintenance and any operational provided by the supplier (Van Weele 2005).

However, the purchasing steps covered above, appear to be identified differently, but internally share common tasks. In the process proposed by Van Weele (2005) and Choffray and Lilien,(1980), the last step is the product and supplier selection, but this step involves the purchase contract statement. Moreover, Valk and Rozemeijer, (2009) identify the determination of the purchase specification as the first step, in fact, this step apparently involves the identification of the requirements.

4.5.3 The applicability of generic purchasing process for PSS

After the analysis of the selected purchasing processes, the purchasing of product service systems will be covered to investigate the applicability of the processes in order to purchase PSS. The proposed purchasing process by Van Weele (2005) will be considered as one of the most cited purchasing process. The traditional purchase process shows the relationship between the buyer (the customer) and the supplier in a traditional business manner. This is when the customer buys a product and the ownership of the product is transferred to him (Robinson et al., 1967; and Van Weele, 2005). The customer in such cases pays for the consumables, services, maintenance and disposal (Baines et al., 2007). (Markeset & Kumar, 2005) argue that in traditional purchasing, the owner of the product usually executes the operations and maintenance processes, and

the owner may require expert assistance and spare parts from the manufacturer or any third party.

Needs identification is considered to be one of the major steps in the purchase process (Robinson et al., 1967, Johnston & Bonoma, 1981; Kakouris et al., 2006). On the other hand, this step seems to be applicable to purchasing PSS as the customer seeks to fulfil his needs (Stremersch & Frambach, 2001; Tukker, 2004). However, several characteristics for PSS customers have been identified in Section 3.6 (customer's culture, environmental awareness, competence availability, operation ability, customer's resources and affordability), therefore, PSS customer characteristics must be considered in the purchasing process.

Customer characteristics play their role in the acquisition of a PSS. For instance, in terms of ownership, some customers may prefer to own the product/service (Neely 2008). This allows the customer a wider range of purchase alternatives. Moreover, customer resources have their role in the purchasing decision; consideration of customer resources play a significant role in the adoption of PSS. These resources include facilities, materials, liquid funds, complementary skills, knowledge and information (Ng and Nudurupati, 2010). Therefore, customer characteristics must have a place in the purchasing process.

Customer capability in terms of operation, maintenance, and service seen to be one of the essential roles in the adoption of PSS (Baines et al., 2007, Plepys, 2003, and Markeset and Kumar, 2005), actually the traditional purchase process is lacking this step. Additionally, some customers consider PSS as a way to outsource their service and maintenance demands to other providers or the OEM, allowing them to focus more on the core business values and thus to reduce business risks (Kumar et al., 2004).

The buyer in a traditional process turns his attention to the price of his purchase in how to reduce the cost, on the other hand purchasing a PSS focuses on the perceived value of the purchase. However, the value is created in joint co-creation and demonstrated as value in use, rather than in product (Lindgreen et

al., 2012). Assessing value in use, needs to be considered in the purchasing process of a PSS. In service environments, value for the customer lies in use (Neely et al., 2011).

PSS characteristics draw another difference between the traditional purchase and the purchase of a PSS. Van Halen et al. (2005) identified the PSS characteristics as:

- Acquiring a service, delivers intangible values which are difficult to capture and describe as a function.
- Providing a service develops through people who provide it, which requires very high people management skills.
- Physically, it is unable to store service, which makes the task of estimating the demand is very significant.
- Service consumption may increase or decrease the environmental impact.

Although these characteristics have been seen from manufacturers' perspective, PSS customer may benefit from the consideration of them during the purchase process. The purchase of a product or service may transfer the responsibility of the product or service to the customer, which accordingly transfers the associated risk, and in PSS, the risk can be in the domain of the supplier or it can be shared (Lockett et al. 2011). Webster and Wind (1972) argue the decision to buy is motivated by the evaluation of risk in the purchasing process.

The significance of performance of service delivery, led to the development of a conceptual framework for service delivery negotiation process by Kumar et al. (2004). They argue that the framework would be useful to reach a win-win situation for both the service provider and customer. They defined a number of factors and elements significant in the process of service delivery. Also, they argued that the availability of a system is determined by three elements:

- Reliability: product characteristics
- Maintainability: technical systems

- Supportability: logistics and maintenance support

Therefore, system requirement needs to be identified, in order to draw a robust delivery strategy.

it can be argued that purchasing PSS might not differ, as it is concerned with purchasing goods and services. As a matter of fact, the purchasing processes above must be assessed within the context of PSS. By considering the findings Chapter 5, it is apparent that the PSS purchasing process differs from the traditional one. The purchasing processes are related to each other; therefore, the customer characteristics must be identified early. The identification of customer characteristics draws the whole picture of the precise required specifications. For instance, if the PSS customer is unable to support his purchase in terms of maintenance and operation, his requirements must consider the capabilities of the supplier in terms of service and operation capabilities (Baines et al., 2011). Despite the increasing attention given to the PSS market, it is still limited in comparison to the traditional purchase.

An essential part of the purchasing of a PSS is the service delivery strategy (Datta and Roy, 2011). In the traditional purchasing process, the customer is concerned with the date and time of the delivery, as well as the location. In purchasing a PSS, the delivery is related to services and other related works, which means it is a continuous operation. The purchasing process of a PSS must include the service delivery strategy, although details would be discussed and agreed during the negotiations.

Searching for sources in the traditional process is influenced by the required product, rather than the required output. On the other hand, a PSS customer tends to consider a comprehensive picture regarding the required PSS and the expected outcome. This step is actually influenced by PSS characteristics, service availability, service complexity and supplier reputation (Neely et al., 2011; and Kumar and Kumar, 2004)

As the supplier and the customer engage in a long-term relationship, it is very important to consider the risk transfer, as a result of the purchase contract (Van

Weele, 2005), which includes technical risk, contractual risk, and performance risk. In purchasing a PSS, such as purchasing the complex service, the associated risk will be high, and both the supplier and the customer should negotiate the responsibility of the risk (Goedkoop et al. (1999). Providing a PSS may include providing industrial equipment, as well as services, which forces the customer to assess the related risk regarding possible issues, such as component obsolescence (Meier et al., 2010).

Before the final agreement, the PSS customer needs to assess the possible purchasing alternatives. These alternatives are based on the PSS categories as identified by (Tukker, 2004). For instance, the PSS customer may acquire a product, or pay for use, or he may pay for an agreed performance. However, the possible purchasing process for PSS can be defined by modifying the traditional purchasing process, after considering several factors. First, after the identification of need as in the traditional process, a PSS customer must identify his characteristics and prioritise them. This step shapes a PSS customer to enable the decision maker to select the most suitable offer. Factors that influence the purchasing, also need to be clarified; these factors include economic condition, organisational regulations and other external factors.

Second, after obtaining the offers, the PSS offers need to be analysed, based on the PSS parameters. This is to provide the PSS customer a comprehensive knowledge of the actual offer and the capability of the customer to acquire PSS, based on his characteristics. The step of alternative assessment and selection involves the assessment of each offer in comparison with customer characteristic, as well as factors that influence the purchasing decisions.

4.6 Requirements for PSS Customer's Framework

In the previous sections, a systematic review has been conducted to explore the available frameworks and methodologies within the context of PSS. Also, the theory of purchasing was explored. The aim is to understand how these frameworks developed, as well as to extract parameters and factors that can affect the PSS customers in their assessment and selection of a PSS. After selecting the most relevant articles from academic journals, frameworks in

these articles are analysed to investigate the available strategies, factors, and elements that could support and help re-engineer the required framework. It should be noted that most of the analysed frameworks support the product and/or service providers.

As a result, a number of parameters are defined to develop a PSS customer framework. Due to the nature of these parameters, it was found necessary to categorise them for better understanding.

Table 4-3: PSS customers' framework parameters

Categories	**Parameters**
Quality	Quality of service, quality of product, quality of repair, durability, reliability
Customer service	Flexibility, response time, communication
Delivery	Quality of delivery, delivery frequency, delivery strategy
Provider capabilities	Operation, maintenance, resources, training and through life support
Contractual consideration	Contract definition, scope, period, payment methods
Affordability	Cost reduction, service cost, total cost, operation cost
Provider availability	Geographical location, contact point, time, flexibility, response time
PSS technology	Complexity, IT compatibility, remote access

The conceptual framework for a PSS customer will be illustrated graphically as in Figure 4-8 and involves customer characteristics, PSS parameters and other influencing factors.

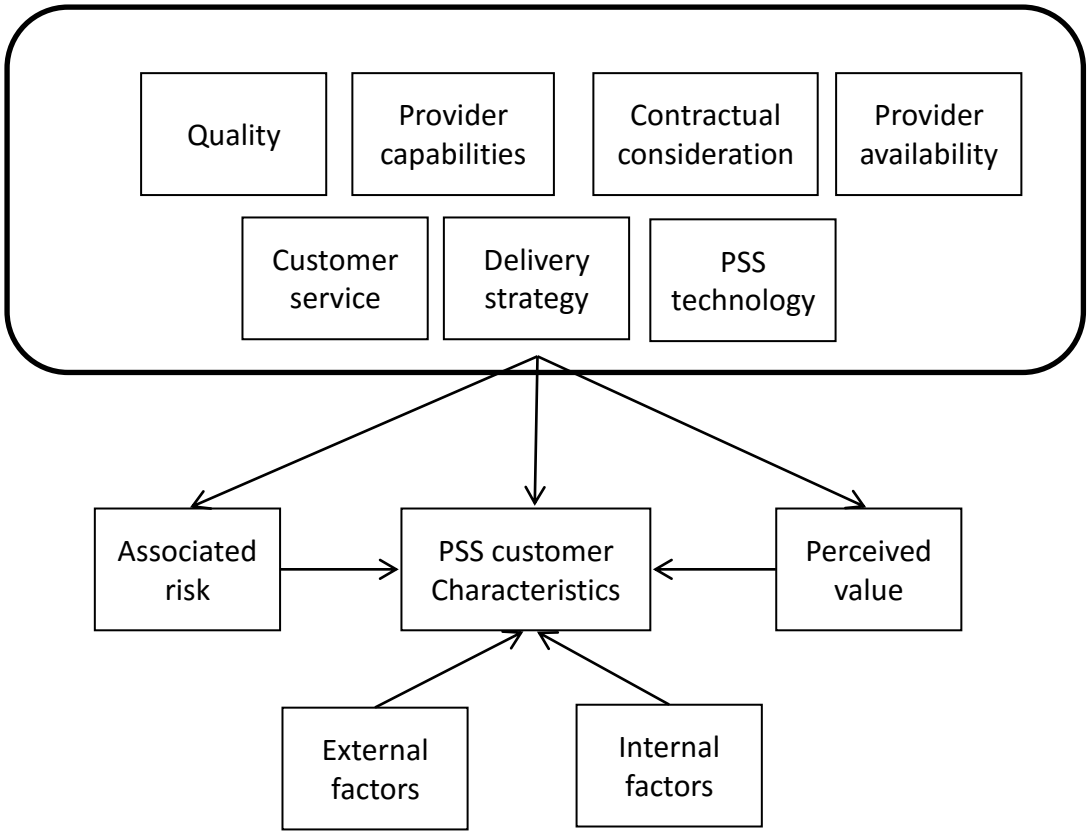


Figure 4-8: A conceptual framework for PSS' customers

The conceptual framework explains the relationship between the offered PSS and PSS customer characteristics, as well as other factors that affect the acquisition of a PSS. It should be noted that PSS parameters are represented in groups. For example, provider capabilities have a set of parameters, such as operation capability, maintenance capability and resources.

The upper part of the framework represents the characteristics of the offered PSS. These characteristics represent the tangible and intangible attributes of the PSS which include quality, provider availability, delivery strategy etc. Therefore, PSS customers identify the characteristics from their point of view. There are two main concerns associated with the PSS characteristics, namely, the associated risk and the perceived value. The associated risk with PSS, as well as the perceived value influence the decision of the customer when

acquiring a PSS. The associated risk is identified by the customer based on his awareness about the PSS that would be acquired. This can be any awareness related to the contents of the PSS such as the environmental issues, the operational requirements or the required services to maintain the PSS. Additionally, the delivery strategy may rise the concern of the customer as this may affect the core business of the organisation. This is actually allowing PSS customer to use the PSS rather than own it. In terms of the perceived values, the PSS provider may offer additional benefits to the purchasing to increase the opportunity to win the deal. These benefits have its influence on the customer's characteristics which therefore affect the decision of the purchasing. As illustrated in Figure 4-8, the arrows indicate these two concerns are resulted from the identified PSS characteristics effect the PSS customer characterises. Customer's characteristics represent the attributes and attitude of the customer.

PSS customer's characteristics can be seen as the core of the framework as these characteristics determine the decision of the purchasing. However, each customer has his own prioritisation of the significance of these characteristics. For instance, a PSS customer may see the operation ability as the major element to select the PSS supplier. on the other hand, the operation ability may have no effect of the decision of the purchasing such as the purchasing of services. PSS customer's characteristics also affected by number of factors that affect PSS customers in the acquisition of a PSS. Organisational regulations as an internal factor has a role in the PSS acquisition as it shapes the selection decision of PSS. The organisation policy has a role in the purchasing decision as well as the current and future requirement of the organisation. Moreover, the external factors such as the economic situation and the global demand have its influence in the decision of the selection of PSS supplier.

In general, the proposed framework identifies the factors that affect the decision of the selection of PSS supplier. The selection of PSS supplier involves the evaluation of characteristics of PSS as each supplier offers his PSS with different attributes. PSS suppliers usually offer additional values to guarantee a deal. The perceived values and the associated risk affect the decision of the

customer when evaluates the PSS offerings. In order to select the PSS supplier, the internal and external factors have a role in the evaluation of PSS suppliers. More importantly, the framework presents the customer's characteristics which represent the main block in the framework. These characteristics identifies as: Customer culture, Environmental awareness, Competence availability, Operation ability, Customer's resources and Affordability.

4.7 The Execution of Case Study

This section represents the second stage of the development of the framework and also represents the data collection and framework development in the adopted research methodology. Development of the PSS framework in this phase requires putting the theory into practice. Therefore, in order to gain in-depth understanding of purchasing PSS in practice, the field study is guided by the question:

What decision parameters impact on purchasing PSS?

A case-study based research methodology has been selected. Semi-structured interview technique has been chosen, as it is considered to be appropriate for data collection and it allows the researcher the opportunity to probe deeply to gain further information with the possibility to reveal new issues and concepts. The interview has been piloted several times to ensure its applicability and quality.

4.7.1 Selection of cases

One of the important steps in the conducting of case study research is to select the cases to be studied. Miles and Huberman (1994) showed that the boundaries of the study must be defined carefully to link directly with the research questions. As the focus of the research has been clarified and the research question set as above, case selection must fit the data required by the researcher. The researcher took into account the number of cases necessary to study. This requires very careful consideration as the quality of data and the accuracy of the results could be affected by researcher bias.

To select the cases, the sample population needs to be identified. By exploring the global market indicators (World Bank,2014), the developing countries; particularly Middle East, have the highest government spending and rapid private sector growth. Saudi Arabia, for example, represents the most dependent country in the Middle East in the purchasing of heavy industry, complex systems, high technology and services, which signifies a wide variety of the forms of purchasing PSS. The governmental and industrial sectors of Saudi Arabia share common characteristics: in the absence of the ability to source products locally, they depend mostly on foreign manufacturers and organisations to supply high-tech products and other essential high value assets as well as the associated services (maintenance, spare parts, after life services etc.). High-tech equipment in the health sector, advanced educational tools in the education sector, complex systems in industry, and critical assets owned by the Ministry of Defence are such examples of high dependency on local and external suppliers. Therefore, Saudi Arabia was selected to conduct the study as the governmental and industrial sectors in Saudi Arabia depend heavily on the purchasing of PSS. This actually gives the researcher the opportunity to gain more understanding and more data on the behaviour of purchasing PSS.

Investigating the purchasing of PSS in Saudi Arabia would be difficult and time consuming. Thus, the sample of our study must satisfy a number of criteria to narrow the selection boundaries in order to select the most suitable cases. These criteria can be defined as follows:

A customer of PSS: there must be evidence that the customer purchased PSS in any form.

Frequency of purchases: this means that the target of our sample requires multiple purchases of PSS to provide the opportunity to address the required question for data collection.

Size: the selected case must be large, with regard to business and employees. This ensures the possibility of purchasing PSS within the main PSS categories, as well as providing multiple data resources.

Diversity: to ensure coverage is given to the purchasing of PSS from different aspects (i.e. different industries).

Organisational type: this includes governmental, semi-governmental and private organisations.

Moreover, the selection of the cases involved the test of sampling prior to taking the final decision of the selection by asking three questions to the potential organisations Miles and Huberman (1994):

- Is it a significant case with regard to the developed framework?
- Is there any evidence confirming the existence of the phenomena to be studied?
- Is it feasible?

Therefore, the starting point was to find such organisations that have purchased PSS in Saudi Arabia. The Chamber of Commerce in Saudi Arabia is considered to be the core of active organisations and reliable data base for the suppliers and contractors' information. The Chamber of Commerce was accessed to find potential organisations that may possibly purchase PSS. The result showed that there are 2156 registered organisations across Saudi Arabia. Due to the massive geographical area of Saudi Arabia, the Central and Eastern areas were selected to conduct the study, therefore the number of organisations was reduced to 797. By applying the selection criteria set above, the result was 86 organisations. Most of the organisations were found from the same industry, for example, in the food industry, there were more than 27 companies; 12 companies came from the construction industry. Therefore, the final result filtered down to be 13 organisations representing the major industries in Saudi Arabia.

The next step was to contact these organisations and present the research topic and the aim of the researchers. Five organisations were not willing to participate in the study because of its confidential content and the data of three other organisations were difficult to access. As a result, five cases have been found and are willing to participate in the study, as they fulfil the selection

criteria mentioned above. All five cases originated from various sectors (i.e., oil and gas, telecommunication, health care and banking services) and represent various organisation types (i.e. governmental, semi-governmental and private). All organisations vary in size and scope, as well as organisational structure which specify the involvement of departments in the evaluation and purchasing of PSS.

4.7.2 Data collection

This step is considered to be the core of this research because the potential results rely on the quality and reliability of the collected data. Although there are several data sources, the semi-structured interview has been selected (updated, based on emerging data), archival sources (e.g. documents and contracts) and press releases (certified sources). The latter is valuable as a source of specific information about the companies that are available as media coverage as part of public relations exercises. The availability of multiple sources of data, increases data reliability and facilitates the process of triangulation. Investigating the purchasing of PSS, naturally involves different viewpoints (e.g. technical, engineering, financial and decision maker) therefore, it was very important to interview multiple respondents. Therefore, the number of the interviewees in each case varied. In HealthCo, there were four participants, representing the buying members in the purchasing department, whilst only one employee from OilCo participated in the interview as the interviewee was a purchasing consultant and a highly skilled expert. The interview protocol was designed to start with broad questions initially, and then specific and detailed questions followed. The interview questions for HealthCo is provided in Appendix 2). To ensure the availability of comparable data, interviews have been conducted at the highest managerial and technical levels. Case description is illustrated in Table 4-4.

Table 4-4: Cases description

Case	Core Business	Interviewee position	Duration of the interview (min)
HealthCo	Public health provider	Purchasing manager	95
		Contracting supervisor	68
		Maintenance supervisor	72
		Medical equipment advisor	85
OilCo	Oil and gas industry	Purchasing Consultant	110
BankCo	Banking services	Purchasing manager	120
		Technical unit supervisor	90
TeleCo1	Telecommunication provider	Project supervisor	104
		Technical support advisor	88
		Purchasing supervisor	63
TeleCo2	Telecommunication provider	Contracting specialist	70
		Quotes analyst	55

In total, 12 interviews were conducted over 14 days. The interviews lasted between one and two hours. However, one of the interviews in TeleCo2 lasted less than one hour because the interviewee was a quotes analysis and concentrated on more technical questions. The interviews were conducted on a semi-structured question basis. The semi-structured interviews can be carried out intermittently, to support the participation observation and diary and obtain any additional information. The loose interviews allow interviewees the opportunity to comment on any side of the methodology (Oppenheim, 2000).

The interview questions to a large extent were guided by the research question. The strategy of the questions was to gather as much information as possible, to understand how the organisations purchased or would purchase PSS.

The questions addressed to the interviewees were exploratory in nature, followed by probing questions in an interactive manner. The focus was on how to purchase PSS and what decision-makers should consider in this matter. Copies of previous contracts from two companies (HealtCo and TeleCo2) had been provided. These contracts helped to develop the probing questions that were largely based on the content of the contract which included the details of the products purchased, services provided, period of contract, terms and condition, liabilities, etc. The interviews were treated in a confidential manner as required by the interviewees.

4.7.3 Data documentation and write up

After recording the interviews, the first step was to translate non-English interviews and notes into English and produce written documents covering all interview scripts. As multiple data sources are used in this research, data from other sources, such as documents and other material have been used to fill gaps in the data. This has been achieved by converting data, notes and any other gathered information into expanded write ups. However, data documentation can include documenting ideas, notes, materials and documents observed during the execution of case study. The write-up step resulted in 12-14 pages of raw data for each interview.

4.7.4 Data coding and analysis

Coding of the collected data is seen as central to effective case research (Voss *et al.*, 2002). Miles, Huberman and Saldana (2013) defined codes as “labels assigned symbolic meaning to the descriptive or inferential information compiled during a study”. As the purpose of this research was to investigate how customers purchase PSS, the focus was on interviewees’ responses that can be considered to affect the decision to purchase PSS. The coding process has

been conducted on an iterative manner for each transcription. Figure 4-9 illustrates the coding process applied in this study.

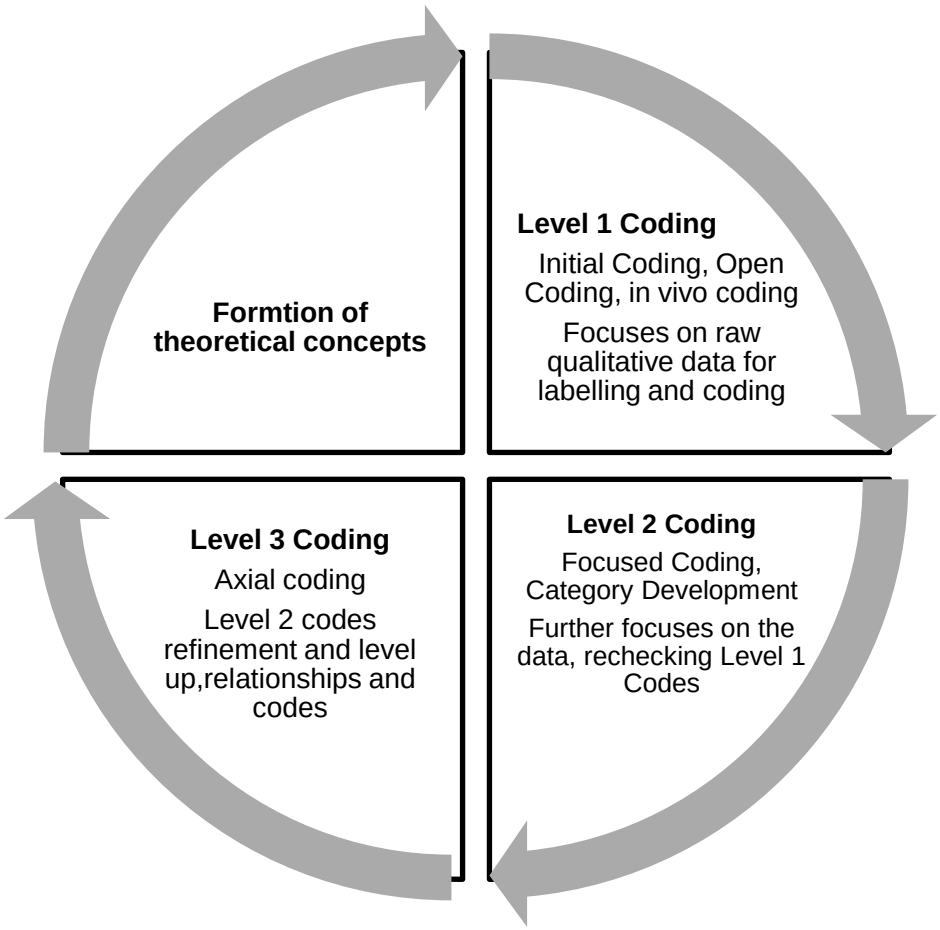


Figure 4-9: Coding process

Step 1: Data processing and preparation

In this step, basic raw data (recording, notes) must be processed before they are available for analysis. However, all recorded interviews have been transcribed into written transcripts. The required translations have been done carefully to emulate and reflect the interviewees' responses. Supported documents were then considered to fill any gaps found in the interviewees' responses. In addition to raw data, field notes, documents and artefacts taken during the interviews, have been converted and expanded into written text, to be compiled within the context of the transcripts. This step helps to reduce and compile the interview transcript, to consist of 12-14 pages for each write-up.

Case write-ups were completed without any interpretations in this step to reflect the reality of the phenomenon in its natural environment.

Step 2: Review and familiarisation

After data processing and preparation, it was found that reviewing the final transcripts was necessary. The reason behind this was to cover all perspectives of all participants. The interviews were directed to understand the attitudes of the studied organisations in the purchase of PSS. Therefore, each interviewee expressed his own experience regarding the previous and current PSS purchases. This included terminologies and phrases which may differ from other interviewees. For example, a number of interviewees used the term “product” to explain their purchases, other interviewees on the other hand used the terms “equipment” or “devices”. Also the concept of PSS has been explained from different interviewees from different viewpoints with different terms. Transcript reviewing was done by reading the final transcripts to ascertain the meanings of the used terms and words as some words, such as technical and coded words, needed to be fully understood before conducting the data analysis.

Step 3: Coding

This step involves reading the transcripts line by line to capture any possible response related to the phenomenon under study, in the form of words, phrases, sentences or paragraphs, also known as codes (or labels). Purchasing PSS involves several levels of decision-making; technical, strategic, financial and managerial. However, there is no specific coding method in qualitative research, as it mainly depends on the type of data collected and what precisely a researcher wants to find. In this research it was found that it was better to start coding, line by line, also known as *open coding*. This provides the opportunity to discover and highlight emerging concepts, thoughts and ideas. However, coding is considered to be time consuming (Miles and Huberman, 1994) as it involves reading transcripts several times to find meaningful descriptions.

Hahn (2008) introduced three levels of coding in the coding process. These levels start with the level of initial coding and result in the final findings of theoretical concepts. For the purpose of this research and as each researcher may select a different approach to achieve reliable results, the coding process developed, based on three levels, as illustrated in Figure 4-9.

Level 1 Coding

As shown in Figure 4-9, the coding process started with Level 1, which involved initial coding or open coding. This is actually the first step in handling the raw data to achieve the insight required to answer the research question. The process of open coding is iterative, and started by reading each transcript and highlighting ideas and distinct concepts that are related to the research problem, which is purchasing PSS. In Qualitative Data Analysis (QDA), Computer programmes are helpful to do such coding. ATLAS.ti is one of the software used widely in QDA, as it allows the researcher the opportunity to treat the collected data in such a way that gives him an interpretation and understanding of the collected data. Careful attention has been considered to participants' responses, and allowed the researcher to reflect the words, phrases or paragraphs into a meaningful concept "code" that affect the decision to purchase PSS. The developed code helps to reduce chunks of data; paragraphs, sentences, statements or even a document, by summarising it into meaningful code.

Highlighting is used to identify codes and concepts. Different colours are used to distinguish each concept. In this case, many codes have been developed. As coding through the transcripts, it must be mentioned that coding is not precise, as each researcher has his own reasons and focus, while reading the transcript. However, the first step was to read through the text and create quotes using ATLAS.ti; this step is to reduce the raw data and focus on the chunk of data or potential responses that can be coded. Moreover, coding is interpretive action, rather than precise explanations (Saldana, 2009). For that reason, coding in this step has been conducted in a cyclical manner to ensure no other concept is missed. Thus, the first round of coding was followed by a second round, to filter

the initial codes and eliminate those codes not related to the PSS, or capture new emergent concepts that arise. Open coding and in vivo coding methods were used to capture any concept; words, phrase, sentence or paragraph, emerging from the transcripts. The in vivo method was considered, as it expresses the participants' inspirations rather than anything generated by the researcher.

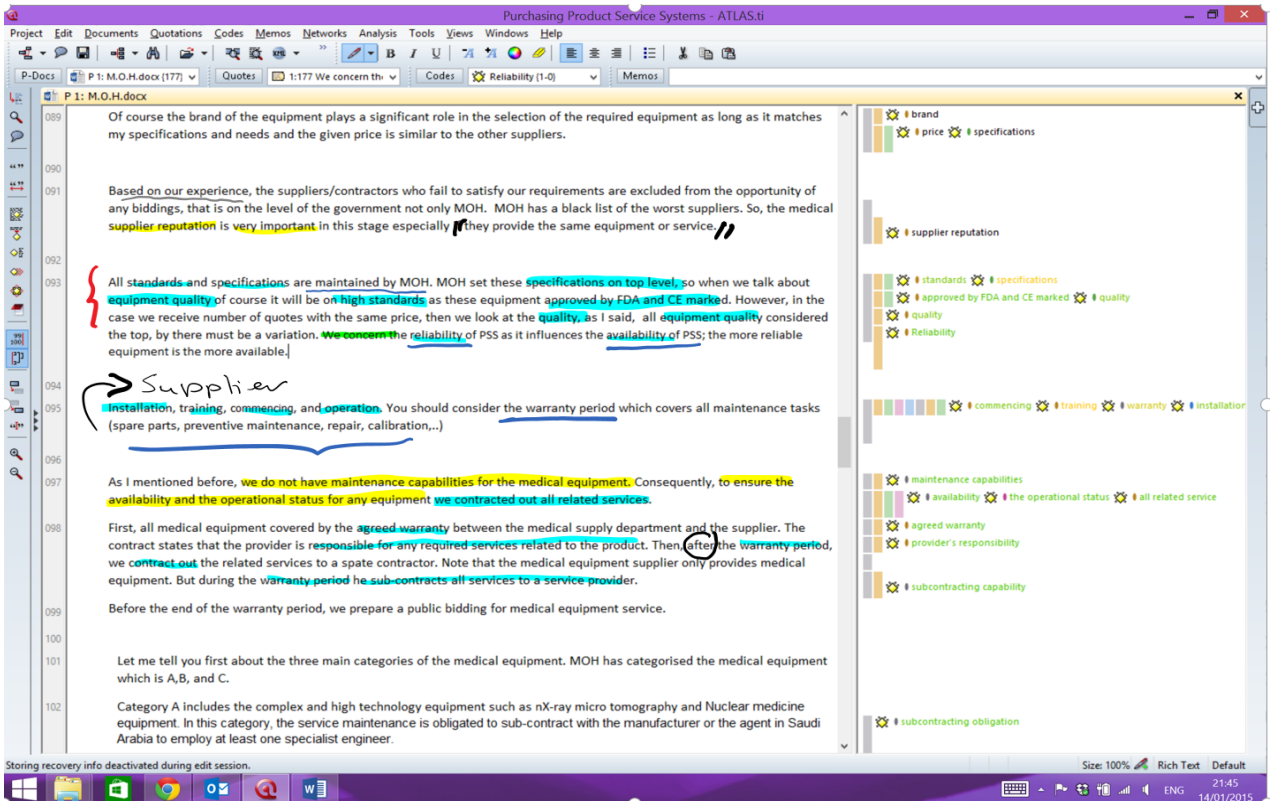


Figure 4-10: An example of the initial coding (HealthCo)

This stage has been applied to the 12 transcripts, therefore the results produced many codes developed from the transcripts. Some codes may be repeated, as the participants may repeat some concepts related the purchasing of PSS. The point here was to build fundamental codes to start with and then to move forward to Stage 2. For example, in TeleCo1, one of the interviewees mentioned that "*we analyse the offering and focus on the provider experience and the length of time he has been in the market*". This indicates that the provider experience plays a role in the evaluation of the PSS. BankCo stated "*the received quotations sometimes indicate that all the equipment seems*

similar in terms of the function, but we are concerned with the quality and reliability as a requirement of our daily work". Therefore, BankCo describes clearly that the reliability of the PSS matters when distinguishing between the available PSSs. Table 4-5 illustrates examples of selected quotes from each case and the developed related codes.

Table 4-5: An example of codes development

Case	Quote	Developed code
HealthCo	*"The lowest risk the equipment may affect the patient, the quality, safety. When a hospital requests medical equipment, they just determine the purpose of it; we on the other hand take action to investigate the appropriate equipment. We are also concerned with spare parts cost and consumables cost."*	• Risk • Infection • Part cost • Consumables cost
OilCo	*"then we will evaluate them, based on different factors such as will this be sufficient in terms of cost savings and in terms of local content"*	• Cost saving • Local content
BankCo	*"Work flow is really essential to the bank. Consequently, the technical characteristics of the product must meet the highest specification in the market"*	• Core business • Technical characteristic's • specifications
TeleCo1	*"But we also keep an eye on the supplier's capabilities in terms of performance monitor as they affect the provided services to our customers"*	• supplier capabilities • Performance monitoring • Customer satisfaction • Core business
TeleCo2	*"We take advantage of the warranty period; say 12 months. But the supplier must provide us a continuous service, so we have a contact in case of any problem."*	• Warranty • Service availability • Contact point • Advantages

Figure 4-11 illustrates a sample of the initial codes for HealthCo. These codes are not finalised and subject to changes, as the coding process is iterative at each level.

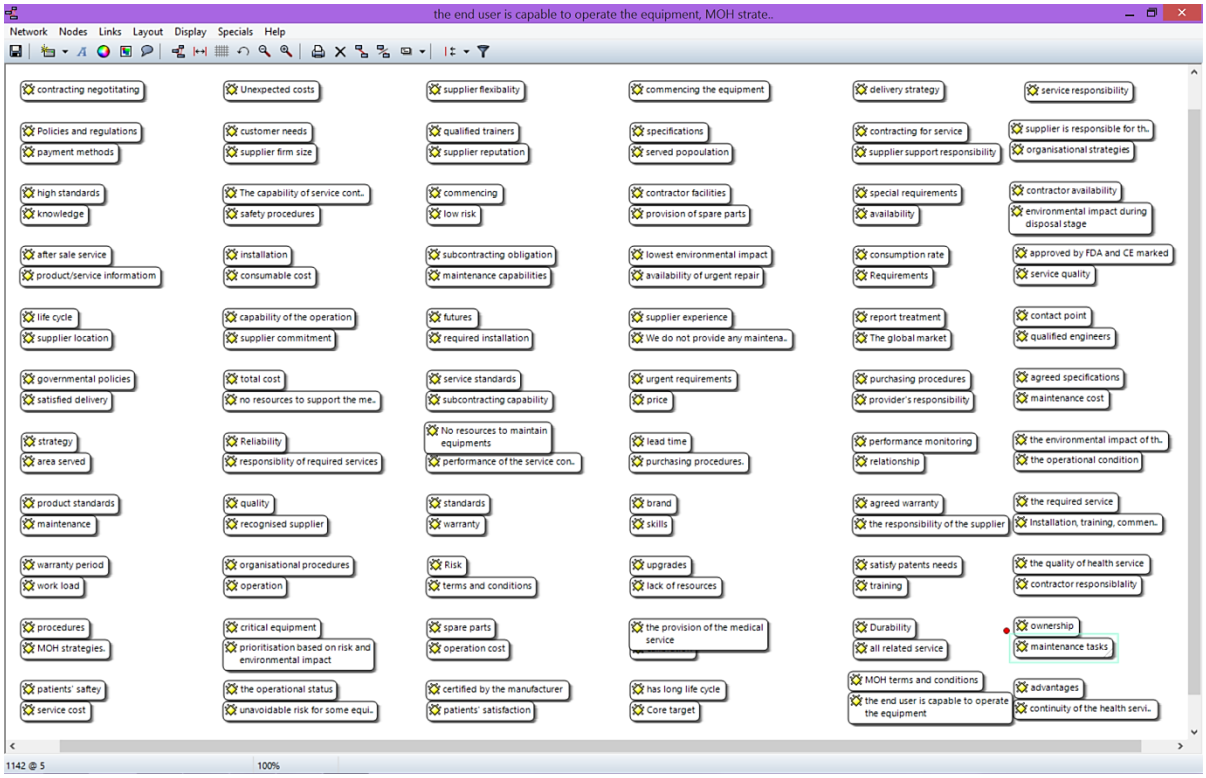


Figure 4-11: Screenshot of results of initial coding in HealthCo

Level 2 Coding:

After the initial coding, the next step is to categorise these codes into categories by grouping them around the research question. Focused coding, involves searching for the most frequent and significant codes to develop the most distinct category (Miles *et al.*, 2013). Thus the resulted codes are relevant to the decision of purchasing PSS. It is helpful to review codes and eliminate irrelevant ones, combine smaller categories into larger ones. It should be mentioned that the developed codes were based on what the participants mean by their responses, not what the researcher wants to understand. Level 2 coding involves re-examining Level 1 codes, by focusing on these codes, as well as the raw data.

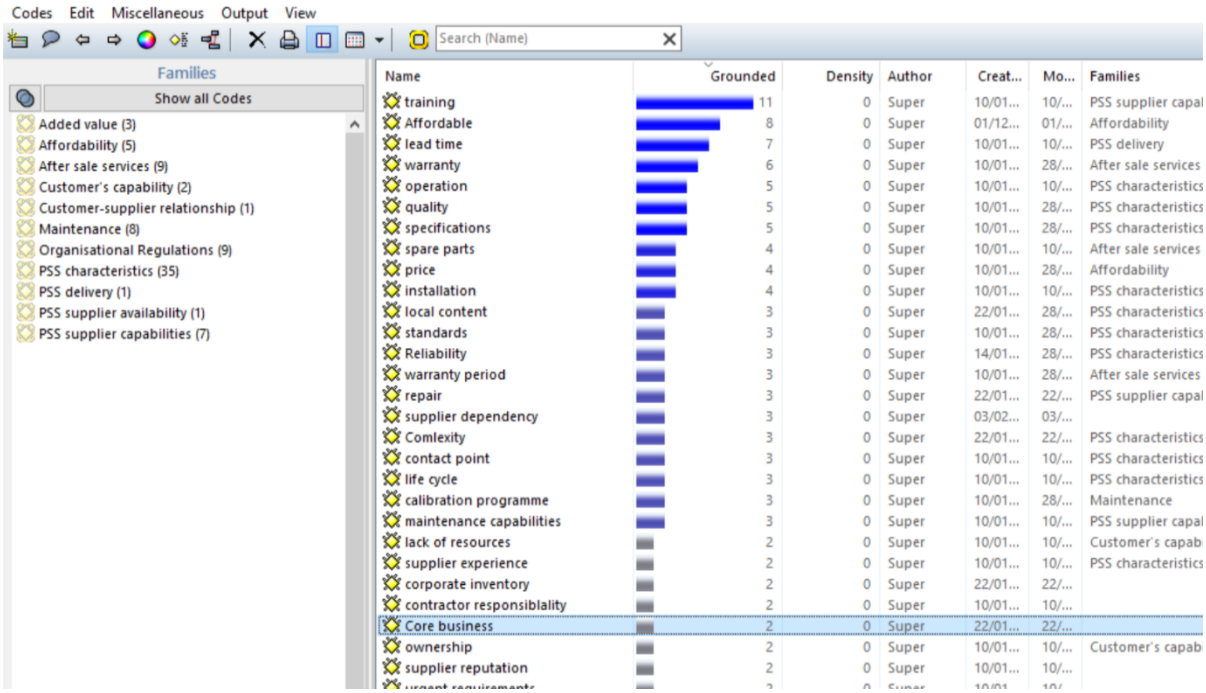


Figure 4-12: Codes categorisation (screenshot)

At this level, repetitive ideas can be seen and the organising of these codes into larger codes that connect them with different codes. At this level, focused coding or category coding is conducted from the result of the initial codes. Number of codes found similar and the interviewees used them, such as cost and price, repair and fix in BankCo. In TeleCo1, the terms contact point and helpline are used to express the same meaning. As a result, the produced codes were reviewed and filtered based on similarity and then categorised accordingly as shown in Figure 4-12. The codes were collated under categories to develop a meaningful definition. The category PSS characteristics refer to perceived attributes of the PSS. For example, “Quality” and “Specification” have been mentioned by all the five cases as key roles in the evaluation of the PSS. “Ease of use” mentioned by all cases except OilCo. Similarly, Brand, Complexity and Life cycle.

The category “Cost” includes all costs related to the purchasing, such as operation cost, maintenance cost, service cost and parts cost. Although four cases concern the operation aspects of the PSS, it was observed that OilCo did not pay sufficient attention to the operation cost because the company has the

capability to operate the PSS, as well as the training centre that runs training alongside with its purchasing. Moreover, “supplier capabilities” has been identified as one of the categories, which include, supplier’s firm size, location, experience, facilities, etc. “Operational capability” refers to the operational capabilities from the supplier firm to operate the purchased PSS, mentioned by TeleCo1 and TeleCo2 as one of the significant factors in the evaluation of the PSS. “Maintenance capability”, which refers to the required capabilities to maintain the purchased PSS, was also highlighted by the five cases as an essential factor of the evaluation. For each subcategory, the number of codes also identified to be subsumed under maintenance and operational (repair plan, skills, equipment, and knowledge). Moreover, HealthCo, TeleCo1 and TeleCo2 are concerned with the facilities of the PSS providers, while OilCo and BankCo did not pay attention to the facilities of the provider. On the other hand, “Customer aspects” include all customer organisations, capabilities and requirements. For example, the operation capability of the customer was observed in HealthCo, BankCo, TeleCo1and TeleCo2. This capability was actually identified, based on the purchasing PSS in the conducting of the study.

Level 3 Coding:

At this level of coding, and after categorising the developed codes, the analytical work has been extended to some extent by describing these categories. In Axial coding, there is a need to identify relationships among the resulted codes and the relationships between categories and sub-categories to conceptualise the phenomenon being studied (this will be discussed in upcoming sections). However, it should be noted that at each level of the coding process (Level 1, 2 and 3), the researcher reviewed these codes to level them out, based on similarity and common characteristics, as this organises the codes, and groups them for meaningful clarification. It is essential to review the data, codes and categories to make sure that the resulted codes and categories are sharpened to represent the analytical relationships and describe the phenomenon being studied. By reaching this level in data analysis, concepts and their related outcomes and consequences can be seen to conceptualise the

purchasing PSS. The developed categories and their interrelationships are identified to provide the researcher greater insight and further development and refinement to achieve a coherent view in describing the phenomenon under study (Strauss, 1987).

Table 4-6: Purchasing parameters among the case studies

Parameter	Cases				
	HealthCo	OilCo	BankCo	TeleCo1	TeleCo2
PSS Characteristics					
Quality	●	●	●	●	●
Specifications	●	●	●	●	●
Brand	●		●	●	●
Life cycle	●	●	●	●	●
Complexity	●		●	●	●
Compatibility	●	●	●	●	●
Reliability	●	●	●	●	●
Ease of use	●		●	●	●
Technological changes	●			●	●
PSS Supplier					
Company size	●	●		●	●
Reputation			●	●	●
Location		●	●	●	●
Experience	●	●	●	●	●
Cooperation		●		●	●
Facilities	●			●	●
Repair action	●			●	●
Capabilities (Operation, Maintenance, Service, Training)	●	●	●	●	●
Organisational aspects					
Core business	●	●	●	●	●

Obligations	●	●		●	●
Competition			●	●	●
Customer satisfaction	●	●	●	●	●
Policies	●	●	●	●	●
Influences of authority		●			
Customer aspect					
Quantity				●	●
Operation capabilities		●	●	●	●
Maintenance capabilities	●	●	●	●	●
Service capabilities	●	●	●	●	●
Affordability	●		●	●	●
Current and future demand		●		●	●
Operation requirements	●			●	●
Customers' demand	●	●	●	●	●
Frequency of use	●		●	●	●
Location	●	●	●	●	●
Knowledge	●	●		●	●
Resources	●	●	●	●	●
Ownership	●		●	●	
PSS delivery					
Delivery Strategy	●	●		●	●
Service Delivery	●	●	●	●	●
Distribution	●				
Lead Time		●		●	●
Commitment	●	●	●	●	●
Cost					
Operation cost		●		●	●
Maintenance cost	●	●	●	●	●
Consumables cost	●		●		

Service cost	●			●	●
Spare parts cost	●	●	●		●
Total cost	●	●			●
After sale services					
Warranty	●	●	●	●	●
Contact point	●	●	●	●	●
Supplier availability	●		●	●	●
Response time	●	●	●	●	●
Training	●	●	●	●	●
Additional value					
Cost reduction		●		●	●
Added value	●	●		●	●
Advantages	●		●	●	●
Contractual agreement					
Negotiation skills	●	●		●	
Long term relationship	●	●		●	●
Legal issues		●		●	●
Flexibility	●	●	●	●	●
Cooperation	●	●	●	●	●
Penalty charges		●		●	`●
Risk					
Disposal action	●	●		●	
Environmental impact	●	●			
Obsolescence	●		●	●	
Nature of business		●			●

4.7.4.1 Within-case analysis

Within-case analysis typically requires write-up for each case in great detail, which would significantly increase the length of this paper. However, for the purpose of this paper, we provide a brief detailed analysis for the parameters considered by each case when purchasing the PSS as given as an example

during the interview. In the case of OilCo, the purchasing process in OilCo is based on competitive bidding and is very strict, and organised unlike any other organisation. The interviewee mentioned that the company's purchases are not just products or services, they deal with huge projects. This includes building and maintaining new refineries, new planets, drilling, installing pipes, oil rigs and many related works. Additionally, PSS providers in OilCo are unlike other PSS providers, as they are primarily the manufacturers of the original equipment (OEM).

Core business plays a significant role in the process of evaluation and purchasing of PSS. "Currently we are marching towards finding more oil and gas for industry as it is the main mission of the company and we rely heavily on our contractors" (Purchasing consultant). The reason behind this is the commitment of OilCo to satisfy their customers in the global markets, which drives OilCo to expand their operations to meet buoyant demand. Moreover, the obligations imposed by the Organization of the Petroleum Exporting Countries (OPEC) influences the production strategies, which affect the evaluation and purchasing of PSS.

The Cost of the PSS found one of the important parameters to evaluate the PSS. For example, operation cost and service cost play a key role to evaluate the available providers. In some projects, the total cost of the project, as offered by the PSS providers, was considered to be an essential evaluation parameter. Customer aspects, such as the capabilities of OilCo in terms of service and operation, play a role to evaluate the PSS. "Our capabilities do not match the current level of operations out there, so we have to depend heavily on service providers to do this work" (Purchasing consultant).

The nature of the oil and gas business is challenging and affects the process of purchasing a PSS in terms of the associated risk and the environmental consequences. "The oil business is very cyclical and represents high risk for us" (Purchasing consultant). Additionally, after sales service, particularly response time and training, have a role in the evaluation of PSS.

Contractor capabilities play a significant role in the evaluation of PSS. This is apparent when another oilfield service contractor was awarded a drilling contract by OilCo which includes complex tasks, such as the provision of drilling rigs, directional and horizontal drilling, logging while drilling, cementing, mud engineering. Contractor knowledge, in terms of installation and other technical requirements, were found significant in the evaluation of the PSS. The capability of the contractor to manage subcontractors is very important, as it plays a major part in the project development. Likewise, provider proficiency and experience were found essential in the selection of the best provider.

Furthermore, PSS characteristics are found to have significant influence on the evaluation of PSS. For instance, Life cycle, quality, reliability, technical data and specifications of the PSS are very important for OilCo to evaluate the PSS. Contractor flexibility, as well as the commitment of agreed dates, e.g. delivery date, leas time and operation date, are essential. The local content of the PSS also has a role, as the purchasing consultant stated “in such a contract, we are keen that the contractor maintains a certain level of local content of the workforce involved in the project”. Additionally, OilCo is concerned with the capability of providers to collaborate with other contractors, as the job is usually part of a larger project.

HealthCo on the other hand pay careful attention to the characteristics of the PSS. “When analysing the medical equipment offerings, we focus on the quality of them and the reliability of the product,” (medical equipment advisor). Moreover, the brand, price and specifications found, have a role in the evaluation process. The providers also made their evaluation based on several attributes such as reputation, location, experience and capabilities. In service contracts, HealthCo considered the service delivery and commitment as essential parameters to select the contractor.

After sale services also has its influence in the supplier selection in HealthCo as each supplier provides a different services package. “We always look at what we obtain after purchasing the required medical equipment or service”. This includes the given warranty, maintenance tasks, the assigned contact point and

training. “Operating medical equipment is an issue, as we prefer to purchase a product our people are familiar with” (Contracting Supervisor). Interestingly, HealthCo places its concern with capabilities, in terms of operating the medical equipment. Therefore, ease of use, was found to be a significant parameter that affects the purchasing decision, hence the complexity of the PSS has a role.

Additionally, the contractual aspects were observed to have an influence in the purchasing of PSS. HealthCo pay attention to the relationship with the supplier, as providing medical equipment requires a lengthy agreement. “Some suppliers understand our business and appreciate the modifications regarding the contract, even after the final approval”. (Purchasing manager). Regarding the cost, HealthCo is concerned with the total cost of the purchasing (service, parts, consumables, etc.) to select the best supplier and also match the financial situation at the time of purchasing. In the service contract, such as cleaning, the environmental impact is seen as the most present parameter. In contracting for medical equipment, HealthCo focus on suppliers’ attributes such as reputation and experience to ensure that they get what they need. “Our purchasing team neglect any offering when the supplier does not provide the necessary information about his capability, in terms of operation and service”. (Contracting Supervisor).

PSS characteristics, significantly have their role in the evaluation of the PSS in BankCo. “In our purchasing of banking equipment, the quality and specifications are of concern, as well as how the end user would be able to deal with it” (Purchasing Manager). Therefore, BankCo concerns the capability of the end user to operate the banking equipment. Additionally, the purchasing must be compatible with the internal network of BankCo. “Of course we seek the affordable offering but our concern is also with the most suitable one, as sometimes we may find a cheap offering but it may not match the end user capability”. (Technical unit supervisor). Therefore, the price influences the selection of the PSS but more importantly, the ease of use has greater influence than the evaluation of the PSS.

The nature of the business in BankCo creates strong of competition in the market, as they provide banking services. Therefore, some organisational aspects, such as core business, competition, and customer satisfaction have been found to influence the selection of the PSS. “Although such equipment is reliable and has a long life, we ensure that the supplier provides the required service delivered in time when needed”. (Purchasing Manager). Moreover, the suppliers’ attributes have been found to affect the evaluation of the PSS. These attributes include reputation, location and experience. The capability of the supplier to deliver the required training, service and operation also influence the evaluation process.

After sales service was found to be one of the parameters that affects the evaluation of the PSS. It was observed that BankCo focus on what they obtain after purchasing the equipment. These services include the given warranty, contact point, the availability of the supplier and the response time. As PSS suppliers tend to enhance their PSS by adding some values, BankCo takes advantage and pays greater attention to these offerings that include more additional values. Moreover, the obsolescence of the equipment was found to affect the purchasing of PSS. BankCo is concerned with the risk of the obsolescence of their purchases and seeks to ensure that the supplier is capable to support the equipment during its life cycle or the agreed contract period.

Purchasing in TeleCo2 is primarily concerned with the characteristics of the PSS, as well as the supplier. In the purchasing of network solutions, TeleCo2 evaluates the PSS, based on the quality, life cycle, reliability and compatibility. On the other hand, for copying machine contracts, the company focus on the specifications and the ease of the use of the purchasing. In addition, consumable costs and parts cost have a role in the evaluation process. Supplier reputation and the given warranty were found important to evaluate the PSS: “we deal with risky business. And that is why we trust those suppliers who have more experience and a good reputation” (Purchasing Supervisor).

Providing network solutions to TeleCo2 requires the supplier to be capable of operating, maintaining and monitoring these devices, therefore, supplier capability is considered to be one of the significant parameters in the evaluation of PSS. “Our policy is to focus on our core business which makes us rely on our suppliers and their operation and maintenance experience to provide us with what we need” (Project Supervisor). TeleCo2 capabilities play a role in the evaluation of the purchasing. For example, capabilities of operation, maintenance and service were found to be important to determine the selection of the appropriate supplier.

The purchasing manager in TeleCo2 mentioned that the company appreciates the most affordable offering and also the cost of the expected maintenance and operation. In purchasing where the end user is involved in the operation task, the concern of the company is with what suits the end user skills and knowledge. “The company has experienced both good and bad in the delivery of our purchasing. Sometimes the supplier fails to deliver the purchasing on time or as we need” (Contracting Specialist).

Regarding the case of TeleCo1, during the evaluation of the received PSS offerings, they focus on the provided information regarding the offered PSS. The information must be in detail, covering all aspects related to the PSS. This includes PSS characteristics, such as specifications, brand, quality, required services, expected life cycle, spare parts and provider skills. As the PSS provider is responsible for the operation of many of network devices, such as antenna and transmitters, it is essential to consider the provider’s capability in terms of performance monitoring. “The main focus of the company is on running its business by providing competitive services to our customers. For this reason, we investigate the offerings carefully to select the appropriate supplier”. (Contracting Specialist). The core business has a role in the evaluation of the PSS as TeleCo1 provides its service to millions of customers.

TeleCo1’s capabilities were found important to select the provider as mentioned by the Contracting Specialist “We concern our capability in terms of running the service. We order the service that is tailored to our target and needs”.

Moreover, as the communication devices must be in operational condition at all times, parameters, such as response time, repair action and service delivery were seen as important in the evaluation of the PSS. “The company deals with many providers, but we are keen to evaluate them, based on their experience and reputation” (Quotes analyst). In fact, the provider’s reputation and experience were seen as essential parameters to evaluate the PSS. Decision makers in TeleCo1 also consider the cost of PSS. This includes the parts cost, operation cost and maintenance cost. TeleCo1 however, would not consider these costs in a pure service contract.

In terms of after sales parameters, TeleCo1 showed considerable attention to the warranty, contact point, and response time as these parameters have a huge influence on the TeleCo1 business. “For any problem in our network, the response time of the provider makes a difference” (Contracting Specialist). The response time depends on the provider’s reputation and experience as these parameters were also found significant in the evaluation of the PSS. According to one of the contracts awarded to a provider, TeleCo1 were observed to appreciate the provider who offered cost reduction as an additional value. Also, some providers promote their offerings by giving some advantages to TeleCo1.

4.7.4.2 Cross-cases analysis

Cross-case analysis is considered to be one of the major phases in data analysis with multiple case studies. It allows the researcher the opportunity to deepen his understanding and explanation (Glaser and Strauss, 1970). In this section, the data will be analysed across all the cases, in order to identify similarities and differences in the degree of formalisation in the evaluation of PSS. By identifying these similarities and differences, we seek to provide further insight into issues concerning the process of the evaluation of the offered PSS, as well as the tendency to purchase in each organisation.

The findings within the case analyses revealed a number of parameters that have been considered in all five cases in order to purchase PSS. It must be noted that each case has its own strategies and requirements which affect the prioritisation of these parameters. Some cases pay attention to specific

parameters, to ensure that their purchasing matches their situation. Moreover, it is obvious that there are number of similarities amongst all cases. This actually strengthens the findings. The purpose of cross-case analysis in this paper is to analyse the impact of the identified parameters on the decision of purchasing PSS.

Table 4-6 illustrates cross-cases comparison, which shows similarities and differences among all cases. It can be seen that most of the decision parameters are common between all cases, on the other hand, few of these parameters are unique and considered by few cases. For example, the influence of the authority in OilCo has a significant impact on the purchasing of PSS in OilCo, whereas the other cases do not see a significant impact on the purchasing decision. On the other hand, TeleCo2 argues the purpose of the use of a PSS; particularly confidentiality, plays a role. This is clear when TeleCo2 contracted to use multi-function copying machines, excluding those to be used at the managerial level or for processing their own confidential documents. To understand these relationships, we need to explore similarities and differences among all five cases. Most cases share the same concerns when purchasing a PSS. Although some cases may not pay attention to several parameters as in the above Table, but it is noticed that those parameters may appear in another category.

Regarding PSS characteristics, the result emphasises the significant impact of these parameters on the evaluation pf PSS. Parameters such as quality, specification, brand and life cycle represent the attributes of a PSS. These attributes are seen as essential by HealthCo, for example, as they purchase medical equipment and it is of importance when they evaluate the PSS. OilCo also pays attention to PSS characteristics. The company's concern is in the specification of the PSS, as it must meet the company standards. On the other hand, OilCo did not pay any attention to the brand of PSS, as they usually purchase heavy machinery and complex projects, BankCo also tends to avoid purchases incompatible with the company infrastructure. Ease of use found an essential parameter in HealthCo, BankCo, TeleCo1 and TeleCo2, particularly

for the purchasing that need to be used by their employees. The consideration of each parameter actually is linked to the type of purchasing and the degree of involvement of the end user. Purchasing pure services was not influenced by the physical attributes as the PSS in this case is based on intangible content. However, the delivery of the service and the quality of the service found key parameters in HealthCo, BankCo and TeleCo1. OilCo focus significantly on the lead time of the provision of the required services.

In terms of cost, all five cases see this parameter from different perspectives. For example, HealthCo and OilCo evaluate the PSS, based on the operation cost and maintenance cost as they deal with equipment they use on daily basis. Similarly, TeleCo1 and TeleCo2 pay attention to the operation cost as they contract to operate communication devices. Consumable cost is usually associated with the purchasing of physical attributes, such as medical equipment, office supply and banking equipment. These organisations pay attention to consumable cost as they rely of the use of such consumables frequently; unlike OilCo as the purchases are mainly complex engineered tools and machineries. Spare part cost was deemed to be important across all cases, along with the service cost. It should be mentioned that the consideration of these parameters depends on the type of purchasing, as tangibility and intangibility of the PSS has a role.

Moreover, after sales service plays an important role in the evaluation of the PSS across all cases. Although all cases showed considerable attention to this parameter, each case focuses on what really matters to their situation. OilCo gave the highest priority to the response time for the PSS provider to respond to a required task. Also the lead time to deliver a PSS was found essential, as it affects OilCo' s core business. HealthCo and BankCo focus on the given warranty and training for the equipment they purchase. TeleCo1 and TeleCo2 are concerned with the availability of the supplier, especially for the purchasing of communication devices, as the supplier is responsible for operation and maintenance works. For office supply purchasing, such as multi-function

copying machines, TeleCo1 and TeleCo2 focus more on the period of warranty and contact point of the supplier.

Characteristics related to the PSS suppliers found considerable for all cases. Supplier reputation seen by HealthCo, BankCo, TeleCo1 and TekeCo2 as one of the values they appreciate when evaluating the PSS. OilCo argues that the potential suppliers in Oil and gas business are limited and known, therefore, they don't take the reputation into account. The location of the supplier was argued by TeleCo1 and TeleCo2 as an essential parameter, as the nature of the purchasing in these companies, mainly operational tasks and the location of the supplier affects the response time, as well as any repair action or emergency action. The experience of the supplier was mentioned by all cases as one of the parameters they consider. However, HealthCo, TeleCo1 and TeleCo2 see the experience of the supplier as an important attribute in the selection of the supplier. Regarding the cooperation between the supplier and the customer, OilCo, TeleCo1 and TeleCo2 showed significant concern over the degree of cooperation. They argue that the PSS contract involves several tasks which require executing over several years.

It was found that purchasing practitioners in OilCo, TeleCo1 and TeleCo2 give importance to the delivery strategy of the PSS to the sites where the PSS is located. This involves the installation process and other related works for telecommunication devices in TeleCo1 and TeleCo2. Similarly, in OilCo contracts, lead time represents the most important parameter to evaluate the PSS. In HealthCo service contracts, such as laundry service, service delivery and distribution were found important in the evaluation of a PSS. BankCo shows concern to the commitment of the supplier to deliver the required PSS and its related services.

The role of the contractual agreement has an impact on the evaluation of PSS. Although flexibility found a common parameter in all cases, the negotiation skills of the supplier were found vital in HealthCo, OilCo and TeleCo1 as they affect the decision of purchasing a PSS. Penalty charges in the agreement were argued by OilCo, TeleCo1 and TeleCo2 as an important parameter in the

selection of the supplier. Moreover, the consideration of the legal issue by the supplier as mentioned by OilCo, TeleCo1 and TeleCo2 has a role to select the PSS supplier. This is apparently due to the nature of business in these companies.

The action of disposal was found to be another important parameter in HealthCo, as they concern the after life cycle of the medical equipment. The used pipeline in OilCo, is also disposed of after a specific period, and therefore, this kind of risk influences the evaluation of PSS. TeleCo1 also give attention to this risk particularly in the contract of office supply and they ensure the capability of the supplier to take responsibility. The risk of the environmental impact of the PSS has a role; this risk is only mentioned by HealthCo and OilCo as the type of the PSS mostly associated with environmental risk.

The capabilities of PSS customers represent a key parameter in the purchasing of PSS. The consideration of these capabilities differs across all five cases. For example, TeleCo1 and TeleCo2 focus on the operation and service capability as the PSS contract involved operation communication devices across their networks. On the other hand, service contracts in HealthCo only involve the resources to be used. BankCo and HealthCo argued that the ownership of the PSS plays a role in the evaluation of the PSS. However, the current and future demand of OilCo, TeleCo1 and TeleCo2 affect the decision to purchase. It was apparent that affordability plays a significant role as a parameter that affects the evaluation of PSS in all cases except OilCo. In fact, the financial situation and the nature of the business of OilCo led the focus to other parameters that affect the purchasing decision.

4.8 Analysis and Discussion of the Results

Based on within case analysis and across case analysis, we find that the decision to purchase a PSS is influenced by a number of parameters. The decision parameters were considered to be the attributes, specifications and any related aspects to the PSS offering and can be referred as values. For these parameters related to the PSS, we can collate them as: PSS characteristics, PSS supplier, PSS delivery, cost, after sale services, additional

values, contractual agreement and risk. On the other hand, parameters related to the customer are organisational aspects and customer aspects.

Interestingly, all organisations consider their specific requirements, as well as internal capabilities, which might be affected by the required PSS as the Purchasing Manager in HealthCo stated: “sometimes we need to ensure that the selection of the suppler really corresponds with our requirements and capabilities,”

A common view among interviewees was that decision making departments take an interest with the matching between the PSS offerings and the capabilities of the organisation to deal with it. This actually indicates the complexity of the decision-making task in such organisations to purchase a PSS. Moreover, the Contracting Specialist in TeleCo1 stated “We are concerned with our capability in terms of running the service. We order the service that is tailored to our target and needs”. Similarly, in a PSS contract in TeleCo2, the contract was rewarded to the supplier that matched up TeleCo2’s capabilities, even though other suppliers offered affordable PSS with better attributes. In fact, this allows us a clearer view of how these organisations deal with PSS offerings.

PSS customers pay attention to their requirements when purchasing a PSS. However, the fact is, the internal capabilities actually play a critical role, as they are considered as customer requirements. Therefore, the customer capabilities represent the internal capabilities of the customer to acquire a PSS; this includes the capabilities of operation, service, maintenance, and so on. These capabilities on the other hand characterised the PSS customer, as each customer has unique capabilities. Thus, we would refer to these capabilities as “customer characteristics” as discussed in Chapter 5. The purchasing process in HealthCo, for instance, involves the analysis of the PSS offerings based on what the suppliers offer, then what the HealthCo would be capable of doing. This step is in fact to “*match up*” or “*fit*” the offerings with the internal capabilities. As in the HealthCo purchase regarding medical equipment, the concern is with the capability of the end user to operate it and the capability of

the technical staff to maintain and support the equipment. Therefore, the assessment of the PSS offerings does not necessarily result in the final selection of the offered PSS's. The diversity of the PSS enables the customer to best fit the preferred PSS with his characteristics.

As all parameters that affect the decision to purchase a PSS have been identified, the behaviour of the customers in all cases has been observed to detect how these parameters interact in all organisations. The identification of the requirements is found to be the driver behind the tendency of purchasing a PSS. Each case seeks to fulfil its current or future need; these needs can be seen as a problem, which require a solution. PSS providers offer what the customer needs and what he identifies as a solution. The PSS offerings however, are received by the customer and assessed, based on what they expect to be valuable

Each case has a vision to decide what is of greater value to them (personal and organisational). The assessment involves both the provider and the offering. PSS customers are concerned with what they are capable of with regard to the PSS. For instance, the PSS may require specific operational skills, comprehensive maintenance tasks, or additional requirements. Each organisation has its own unique conditions, circumstances and capabilities. Sometimes the customer may find a valuable offering but their capabilities force them to consider an alternative.

PSS customer characteristics interact independently with the PSS offerings. This means the customer situation determines the best selection of the PSS offerings to fulfil the customer need, unlike the PSS providers' expectation that the offerings force the customer in a certain direction in the selection of the PSS offerings. Customer characteristics in this case are those latent needs unseen by the provider. These needs however, include all capabilities that the customer exhibited to achieve the maximum benefits from the purchased PSS, which include the operating capabilities and skills, the capability to maintain, support and serve the PSS and facilities, and resources that the customer has, to acquire the PSS. The PSS customer is shaped by his characteristics, therefore,

the PSS offerings may not fit that customer's characteristics, although the providers consider all possible requirements, as well as the marketplace. Therefore, the customer is required to assess the PSS offerings, based on the most appreciated attributes; these attributes are seen as values and include specifications related to the PSS and those related to the providers. As a result, a list of perceived values will be developed and prioritised. The customer must identify those latent needs that relate to the purchase to ensure the applicability of the PSS offerings. Likewise, these customer's characteristics have to be assessed and prioritised accordingly. Ultimately, the result will be shaped and tailored to the desired PSS. The PSS provider will work jointly with the customer to modify and redesign the offering to fit the PSS customer characteristics.

Assessing the offered PSS may result in a preferred offer, based on PSS values. But, essentially this may not necessarily fit the customer characteristics. In fact, when a customer has to select the suitable PSS, his characteristics play a role in this case, even though the selected PSS has fewer values than the others. For instance, in the case of purchasing copying machines in BankCo, the purchasing groups assessed the offered PSS, based on the perceived values. Therefore, the possible supplier would be the one who offers the most appreciated values. As a result, the potential suppliers are ranked from the top as supplier 1, supplier 2, supplier 3 and supplier 4. It would seem obvious that, supplier 1 would be the awarded supplier. However, by considering BankCo's capabilities, the purchasing group members selected supplier 3, as the supplier fitted BankCo's capabilities in terms of the operation skills of the end users.

Moreover, HealthCo has to select from a number of PSS offerings (medical equipment). Initially, supplier 1 was found to be the best, as he offers the best quality and provides a long warranty. However, another supplier was awarded the contract as HealthCo focus their concern on affordability as one of the important characteristics. The assessment of the customer's characteristics has a significant role in the selection of the suitable supplier. The PSS perceived values provide a clear image of the potential suppliers, but the best selection is not made unless providing a fit for the customer's characteristics.

4.9 Customer Requirements and Capabilities

It has been noticed in marketing research that many new products/services failed to capture the interest of customers (Goffin *et al.*, 2010). They argue that that failure might be due to the poor understanding of customer requirements and needs. In order to achieve successful competitive marketing, manufacturers depend heavily on meeting customer requirements (Kwong and Bai 2003). Customer Requirements (CRs) have been considered in several articles in literature, such as new product development (NPD) (Chan *et al.*, 1999), new service development (NSD) (Cavalieri and Pezzotta 2012), innovation and R&D. In new product (service) development, customer needs have been considered as the driving force and source for idea generation (Morris, 2009). A good understanding of the market has been seen as a key success for firms to fulfil their customer requirement (Balachandra and Friar 1997) as well as to improve customer satisfaction (Toossi *et al.*, 2013). They argue that customer requirements can be difficult to understand because of lack of understanding by the customers themselves. These requirements represent the needs of the customer, as well as those capabilities that the customer possesses in relation to the required outcomes of the PSS.

PSS customers pay attention to their requirements when purchasing a PSS. However, the fact is, the internal capabilities actually play a critical role, as they are considered as customer requirements. Therefore, the customer capabilities represent the internal capabilities of the customer to acquire a PSS; this includes the capabilities of operation, service, maintenance, and so on. These capabilities on the other hand characterised the PSS customer, as each customer has unique capabilities. Thus, we would refer to these capabilities as “customer characteristics”. Purchasing process in HealthCo, for instance, involves the analysis of the PSS offerings, based on what the suppliers offer, then what the HealthCo would be capable of achieving. This step is in fact to “*match up*” or “*fit*” the offerings with the internal capabilities. As in the HealthCo purchase regarding medical equipment, the concern is with the capability of the end user to operate it and the capability of the technical staff to maintain and support the equipment. Therefore, the assessment of the PSS offerings does

not necessarily result in the final selection from the offered PSS's. The diversity of the PSS enables the customer to best fit the preferred PSS with his characteristics.

The result identified a number of characteristics in the five case studies. These characteristics can be summarised as follows:

- Ownership orientation
- Operational capability and capacity
- Competence availability
- Customer's resources
- Advantages orientation
- Business orientation
- Environmental awareness
- Affordability
- Risk acceptance

The above listed characteristics represent the characteristics of the conducted five cases. The five cases share the same characteristics with different intention, based on the type of purchase and the situation. Six of the resulted characteristics have been identified early in Chapter 5 as one of the objectives of the research programme. Table 4-7 illustrates the customer's characteristics for OilCo, HealthCo, BankCo, TeleCo1 and TeleCo2.

Table 4-7: Customers' characteristics within the five cases

Characteristic	Description
Ownership orientation	Represents the susceptibility of the customer to own the PSS.
Operational capability and capacity	Operating capabilities possessed by the person to operate a PSS if required.
Competence availability	The knowledge and skills to perform the service form the PSS.
Customer's resources	All accessible resourced belong to the

	customer and can be used by the supplier.
Advantages orientation	The tendency of the customer to take advantages from the PSS supplier.
Business orientation	The tendency of the customer to focus on the core business.
Environmental awareness	The customer's ability to deal with possible environmental implication of the PSS.
Affordability	The potential price that the customer is willing to pay for the PSS.
Risk acceptance	The customer's ability to accept the associated risk during and after the consumption of the PSS.

4.10 Purchasing PSS framework in current practice

As all parameters that affect the decision of purchasing a PSS have been identified, the behaviour of the customers in all cases has been observed to ascertain how these parameters interact in all organisations. The identification of the requirements is found to be the driver behind the intention of purchasing a PSS. Each case seeks to fulfil its current or future need; these needs can be seen as a problem, which require a solution. PSS providers offer what the customer needs and what he identifies as a solution. The PSS offerings however, are received by the customer and assessed, based on what they expect to be valuable *(the perceived values)*.

Each case has its vision to decide what is of greater value to them (personal and organisational). The assessment involves both the provider and the offering. PSS customers are concerned with and what they capable of with regard to the PSS. For instance, the PSS may require specific operational skills, comprehensive maintenance tasks, or additional requirements. Each organisation has its own and unique conditions, circumstances and capabilities.

Sometimes the customer may find a valuable offering, but their capabilities force them to consider another offering.

The framework is constructed, based on the defined parameters, combined with the observations of the researcher during the interviews. These observations potentially concern the behaviour of decision makers in the covered organisations which may not have been elicited during the interviews. However, parameters that relate to the offered PSS, such as quality, reliability, specifications, brand, life cycle, complexity, compatibility, price and ease of use, as well as those related to the supplier, such as firm size, reputation, location and experience, will be considered as PSS values, as they are part of the assessment from the PSS customer's side. On the other hand, customer capabilities and demand will be considered as another construct that interacts with the PSS values. Another construct will cover external drivers that affect the decision to purchase a PSS. More importantly, the main focus of the customer is to fit the PSS offers to his characteristics. This will reduce the number of offerings, and determine which PSS offering fits the current characteristics of the customer.

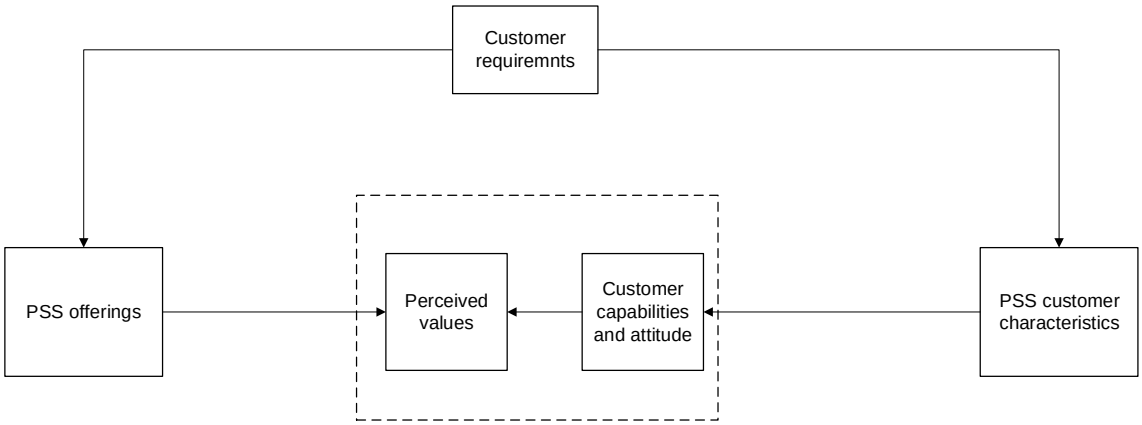


Figure 4-13: A current practice framework for purchasing a PSS

As illustrated in Figure 4-13, PSS customer characteristics interact independently with the PSS offerings. This means the customer situation determines the best selection of the PSS offerings to fulfil the customer need,

unlike the PSS providers' expectation that the offerings force the customer in the selection of the PSS offerings. Customer characteristics in this case are those latent needs unseen by the provider. These needs however, include all capabilities that the customer exhibited to achieve the maximum benefits from the purchased PSS, which include the operating capabilities and skills, the capability to maintain, support and serve the PSS and facilities, and resources that the customer has, to acquire the PSS. The PSS customer is shaped by his characteristics, therefore, the PSS offerings may not fit that customer's characteristics, although the providers consider all possible requirements, as well as the marketplace. Therefore, the customer is required to assess the PSS offerings based on the most appreciated attributes; these attributes are seen as values and include specifications related to the PSS and those related to the providers. As a result, a list of perceived values will be developed and prioritised. The customer must identify those latent needs that relate to the purchase, to ensure the applicability of the PSS offerings. Likewise, these customer characteristics have to be assessed and prioritised accordingly. Ultimately, the result will be shaped and tailored to the desired PSS. The PSS provider will work jointly with the customer to modify and redesign the offering to fit the PSS customer's characteristics.

Assessing the offered PSS may result in a preferred offer, based on PSS values, but, essentially may not necessarily fit the customer's characteristics. In fact, when a customer has to select the suitable PSS, his characteristics play a role in this case, even though the selected PSS has fewer values than the others. For instance, in the case of purchasing copying machines in BankCo, the purchasing groups assessed the offered PSS, based on the perceived values. Therefore, the possible supplier would be the one who offers the most appreciated values. As a result, the potential suppliers ranked from top as supplier 1, supplier 2, supplier 3 and supplier 4. Although it would seem obvious that supplier 1 would be the awarded supplier. By considering BankCo capabilities, purchasing group members select supplier 3, as the supplier fits BankCo capabilities in terms of the operational skills of the end users.

Moreover, HealthCo has to select from a number of PSS offerings (medical equipment). Initially, supplier 1 was found to be the best, as he offers the best quality and provides a long warranty. However, another supplier was awarded the contract as HealthCo concerns are with affordability as one of the important characteristics. The assessment of customer's characteristics has a significant role in the selection of the suitable supplier. The PSS perceived values provide a clear image of the potential suppliers, but is definitely not the best selection unless it fits the customer's characteristics. The framework provides a clear strategy for PSS customers to select the best PSS supplier and can be used to avoid any undesirable result, which affects the expected outcome, as well as the overall performance for the customer's organisation.

4.11 Validation

Research validity is considered to be one of the essential measures of the trustworthiness of research findings (Yin, 2013). This research has adopted the case study approach as mentioned in the early phase of the research; this approach involves different research methods such as systematic collection, coding and result interpretation. According to Pope and Mays (1995), validation strategies in qualitative research are sometimes recommended to be used in feeding the findings back to the participants to determine whether they judge the findings to be reasonable based on their experience. They also suggested to use interviews and focus groups with the same people. In this phase of the research, the development of the PSS framework involved working cooperatively with five organisations to identify the decision parameters related to purchasing a PSS.

Having identified customers' characteristics across the five case studies, it is essential to ensure the validity of these characteristics within the five case studies. Therefore, 12 participants were used to validate the obtained characteristics and their role in the purchasing of a PSS. The validity check involves holding discussion sessions with group members in each organisation. The group discussion addressed the following points:

- The extent of the nine customers' characteristics in representing the organisation.
- The influence of these characteristics in purchasing a PSS.

Each discussion session lasted for 40 minutes, on average, for each case. The session started with re-introducing the research aim and the industrial problem, and then proceeded to presenting the ultimate findings. The session was open for any questions or comments from the participants. The discussion first focused on the final nine characteristics as a result from the field study. The participants expressed their acceptance of all the characteristics to represent their organisations. The participants in MobileCo mentioned that although these characteristics represent their company, their view of each characteristic would vary depending on the company's requirements and the type of the purchasing. BankCo and HotelCo commented on the final characteristics as best describing their companies. They also claimed that it is not necessary for these characteristics to be present simultaneously. HealthCo and TeleCo were also satisfied and agreed that these characteristics represent their generic profile.

Regarding the influence of the identified characteristics on the purchasing of PSS, all participants from the five organisations emphasised that these characteristics play a major role in the purchasing decision and supplier selection. The identified characteristics were described by most of the participants as the real benchmark to select the PSS supplier.

4.12 Chapter Summary

This chapter explained the development of PSS customer's framework. The development of the framework has been achieved through two stages. Firstly, a systematic literature review has been conducted to investigate the existing PSS frameworks and methodologies to enhance the researcher position to develop the required framework. As a result, an initial framework was proposed. Then, case study with the relevant methods has been executed with five organisations in Saudi Arabia. The data was collected based on semi-structured interviews with key persons in the selected originations. The analysis of data has been

conducted in a systematic manner to achieve a meaningful result. The obtained result from coding process provides a greater understanding of the decision parameters that affect the purchasing of PSS. The decision parameters then have been identified and, a PSS framework proposed, based on the findings of this chapter. Nine customers' characteristics were identified to represent the five organisations in this study. These characteristics are: Ownership orientation, Operational capability and capacity, Competence availability, Customer's resources, Advantages orientation, Business orientation, Environmental awareness, Affordability and Risk acceptance. The validity of the final finding was discussed in feedback sessions.

5 DEVELOPMENT OF PSS FRAMEWORK ASSESSMENT TOOL

5.1 Introduction

This chapter deals with the development of a PSS assessment tool. In the previous chapter, the PSS framework has been developed jointly with five organisations in Saudi Arabia. This framework represents the modified draft of the PSS customer framework. In this chapter, the PSS framework will be further refined, based on the emergent concepts. Then, the suggested changes will be collated to refine the developed PSS framework. After that, the framework will be validated, using five case studies to insure its applicability and validity in real practice. The test and validity method has been set to cover the PSS customers' characteristics and the co-developed framework. The framework is validated by means of expert feedback within the same five cases in Saudi Arabia that participated in the co-development of the framework.

The assessment tool reflects the interaction of the decision parameters that form the PSS customer framework. However, the development of the PSS framework revealed the role of the fit concept, as well as the concept of value. In order to develop the assessment tool, there is a need to explore these concepts and related techniques. Moreover, the aim of the research concerns the purchasing of PSS, which involves the selection of suppliers, therefore, the supplier selection method is covered to enhance the development of the PSS assessment tool.

5.2 The Concept of Fit

The concept of fit has been discussed in the literature from different perspectives. Person-environment (P-E) fit defined by (Kristof-Brown *et al.*, 2002) as "a comprehensive notion that necessarily includes one's compatibility with multiple systems in the work environment". This theory has been addressed, to measure the fitness between a person's characteristics and properties of a job (Rounds *et al.*, 1987). They argue that a person receives more positive outcomes when he chooses a job, compatible with his

characteristics. Within the P-E fit, several types of fit have been introduced, such as person-organisation (P-O) fit; which concern the personal and the organisational values, person-job (P-J) fit, which concern the personal abilities and skills and job demand (Morley, 2007). Therefore, the concept of fit, refers to congruence between the values and the interest of the employee, and the characteristics of the organisation and values it provides (Hinkle and Choi, 2009). Moreover, one of the most cited fit models in information systems is Task-Technology Fit (TTF). Goodhue and Thompson (1995) argue that the individual performance is positively impacted by the Information Technology (IT) and can be used if IT capabilities match the user's needs.

From this perspective, the purchasing of a PSS has been seen as the congruence between the perceived values of a PSS and customer characteristics. According to the interviewees in the cases under study, they concern the degree of fitness between the offered PSS and their capabilities. In fact, this gives us a new vision of how purchasing practitioners act when purchasing a PSS. Fitting a PSS into customer capabilities means that the capabilities are the independent variables and the PSS offerings are the dependent variables.

5.3 The Concept of Value

In the early history of economy, the old model of marketing, was based on the exchange of goods, where manufacturers were concerned only with the output they gained. This dominant logic is known as Goods-Dominant (G-D) logic, concerned with the tangible resources, embedded values and transaction. Then, after decades, marketing witnessed the emergence of a new perspective to transform the traditional dominant logic, by focusing on value creation, intangible resources and information known as Service-Dominant logic (S-D) logic (Vargo and Lusch 2004). However, in extreme competitive situations in the global market, manufacturers have realised the importance of shifting from the old model of focusing on the exchange of goods, to the provision of capabilities. (Sheth *et al.*, 2009). Vargo and Lusch (2004) argue that it is the time to shift the focus from tangibles toward intangibles (i.e. skills, knowledge, and information).

(Toossi *et al.*, 2013) identify that manufacturers changed their direction by adopting a service-oriented business strategy rather than focusing on goods production.

This shift towards service oriented business, created the phenomenon of providing integrated bundles, which combines products and services. This is obvious when the term servitisation was coined by (Vandermerwe and Rada, 1988). Offering integrated bundles by adding value to the customers, has been considered to be a more sustainable and profitable strategy for manufacturers and customers alike (Tim Baines *et al.*, 2011). This transition has been defined by other scholars as product-service systems as in ((Mont, 2000; Baines *et al.*, 2007), customer solutions (Davies, 2004). From this point, marketing firms realised the shift toward solution-focused, rather than product-focused (Sheth *et al.*, 2009) ,which forces purchasing firms to seek diverse solutions.

Recently, manufacturers of PSS have realised the importance of focusing on the satisfaction of their customers, by providing the required integrated solutions (spare part, after sale services, etc.) (Raja et al, 2013). In marketing research, the offered PSSs have been considered to capture PSS customers' requirements, as well as customer satisfaction (Lele and Sheth, 1987). Therefore, to ensure the fulfilment of customer's needs, it is essential to consider the role of the customer in S-D logic, as well as hidden role in the value creation process (Lusch and Vargo, 2009).

The concept of value has been commonly mentioned in different disciplines like production management, customer behaviour, strategy, manufacturing, and marketing. However, in marketing, researchers use terms such as, customer satisfaction and customer value when referring to the concept of value (Ulaga and Chacour, 2001). The concept of "perceived value" has been seen as ambiguous in literature, as the differentiation among related concepts such as "values", "price" and "utility" is vague (Sanchez-Fernandez and Iniesta-Bonillo, 2007). Additionally, they argue that marketing researchers use the terms "value" and "values" as the same concept. On the other hand, Holbrook, (1994, 1999) considers both terms are distinct and refer to different meanings. He argues that

the term *value* is “an outcome of an evaluative judgment” while the term *values* “refers to the standards, rules, criteria, norms, goals, or ideals that serve as the basis for such an evaluative judgment”. However, one of the keys points to this research is the assessment of the PSS values, therefore, it is essential to understand the definition of value. The term *value* has been defined from different disciplines. Table 5-1 illustrates different definitions of value in the literature.

Table 5-1: Common value definitions

Value definition	Author, year
“The ratio of perceived benefits relative to perceived sacrifice”	Monroe (1990)
“Worth in monetary terms of the technical, economic, service, and social benefits a customer receives in exchange for the price it pays for a market offering”	Anderson and Narus 1998
“A comparison of what customers think a company should offer (i.e. their expectations) with the company’s actual performance”	Parasuraman, Zeithaml and Berry (1985)
“The customer’s overall assessment of the utility of a product based on perception of what is received and what is given”	Zeithaml (1988)

From the above definitions, the definition of value is based on the concept of monetary worth or perceived benefits vs sacrifices (Zeithaml, 1988), and treated as embedded utility or value added and this attitude reflects the traditional goods-dominant logic where value added is assessed at the factory gate (Vargo and Lusch, 2004). They argue that the value is defined by the producer, which explains the context of exchanged value or exchange for the price a customer pays (Anderson and Narus, 1998).

However, customer value is generally described as a transaction, based on giving to receive benefits (Zeithaml, 1988). Monroe (1991) sees that the

perceived value is a ratio between the perceived benefits and the perceived sacrifices. The perceived benefits include the physical attributes of the purchase, service attributes, the price and the available support related to the product/service. On the other hand, the perceived sacrifices include any sacrifices given by the customer, in order to purchase the product/service. This includes all potential expenses related to the purchase (price, repair and maintenance costs, handling cost, installation and risk) (Ravald and Grönroos, 1996). This definition is very similar to Zeithaml (1988), but Zeithaml also mentioned that the perceived value differs among customers, as the perceived value is subjective and individual. Moreover, a customer may evaluate the same purchase (product/service) in a different manner from different perspectives (Ravald and Grönroos, 1996).

Armstrong et al., (2012) in their book "*Principles of Marketing*" define the perceived value as "as the customer's evaluation of the difference between all the benefits and all the costs of a marketing offer, relative to those of competing offers". Sánchez et al. (2006) support the concept of value by considering the perceived value as a subjective construct, formed by two parts. The first part stands for the perceived benefits (economic, social and relationship) and the other part stands for the perceived sacrifices (price, time, risk and effort). However, the definition of 'perceived value' has been included in the list of research priorities for 2006–2008 by the Marketing Science Institute. Subsequently, a new value perspective has been introduced by (Vargo and Lusch, 2004), as they argue that the value is grasped when a service is used. From this new view, the term *value-in-use* has been introduced stressing the role of the customer experience in the perception of the value (Prahalad and Ramaswamy, 2004). Customers will not gain any value until they take part in activities that include the use of it (Sandström *et al.*, 2008), and . However, Macdonald et al. (2011) argue that the definition of value in use is still vague, and defined the term value-in-use as "A customer's outcome, purpose or objective that is achieved through service". This actually emphasises the role of the customer as he is always involved in the creation of value.

5.3.1 Value co-creation

In service dominant logic, the customer has been seen as a co-producer and the value is created and identified by the customer (Vargo and Lusch, 2004). This new transition therefore, stresses the significance of value co-creation and a tangible product, merely created within the factory and exchanged with a customer (i.e. value-in-exchanged) (Payne *et al.*, 2008) or value in use (Macdonald *et al.*, 2011)

In order to achieve successful marketing, the role of the customer has been recognised as an active part of the new product development (NPD), as well as new service development (NSD). In the context of product service systems PSS), manufacturers aim to provide the required solutions for their customers (Tuli *et al.*, 2007). Baines et al. (2007) define the PSS as “an integrated product and service offering that delivers value in use”. This explains the importance of maintaining a collaboration relationship with customers, in order to deliver the required values. Buyer and seller in this case are co-creating the values together by integrating resources and experiences (Lusch & Vargo, 2009). Providing values has been considered to be very important in mass production, but it is more importantly considered in providing service, as the service market attracts more attention, especially after the realisation that values can be added from technological improvements, product image and design (Mont, 2000).

However, Woodruff (1997) argues that value creation is a fundamental point for any organisation to survive in the competitive market. Durugbo et al. (2010) see PSS as “a business model for promoting the co-creation of value between customers and companies”. This clearly identifies the importance of involving the customer in the creation of the values. However, in marketing, it has been seen that value was embedded in a product from economic view point and considers the customer as a value co-creator (Vargo and Lusch, 2004).

Value creation has been identified as a function of interaction between the firm and the customer and is referred to as customer’s creation of value-in-use (Grönroos and Voima, 2013). Payne et al. (2008) argue that the customer’s value creation process can be defined as “a series of activities performed by the

customer to achieve a particular goal". It has been argued that it is important to define the context in which value is perceived, to assess customer value (Vargo and Lusch, 2004). They also highlight the process of the value creation during the consumption or usage by a customer, rather than created by the manufacturer as an output. Moreover, they proposed a framework for value in use assessment in the context of a maintenance service. Although, understanding that the perceived values from the customer perspective has a role for decision makers in any organisation, the values of PSS offerings might be seen from different perspectives, as the customer seeks to fulfil his needs. However, for the purpose of this research, we need to clarify that PSS customers may view the PSS offerings at the point of purchasing. Keeping in mind that a PSS provider considers the customer requirements, as well as his needs, the value creation process takes place in the early stage of PSS design.

5.3.2 The assessment of the perceived value

Assessing value in use has been highlighted in recent researches (Macdonald et al. 2011, Vargo and Lusch (2004). Assessing value in use has been considered as an essential step for suppliers and customers alike, as assessing values would enable customers to identify the most valuable attributes in the PSS offerings. Therefore, the suppliers can understand the customer behaviour regarding the preferred values in their PSS. On the other hand, some may argue that these values may not fit their requirements. Nevertheless, what is offered does not mean that it is the appropriate one for all customers. To clarify this, let us consider that a customer wants to purchase a PSS. By assessing value in use, provides important indicators concerning the most appreciated attributes of the offered PSS. In this case, the customer evaluates the PSS, based on the received quotes for example. Now, the question is, do these values fit the customer's requirements? For a specific customer the answer could be yes. But on the other hand, what fits one customer requirement may not fit another, as each customer has his own and unique characteristics.

5.4 Understanding Customer Requirements

In marketing research, it has been noticed that many new products/services failed to capture the interest of customers (Goffin et al., 2010). They argue that, that failure might be due to the poor understanding of customers' requirements and needs. In order to achieve successful competitive marketing, manufacturers depend heavily on meeting customer requirements (Kwong and Bai 2003). Customer requirements (CRs) have been of interest in several literatures, such as new product development (NPD) (Chan *et al.*, 1999), new service development (NSD) (Cavalieri and Pezzotta 2012), innovation and R&D. In new product (service) development, customer needs have been considered as the driving force and source for the generation of ideas (Morris, 2009). A good understanding of the market has been seen as a key to success for firms to fulfil their customers' requirements (Balachandra and Friar 1997) as well as boosting customer satisfaction (Toossi *et al.*, 2013). They argue that customer requirements may be difficult to total understand because there may be a lack of understanding by the customers themselves.

In the context of product service systems (PSS), the case can be seen the same, as PSS providers aim to fulfil customers' needs (Goedkoop *et al.*, 1999). Therefore, the term *customer's need* has been defined as "a description, in the customer's own words, of the benefit to be fulfilled by the product or service" (Gaskin *et al.*, 2010). In most cases, the customer may not be aware of their hidden needs or find it difficult to articulate these needs themselves (Goffin et al., 2012). Customer hidden needs however, can be defined as stated by Goffin et al., (2010) as "issues and problems that customers face but have not yet realised". In addition, they define three types of customer needs as:

> ***Known need***: these needs that are already recognised and addressed by existing products and services.
>
> ***Unmet needs***: already recognised by customers but not yet addressed by products and services.

Hidden needs: never been articulated, either by customers themselves or market researchers.

Apparently, PSS customers may focus on what is offered, rather than what fulfil their needs, which may result undesirable output in terms of performance for instance. This actually explains the reason why most organisations recognise the significance of listening to the voice of their customers to achieve their targets and developed number of techniques in order to understand customer needs.

5.4.1 Identifying customer's needs techniques

Conducting marketing research to identify customers' needs, involves gathering data from customers. There are several methods in marketing research, such as formal survey, focus group, customer contact, and customer complaints (Lai *et al.*, 2008). Goffin et al. (2010) argue that the old techniques of listening to the VOC may not provide a real situation of the customer needs. They argue that traditional marketing techniques are based on the existing products/services attributes and these attributes are subject to change as customers also change their requirements and attitudes.

Additionally, these techniques rely on direct questions, based on surveys, interviews or focus group. The questions are usually based on product/service futures customers prefer. On one hand, the method of conjoint analysis has been considered to be used to understand the trade-offs that a customer is willing to make between different combinations of products/services Goffin et al. (2010). Wang and Tseng, (2014) point out that the conjoint analysis relies on the responses from the customers, based on their preferences, as they have been offered a number of alternatives regarding products/services. The following section will highlight the most frequently mentioned techniques in the literature review.

5.4.1.1 Ethnographic market research

In studying native tribe culture, ethnographic research originally was used as an approach by anthropologists, and in the late 1970s it captured the attention of

marketing researchers (Schröder and Steinhoff 2009). The approach has been used initially within the context of B2C, and then increasingly within B2B (Goffin et al. 2010). Ethnographic market research involves several techniques to collect data, but is mainly concerned with understanding user behaviour in real life and in their own environment (Goffin *et al.*, 2012).

As stated by Mouncey and Wimmer (2007), Ethnographic research is “a tool which allows us to obtain insights into the reality of our consumers-their real lives”. One of the advantages of observing the customer uses a product or service is to gain a better understanding of the customers’ needs and issues that they cannot express. Conducting ethnographic market research is believed to bring the customers’ vision for the purpose of new development and product improvement; in other words, capturing the voice of the customer (VOC) (Wang and Tseng, 2014).

5.4.1.2 Lead user method

One essential function in marketing research is to precisely understand user needs and use them to develop new products. For this reason, companies work very closely with their customer to uncover their needs, which can be used for the development of new products or improve the current ones, as well as break away from me-too product extension to the creation of new market directions (Eisenberg, 2011). He stated that the lead users are “individuals or firms who have product or service needs beyond what is currently available in the general market”. The user however, can be seen as a contributor in the developed product, service and process, and argued to be the actual developer of successful new products (Urban and von Hippel, 1988).

Von Hippel (1986) identified the lead users of product, service or process to be those who exhibited two characteristics: they face needs earlier than the marketplace encounter them; they expect to gain significant benefits from finding a solution to these needs. However, Goffin et al. (2010) argue that the lead user method, purposes to contribute to the successful level of new products and series. The method tends to analyse the future needs of the customers and depends on project team and requires advanced interviewing

skills and direct observation (Eisenberg, 2011). To apply the lead users technique, four phases have been commonly identified across the literature; for example (Eisenberg, 2011; Lilien et al. (2002); and Urban and von Hippel, 1988).

5.4.1.3 Repertory Grids Technique

The repertory grid (RG) technique has been originally found in the field of psychology in the 1950s by George Kelly, who developed the theory of personal constructs (Goffin et al., 2010). The opinion behind the theory is that each person develops rules by which he views people, situation or objects, and these can be referred to as personal constructs. This technique has been adapted successfully in several fields, such as management research; new product development (Goffin and Koners, 2011); and industrial marketing (Toossi *et al.*, 2013). Market researchers acknowledged the significance of the repertory grid technique as a method to investigate the market demand and issues (Goffin et al., 2010). Repertory grid can be defined as a data collection method which can be of use for in depth interviewing technique, to elicit the real perception of the individual regarding a specific situation or phenomenon (Fransella et al., 2004; and Goffin et al., 2010).

In terms of customer needs, it has been claimed that the RG method is considered to be one of the most promising methods to identify customer needs. Repertory grid analysis (RGA) is a method that has its origins in the field of psychology and is a potent method for identifying hidden customer needs. Despite its proven usefulness and effectiveness, it is not used very often, which is probably due to the skill the interviewer has to possess, in order to execute the method properly. Although many studies and researchers are positive that RGA actually elicits hidden customer needs, there are those who say otherwise. Van Kleef, et al. (2005) claim that RGA is only a method for discovering incremental improvements of a product. This needs to be assessed under specific challenges.

5.5 Supplier Selection

In this section, a literature review will be provided of the supplier selection within the purchasing PSS context, as this part of the literature review is considered to be extremely relevant and important for this research. In order to satisfy the customer's demands, manufacturers tend to offer high quality products and services, and therefore customers require the appropriate strategy to select the suppliers that are attentive to their needs and competencies.

Considering the global supply chain in supplier selection, the operational and strategic factors, such as delivery, reliability, quality, etc., must be taken into account to ensure the balanced satisfaction between the buyer and the seller. Several industrial firms, however, prefer to work together with a particular supplier in a single source relationship (Stremersch et al., 2001). At a time when a customer seeks to acquire a specific product and/or service to meet his needs, a supplier selection process is required in order to appropriately select the PSS providers. This process requires the assessment of the PSS offers (Baines et al., 2007; Ng et al., 2009).

"The objective of supplier selection is to identify suppliers with the highest potential for meeting a firm's needs consistently and at an acceptable cost" (Kahraman et al., 2003). The general consensus in the scientific literature on supplier selection, is that it is a task of extreme importance within purchasing and supply management (Dickson, 1966; Kraljic, 1983; Weber et al., 1991; Choi and Hartley, 1996; De Boer et al., 2001; Sarkar and Mohapatra, 2006).

Some even identify the task of supplier selection as the most important of all within purchasing and supply chain management, as a supplier significantly impacts among others the quality, cost, price and lead time of purchased goods and services (Dulmin and Mininno, 2003; Humphreys et al., 2007; Sarkis et al., 2007). In addition, Luo et al. (2009) identify three recent trends in purchasing practices, which further emphasise the importance of the supplier selection. Firstly, due to the increased desire to outsource, firms spend a larger share of their revenue on externally sourced goods and services, which directly increases the impact of the suppliers' performance on purchasers (Weber and

Ellram, 1992). Second, the increased use of supply base reduction, further increases the buyer's dependence upon its suppliers' performance (Power et al., 2001). Third, the fact that nowadays purchasers and suppliers seek for a closer relationship, based on collaboration and co-operation, again increases the role and contribution of suppliers in the performance of the purchaser (Heidi and John, 1990).

Furthermore, the supplier selection process cannot merely be described as one of extreme importance, but also as a process which is highly complex for a number of reasons. Firstly, Weber et al. (1991) stress that the supplier selection process is highly complex, due to the involvement of multiple and often conflicting criteria. To be able to obtain a satisfying supplier selection, potential suppliers need to be assessed against these criteria, and, as these criteria might be conflicting (e.g. cost vs. quality) trade-offs are typically required (Chen et al., 2006). Hence, the supplier selection can be best described as a multi-criteria decision-making problem, in which typically, certain criteria (e.g. quality) are sought to be maximised, whilst other criteria (e.g. cost, delivery time) are sought to be minimised (Dickson, 1966; Weber et al., 1991). Second, the increased sourcing and purchasing opportunities provided by the intensified globalisation of world trade, and the facilities of enhanced communication methods, by means of the internet, is another factor which has increased the complexity of the supplier selection process (Kahraman and Kaya, 2010; Luo et al., 2009).

5.5.1 Supplier selection methods

Weber et al. (1991) reviewed and classified 74 purchasing related articles from the scientific literature from 1966 until 1990. They argue that the supplier selection decision models for the final choice, used in this particular time period, can be grouped into three general categories:

1. Linear weighting models;
2. Mathematical programming models; and
3. Statistical/probabilistic approaches.

Correspondingly, Degraeve et al. (2000) and De Boer et al. (2001) show similarly that there are five categories of supplier selection methods, respectively:

1. Rating and linear weighting models;
2. Total cost approaches;
3. Mathematical programming models;
4. Statistical approaches; and
5. Artificial intelligence (AI)-based models.

Luo et al. (2009) also discuss four main categories of methods and models:

1. Linear weighting/mathematic programming;
2. Analytical hierarchy process (AHP);
3. Fuzzy set theoretic analysis; and
4. Other methods and models.

Wu and Barnes (2010) argue for the existence of the following four categories: (1) Linear weighting; (2) Mathematical programming; (3) Fuzzy set theory; (4) AHP/ANP.As has been pointed out, and multiple authors have categorised the final supplier selection methods and models in various ways. For the purpose of this literature review, the general classification as initially defined by Weber et al. (1991), and in a later stage similarly, although in an extended fashion, adopted by Degraeve et al. (2000) and De Boer et al. (2001), has been chosen to further elaborate upon. This choice was made, due to comprehensiveness of the classification, and the fact that all methods can reasonably be placed into a relatively small number of categories. In addition, this classification seems quite robust, considering its applicability, and despite the time period (Weber, 1991; De Boer et al., 2001) between the authors.

5.6 PSS assessment tool: design and development

The PSS customer framework is refined based on the emergent concepts as mentioned in the previous sections (Figure 5-1). The framework was slightly modified by adopting the concept of fit. As illustrated in Figure 5-1, customer's requirements determine the characteristics of the required PSS in terms of its

tangible and intangible components. Thus, the PSS supplier Cn offer what exactly the customer needs. Likewise, customer's requirements identify the actual capabilities of the customer from different aspects such as the operation requirements, the required services and resources. These capabilities and attitude shape the customer's characteristics. therefore, the customer's characteristics identify the PSS customer. On the other hand, the customer takes advantage from the PSS offerings by evaluating these offerings based on the perceived values.

As a result, the assessed perceived values need to fit the customer's characteristics. As shown in Figure 5-1, the shaded container represents the fit between the customer's characteristics and the perceived values. Customer's characteristics represent the actual situation of the customer in terms of the available resources, operation ability, competence capability, the current awareness. Therefore, these characteristics are unlikely to be changed. On the other hand, the PSS offerings provide various options for the customer to select the best PSS that fit his characteristics.

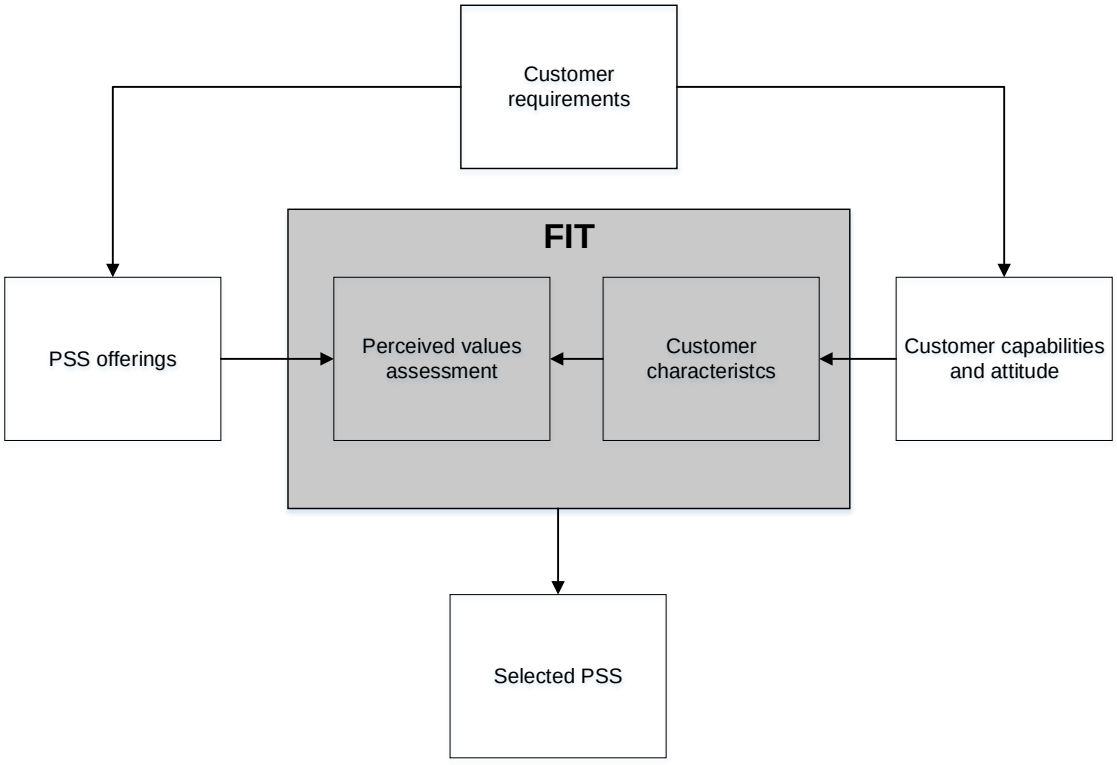


Figure 5-1: PSS Supplier-Customer Fit framework

The researcher took one step ahead to test the framework in real cases. In order to test the supplier-customer fit framework, an assessment tool has been developed, based on the S-C Fit assessment process. The development of the tool, considered to simulate the process of PSS assessment phases as shown in Figure 5-2, which in fact, reflects the developed framework. The tool is computer-based and used Java as programming language. The assessment of PSS means that a customer assesses the PSS offerings from which he must select the most suitable offering. Variant techniques have been employed for the purpose of the assessment of the PSS. These techniques include data collection and data analysis, which include Repertory Grid, variability analysis and frequency analysis.

The assessment of PSS offerings starts from the value assessment, creation of value dimensions, customer's characteristics assessment, value dimension-customer characteristics relativity and finally, fit calculation. Each phase of the assessment process consists of techniques, calculations and algorithms to achieve a reliable result. The next section explains the tool development in great detail.

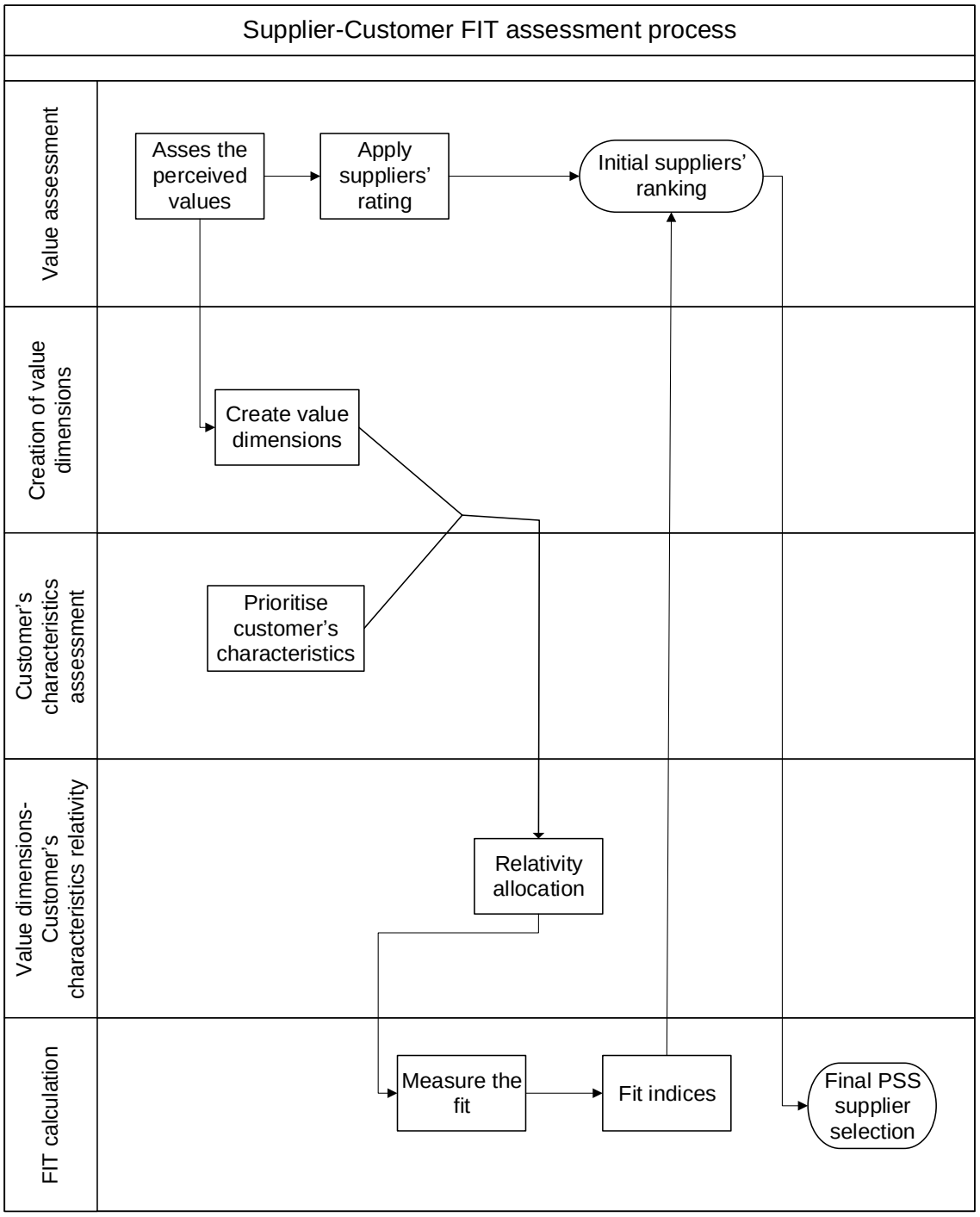


Figure 5-2: Revised PSS Supplier-Customer fit process

5.6.1 Phase 1: Value assessment

This phase represents the starting point of the supplier-customer fit. However, to provide a comprehensive illustration of the tool development, screenshots for the tool are provided, along with explanation of the development of the tool. The

first screen represents the data entry for the user. The user will be asked to provide the required information to enable the use of the assessment tool. The information includes the location to save the final report, the number of PSS offerings and the number of the user who will use the tool to assess the PSS offerings. A screenshot is provided to illustrate the data entry screen for the user as in Figure 5-3.

Figure 5-3: The first Data entry screen

After providing the required information, pressing “START” button is required to proceed to the next screen. The next screen is to enter the required details for the PSS offering and the assessors (users) of the tool as shown in Figure 5-4. It should be mentioned that all fields in the first screen are mandatory and a prompt message appears if no data are entered.

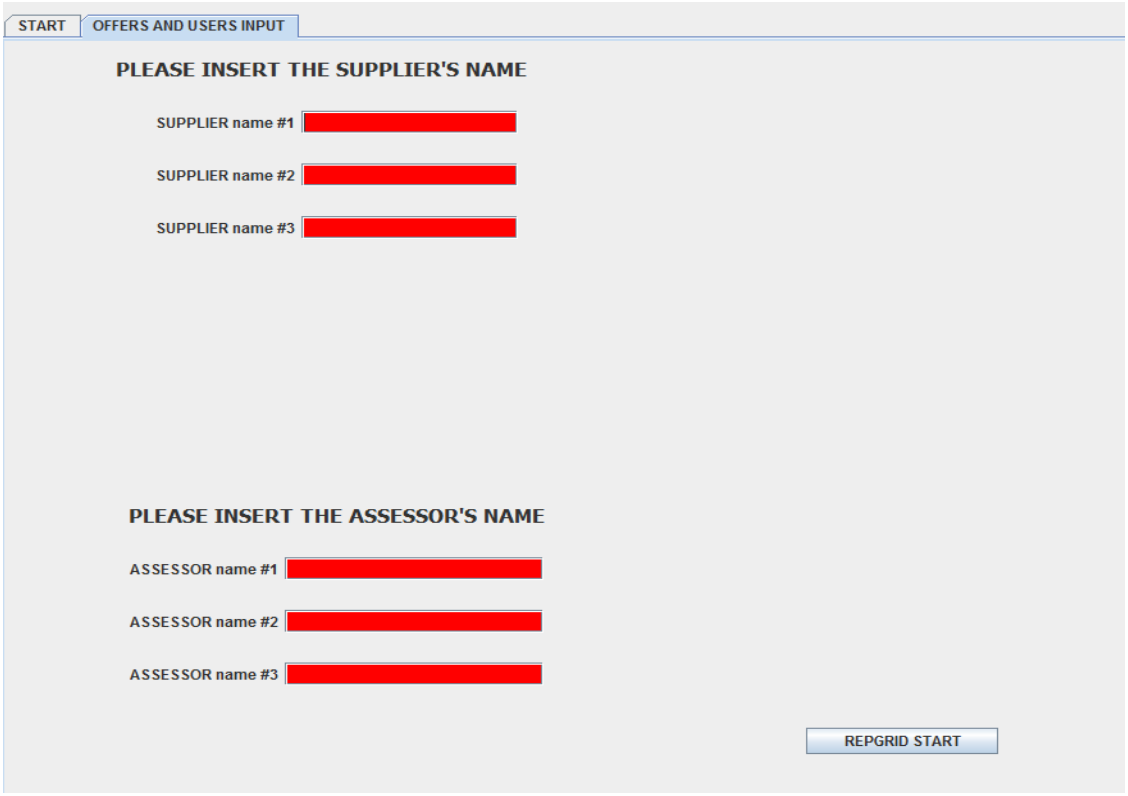


Figure 5-4: The second data input screen of the tool

Once the user enters the required information, the tool will proceed to the value assessment process.

In order to assess the PSS offerings, data collection must be conducted. Due to the subjectivity of such data, a data collection technique needs to be selected in such a way that captures the required data for the purpose of the developed tool. As mentioned earlier, the research has been considered to be exploratory and the nature of the data is likely to be qualitative in this type of research (Saunders et al., 2007). Moreover, the interviewing technique has been selected as it provides deep insight to understand the understudy phenomena. The first phase of the process involves the elicitation of the perceived values from the PSS offering. These values however are subjective, depending on the purchasing situation, the nature of the purchasing and the customer vision.

Repertory Grid Technique (RGT) technique has been chosen as the data collection method. The repertory grid (Repgrid) is based on Personal Construct Theory (PCT) as proposed by Kelly (1995), a structured interview aims to elicit

the personal perceptions of a person, regarding a phenomena or topic. RepGrid has been deployed widely in consumer research to understand buyer behaviour “to understand the individual and shared meanings that consumers attach to their consumption experiences" (Marsden and Littler 2000). One of its advantages is that the bias of the researcher is eliminated (Goffin *et al.*, 2006; Jankowicz, 2005).

According to Jankowicz (2005), applying the repertory grid interviewing technique involves four components as follows:

- Topic: who is purchasing a PSS in this case
- Elements: what are the PSS suppliers’ names
- Constructs: the elicited values from the selected PSS suppliers
- Rating: the given weights for each elicited value (scale 1 – 5)

During the interview, the interviewee; the PSS customer in this case, will be asked to select at least three PSS suppliers, and then a combination of three suppliers is selected randomly (triad). The PSS customer then will be asked to answer the question, which was developed to suit the research (Figure 5-5):

"Can you think of any ways in which two of these suppliers are similar to each other and different from the third?"

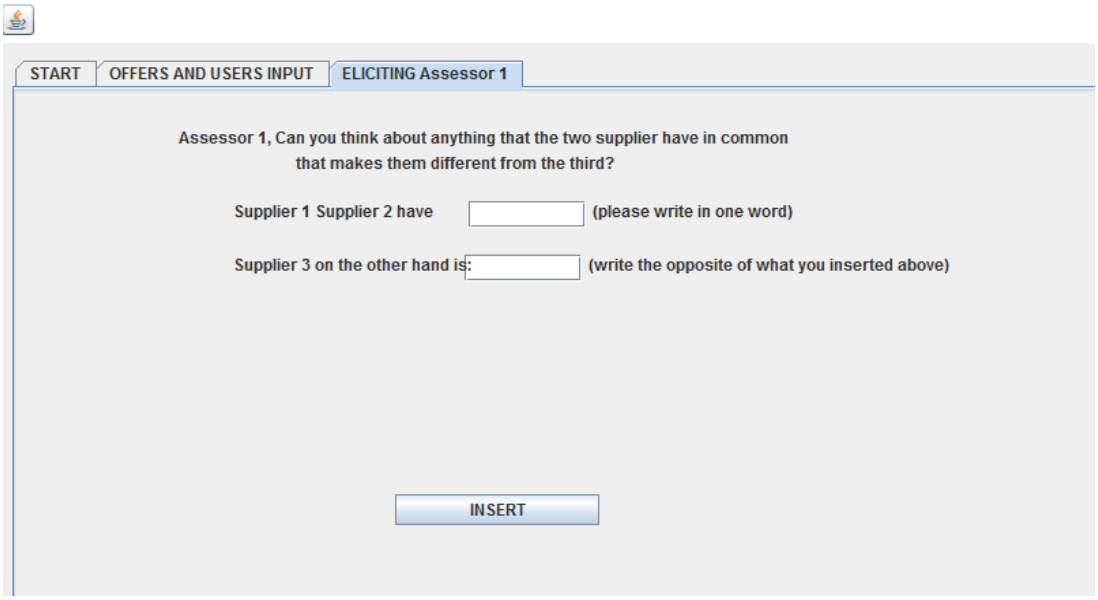


Figure 5-5: RepGrid process screen

The answer to this question will be entered as a construct. At the same time, the negative pole will be determined as part of the procedure of RepGrid (Goffin et al, 2006), for example, if the elicited construct is “good delivery”, the pole will be the contrasting, which is “poor delivery”. The next triad will produce another combination of suppliers, and the same question will be repeated. This process will be repeated until the interview cannot go any further or no meaningful construct can be developed. By the end of constructs elicitation, the developed constructs pole will be refined by laddering them up. This is done by starting with the first construct and asking the interviewee “which pole she/he prefers?”.

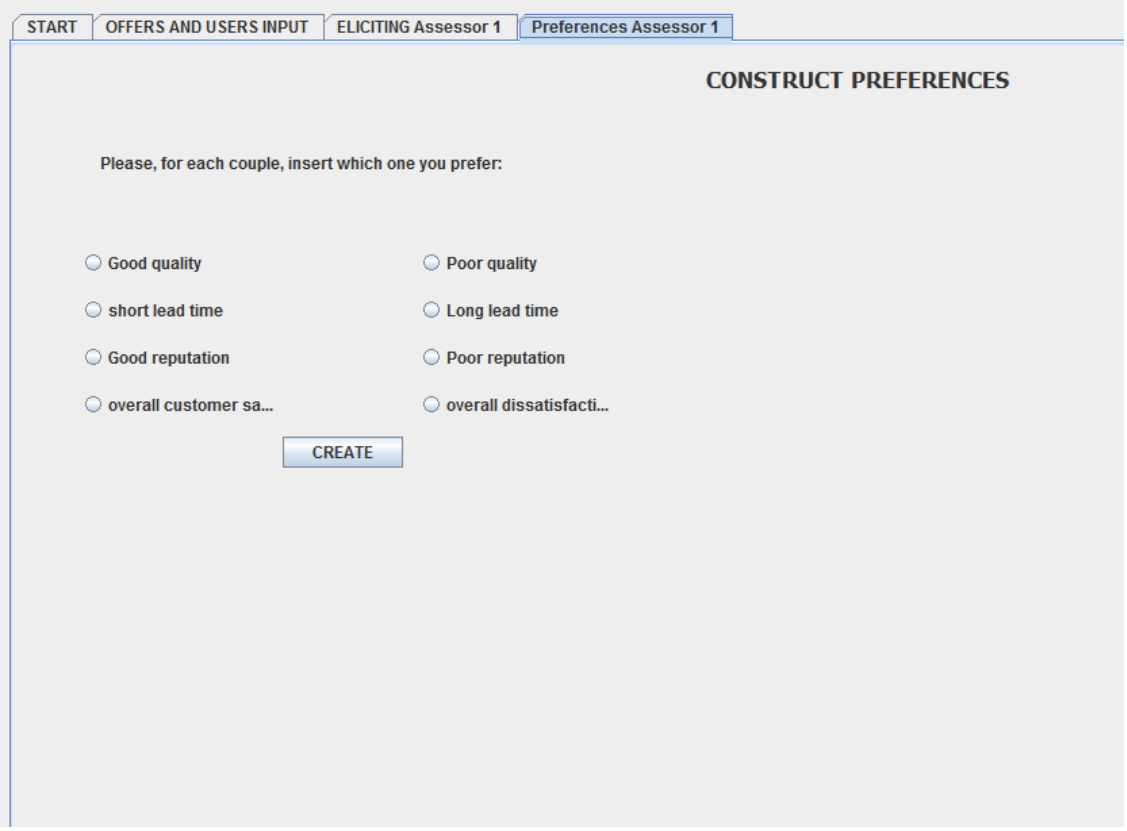


Figure 5-6: Constructs preferences

The selected preferred constructs will be considered as the original constructs, whereas the non-preferred constructs are identified as the contrasting constructs. The developed constructs will be rated among all suppliers (the rating is based on the scale 1-5) (Goffin et al., 2006). It should be mentioned

that the researcher has conducted a pilot RepGrid technique several times, to become familiar with its process.

Appendix A explains in detail the computer-based process as a user guideline. The result of this phase is an initial suppliers ranking. This ranking will be used to achieve to the best ranking with the consideration of customer's characteristics. As the initial ranking has resulted from the RepGrid rating, we will represent it as *RepGridRanking* for the purpose of the calculation of the final ranking in the tool design.

5.6.2 Phase 2: Creation of value dimensions

Eliciting the constructs from the RepGrid interview provides rich data regarding the most appreciated values the PSS customer may see from each supplier. In some cases, the elicited constructs could be very similar in terms of the meaning or share the same meaning. Therefore, the interviewee will be given the time to review the constructs and decide which constructs can be grouped under one category and then name this category to reflect the overall meaning of the selected construct. For example, the constructs "cheap repair cost" and "affordable" can be categorised the value dimension "Cost" and so on. The reason behind this is to develop meaningful value dimensions that represent the related constructs, as these will be used in another phase of the assessment process. An example is provided in Figure 5-7.

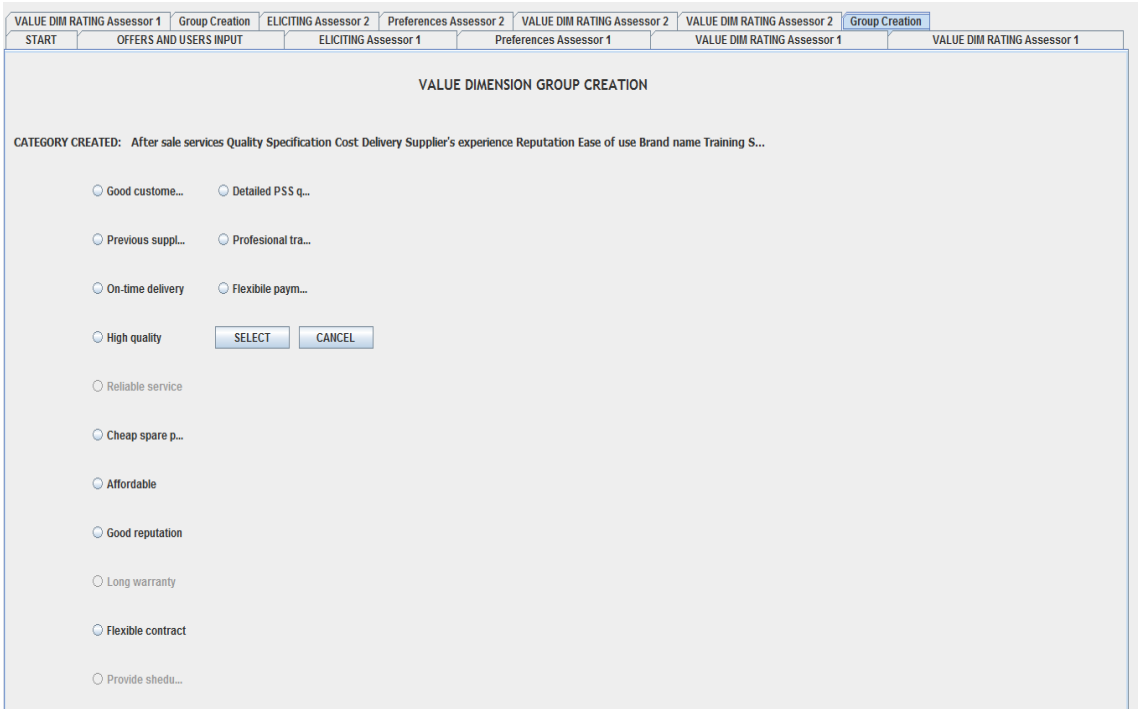


Figure 5-7: Creation of value dimensions' screenshot

As the results obtained from Phase 1 and Phase 2, it is important to employ quantitative measures to recognise the most significant constructs elicited by RepGrid. Lemek, Goffin, and Szwejczewski (2003) proposed two measures to be used along with RepGrid: Frequency analysis and Variability analysis. Frequency analysis refers to the number of times a construct is mentioned. Once the participants have elicited the constructs, frequency analysis is applied to identify the most mentioned construct. It was proposed by (Goffin *et al.*, 2006; Lemek *et al.*, 2003) that is better for frequency to be more than 25%. In this research, the frequency can be calculated manually.

On the other hand, the variability analysis as suggested by (Goffin *et al.*, 2006) is a "mathematical measure of the spread of ratings on a particular construct that can be used to help identify more important constructs". Therefore, a higher spread of a construct rating means high importance. Both frequency and variability analysis are used as indicators to help identify the most important constructs "value dimensions). This has a role in the process of s-c assessment as it helps the participants to understand the critical value dimensions they must focus on.

In order to calculate the variability in a grid, (Goffin *et al.*, 2006) suggested that the variability for a grid is a dependant measure which varies across all grids. For example, if a participant elicited 6 constructs, the average variability would be 16.6 % (i.e., 100/6), whereas if 12 constructs have been elicited, the variability would be 8.3 % (100/12). Therefore, the average variability (VAR) for each construct in a grid needs to be calculated. To calculate AVAR, the standard deviation for the given rates for each element is calculated by multiplying by the number of construct in that grid, divided by the average number of construct across all grids. This is given by the equation (5-1)

$$\text{AVAR for construct}_j = \frac{\text{STDEV}(\text{Construct}_i) * \text{Number of construct in Grid}_i}{\text{Average Number of constructs}} \quad \textbf{(5-1)}$$

Then, the AVAR need to be normalised by multiplying the AVAR for a construct by the average for the grid

$$\text{ANV. for Construct}_j = \text{AV for Grid}_i * \text{Variability for construct}_j \quad \textbf{(5-2)}$$

Where

$$\text{AV for Grid}_i = \frac{100}{\text{Number of constructs in Grid}_i} \quad \textbf{(5-3)}$$

As the elicited constructs are categorised into value dimensions, the variability for each value dimension needs to calculated as follows:

$$\text{Variability for category}_i = \frac{\sum_{j=1}^{m} \text{ANV. for Construct}_j}{n} \quad \textbf{(5-4)}$$

Finally, (Goffin *et al.*, 2006) suggested that the average normalised variability need to be compared to a threshold value to give a reliable level of variability. They proposed a baseline for the variability to be compared with as it indicates the importance of the value dimension. The baseline (BL) is calculated as follows:

$$\text{Baseline} = \frac{100}{\text{Average number of constructs}} \quad \textbf{(5-5)}$$

This means, if the BL, for example is 12.6, then the ANV higher than 12.6 is considered to important, which means that the rating for a construct among the suppliers is highly spread. A higher ANV than the baseline, indicates the significance of the construct for the participant, therefore, the elicited construct will have more impact on the assessment process.

5.6.3 Phase 3: Customer's characteristics assessment

Customer's characteristics are considered to be the heart of the S-C Fit framework. Therefore, it is essential to know and understand the customer's capabilities in order to purchase a PSS. However, customer's characteristics are of a dynamic nature and subject to changes based on purchasing type and the customer situation at the time of purchase. As a result, this phase will focus on what characteristics related to the PSS the customer is concerned with. In fact, this phase prioritises the customer's characteristics rather than assesses its availability in the customer's organisation. The assessment of the fitness of these characteristics will be part of the fit calculation phase.

To help the customer prioritise his characteristics, the analytical hierarchy process (AHP) has been used. AHP has been discussed as one of the popular techniques in multi criteria decision-making, which forms the supplier selection problem into a hierarchy that allows structuring and modelling of a complex decision into smaller parts at different levels (Saaty, 1980). Moreover, Saaty (1980) argues that AHP is suitable for supplier selection, due to its inherent capability to take both qualitative and quantitative criteria into consideration. The AHP in the S-C Fit assessment will be used, as it enables pairwise comparison to distinguish the importance between two elements. The tool has been designed to employ the customer's characteristics importance as "AHP priority calculator".

The pairwise comparison is a process based on nine-point scale, applied to derive the relative importance for given elements (Saaty, 1978). For example, when applying the concept of pairwise comparison to a product's price (product

A, product B and product C); as illustrated in Table 5-2, we need to derive the relative importance for the product's price. Each element in the left column will be compared to the elements on the top. Each comparison is converted into a numerical value, based on a nine-point scale as proposed by Saaty (1978).

Table 5-2: An example of pairwise comparison matrix

Price comparison	*Product A*	*Product B*	*Product C*
Product A	w_1/w_1	w_1/w_2	w_1/w_3
Product B	w_2/w_1	w_2/w_2	w_2/w_3
Product C	w_3/w_1	w_3/w_2	w/w_3

w_1, w_2 and w_2 represents the given weight in the comparison judgment, therefore the generated pairwise comparison matrix generates a vector of preferences (Wang *et al.*, 2013). Inconsistency is affected by human judgment and Saaty (2004) argues that in reality, the pairwise comparison matrices are likely to be consistent, therefore, the consistency ratio (CR) needs to be calculated. According to Saaty (1980), the consistency ratio (CR) can be calculated as follows:

$$CR = \frac{CI}{RI} \quad \textbf{(5-6)}$$

Where CI is the consistency index and RI is the average random consistency index (RI). According to Saaty (1978), the consistency ratio (CR) must not exceed 10% when assessing the pairwise comparison matrix.

In the development of the S-C Fit assessment tool, the priority calculation is based on the identified nine customer characteristics, which means 36 pair comparisons will be applied. The customer will be asked to rate the importance between a pair each time by responding to the question:

Which characteristic, with respect to your PSS purchasing is more important, and how much more on a scale 1-9?

The given rating scale is based on The Fundamental Scale of Absolute Numbers as given by (Saaty, 2004). Table 5-3 demonstrates the importance rating and its relative explanation.

Table 5-3: The Fundamental scale of absolute numbers

Intensity of Importance	Definition	Explanation
1	Equal importance	Characteristic C_i and C_j are equally important
2	Weak or slight	intermediate values
3	Moderate importance	C_i slightly favour over C_j
4	Moderate plus	intermediate values
5	Strong importance	Experience and judgment strongly favour C_i over C_j
6	Strong plus	intermediate values
7	Very strong or demonstrated	C_i is favoured very strongly over C_j
8	Very, very strong	intermediate values
9	Extreme importance	The evidence favouring C_i over C_j is of the highest Possible order of affirmation

The customer is required to conduct the pairwise comparison between each given characteristic in careful and accurate consideration. As illustrated in Figure 5-8.

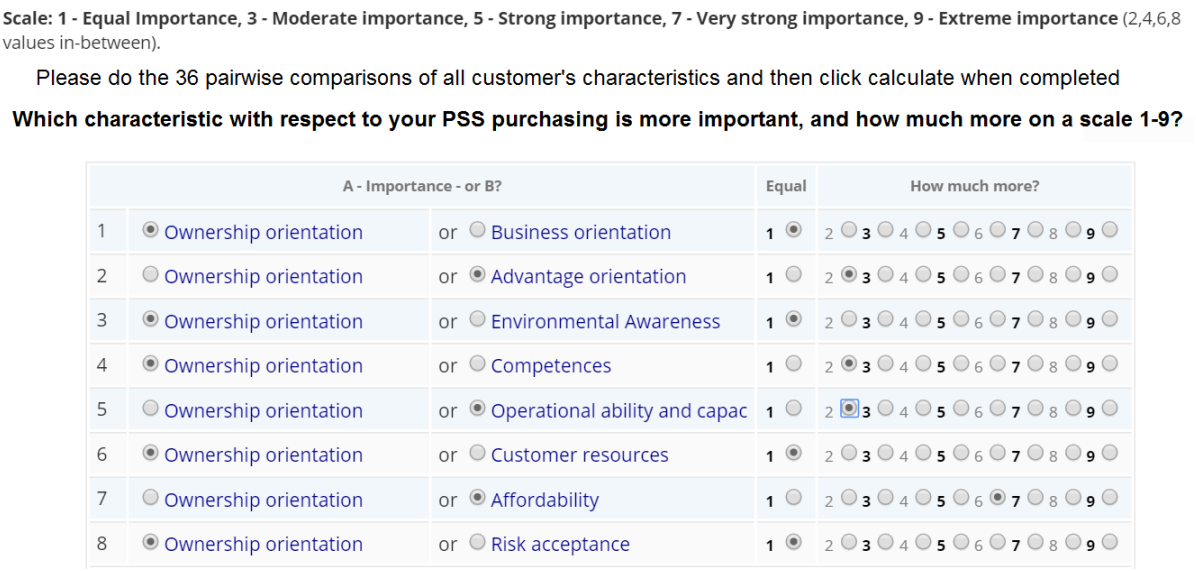


Figure 5-8: An example of screenshot for priority calculation

After calculating the importance of the customer's characteristics, the importance level will be generated accordingly. An example of the importance level is given in Table 5-4. The next phase is to assign the relative value dimensions to the related customer characteristics.

Table 5-4: An example of customer's characteristics importance level

Customer's characteristics	Importance level %	Rank
Ownership orientation	17.9	2
Business orientation	10.9	3
Advantage orientation	18.3	1
Environmental Awareness	7.7	9
Competences	10.0	4
Operational ability and capacity	8.7	6
Customer resources	8.6	8
Affordability	9.4	5
Risk acceptance	8.6	7

5.6.4 Phase 4: Relativity allocation

As the importance of customer characteristics are calculated, these characteristics need to be allocated to the much related value dimensions. In order to identify the relativity, the created value dimensions will be given in a column, with each value dimension corresponding to the nine customer's

characteristics in a row. The interviewee will be asked to confirm whether there is any relativity or not by selecting the two given options “Yes” or “No”. For example, consider that we have a value dimension named “Cost”, the screen, while implementing the tool, will show the Cost on the left column and the nine characteristics in a row as shown in Figure 5-9.

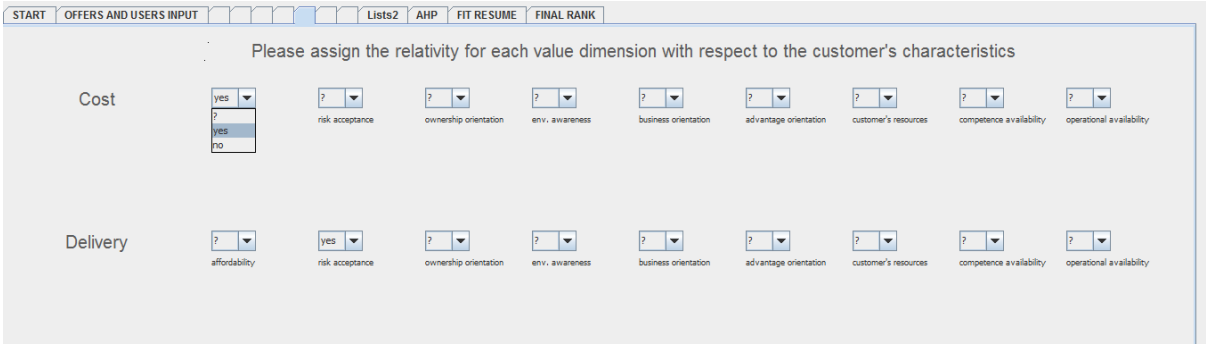


Figure 5-9: An example of the relativity allocation (given by the author)

The tool is designed to be flexible and user-friendly to allow the interviewee to go through the value dimensions and the customer’s characteristics easily and select or change his selection. Each characteristic has a drop down button where she/he can select the option. It is not necessarily the case that each value dimension has a relationship with one of the characteristics, the interviewee only defines which value dimensions have an impact on his characteristics, by considering the PSS purchasing and his situation.

5.6.5 Phase 5: Measuring Fit

The last phase in the process is the calculation of the degree of fit. This phase is considered to be the core of the PSS S-C Fit framework as it represents the concluded concept achieved by the researcher. The concept of fit is “rooted in the concept of “matching” or “aligning” organisational resources with environmental opportunities and threats” (Zajac *et al.*, 2000). In Task Technology Fit (TTF), Goodhue and Thompson (1995) developed a measure for TTF comprises of 8 factor. The instrument was from a seven-point scale where 1 is strongly disagree and 7 strongly agree. Additionally, Goodhue (1998) developed a task-technology fit instrument to measure the impact of the information systems (IS) of an organisation of the user evaluation. The

developed instrument was questionnaire-based with variant types of questions. A sample of the question is given as follows:
"Please assess how satisfactory in meeting your needs you find the data environment."

The rating is given, based on 0-10 scale ranging from "very unsatisfactory" to "very satisfactory".

On the other hand, (Chuang *et al.*, 2014) developed a multidimensional instrument of Person-Environment Fit (P-E) based on multiple theories. They conducted their study from four fit types, which are the Person-Job Fit, the Person-Organization Fit, the Person-Group Fit, and the Person-Supervisor Fit. The developed survey covered several questions measuring different fit aspects, based on seven-point scale ranging from 1 (no match) to 7 (complete match). For example, for Person-Job fit scale, the question is given as follows:

"How would you describe the match between your professional skills, knowledge, and abilities and those required by the job?"

"How would you describe the match between the characteristics of your current job (e.g., autonomy, importance, and skill variety) and those you desire for a job?"

As the developed framework adopts the concept of fit, it is applicable to use the developed instruments as mentioned above. Therefore, in the context of PSS, the concept of fit, seeks to achieve a good match between the PSS suppliers and the customer characteristics. To measure the fit between the value dimension and the customer's characteristics, the fit degree needs to be specified, based on the interviewee's judgment. Consequently, the interviewee will be asked to evaluate the level of fitness between value dimensions and its related customer's characteristics. The question is given as follows:

"How would you describe the match between the PSS supplier(s) and your organisation's characteristics?"

The given rating scale is based on 1-5 point where 1 = Very weak, 2 = Weak, 3 = Normal. 4 = Strong, and 5 = Very strong as shown in Figure 5-10.

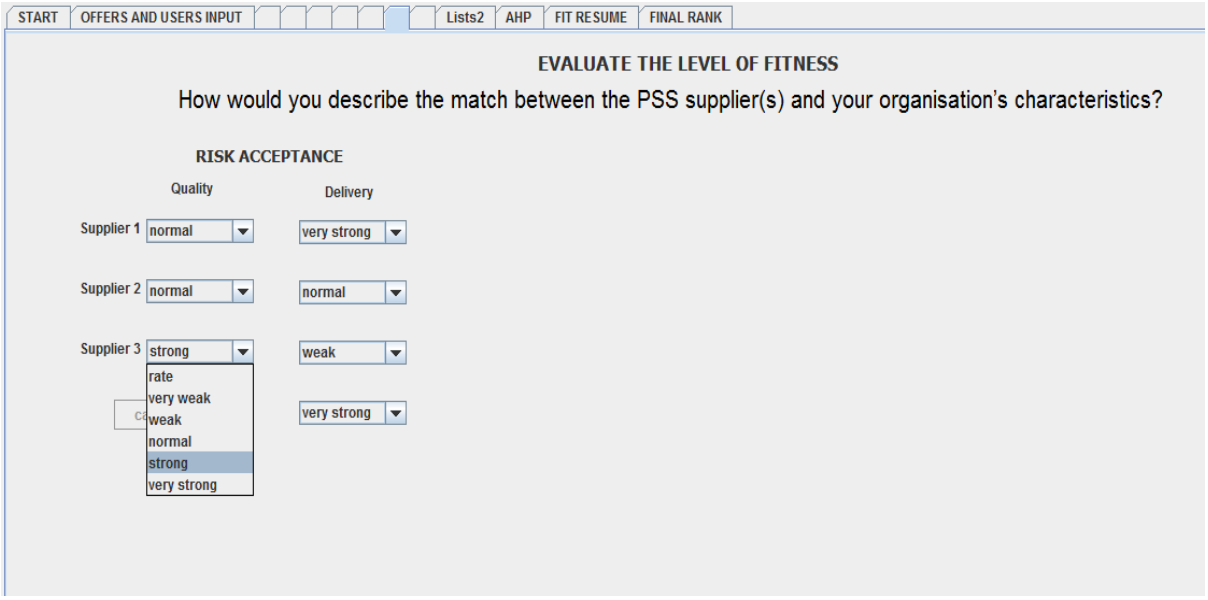


Figure 5-10: An example of fit measuring (given by the author)

Figure 5-10 demonstrate the implementation of Phase 5 which involves the measuring of the fit degree. As shown, the customer's characteristics "Risk acceptance" which is linked to the value dimensions "Quality" and "Delivery" as resulted from Phase 4 are measured, based on the degree of fit for each supplier. The fitness indices are calculated, based on the resulted importance level for each customer's characteristics calculated in Phase 3 and the measured fit degree for each supplier.

The customer's characteristics in Phase 4 is linked to relative value dimensions. In fact, the same value dimension can be allocated to different customer characteristics. In order to calculate the fit degree for each PSS supplier, first, the degree of fit for each customer's characteristics among all suppliers is calculated. This is calculated as the summation of all given fit degrees for each characteristic with respect to its related value dimensions, divided by the number of value dimensions allocated the customers' characteristics (CS) as shown in Equation 5-7.

$$\mathrm{FitC_iS_j} = \frac{\sum_{i=1}^{n} \mathrm{FitDegree_{i,j}}}{n} \quad , j = 1,2, \dots, m \qquad \textbf{(5-7)}$$

After calculating the fit degree for all allocated customers for each supplier (S_j), the overall index for each supplier is calculated by multiplying the results of Equation 5-8 by the importance level for each customer's characteristics as mentioned in Phase 3. This is given by the equation:

$$FitIndexS_j = FitC_iS_j * Importance\ levelC_i \qquad \textbf{(5-8)}$$

Where S_j is $Supplier_j$, j=1, 2,….,m

C_i represents the customer's characteristics, i=1,2,,,,,,9

The last step in this phase is to calculate the final suppliers ranking. The final suppliers ranking is calculated by multiplying the fit index for each supplier by the initial ranking obtained from Phase 1. This is given by:

$$\mathrm{FinalRankingS_i} = \mathrm{FitIndexS_i} * \mathrm{RepGridS_i} \qquad \textbf{(5-9)}$$

The final ranking of the suppliers is affected by the fit index for each customer's characteristics for each supplier. These characteristics in fact provide a clear view of the customer's situation in terms of supplier's suitability. The researcher has produced a workbook for the user of tool and can be found in Appendix 1.

5.7 Testing and Verification

The tool development and design have been described in Section 5.6. The Java platform has been used to programme the S-C Fit process. The tool has been developed to be user-friendly to ensure the flexibility of the process in obtaining the required results. Therefore, it is essential to test the tool to ensure the usability and verify the adopted measurements. To verify the adopted measures and techniques, the researcher used the tool several times and debugged the calculation process and measures. The tool has been slightly modified, based on the obtained results and then verified accordingly.

5.8 Chapter Summary

The purpose of this chapter was to develop a PSS assessment tool. The emergent concepts have been considered and explored in order to refine the developed framework. Therefore, the final PSS Supplier-Customer Fit Framework was presented. The concept of fit and values has been explored. Related techniques were presented to help develop the assessment tool. An assessment process was developed to guide the development of the assessment tool. The use of the tool is explained in detail. The next phase of the research is to validate the developed PSS framework using the developed PSS assessment tool in real life, which will be described in the next chapter.

6 VALIDATION OF THE PSS CUSTOMERS FRAMEWORK

6.1 Introduction

This chapter describes the objective of Phase 5 in the research programme, namely, to validate the PSS customer framework using case studies. A PSS assessment tool has been designed to carry out the validity of the proposed framework. This chapter first presents the objective and method of this phase. Then the selection of the cases is clarified. Each case is presented with a brief description, followed by the results of the tool use. A discussion session was held for each case to obtain a feedback for the purpose of any enhancement.

The PSS S-C Fit framework has been validated, based on feedback sessions from academic and industrial perspectives. Then, a PSS S-C Fit process has been developed to test the proposed framework in practice. The designed tool was tested initially to ensure and verify the adopted measures usability from the user side. Further validation is applied in this chapter by conducting case studies. Five organisations have been selected to validate the proposed framework. The validation mainly relies on the implementation of the developed tool and feedback sessions held for each case. It should be noticed that the terms values, attributes and constructs are used interchangeably as they refer to the same meaning. This chapter first presents the methodology for the selection of case studies, then the selected cases are described. The results of the case studies are presented followed by discussion and feedback sessions. The first case study is described in great detail.

6.2 Selection of Cases

At this stage of the research, the selection of case has a significant role. The case study research strategy has been adopted, as the nature of the research requires exploratory investigation. As the developed PSS S-C Fit framework needs to be applied, the developed tool needs to be used in real life with PSS customers. Therefore, to validate the developed framework, the tool will be used in five organisations in Saudi Arabia. The case studies selection criteria as mentioned in Section 7.2 has been used as the execution of case studies in this phase, is in the same context as product service systems (PSS).

The developed framework needs to be tested in different situations, although the PSS S-C Fit process is still the same. This is to enhance the generalisation of the results and to obviate the developed framework from any restriction to deal with a specific problem. Accordingly, five case studies from different sectors were selected. The case studies were executed in Saudi Arabia. This chapter describes the executed case studies with an appropriate description for each case. The results were discussed, followed by feedback sessions from the participants. It should be mentioned that all cases and participants' names are considered to be confidential and appropriate terms are given.

6.3 Case study 1: HealthCo

HealthCo is a public health provider serving more than 120 general hospitals in Saudi Arabia with an annual budget exceeding14 billion dollars according to the project manager in purchasing department in HealthCo. This case is one of PSS customers in Saudi Arabia particularly in purchasing medical equipment and services. The purchasing department deals with many PSS offerings and has to select the best PSS supplier. The increasing demands on the purchase of medical equipment has made the supplier selection more complicated and risky. The tool has been implemented in collaboration with three members of the purchasing group in HealthCo as shown in Table 6-1. The PSS contract in this case involved purchasing Magnetic Resonance Imaging equipment (MRI). The HealthCo were required to purchase MRIs to cover more than 14 units in a number of hospitals. The contract approximately ranged between 19 - 22 million SAR (Av £ 3.5 million).

Table 6-1: Participants profile

Participant	Position	Years of experience
Assessor 1	Purchasing manager	9
Assessor 2	Medical equipment advisor	17
Assessor 3	Contracts analyst	12

The next sections describe the results of the implementation of the tool. The results were obtained from the result file generated by the tool, once the assessment was completed.

6.3.1 Results of HealthCo

This section describes the results of the five phases of tool. The result of each phase is demonstrated by Tables and Figures. The first phase of the implementation of the tool started by conducting repertory grid structured interview. The interview began with the first participant, referred to as “Assessor1”, then the second participant as “Assessor 2” and the third participant as “Assessor 3”. Three suppliers are identified as elements. The results of the interviews are shown respectively in Table 6-2, Table 6-3 and Table 6-4.

Table 6-2: Repertory Grid results (Interviewee: Assessor1, HealthCo)

Constructs	Elements - Suppliers			pole
	Supplier 1	Supplier 2	Supplier 3	
Good quality	2	4	1	Poor quality
Ease of use	1	3	1	Difficult to use
Known brand	2	1	3	Unknown brand
Providing training	2	3	1	No training
On-site support	2	3	2	Limited support
Quick response	2	3	1	Slow response
High standards	4	2	1	Low standards
Complex	4	2	3	Non-complex
Affordable consumables	2	2	1	Expensive consumables
Expensive spare parts	2	5	3	Cheap spare parts
Low noise	1	3	4	High noise
Good customer service	2	1	3	Poor customer service
Good reputation	1	3	2	Poor reputation
Long warranty	2	3	1	Short warranty
Flexible contract	5	3	1	Non-flexible contract
Clear agreement	3	2	2	Not clear arrangement

Understand our requirements	2	3	2	Does not understand requirements
Affordable	3	2	5	Expensive
Long lead time	2	4	1	Short lead time
Provide replacement	1	2	4	No replacement

Table 6-3: Repertory Grid results (Interviewee: Assessor2, HealthCo)

Constructs	Elements - Suppliers			pole
	Supplier 1	Supplier 2	Supplier 3	
Good customer service	1	2	4	Poor customer service
Previous supplier	1	3	1	New supplier
Slow delivery	2	3	2	On time delivery
High quality	2	3	2	Poor quality
Reliable service	2	4	2	Not reliable service
Costly spare parts	3	4	2	Cheap spare parts
Affordable	2	1	3	Expensive
Good reputation	2	4	2	Poor reputation
Long warranty	1	2	2	Short warranty
Flexible contract	3	2	1	Non-flexible contract
Provide schedule maintenance	2	1	1	Not clear arrangement
Detailed PSS quotes	2	1	4	Not detailed

Professional training	3	3	2	Limited training
Flexible payment method	2	4	2	Non-flexible payment

Table 6-4: Repertory Grid results (Interviewee: Assessor3, HealthCo)

Constructs	Elements - Suppliers			Pole
	Supplier 1	Supplier 2	Supplier 3	
Good reputation	2	2	4	Poor reputation
Good inventory management	2	1	4	Poor inventory management
Comprehensive training	1	2	4	Basic training
Complex	2	2	3	Non-complex
Affordable	4	1	2	Expensive
24 support	1	3	2	During working hours support
Assigned contact point	2	1	4	Not specified
Full service programme	1	3	2	On demand
Spare parts availability	2	1	5	Available from a third party
Good experience	2	1	3	Poor experience

On completion of the interviews, the tool generates the initial suppliers' ranking, based on the given weights in the grids. The initial ranking is shown in Table 6-5.

Table 6-5: Suppliers' ranking based on RepGrid

Supplier Ranking	Score
Supplier 2	79.33
Supplier 1	71.66
Supplier 3	69.00

The next phase of the tool implementation is to create value dimensions. The assessor categorises the elicited constructs (values), based on the similarities from his point of view. Table 6-6 shows the created value dimensions.

Table 6-6: Value dimensions categorisation

Value dimensions	Constructs
After sale services	Good customer service
	Long warranty
	Reliable service
	Provide schedule maintenance
	Full-service programme
	Spare parts availability
Quality	Good quality
	High standards
Specification	Complex
	Low noise
Cost	Affordable
	Expensive spare parts
	Affordable consumables
Delivery	Quick response
	Long lead time

	Slow delivery
Supplier's experience	Understands our requirements
	Good experience
	Previous supplier
Reputation	Good reputation
Ease of use	Ease of use
Brand name	Known brand
Training	Provides training
Support	On-site support
	Provide replacement
	Good customer service
	24 support
	Assigned contact point
	Good inventory management
Contractual aspects	Flexible contract
	Clear agreement
	Detailed PSS quotes
	Flexible payment method

Then, the frequency and variability analysis are performed. Table 6-7 shows the frequency and variability results. These results are important as they show the most significant supplier's attributes (values) appreciated by the customer.

Table 6-7: Variability and Frequency analysis

Category (value dimension)	Frequency (%)	Variability (BL 6.82 %)
After sale services	100	7.20
Quality	66	8.26
Specification	66	7.06
Cost	100	8.14

Delivery	66	7.06
Supplier's experience	100	6.21
Reputation	100	7.52
Ease of use	33	7.87
Brand name	33	6.82
Training	100	7.06
Support	100	8.74
Contractual aspects	66	8.54

Then, the next phase is to weight the importance level for HealthCo' s characteristics. Table 6-8 shows the given weights for HealthCo's characteristics.

Table 6-8: HealthCo' s characteristics priority weights

Category	Priority	Rank
Ownership orientation	3.12%	8
Business orientation	15.90%	2
Advantage orientation	9.30%	7
Environmental Awareness	2.90%	9
Competences	11.41%	5
Operational ability and capacity	20.45%	1
Customer resources	10.46%	6
Affordability	14.90%	3
Risk acceptance	11.56%	4

Consistency ratio (CR) = 7.8%

In addition, the resulted weights of the customer's characteristics have been visualised as shown in Figure 6-1. This is to give the customer a clear view of his organisation and how they would purchase a PSS. Also, these results are important to complete the next phases.

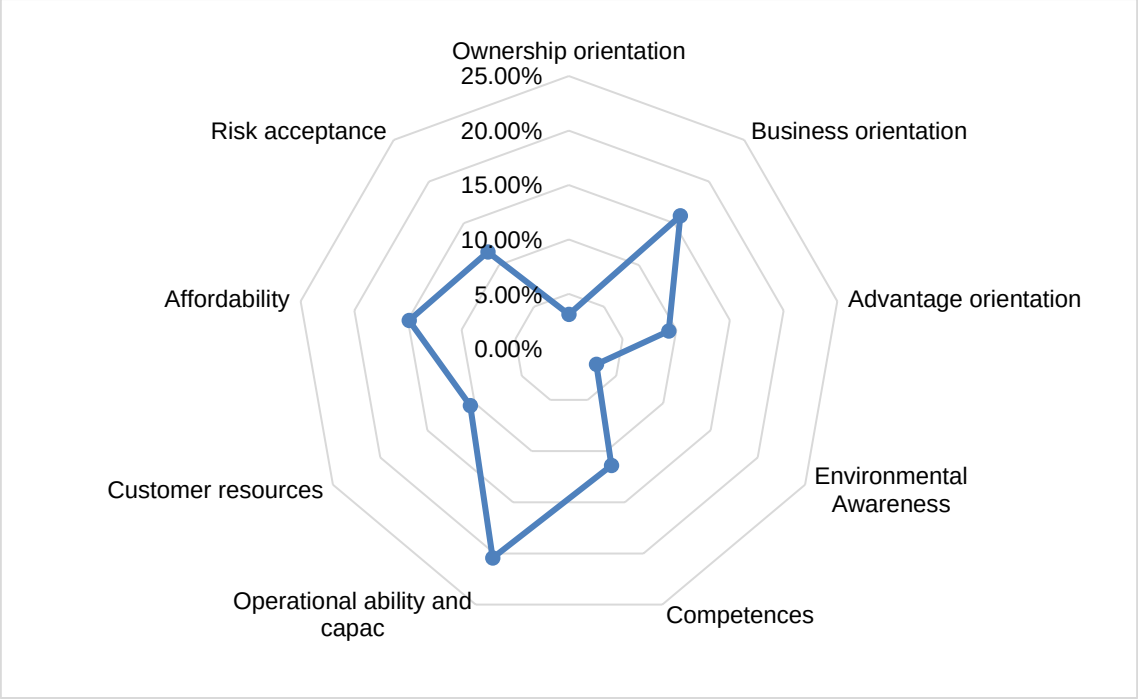


Figure 6-1: HealthCo's characteristics prioritisation chart

After calculating the weights of the customer's characteristics, the next phase is to allocate the customer's characteristics to their relevant value dimension. To simplify this allocation, the assessor was asked to assess any relationship between the value dimensions and his characteristics for anything that could affect the decision to purchase a PSS. Then, the assessor was asked to measure the fit degree between the value dimensions and the related customer's characteristics. Table 6-9 illustrates the fit allocation and its given degrees by the assessors.

Table 6-9: Fit degrees allocation for HealthCo

	Affordability		**Business orientation**			**Risk**	
	Cost	Specification	Reputation	Specification	Brand name	Contractual aspects	Support
Supplier 1	Normal	Strong	Strong	Normal	Strong	Very Strong	Very strong
Supplier 2	Strong	Strong	Normal	Weak	Strong	Normal	Strong
Supplier 3	Strong	Weak	Normal	Normal	Weak	Normal	Normal
	Ownership orientation		**Advantages orientation**	**Competence**	**Customer's resources**	**Operation capability**	
	Reputation	Supplier experience	Support	Supplier experience	Supplier experience	Ease of use	Training
Supplier 1	Very strong	Very strong	Strong	Normal	Normal	Very strong	Very strong
Supplier 2	Normal	Normal	Strong	Normal	Weak	Strong	Strong
Supplier 3	Strong	Strong	Normal	Strong	Normal	Normal	Weak

After measuring the fit degrees between the value dimensions and their related characteristics, the fit indices were generated for each supplier. As a result, the final suppliers' ranking was obtained.

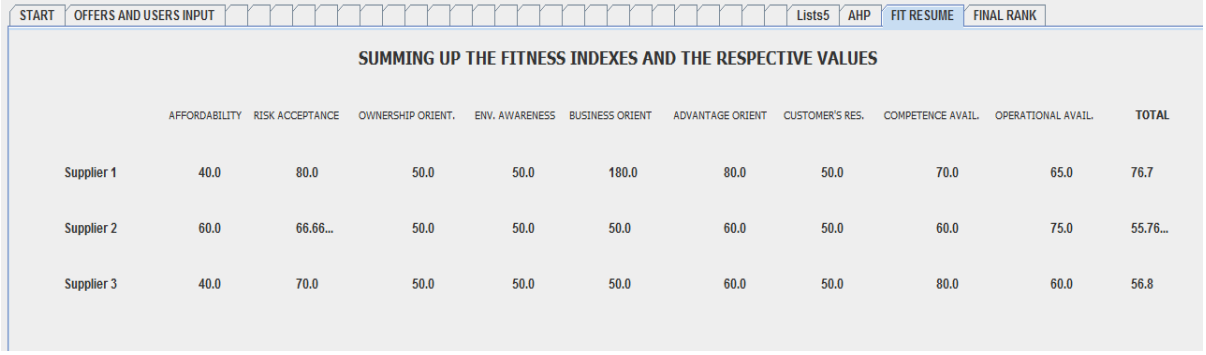


Figure 6-2: Fitness indices for HealthCo (screenshot)

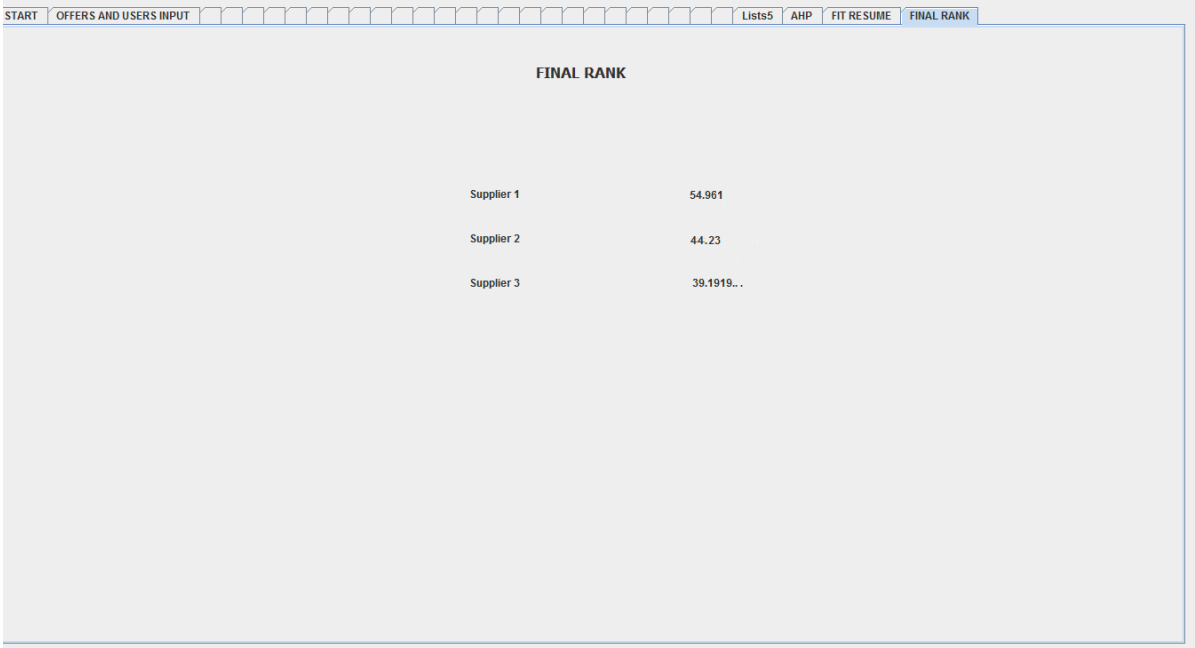


Figure 6-3: Final Ranking (screenshot)

Table 6-10: The final suppliers' ranking

Supplier Ranking	Fitness degree
Supplier 1	54.96
Supplier 2	44.23
Supplier 3	39.19

6.3.2 Discussion and feedback sessions

The result obtained after implementing the developed tool with HealthCo, provides the researcher and the participants a clear view of the PSS offerings, as well as the current situation of the customer. This helps the customer (HealthCo) to understand their options and what best fits their conditions. In the first phase of the tool, the results were based on RepGrid and gave comprehensive perceptions of the PSS suppliers and what HealthCo mostly appreciated in terms of the suppliers' attributes (values). The elicited constructs from each assessor in HealthCo have been rated from each assessor separately. Then the suppliers' rankings were supplied. This ranking represents the perception of each PSS supplier from the assessors' perspectives.

The RepGrid results indicate that supplier 2 is the best supplier with score of 79.33, followed by supplier 1 and supplier 3. By looking at constructs elicited by the three assessors, we can find strong similarities in terms of the suppliers' perception. Moreover, the given weights for each construct differ from one assessor to another. However, supplier 2 received the highest rates, as we can see in RepGrid results. The rates given by the assessors, apparently give priority for supplier 2 as more likely to be selected. For example, the elicited construct "***Affordable***", Assessor 1 gave the rates for the three suppliers as: Supplier 1 = 3, Supplier 2= 2, and Supplier 3= 5. Assessor 2 rated the supplier as Supplier 1 = 2, Supplier 2= 1, and Supplier 3= 3. On the other hand, assessor 3 rated the suppliers as: Supplier 1 = 4, Supplier 2= 1, and Supplier 3= 2. Supplier 2 actually received high rates regarding many constructs. However, supplier 2 received low rates in some of the constructs, such as quality in comparison with the other suppliers.

For a clearer view of the elicited constructs and due to the similarities in some constructs, creation of value dimensions has been applied, and then a frequency and variability analysis performed. The result indicates the most important values that HealthCo recognises, which in turn would help HealthCo to understand what they need to focus on. The frequency indicates the number of times the value dimensions are mentioned by the assessors, which actually

represent the importance of the value dimension. As we can see, **After sales service, Supplier's experience, Training, Support, Cost and Reputation** received 100% which means, these value dimensions were mentioned by all three assessors. Whereas **Ease of use** was mentioned by only one assessor. Moreover, the variability analysis result shows another important indicator. The calculated baseline (BL) was 6.82. From Table 6-7, we can see that all value dimensions passed the baseline, except the category “Supplier's experience”, which has 6.21 variability. This indicates that most of the value dimensions were important. However, Support, Contractual aspects and Cost received high variability. This means that the given rates to these categories ranged widely. For the category below the baseline, it does not infer neglect of this category, as these value dimensions have a role in the next phase of the assessment.

The result of the HealthCo characteristics prioritisation indicates the concerns of HealthCo regarding their internal capabilities and attitude with respect to the PSS suppliers. The shaded characteristics show that **Operational ability and capacity, Business orientation and Affordability** have a significant impact on the decision to purchase a PSS. For example, the **Operational ability characteristic** possesses 20.45% of HealthCo concern of the required operation capabilities of the PSS. Figure 6-1visualises these results in such a way to allow the decision maker to capture the situation of their organisation, hence, select the most appropriate supplier. This is actually one of the major phases, as these characteristics play a significant role in the next phase.

The HealthCo characteristics allocation with the related value dimensions was performed. Then, the degrees of fit were assigned. These degrees represent the extent of fitness between HealthCo characteristics and the value dimensions. Based on the fit degrees, the final suppliers’ ranking has been calculated. The final ranking was supplier 1, supplier 2 and supplier 3. This means that supplier 1 is the most suitable supplier to select. This was an interesting result in comparison with the initial result obtained from RepGrid.

To investigate what actually occurred and why the suppliers ranking altered, a feedback session was held with the assessors to discuss the obtained results.

First, we need to look at the initial ranking. In the initial ranking, supplier 2 was found the best, based on the perception of the elicited values. In fact, that was reasonable. As we can notice, supplier 2 was rated by the assessors as the best brand and the cheapest, on the other hand, the other suppliers were rated to be less qualified. Moreover, RepGrid results show that assessor 3 rated supplier 2 as the best, as most of the given weights ranged from 1 to 2. The ranking calculation follows a logical sequence where all suppliers rated, based on the perceived rates. All assessors confirmed that supplier 1 was selected as he was more qualified than the others. Assessor 3 stated that "*supplier 1 offered the cheapest medical equipment*". On the other hand, assessor 1 said that they fell more comfortable with supplier 2 as he offered a known brand.

However, the final result gave a different and interesting ranking. After considering the HealthCo characteristics and the degree of fit that each supplier assigned to these characteristics, supplier 1 prevailed. The fit indices indicate the fit degrees for each supplier. In fact, what the customer appreciates from the elicited values from the PSS suppliers does not necessarily reflect the suitability of the PSS to the customer's organisation. The fit degrees illustrate the significant fit distinction between all PSS suppliers. For example, the HealthCo's characteristic "**Risk**" has been related to two value dimensions, namely "**Contractual aspects**" and "**Support**". The assessors measured the fit for Quality among all suppliers as: supplier 1= **Strong**, supplier 2= **Normal**, and supplier 3= **very weak**. With respect to Delivery, fit measures were: supplier 1=**Very strong**, supplier 2= **Normal** and supplier 3= **Very weak**. This indicates that supplier 1 is likely to fit HealthCo in terms of its characteristics "Risk". The importance weight given to Risk in the prioritisation of HealthCo was 11.56% and ranked as the fourth which supports the final selection. Moreover, all assessors believe that supplier 2 offered the best price and the best brand. By looking at these values, price was linked to the dimension of "**Affordability**" and Brand has not been related to any characteristics. Thus, the fit degree of supplier 1 was normal, supplier 2 was strong and supplier 3 was very weak. So, we can see that supplier 2 is more qualified. However, we need to look at the importance levels of the HealthCo, **Affordability** has been prioritised as

14.90% as one of the top three characteristics. Therefore, supplier 2 is more likely to win, but we need to look at all value dimensions and their corresponding fit degrees.

However, it was more reasonable to look at the most important characteristics for HealthCo. The result indicates that the highest importance of HealthCo characteristics was **Operational ability and capacity** which received 20.45. This means Operational ability and capacity characteristic have the greatest impact on the supplier selection. The reason behind this was the fact that HealthCo is concerned with the operation of the MRIs, as this equipment requires special skills to be attained. Now let us look at the fit degrees given to the related value dimensions. There were two values related to **Operational ability** namely **Ease of use** and **Training**. With respect to **Ease of use**, the fit degrees were given as: *supplier 1* ***very strong***, supplier 2 **strong** and supplier 3 **Normal**. Also, for the value **Training**, the fit degrees were given as: *supplier 1* ***very strong***, supplier 2 **strong** and supplier 3 **Weak.** We can see clearly that supplier 1 was fitting the HealthCo operational ability, which in turn affects the calculated fit index for supplier 1. On the other hand, we can see that supplier 3 was the worst; that actually explains the reason why supplier 3 was last in the ranking. Supplier 1 and supplier 2 were more qualified. But supplier 1 won, because he received high fit degrees in most of the value dimensions.

The final ranking was agreed by the assessors and they were very satisfied. Assessor 2 argued that they should focus on their characteristics, as the elicited values were insufficient to distinguish between the offered PSS. Assessor 3 was asked about his opinion regarding the final ranking, and he stated “I can see why we had some issues in previous contracts”. The overall feedback was very positive and supported the final selection, as supplier 1 was the most suitable supplier regarding HealthCo’s characteristics. The participants expressed their interest in the concept of fit as part of the supplier selection process.

6.4 Case study 2: MobileCo

The second case is a private company in telecommunication sector and referred to as MobileCo. The core business of this company is the provision of

mobile telecom and data services nationwide. The company has grown rapidly, supported by a huge infrastructure and thousands of skilled employees, which exceed 4000 with more than 300 branches spread throughout Saudi Arabia. MobileCo purchases all equipment and services in the form of a PSS to run its business. This actually includes assets to build its infrastructure, such as mobile towers, transmitters and cables. They outsource many tasks to maintain their services in a reliable operational condition.

MobileCo focuses on supporting their daily works to satisfy their customers. The implementation of the PSS assessment tool involved the purchasing of Microwave transmission devices. These devices have to be located on the mobile towers to support the data transmission. According to the purchasing manager in MobileCo, the amount for the purchase exceeds SAR 40 million (£ 7 million). The selection of supplier goes through a long and complicated process and involves different departments. The implementation of the tool involves three participants, representing different departments as shown in Table 6-11 and the process phases were reviewed before starting the tool.

Table 6-11: Participants profile

Participant	Position	Years of experience
Participant 1	Project manager	14
Participant 2	Purchasing manager	7
Participant 3	Network specialist	16

The next sections describe the results of the implementation of the tool. The results were obtained from the result file generated by the tool, once the assessment completed.

6.4.1 Results of MobileCo

In this section, the results of the implementation of the tool are illustrated, followed by discussion and feedback section.

Table 6-12: Repertory Grid results (Interviewee: Participant 1, MobileCo)

Constructs	Elements - Suppliers				pole
	Supplier 1	Supplier 2	Supplier 3	Supplier 4	
Good quality	2	3	3	2	Poor quality
Quick response time	1	3	3	2	Slow response time
Affordable	4	2	2	2	Expensive
Good experience	1	3	2	2	Poor experience
Local branches	1	5	5	2	Foreign
Good service delivery	1	3	3	2	Poor service delivery
Low repair cost	3	2	2	2	High repair cost
Good specifications	1	4	5	2	Poor specifications
Durable	1	3	3	3	Nondurable
Good staff skills	1	4	4	2	Poor staff skills
Long life cycle	1	3	3	2	Short life cycle
Easy installation	3	2	2	2	Difficult installation
Good reputation	1	3	4	2	Poor reputation
Friendly relationship	1	3	3	1	Normal relationship
Improvement orientation	1	5	5	1	Lack of improvement orientation
Long warranty	1	2	2	4	Short warranty
Good product development	1	3	3	1	Poor product development
Free operation support	1	2	2	2	Charged operation support
Easy civil work	3	1	1	2	Hard civil work

Table 6-13: Repertory Grid results (Interviewee: Participant 2, MobileCo)

Constructs	Elements - Suppliers				pole
	Supplier 1	Supplier 2	Supplier 3	Supplier 4	
More experience	1	3	3	2	Poor experience
Good monitoring	1	5	2	1	Poor monitoring
Good product capability	1	4	4	1	Poor product capability
Good team availability	1	3	5	2	Poor team availability
More discount	2	5	5	1	Less discount
Low cost	4	3	3	2	High cost
More compatible	1	4	4	1	Less compatible
Good customer matching	1	2	4	1	Poor customer matching
More flexible	1	1	4	1	Less flexible
Good customer support	1	1	5	1	Poor customer support
Good reputation	1	3	4	2	Poor reputation
Good network design	3	2	4	1	Poor network design

Table 6-14: Repertory Grid results (Interviewee: Participant 3, MobileCo)

Constructs	Elements - Suppliers				pole
	Supplier 1	Supplier 2	Supplier 3	Supplier 4	
More experience	1	3	5	1	Poor experience
More flexible	2	3	4	4	Less flexible
Good specifications	2	2	3	1	Poor specifications
Upgradable	3	2	2	5	Non-upgradable
Low cost	3	2	2	1	High cost
Fast contract implementation	1	2	2	1	Slow contract implementation
Good product development	3	2	4	1	Poor product development
Non-complex product	1	3	2	4	complex product
Good maintenance	2	3	3	2	Poor maintenance
High technology consultancy	3	2	4	1	Poor technology consultancy

As the RepGrid interviews has completed, the initial suppliers' ranking is presented as shown in Table 6-15.

Table 6-15: Suppliers' ranking based on RepGrid

Suppliers' Ranking	Score
Supplier 1	93.14
Supplier 4	90.72
Supplier 2	61.55
Supplier 3	40.26

Table 6-16: Variability and frequency analysis

Category (value dimensions)	Frequency (%)	Variability (BL 7.32 %)
After sale services	100	5.38
Quality	33	8.92
Specification	66	8.60
Cost	100	6.47
PSS development	100	9.38
Delivery	66	5.66
Supplier's experience	100	8.70
Supplier's location	66	12.85
Communication	33	9.05
Flexibility	66	7.90
Reputation	66	8.80

Table 6-17: MobileCo’s characteristics priority weights

Category	Priority	Rank
Ownership orientation	3.80%	9
Business orientation	10.60%	4
Advantage orientation	6.50%	8
Environmental Awareness	6.60%	7
Competences	7.40%	6
Operational ability and capacity	21.00%	2
Customer resources	12.20%	3
Affordability	23.00%	1
Risk acceptance	9.70%	5

Consistency ratio (CR)= 6.73%

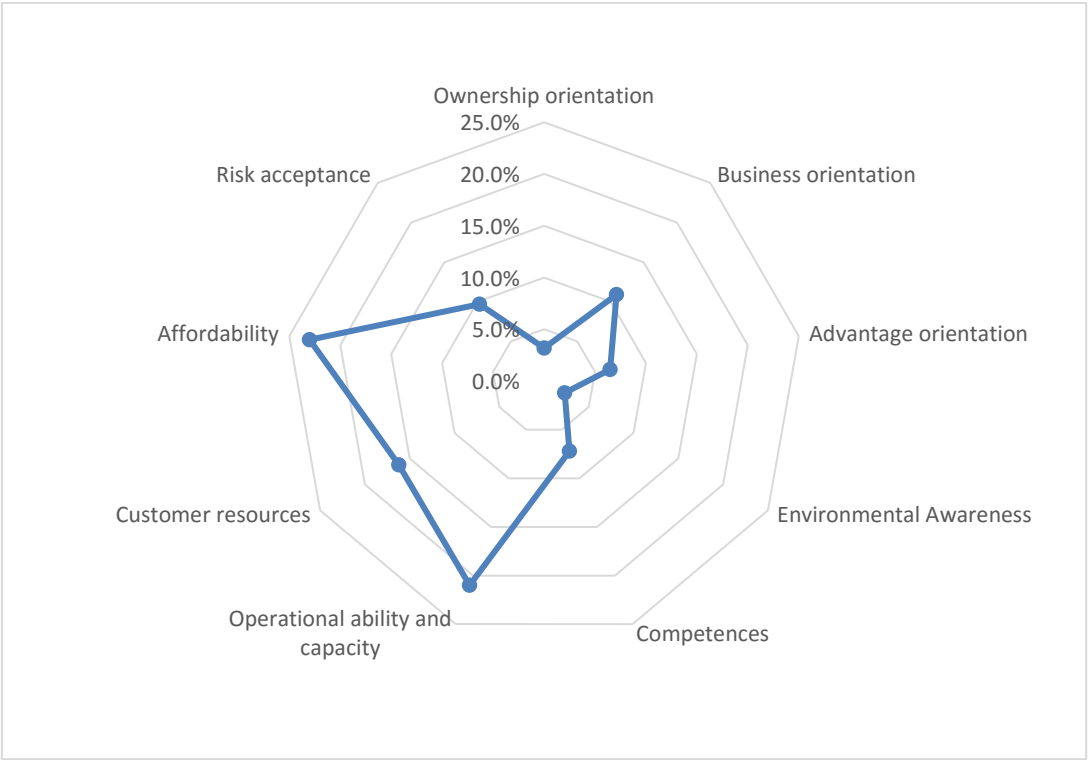


Figure 6-4: MobileCo's characteristics prioritisation chart

Table 6-18: Fit degrees' allocation for MobilyCo's

	Affordability		**Business orientation**			**Risk**	
	Cost	PSS development	Communication skills	Specification	Flexibility	Quality	Delivery
Supplier 1	Very Strong	Strong	Weak	Normal	Strong	Strong	Very Strong
Supplier 2	Strong	Normal	Normal	Weak	Normal	Normal	Normal
Supplier 3	Very weak	Weak	Very Strong	Normal	Strong	Very weak	Very weak
Supplier 4	Normal	Very Strong	Very Strong	Strong	Normal	Strong	Strong
	Ownership orientation		**Advantages orientation**	**Competence**	**Customer's resources**	**Operation capability**	
	Reputation	Supplier experience	After sale services	Quality	Supplier experience	Quality	After sale services
Supplier 1	Weak	Normal	Normal	Very Strong	Normal	Normal	Very strong
Supplier 2	Strong	Strong	Normal	Normal	Weak	Weak	Strong
Supplier 3	Normal	Normal	Weak	Normal	Weak	Strong	Weak
Supplier 4	Strong	Weak	Strong	Strong	Strong	Very strong	Normal

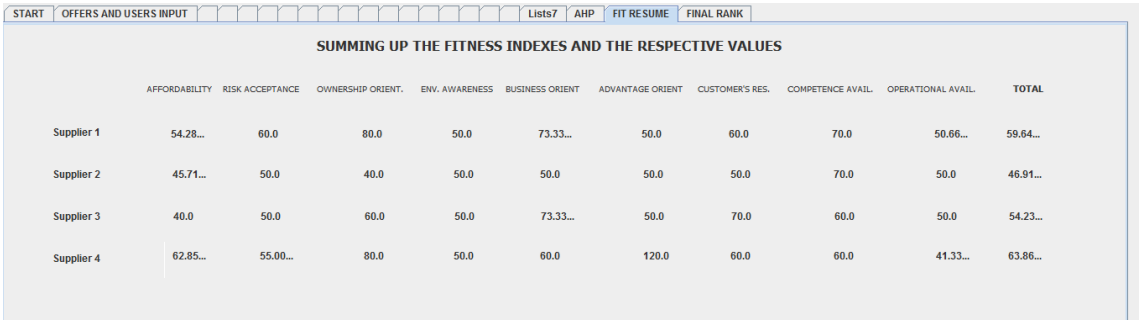


Figure 6-5: Fitness indices for MobilyCo (screenshot)

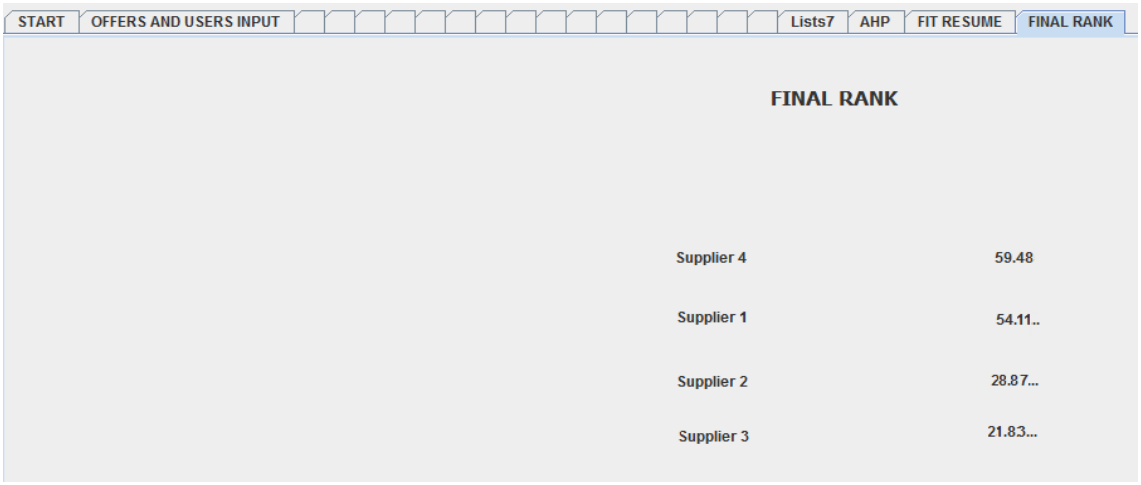


Figure 6-6: Final Ranking (screenshot)

Table 6-19: The final suppliers' ranking

Supplier's final Ranking	Score
Supplier 4	59.48
Supplier 1	54.11
Supplier 2	28.87
Supplier 3	21.83

6.4.2 Discussion and feedback session

The first phase of the implementation of the tool elicited many constructs. These constructs have been rated from each participant separately as shown in Table 6-12, Table 6-13 and Table 6-14. As a result of the suppliers' assessment, supplier 1 was found to be the most qualified supplier for MobilyCo, then supplier 4, supplier 2 and supplier 3 respectively. However, by looking at the frequency and variability analysis for MobileCo, we can identify the most important attributes (values) of the offered PSS. It was noticed that **PSS development and Supplier's experience** have been mentioned by all participants and obtained variability above the calculated baseline (7.32). For **PSS development**, supplier 1 and supplier 4 received the highest rate (rate=1). For **Supplier's experience**, all participants rated supplier 1 as the best and gave the rate "1". On the other hand, participants 2 and 3 rated supplier 4 as less than supplier 1 by giving the rate "2", whereas participant 1 gave the rate 1. These results gave a strong indication of the most qualified supplier and explained the reasons behind the selection of supplier 1 as the best.

However, after conducting the fit assessment, the result of suppliers' ranking has changed. The fit assessment involves the consideration of the customer's characteristics. In this case, MobileCo characteristics have been considered. Consequently, supplier 4 outperformed the other suppliers as the best fit. MobilyCo characteristics assessment indicates that MobilyCo concerns primarily **Affordability, Operational ability**, then **Customer's resources** and so on. Thus, we can understand that the value dimensions related to these characteristics have the greatest impact on the supplier selection. **Affordability** was considered by MobilyCo as the most important characteristic by 23% among the other characteristics. From Table 6-18, we can see the participants related the characteristic "**Affordability**" to the value dimensions ***Cost*** *and* ***PSS development***. The fit degrees given to the supplier regarding the value dimension "Cost" are: Supplier 1 was Very Strong, Supplier 2 was Strong, Supplier 3 was Very weak, Supplier 4 was Normal. This means that supplier 1 can be seen as the best fit. However, by looking to the dimension of PSS development, supplier 4 was the best fit, seen as a very strong fit. This indicates

that supplier 1 and supplier 4 are the bestt possible suppliers fit for MobilyCo. Moreover, the second essential characteristic which is **Operational ability and capacity,** has linked to two value dimensions which are **Quality** and **After-sale services** as shown in Table 6-18. The fit degrees assigned to the suppliers, indicate that supplier 1 and supplier 4 are still the best fit. The overall fit degrees resulted in fit indices as illustrated in Figure 6-5. The highest fit scores were supplier 4 by 63.84 then supplier 1 by 59.64, unlike the initial results as given, based on RepGrid assessment. These indices reveal the suppliers' suitability for MobilyCo when considering the role of their characteristics.

The participants have discussed the obtained results from the tool. A presentation was given based on the obtained results and a discussion session was held to obtain the participants' feedback regarding the initial assessment and result in which all participants mentioned that they rely on the result of the initial suppliers ranking. They argue that they did not expect that the suppliers ranking would change. The purchasing manager in MobilyCo stated, "*I think we must rewrite our purchasing policies*". The project manager added that concept of fit would help to avoid any extra expense and risk.

The researcher asked the participants about their experience with the use of the tool and for any comments or problem that can help to improve the tool. All were satisfied and found the implementation of the tool easy and straight forward. They were interested using the tool in other PSS offerings assessment and were pleased to realise the concept of fit in its role in the supplier selection.

6.5 Case study 3: TeleCo

TeleCo is considered to be the largest telecommunication company in Saudi Arabia, as well as the whole Arab states and considered to be the main telecommunication provider in Saudi Arabia. The company was established in 1998 as a Joint Stock Company. Since then it has increased its services by providing integrated mobile, landline and broadband communications services to over 160 million customers worldwide. The number of employees in the company exceeds 25,000 and a revenue of SAR 45 Billion.

The PSS assessment tool has been conducted, considering a purchasing of multi-function copying machines to be used in 27 branches. These machines are used on a daily basis and must be in operational status most of the day. The total cost of purchasing was around SAR 14 million (£ 2.3 million), based on leasing contracts covering the related services and support during the period of use. The tool implementation held with three members of the purchasing centre in the company, referred to as Assessor 1, Assessor 2 and Assessor 3 as shown in Table 6-20. The participants pointed out that the process of purchasing PSS, passes several levels of assessment, but mainly the selection of the supplier is based on perceived values.

Table 6-20: Participants profile

Participant	Position	Years of experience
Assessor 1	Technical unit member	11
Assessor 2	Purchasing Advisor	14
Assessor 3	Material department manager	5

The results of the suppliers' assessment have been presented as in the next sections.

6.5.1 Results of TeleCo

In this section, the results of RepGrid interviews and focus group interviews are illustrated, followed by a discussion and feedback section to demonstrate the implementation of the assessment tool of the PSS supplier selection.

Table 6-21: Repertory Grid results (Interviewee: Assessor 1, TeleCo)

Constructs	Elements - Suppliers			Pole
	Supplier 1	Supplier 2	Supplier 3	
More experience	2	1	3	Poor experience
Near location	2	3	1	Far location
Reliable service delivery	2	4	2	Less reliable
Long-term insurance	3	2	1	Limited insurance
Consumables availability from different sources	2	3	5	Consumables from the supplier only
Affordable	1	3	2	High cost
full information	1	4	2	less information
Good customer service	4	3	5	Poor customer service
Understands our business	3	2	1	less understanding
provides performance report frequently	4	3	1	Quarterly performance reports
Good reputation	4	2	3	Poor reputation
Flexible contract definition	3	1	2	Less flexible
Protection against future price increases	4	3	2	Limited protection
End user-friendly	1	3	4	Less friendly

Table 6-22: Repertory Grid results (Interviewee: Assessor 2, TeleCo)

Constructs	Elements - Suppliers			Pole
	Supplier 1	Supplier 2	Supplier 3	
Good quality	3	1	3	Poor quality
Quick response	2	3	1	Slow response
Affordable	2	1	2	Expensive
More experience	4	2	3	Poor experience
Good repair service	2	4	3	Poor repair service
Good service delivery	3	2	1	Poor service delivery
Low repair cost	1	2	5	High repair cost
Guaranteed replacement	3	3	1	Conditional replacement
No advance payment	3	1	2	Advanced payment required
Good reputation	2	1	3	Poor reputation
24 hrs contact point	2	1	3	Only during working hours
Flexible contract	2	4	1	Non-flexible contract
Guaranteed running business	2	3	1	Limited guarantee

Table 6-23: Repertory Grid results (Interviewee: Assessor 3, TeleCo)

Constructs	Elements - Suppliers			Pole
	Supplier 1	Supplier 2	Supplier 3	
Knows what we need	2	3	1	Not really
good customer service	2	1	3	Poor customer service
good price	1	3	4	Expensive
Good service delivery	1	5	2	Average service delivery
quick repair service	2	4	1	slow repair service
Flexible contract	2	3	2	Non-flexible contract
very quick response	3	1	2	High repair cost
Good reputation	2	3	4	poor reputation

All participants assessed the three PSS offerings, then the supplier's ranking resulted as shown in Table 6-24.

Table 6-24: Suppliers' ranking based on RepGrid

Suppliers' Ranking	Score
Supplier 1	73.66
Supplier 3	72.66
Supplier 2	68.66

Table 6-24 illustrates the ranking of the three suppliers. As we can see, supplier 1 received the highest rates, based on the elicited constructs. The next step is to categorise the elicited constructs to value dimensions, then calculate the frequency and variability for each value dimension as shown in Table 6-25.

Table 6-25: Variability and frequency analysis

Category (value dimensions)	Frequency (%)	Variability (BL 8.57 %)
Experience	100	9.48
Quality	33	9.23
Location	33	9.90
Flexibility	100	8.87
Delivery	100	12.10
Cost	100	11.11
Purchase information	33	13.09
Response	66	8.80
Consumables sources	33	4.95
Payment method	33	8.57
Insurance	33	8.57
Product replacement	33	9.90
Performance reports	33	13.09
Customer service	66	10.83
Price protection	33	8.57
Reputation	100	8.57
End user-friendly	33	13.09

Table 6-26: TeleCo's characteristics priority weights

Category	Priority	Rank
Ownership orientation	1.12%	8
Business orientation	32.54%	1
Advantage orientation	10.88%	5
Environmental Awareness	0.67%	9
Competences	2.40%	7
Operational ability and capacity	12.69%	4
Customer resources	8.22%	6
Affordability	16.70%	2
Risk acceptance	14.78%	3

Consistency ratio (CR) = 4.4%

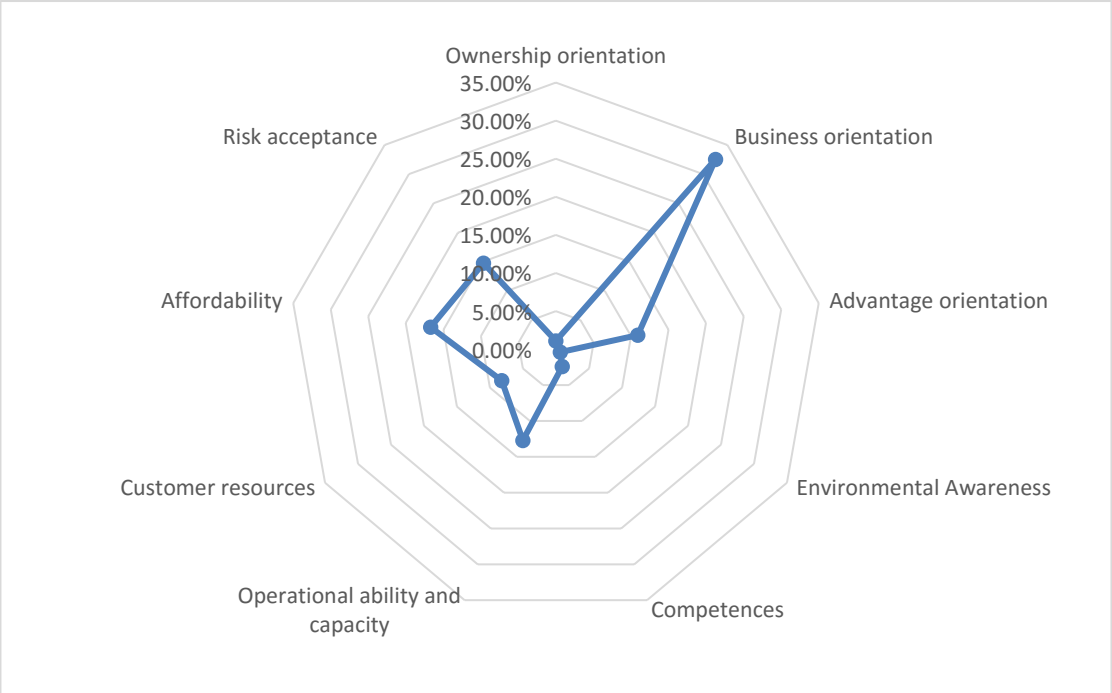


Figure 6-7: TeleCo's characteristics prioritisation chart

Table 6-27: Fit degrees' allocation for TeleCo

	Risk Acceptance						
	Location	Insurance	Price protection	Product replacement	Experience	Response	
Supplier 1	Strong	Weak	Weak	Weak	Normal	Normal	
Supplier 2	Very weak	Strong	Normal	Weak	Normal	Strong	
Supplier 3	Very Strong	Very Strong	Very Strong	Very Strong	Very strong	Very Strong	
	Business orientation			**Advantages orientation**	**Operational availability**	**Affordability**	
	Location	Performance report	Delivery	Product replacement	End user-friendly	Cost	Payment method
Supplier 1	Weak	Weak	Strong	Normal	Strong	Very weak	Weak
Supplier 2	Strong	Normal	Normal	Normal	Normal	Strong	Normal
Supplier 3	Very Strong	Strong	Strong	Very Strong	Normal	Strong	Strong

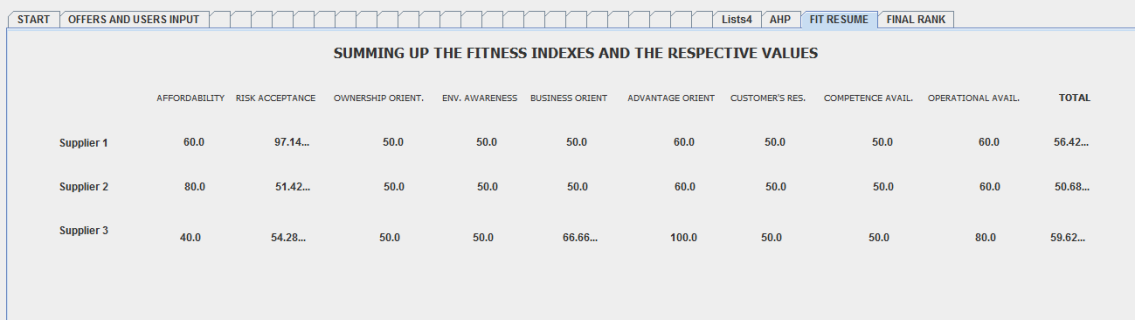


Figure 6-8: Fitness indices for TeleCo (screenshot)

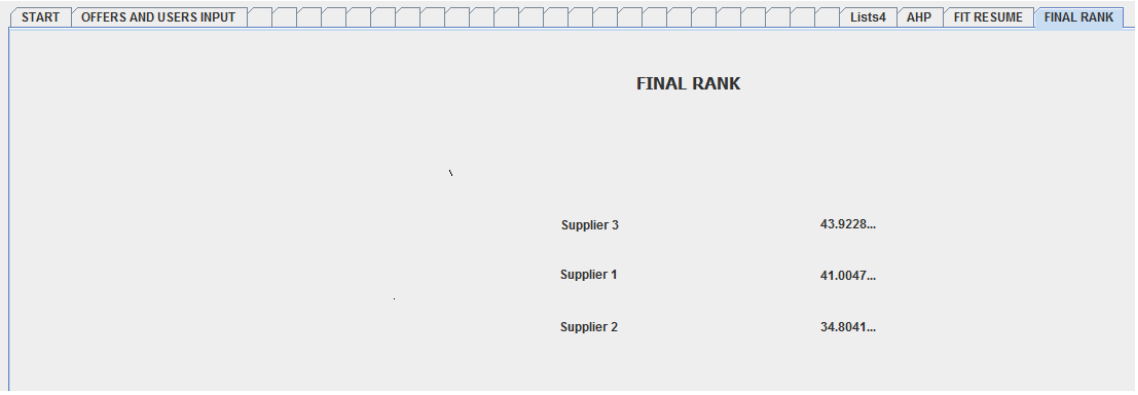


Figure 6-9: Final Ranking (screenshot)

Table 6-28: The final suppliers' ranking

Supplier's Final Ranking	Score
Supplier 3	43.92
Supplier 1	41.00
Supplier 2	34.80

6.5.2 Discussion and feedback sessions

The final phase of the implementation of the tool led to the final suppliers' ranking, as we can see in Table 6-28. However, the initial ranking resulted from RepGrid, represents the supplier assessment, based on the perception of the values. The decision taken by TeleCo to reward the PSS contract to supplier 1 was reasonable for the company at this level of suppliers' assessment. Supplier 1 and supplier 3 were slightly similar, regarding the values they offered. RepGrid illustrates the

elicited constructs from the three assessors and the given rates for each supplier. For example, Assessor 1 rated supplier 1 as the best “1”, regarding the construct “Affordable”, Full information” and “End user-friendly”. On the other hand, the rates given by assessor 2, indicates that supplier 2 is more qualified. On the other hand, assessor 3 gave supplier 3 the highest rates.

The result of the implementation of the tool over the three grids, revealed that supplier 1 qualified better than the others. The scores obtained from the three suppliers show that the three suppliers were relatively close to each other. Table 6-24 shows that supplier 1 scored 73.66 as the most qualified supplier, whereas supplier 2 scored 72.66. We can see that supplier 1 and supplier 2 were somewhat close to each other, regarding the final assessment of each assessor.

However, the frequency and variability analysis gave a clear view of what TeleCo appreciates more, regarding the PSS attributes (values). Table 6-25 demonstrates that most of the value dimensions are considered to be important. **Experience**, **Cost**, **Reputation** and **Delivery** were mentioned by the three assessors during the RepGrid interviews. **Location** was mentioned by assessor 1 only, but we should notice that each assessor assesses the suppliers from his perspective, influenced by his background. At the same time, the value dimension **Location** has high variability “9.90” which is above the baseline 8.57. The variability analysis for most of the value dimensions was found above the baseline, which indicates the greater spread of suppliers’ ratings for the elicited constructs.

The assessment of TeleCo’s characteristics revealed the capabilities TeleCo is most concerned with. TeleCo’s characteristics were prioritised according to the participants as illustrated in Table 6-26. Apparently, **Business orientation**, **Affordability, Risk acceptance** and **Operational ability** represent that characteristics TeleCo focus most on. The other characteristics are still considerable, but have less impact on the suppliers’ assessment. Therefore, we need to look at the value dimensions related to the TeleCo’s characteristics as shown in Table 6-27. The highest impact characteristic is **Business orientation**, which is linked to three value dimensions, namely: **Location, Performance report** and **Delivery**. Now, let us take the value dimension “**Location**” and see what fit degrees are given from the assessors. The fit degree given to the three suppliers are respectively: Weak, Strong

and Very strong. Which means that supplier 3 has the priority as fitting TeleCo. Similarly, we can see that supplier 3 was found to fit TeleCo, regarding the value dimension "**Performance report".** Moreover, for TeleCo's characteristic; "**Affordability**", supplier 1 and supplier 2 were found not to fit well as given Weak and Normal fit degree. On the other hand, supplier 3 was found to fit best, as assessed as Strong fit regarding the value dimensions "Cost" and "Payment method".

The results obtained from the implementation of the tool were discussed in an open session with the three assessors and four other members from TeleCo. The researcher presented the results in slides and explained how and why the final results differed from the initial result. In fact, all participants expressed their pleasure at the final outcome. Regarding TeleCo's characteristics assessment, Assessor 3 stated *"I would say that we always concerned with our capabilities, but we may have failed to identify them as adequately as the tool did".* A member of Planning Department added "I *am very happy that we can achieve a reliable supplier selection in comparison to our old process".*

Regarding the use of the tool, the participants were satisfied and considered the assessment process fair and clear. They argued that the process took a long time to be completed, but they were happy. Assessor 3 stated "even *though it took a long time, we are happy, as long as the process and the results are precise and trustworthy".*

6.6 Case study 4: BankCo

BankCo is a commercial banking services provider, established in 2006. It provides a comprehensive range of retail and corporate banking and investment services. This case serves its clients through a nationwide network of over 100 branches, as well as through a network of ATMs. The number of employees of case 3 exceeded 2700 in 2013 with revenue of 1.89 Billion SR (2013 report INB). It purchases banking service equipment, as well as products/services that supports its business, particularly document solution equipment such as multi-function copying machines and ATMs. The Purchasing Department of case 4 is located in the headquarters in Riyadh, Saudi Arabia. This department receives all purchases orders and processes them according to purchasing procedures applied by case 4 policies.

The assessment tool was conducted, considering the purchasing of banking equipment. According to the purchasing manager, the banking equipment requested to be used in more than 36 branches across the middle area of Saudi Arabia. The contract covers the delivery of the equipment and all related services and maintenance. Two participants were involved in the assessment process, the purchasing manager and a member of the Board of Directors as shown in Table 6-29.

Table 6-29: Participants profile

Participant	Position	Years of experience
Participant 1	Purchasing manager	8
Participant 3	A member of board of directors	18

6.6.1 Results of BankCo

This section presents the results of the implementation of the tool. The results are summarised in Tables and Figures below.

Table 6-30: Repertory Grid results (Interviewee: participant 1, *BankCo*)

Constructs	Elements - Suppliers			pole
	Supplier 1	Supplier 2	Supplier 3	
Good brand	1	2	3	Poor brand
End user familiarity	2	1	2	Not familiar with it
Operation availability guaranteed	1	2	4	Less guaranteed
Good lead time	1	3	1	Poor lead time
Good reputation	2	3	1	Poor reputation
Cheap	2	4	2	expensive
Simple use	3	2	1	Complex
Good trust	1	4	2	Poor trust
Good maintenance programme	2	3	1	Normal maintenance programme
Unlimited warranty	1	3	1	Limited warranty

Table 6-31: Repertory Grid results (Interviewee: Participant 2, *BankCo*)

Constructs	Elements - Suppliers			pole
	Supplier 1	Supplier 2	Supplier 3	
Known brand	2	1	4	New brand
Affordable	1	4	2	expensive
High quality	3	2	1	Poor quality
Good service	2	3	1	Poor service
Direct contact point	1	3	1	Not direct
OEM represented	2	1	4	Not OEM represented
Short response time guaranteed	2	3	1	Longer response time

Quick delivery	2	4	2	Poor delivery
Easy to use	3	2	1	Complex

Table 6-32: Variability and Frequency analysis

Category (value dimension)	Frequency (%)	Variability (BL 10.53 %)
Brand name	100	13.30
Delivery	100	12.15
Price	100	14.12
Quality	50	10.53
Response	50	11.34
Service	100	10.53
Warranty	50	12.15
Trust	50	16.08
OEM supply	50	16.08
End user usage	100	9.04
Reputation	50	10.53
Availability	50	16.08

Table 6-33: Suppliers' rankings with respect to RepGrid results

Suppliers' Ranking	Score
Supplier 1	84.2
Supplier 3	83.0
Supplier 2	67.1

Table 6-34: Customer's characteristics priority weights

Category	Priority	Rank
Ownership orientation	1.34%	8
Business orientation	33.45%	1
Advantage orientation	9.39%	5
Environmental Awareness	2.00%	7
Competences	6.92%	6
Operational ability and capacity	12.31%	3
Customer resources	1.19%	9
Affordability	9.43%	4
Risk acceptance	23.97%	2

Consistency ratio (CR) = 9.13%

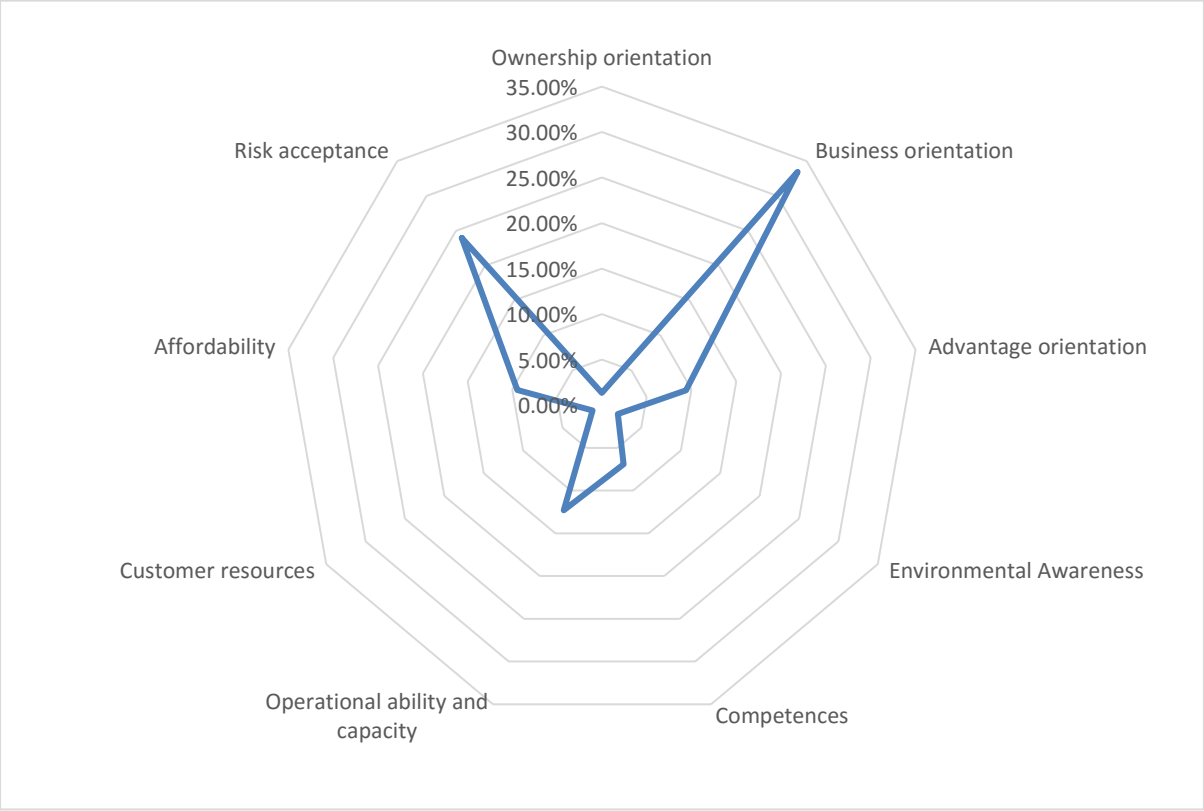


Figure 6-10: Customer's characteristics prioritisation chart

Table 6-35: Fitness degrees' allocation with respect to value dimensions

	Business orientation			**Risk acceptance**		
	Brand name	Response	Reputation	OEM supply	Trust	Service
Supplier 1	Strong	Strong	Normal	Normal	Strong	Strong
Supplier 2	Strong	Normal	Normal	Very strong	Strong	Normal
Supplier 3	Weak	Strong	Very Strong	Normal	Very weak	Strong
	Operational ability			**Affordability**		**Advantages orientation**
	Quality	End-user usage	Availability	Price	Delivery	Warranty
Supplier 1	Normal	Normal	Very strong	Very Strong	Strong	Very Strong
Supplier 2	Strong	Strong	Normal	Very weak	Weak	Weak
Supplier 3	Strong	Strong	Weak	Strong	Strong	Strong

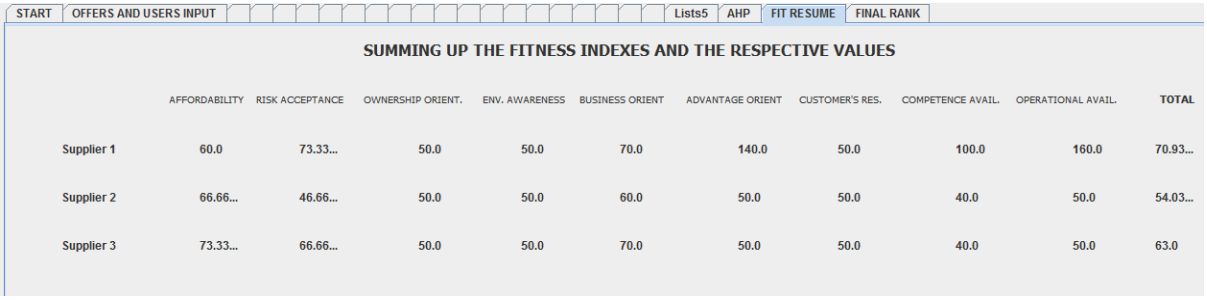


Figure 6-11: Suppliers' fitness indexes

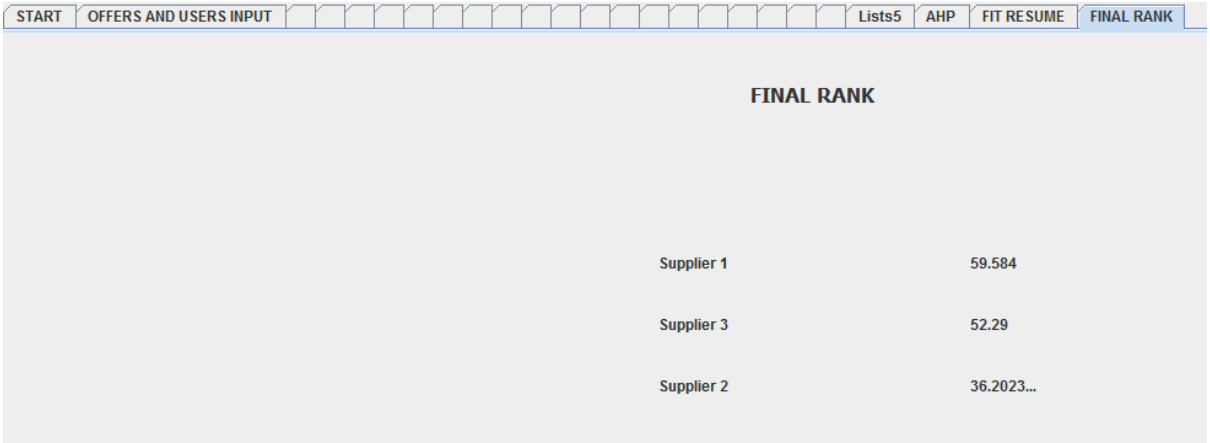


Figure 6-12: Suppliers' final ranking with respect to fitness indexes

Table 6-36: Final Suppliers' rankings with respect to fitness

Supplier's final Ranking	Score
Supplier 1	59.58
Supplier 3	52.29
Supplier 2	36.20

6.6.2 Discussion and feedback sessions

As we can see, in the RepGrid result, the suppliers' ranking was respectively supplier 1, suppler 3 and supplier 2. The participants assessed the perceived values for the three PSS offerings, based on what they appreciate. Interestingly, the final result after applying the fit is still the same. By looking at the RepGrid result, we can see that supplier 1 and supplier 3 were very close to each other. Supplier 1 score

was **84.2**, whereas supplier 3 score was **83**.**0**, therefore, selecting supplier 1 or supplier 3 could be acceptable. The Purchasing Manager commented on the result by mentioning that BankCo deals with supplier 1 and supplier 3 as the best suppliers. After applying the frequency and reliability analysis, we found BankCo focuses more on the **Brand name**, **Delivery**, **Price** and **Services** as significant value dimensions. Although the other value dimensions were mentioned by only one participant, it does not diminish their importance and are still sufficiently significant to be considered in the fit phase. For example, the dimension of **Delivery** has two constructs (values) namely **Good lead time** and **Quick delivery**. For both values, supplier 1 and suppler 3 were rated similarly; supplier 1 and supplier 3 were given the rate "1" as the best in Good lead time and "2" in Quick delivery. This explains the reason of the similarity scores for supplier 1 and supplier 3.

On the other hand, the fit measures in the assessment tool provided a better understanding of the suppliers' match for each value diminutions. BankCo' s characteristics as shown in Table 6-34 highlight the most important characteristics considered in the PSS assessment. **Business orientation**, **Risk acceptance**, **Operational ability** and **Affordability** found the most important characteristics that have the greatest influence on the selection of the suppliers. The participants measured the fit degrees between the value dimensions linked to BankCo' s characteristic and teach the PSS supplier. The result, as shown in Table 6-35 illustrates the degrees of fitness given by the participants. As we can see, the participants focused on the most important characteristics. For example, regarding **Business orientation** as it has the highest weight, the participants selected three value dimensions to relate to it, namely: **Brand name**, **Response** and **Reputation**. Supplier 1 and supplier 2 measured as "**Strong"** fit BankCo better than supplier 3 which was given "**weak"** fit. But, regarding the **Reputation**, supplier 3 fits BankCo as "**Very strong**", better than the other suppliers. Similarly, regarding **Risk acceptance**, supplier 1 and supplier 2 fit better than supplier 3. The overall measures seem to nominate supplier 1 and supplier 3 as better than supplier 2. The calculated fit indices as shown in Figure 6-11 indicate clearly that supplier 1 best fits BankCo.

The final ranking of the suppliers as in Table 6-36 shows that supplier 1 best fits BankCo with a score of **59.58**, supplier 3 with a score of **52.29** and supplier 2 with a score of **36.20**. The participants were very pleased with the result. They mentioned

that supplier 1 and supplier 3 considered to be the best based on their pervious contracts. The final result did not change the initial result, which was obtained by RepGrid. We can conclude that the assessment tool confirmed the final selection. Therefore, the PSS fit assessment process will not necessarily change the initial suppliers' ranking, but it assessed the suppliers based on the degrees of fitness and also taken into consideration the initial ranking. One of the participants said "I was pretty sure that supplier 1 was the best", in fact, they can see the full picture of the concept of fit and understand that high value rate does not mean it fits best. The participants were asked their opinion about the assessment tool and how they found it. The purchasing manager said "*I am happy that this tool can help us to see what we could not see before*". On the other hand, the member of the Board of Directors stated "*the time we spend implementing the tool was not an issue, as the purchasing decision takes a long time, we are pleased with the result and are interested to use the tool".*

6.7 Case study 5: HotelCo

The last case in the study is a hotel service located in Riyadh, Saudi Arabia and referred as HotelCo. The HotelCo was established in 2003 and provides a variety of accommodation services and resorts. HotelCo is one of the growing competitors in the hotel industry in Saudi Arabia and expanded the business rapidly to cover more than 12 main cities in Saudi Arabia. HotelCo mainly focuses on their customers' satisfaction, therefore, concern is with providing services to their customers. From a purchasing perspective, HotelCo has several contractors for different services such as catering, room services, cleaning and textile washing.

The assessment tool was implemented, considering a PSS contract of cleaning services. The contract involves cleaning of the Hotels rooms and hotel lobbies and some other housekeeping services. The tool was implemented with two key persons from the hotel management in Riyadh as illustrated in Table 6-37. A comprehensive presentation of the tool and the expected steps to be covered were given as required.

Table 6-37: Participants profile

Participant	Position	Years of experience
Assessor 1	Assistant General Manager	15
Assessor 2	Purchasing manager	9

6.7.1 Results of HotelCo

Table 6-38: Repertory Grid results (Interviewee: Assessor1, HotelCo)

Constructs	Elements - Suppliers			pole
	Supplier 1	Supplier 2	Supplier 3	
Good experience	1	2	3	Poor experience
good supervision	3	1	2	Poor supervision
Good service	1	2	1	Poor service
On-time delivery	2	3	1	Slow delivery
Good commitment	2	4	2	Lack of commitment
Good price	3	1	2	expensive
Professional workers	1	2	1	less professionally
Use good equipment	4	2	3	Poor equipment
Easy site access	2	3	1	Not easy access
Use of recommended chemical cleaning materials	2	4	1	Normal materials
Minimal disruption while delivering	2	1	2	more disruption
Low environmental risk	1	3	2	high risk

Table 6-39: Repertory Grid results (Interviewee: Assessor2, HotelCo)

Constructs	Elements - Suppliers			pole
	Supplier 1	Supplier 2	Supplier 3	
Good delivery	3	1	2	Poor delivery
Affordable	3	1	1	expensive
Proper delivery vehicles	4	1	2	Poor delivery vehicles
Good quality assurance programme	2	5	3	Poor quality assurance programme
Core business	1	4	3	Not core business
Specialist technical equipment	4	3	1	Not specialist
Delivery staff with polite treatment	1	3	1	Normal treatment
Accept high penalty charges for any delay	2	2	4	Limited charges

Table 6-40: Variability and Frequency analysis

Category (value dimension)	Frequency (%)	Variability (BL 10 %)
Experience	50	8.59
Delivery	100	10.52
Cost	100	10.77
Quality assurance	50	15.28
Core business	50	15.28
Site access	50	10.00
Professionalism	100	11.58

Commitment	50	11.55
Environmental risk	50	10.00
Contractual aspects	50	11.55

Table 6-41: Suppliers' rankings with respect to RepGrid results

Suppliers’ Ranking	Score
Supplier 3	81.5
Supplier 1	74.0
Supplier 2	71.5

Table 6-42: Customer's characteristics priority weights

Category	Priority	Rank
Ownership orientation	0.30%	7
Business orientation	16.88%	2
Advantage orientation	7.34%	5
Environmental Awareness	39.35%	1
Competences	0.10%	9
Operational ability and capacity	0.11%	8
Customer resources	4.96%	6
Affordability	16.84%	3
Risk acceptance	14.12%	4

Consistency ratio (CR) = 7.3%

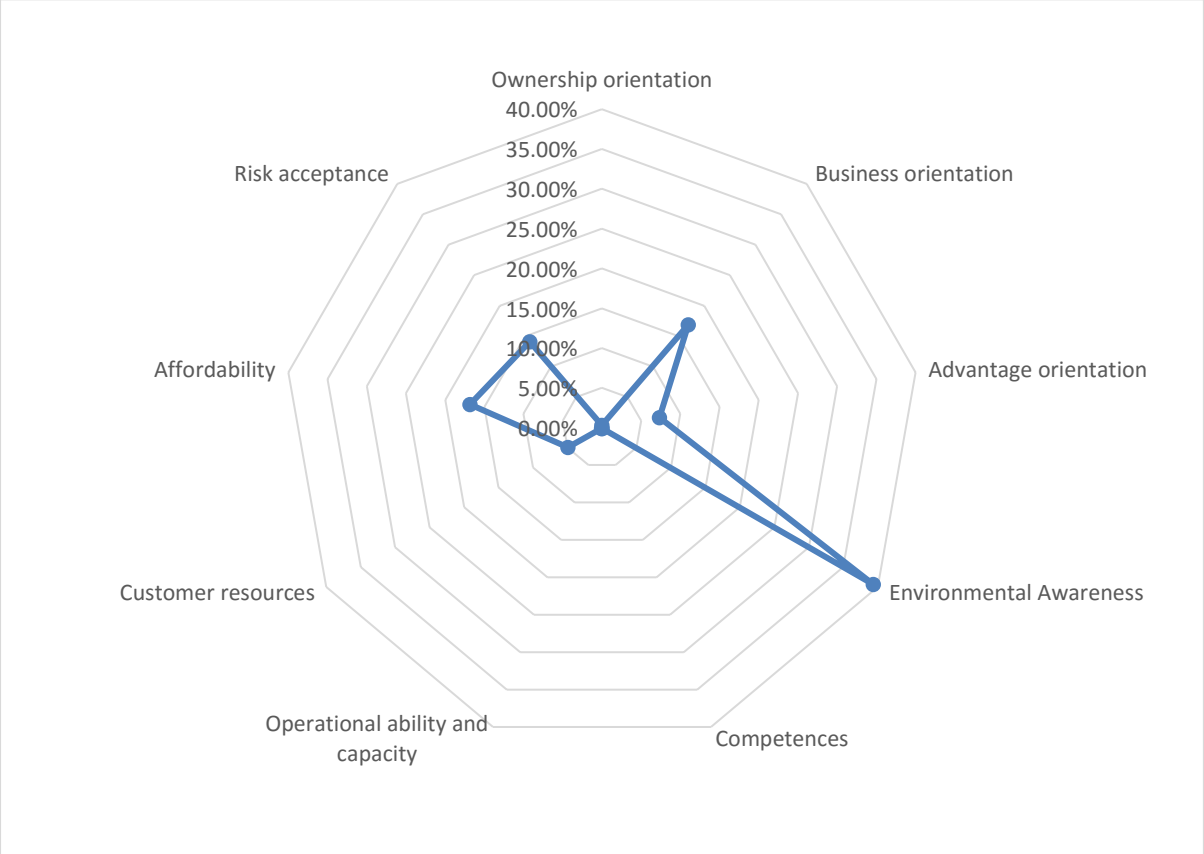


Figure 6-13: Customer's characteristics prioritisation chart

Table 6-43: Fitness degrees' allocation with respect to value dimensions

	Environmental awareness			**Risk Acceptance**		
	Experience	Delivery	Environmental risk	Professionalism	Commitment	Quality assurance
Supplier 1	Very Strong	Strong	Very Strong	Strong	Normal	Very Strong
Supplier 2	Normal	Weak	Normal	Weak	Very strong	Very Weak
Supplier 3	Weak	Strong	Strong	Strong	Normal	Normal

	Business orientation			**Affordability**	**Advantages orientation**		
	Experience	Delivery	Core business	Cost	Commitment	Core business	Contractual aspects
Supplier 1	Very Strong	Strong	Very Strong	Normal	Very strong	Very Strong	Strong
Supplier 2	Normal	Weak	Very Weak	Strong	Weak	Very weak	Strong
Supplier 3	Normal	Strong	Very Weak	Strong	Strong	Weak	Weak

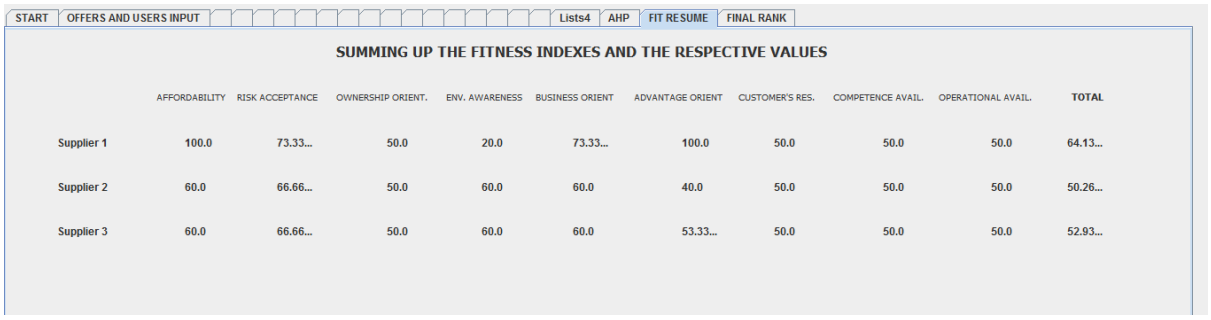


Figure 6-14: Suppliers; fitness indexes

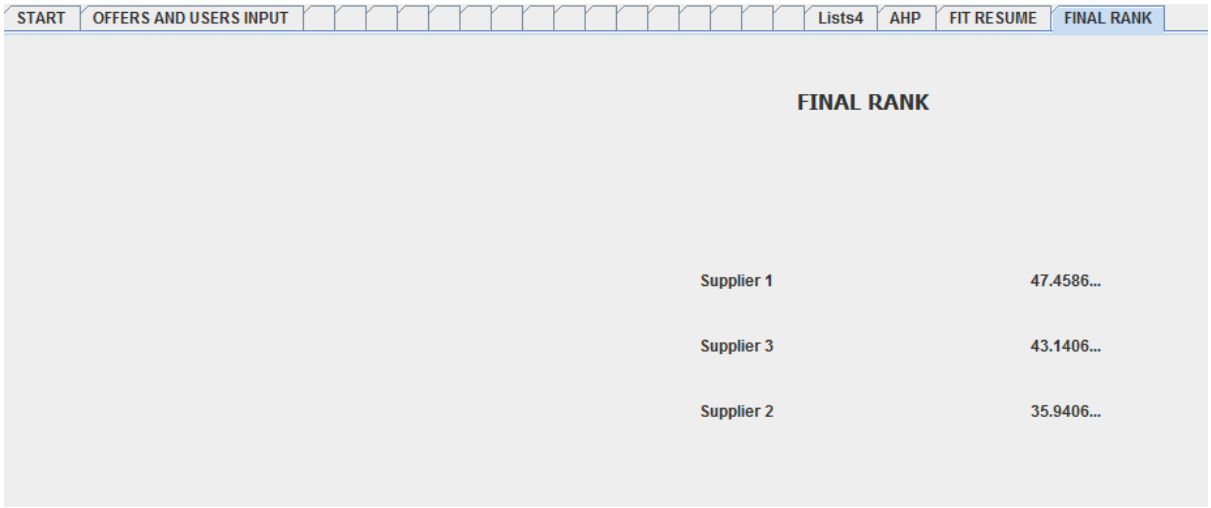


Figure 6-15: Suppliers' final ranking with respect to fitness indexes

Table 6-44: Final Suppliers' rankings with respect to fitness

Supplier's final Ranking	Score
Supplier 1	47.45
Supplier 3	43.14
Supplier 2	35.94

6.7.2 Discussion and feedback sessions

After the final step of the tool implementation, the supplier ranking was resulted. Table 8-41 illustrates the scores obtained for each supplier. The result of the three grids revealed that supplier 3 was better qualified than the others by a score of 84.5, whereas supplier 1 score was 74.0 and supplier 2 by a score of 71.5. The scores were obtained from the three participants from HotelCo. The initial ranking shows that the three suppliers were relatively close to each other. However, the rating of the three suppliers was based on the assessment of the perceived values, therefore, it was required to apply the fit measures to obtain the final ranking.

The value dimensions' creation was applied with the two participants. Then the frequency and variability analysis were performed. The frequency and variability analysis gave a rich vision of what HotelCo appreciates more, regarding the PSS attributes (values). As shown in Table 8-40, **Delivery**, **Cost** and **Professionalism** represent the highest frequency as mentioned by the two participants. The rest of the value dimensions cannot be neglected and are still valuable to the participants. In this case, two participants only attended the assessment process which may not give a whole picture of what they are significantly concerned with Regarding the variability analysis, the calculated baseline was 10%, and the result shows that all the value dimensions passed the baseline, except for value dimension, which was **Experience**. The variability parameter indicates that most of the perceived values were important for HotelCo as we can see. **Quality assurance** and **Core business** received the highest variability 15.28, which gives a good indicator of high spread rating for the perceived values.

The next step was to assign the value dimensions to HotelCo's characteristics by the participants. The result of HotelCo's characteristic prioritisation is shown in **Table 6-42** and visualised in Figure 6-13. As we can see, HotelCo significantly considers that **Environmental awareness** (**39.35%)** has the highest priority. Also, **Business orientation** and **Affordability** were found to have important influence in the purchasing of the required PSS. The rest of the characteristics are still important but with low impact on the final decision.

After the prioritisation of HotelCo characteristics, the degree of fit was carried out. Table 6-43 illustrates the allocated degrees to each supplier with the relative

characteristics. At this step, we can see that the participant assessed the suppliers, based on what they offered and matches to HotelCo characteristics. For example, for the characteristic ***Environmental awareness***, HotelCo assessed supplier 1 as ***Very strong***, supplier 2 ***Normal*** and supplier 3 ***Weak*** fit in terms of the value dimension **Experience**. We should understand that the value dimension Experience was related to three constructs (values) resulted from RepGrid namely Good experience, Good service and Good supervision. Similarly, for the value dimension Delivery, supplier 1 was given the fit degree Strong, supplier 2 Weak and supplier 3 Strong. After measuring the fit degrees for all suppliers, the fit indices were generated.

The fit indices as shown in Figure 6-14, indicates the most suitable suppliers that fit the HotelCo. The obtained fit indices for the three suppliers were respectively; supplier 1 **64.13**, supplier 2 **50.26** and supplier 3 **52.93**. Therefore, the final ranking was obtained as shown in Table 6-44. Supplier 1 was found best to fit the HotelCo with a score of **47.45**, then supplier 3 with **43.14** and lastly supplier 2 with **35.94**. Unlike the initial result, obtained from RepGrid, we can see that supplier 3 took the place of supplier 1. In fact, the initial ranking was based on the given rates for the elicited constructs, rather than the degree of fit. On the other hand, considering HotelCo, capabilities and attitudes played a role in the final ranking of the suppliers.

The result presented on PowerPoints to the participants, and other members joined the session which lasted for 20 minutes. The researcher was keen to get feedback from HotelCo. First, HotelCo participants were very pleased with the final result, as they agree that the initial result may not really reflect their situation. The participants were asked about supplier 3 as represents the cheapest offering and selected initially as the best, but after the tool implementation, supplier 3 was found best. Interestingly, the participants were deeply convinced that supplier 1 fits best. Purchasing manager mentioned: “of course, the PSS offered by supplier 3 was much cheaper than the other, but I think the result of the tool was right because HotelCo is a wealthy company and we do not have a problem to pay, as long as the PSS compiles our concerns and the environmental impacts of the purchasing”. Moreover, the assistant General Manager stated “*I really appreciate what we come up with by the end of the assessment tool. I think our vision regarding the PSS suppliers was somewhat inadequate and we need to focus more on our internal capabilities*”. Other members from the Purchasing Department and Customer Services were satisfied

with the final result and confirmed that HotelCo characteristics need to be considered for future purchasing. Additionally, the use of the tool was found easy and friendly, as none of the participants found any problem with the implementing of the assessment tool.

6.8 Cross-cases Discussion

The previous sections provided individual case analysis, based on the result obtained from the assessment tool implementation. The assessment process started with the assessment of the perceived values, then customer's characteristics assessment, and lastly measuring the fit degrees. Although each case study was conducted and analysed independently, it would be useful to highlight the overall findings across the five cases. The cross-cases analysis, highlights the similarities and differences between the five case studies to enhance our understanding about the PSS offerings assessment.

The assessment tool was implemented with five case organisations from different industries in Saudi Arabia. The RepGrid steps involved eliciting the constructs from the PSS offerings and then the value dimensions were created. Now we look at the most important value dimensions, based on the frequency and variability parameters for each case.

Regarding the customer's characteristics, obviously, all characteristics were considered to play a role in measuring the fit. However, each characteristic differs from another in terms of the impact it has. Also, both the business and the type of purchasing determine the influence of the characteristic on the purchase decision. Table 6-45 illustrates the ranking of customer characteristics for each case, based on the provided weights.

Table 6-45: prioritisation of customer characteristics for the five organisations

Top ranked characteristics	HealthCo	MobileCo	TeleCo	BankCo	HotelCo
1	Operational ability and capacity	Affordability	Business orientation	Business orientation	Environmental Awareness
2	Business orientation	Operational ability and capacity	Affordability	Risk acceptance	Business orientation
3	Affordability	Customer resources	Risk acceptance	Operational ability and capacity	Affordability
4	Risk acceptance	Business orientation	Operational ability and capacity	Affordability	Risk acceptance
5	Competences	Risk acceptance	Advantage orientation	Advantage orientation	Advantage orientation
6	Customer resources	Competences	Customer resources	Competences	Customer resources
7	Advantage orientation	Environmental Awareness	Competences	Environmental Awareness	Ownership orientation
8	Ownership orientation	Advantage orientation	Ownership orientation	Ownership orientation	Operational ability and capacity
9	Environmental Awareness	Ownership orientation	Environmental Awareness	Customer resources	Competences

It can be seen that Operational Ability is considered to be one of the most important characteristics in HealthCo, MobileCo, TeleCo and BankCo. The reason behind that is the type of PSS in the four cases. The purchased item was physical equipment, and required an action from the end-user. For instance, the purchased item in HealthCo was a piece of medical equipment which requires the ability of the operator (end-user) to use it. Therefore, HealthCo is concerned with the operational ability for the end-user in order to purchase a PSS. Similarly, BankCo considered the operational ability for their staff to operate the purchased item. On the other hand, HotelCo has not considered operational ability as a significant characteristic needed to purchase a PSS, and neither has an impact on the degree of suitability. In fact, the PSS in HotelCo was a service contract. The type of purchasing in such cases does not concern the operational ability, as the customer has no interaction. Instead, HotelCo regards Environmental Awareness as the top characteristic to be considered. The purchases, in the case of HotelCo, involve cleaning and housekeeping services. Therefore, HotelCo regards environmental impact as a result of the provided services, and is keen to ensure that the supplier takes the responsibility of dealing with any environmental impact.

Moreover, Business Orientation (as shown in Table 6-45) is found to be another significant characteristic considered by all five cases. One of the main reasons for this is the focus on the core business. TeleCo and BankCo, for example, considered business orientation as the top characteristic in their purchasing. TeleCo mainly provides landline and broadband communications services, whereas BankCo provides banking services. The purchases in both cases were essential to support their business, but they are concerned with providing the required services to their customers. Therefore, business orientation has a role in determining a suitable supplier.

Affordability was also found to be one of the top characteristics in all cases. MobileCo considered affordability as the first characteristic required to purchase a PSS; TeleCo rated affordability as the second most important characteristic; while HealthCo and HotelCo see it as the third most important characteristic. In

fact, selecting the PSS is subject to different considerations, but the financial situation of the organisation plays a big role in finding a suitable supplier who fits the organisation's characteristics. Risk acceptance has a role in purchasing, in the case of BankCo. It was rated as the second most important characteristic, after business orientation.

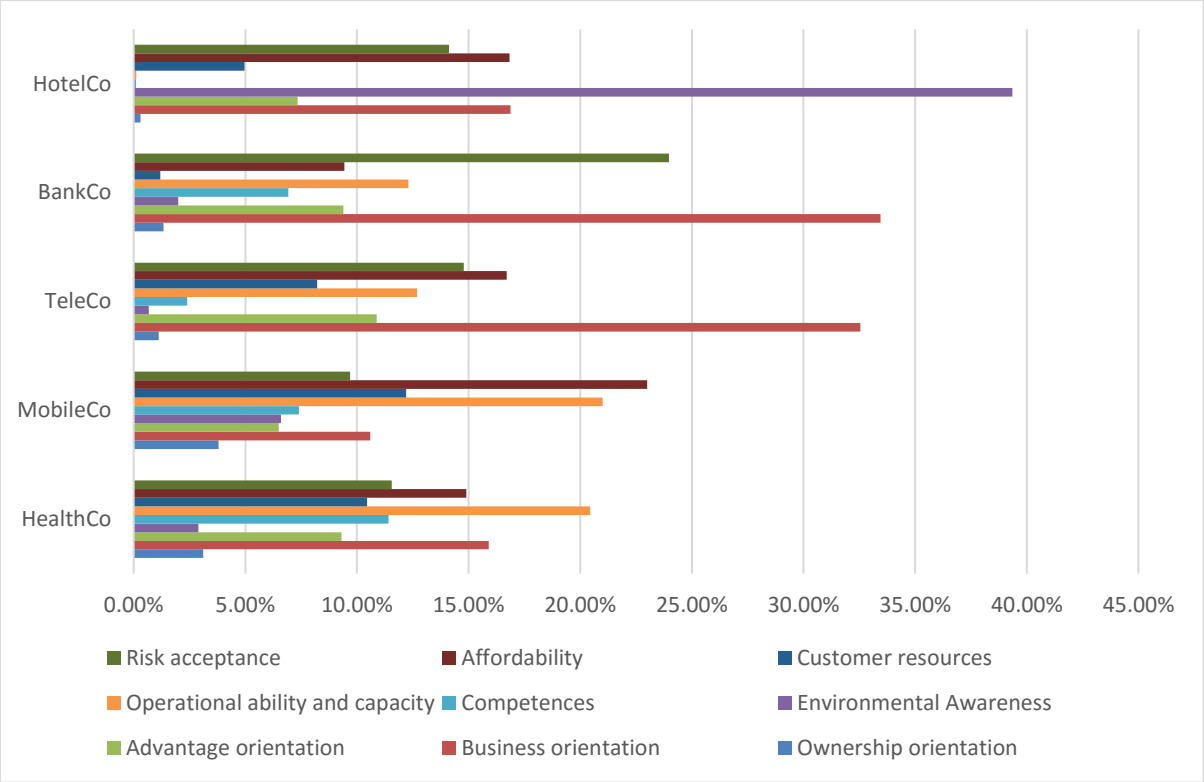


Figure 6-16: Customer's characteristics among the five cases

Form Figure 6-16, we can identify the most important characteristics for each case. It is essential to understand that, each case deals with different purchases in different circumstances. Consequently, the prioritisation of the characteristics differs from one case to another. However, we can summarise the most important characteristics according to the result obtained from the customers' characteristics priority weights, from previous sections. As the prioritisation of each characteristic varies from case to case, it is essential to concentrate on the most significant characteristics across the five organisations, as it plays a significant role in the final supplier selection. Based on the provided prioritisation ratings for the customers' characteristics during the assessment of

the PSS, the highest ratings were organised in order to explore the importance of the characteristics. Consequently, it is necessary to find the leading characteristics (in terms of total percentage), which exceed 50%, as illustrated in Table 6-46.

Table 6-46: Customers' characteristics ratings, in descending order

	Organisations					Average % total weight
	HealthCo	MobileCo	TeleCo	BankCo	HotelCo	
	20.45%	23.00%	32.54 %	33.45%	39.35%	
	15.90%	21.00%	14.78 %	23.97%	16.88%	
	14.90%	12.20%	12.69 %	12.31%	16.84%	
	11.56%	10.60%	16.70 %	9.43%	14.12%	
	11.41%	9.70%	10.88 %	9.39%	7.34%	
	10.46%	7.40%	2.40%	6.92%	4.96%	
	9.30%	6.60%	0.67%	2.00%	0.30%	
	3.12%	6.50%	1.12%	1.34%	0.11%	
	2.90%	3.80%	8.22%	1.19%	0.10%	
% of the total weight	62.81%	66.80%	76.71 %	79.16%	87.19%	74.53%

The calculated ratings of the top four characteristics for each case represent the most influential on the decision of purchasing the PSS. The top four characteristics are: HealthCo – 62.81% of the total ratings, MobileCo – 66.80%, TeleCo – 76.16%, BankCo – 79.16%, and HotelCo – 87.19%. The average total

rating of the four characteristics was 74.53%, which means that the selected characteristics represent the vast proportion for each case. Now, after determining the top influential characteristics for each case, we need to clarify these characteristics. Table 6-47 shows the top four characteristics for each case.

Table 6-47: Top four characteristics across all five cases

	Organisations				
Characteristic	HealthCo	MobileCo	TeleCo	BankCo	HotelCo
Ownership orientation					
Business orientation	15.90%	10.60%	32.54%	33.45%	16.88%
Advantage orientation					
Environmental Awareness					39.35%
Competences					
Operational ability and capacity	20.45%	21.00%	12.69%	12.31%	
Customer resources		12.20%			
Affordability	14.90%	23.00%	16.70%	9.43%	16.84%
Risk acceptance	11.56%		14.78%	23.97%	14.12%

The result, as shown in Table 6-47, reveals that the top four characteristics across the five organisations combined into six characteristics, which are: Business Orientation, Environmental Awareness, Operational Ability and Capacity, Customer Resources, Affordability, and Risk Acceptance. It is clear that the most featured characteristics represent the most important. Therefore, Environmental Awareness and Customer Resources will be excluded, as both are mentioned only once. As a result, the most important customers' characteristics across all five cases are:

- Business Orientation.

- Affordability.
- Risk Acceptance; and
- Operational Ability.

Although all characteristics were deemed important during the PSS assessment, the four listed characteristics represent the most significant characteristics in all five organisations. However, HotelCo recorded Environmental Awareness as the top characteristic, with a rating of 39.35%; whereas, the same characteristic received a low rating in HealthCo (2.90%), MobileCo (6.60%), TeleCo (0.67%), and BankCo (2.00%).

Business orientation represents the highest important characteristic across all five cases. It is obvious that all five cases focus on ensuring the sustainability of their activities and business. Therefore, the selection of a suitable supplier depends on how the PSS and the core business of the organisation fit well with each other.

Operational ability also has the highest influence on the purchase decision in the five cases. HealthCo sees this characteristic as essential, since they are concerned with the ability of the end-user to operate the medical equipment. Similarly, TeleCo, MobileCo and BankCo are concerned with the ability of their staff to operate the purchased items. On the other hand, HotelCo rated this characteristic as the lowest, since the type of purchase was a cleaning service, and, thus, operational ability was not considered.

Affordability was deemed by all five cases as one of the most significant characteristics that affect the purchasing decision. The selection of a supplier depends on how affordable the PSS is. MobileCo's result indicates that affordability is the first characteristic which measures the suitability of the PSS. BankCo, on the other hand, regards affordability as one of the most significant characteristics, but not ***the*** most important, as they regard Business Orientation to be the most significant.

Risk acceptance has an impact on the final selection in PSS assessment, as it's mentioned in all cases, except MobileCo. This characteristic represents the

extent to which the organisation might accept the risk resulting from purchasing the PSS. Risk acceptance rated as the second most important characteristic in BankCo, as they are concerned with the risk and implications of the purchase on banking systems.

Overall, although the customers' characteristics used in the PSS assessment tool are examined for the purpose of selecting a suitable base supplier, the four identified characteristics have a significant impact on the calculation of the degree of suitability. It can be concluded that, the four influential characteristics shape the five organisations in this study. Moreover, it can also be concluded that the selected cases share common characteristics, despite the fact that each case represents a different industry in Saudi Arabia.

6.9 Chapter Summary

This chapter has addressed the final phase in the research methodology which is to validate the developed PSS framework using case studies. The validation involves the use of the developed PSS assessment tool with five cases. The case selection method was presented. The result of each case was , followed by a discussion and feedback session. Subsequently, a cross-cases discussion was facilitated. In this chapter, four customers' characteristics were found to be the most significant characteristics across all cases: Business Orientation, Affordability, Risk Acceptance and Operational Ability.

7 DISCUSSION AND CONCLUSION

7.1 Introduction

This final chapter discusses the key findings of the research, based on the research programme. Moreover, the rationale of this research and the contribution to existing knowledge are presented. First, the dynamic nature of PSS customer's characteristics are discussed. The rationale of the perceived values of PSS and its implications are presented, followed by a decision-making framework for the PSS customer. The generalisability of the research findings is discussed. Lastly, an overview of the research aim and objectives is highlighted; followed by an emphasis on the limitations of the research results.

7.2 Overview of Research Aim and Objectives

This section highlights the aim of this research and the objectives that were to be achieved as discussed in Section 3.2. The aim of this research had been set as follows:

"To develop a decision-making framework to assist PSS customers in assessing, selecting and acquiring PSS offerings"

To satisfy the aim of the research, five objectives have been set to:

1. Identify typical characteristics exhibited by customers who have adopted or are likely to adopt PSS.
2. Capture and analyse the most relevant PSS frameworks and methodologies from the literature that can be used as a basis in the development of the framework.
3. Develop the customer-driven PSS framework.
4. Develop a tool to assess the PSS offerings.
5. Validate the PSS customer's framework.

7.3 Discussion of Research Methodology

This study was guided by a research methodology consisting of four phases developed to achieve the research aim and objectives as stated above. The

researcher reviewed the common research methodologies to decide the appropriate methodology to be followed. Based on the nature of the research and the developed aim and objective, the researcher adopted an inductive approach which involves qualitative data collection techniques. one of the main issues in conducting a qualitative research is the threat of bias. The bias can be generated from the researcher or the participants. The problem of bias argued to affect the reliability and validity of the results. Therefore, the collected data were triangulated to minimise bias. The researcher used different methods to reduce the bias. The data collection was based on different sources; interviews, documents, notes and feedback.

The researcher started to explore the existing knowledge about PSS to gain deep understanding about what has been done. Then, the research concerned the identification of the characteristics that can be exhibited by PSS customers. This was achieved by investigating the existing knowledge related to the concept of PSS. Nine characteristics have been identified as the most exhibited characteristics for PSS customers. Existing literature was critically reviewed, searching for the relevant PSS frameworks and methodology that could develop an adequate framework to assist the customer in the purchase of a PSS. The investigation for PSS frameworks was expanded to include PSS methodologies, to enhance the researcher understanding regarding the development of the required framework. This phase resulted in the development of an initial draft of a conceptual framework for PSS customers. Then data collection was conducted based on semi-structured interviews from five selected organisations ranging from the government sector, semi-government and the private sector. Data were analysed based on a proper data analysis procedure. The concept of PSS was investigated and observed in real practice. After data analysis, the result reviewed with the five cases to obtain feedback and refine the initial result. Then, the research proceeded to test the results. Expert feedback was used to modify and refine the outcome. Finally, validation of the proposed framework was implemented, which involved further testing and validation of the PSS S-C fit framework with five case studies. All suggestions and feedback were taken into account to refine the final outcome.

7.4 Discussion of Research Findings

During the implementation of this research, a number of findings were revealed. These findings are presented in the following sections.

7.4.1 PSS Customers' Characteristics

The concept of PSS has arisen in the late 1990s, and most contributions serve the environmental and social sciences fields. Goedkoop et al. (1999) was the first author who published in the area of PSS. since then, the publications in the area of PSS grew steadily. However, most of the previous research in the PSS field concentrates on PSS suppliers, helping them to plan and implement their strategies to deliver their products/services. Goedkoop et al. (1999) provided more than 140 examples of PSS. They mainly focused on barriers that face manufacturers/suppliers in the adoption of a PSS and mentioned some barriers related to PSS customers. However, the PSS customers had never been the focus of the research and were barely identified based on their characteristics.

PSS manufacturers and suppliers have had attention in a considerable number of works helping them to be more responsible by improving production strategies through take-back, recycling and reducing (Baines *et al.*, 2007). Many detailed case studies (e.g. Xerox, Cannon, Parkersell) were provided by (Morelli, 2003), Manzini et al.(2001) and (Luiten *et al.*, 2001). Nevertheless, no real attempts yet characterise the PSS customer. The exhibited characteristics of PSS customers are lacking in the current literature and have been barely described in such a way that would define PSS customers.

7.4.2 PSS Customer Framework

Another finding in this research was related to the available frameworks that could help PSS customers to select, evaluate and purchase PSS. The systematic review for the available frameworks in PSS show the tendency of these frameworks. For example, the proposed framework by Datta and Roy (2011) to effectively deliver Performance-based Contract (PBC). The framework mainly concerns the provider's aspects with little focus on the customer. Service delivery and design also captured the attention of a number of authors (e.g.

Horenbeek et al., 2012; Kumar & Kumar, 2004) who developed their frameworks to support the PSS providers and to ensure a successful PSS implementation.

Additionally, the available PSS methodologies were developed in the PSS provider's atmosphere. MPSS, for example, as one of the most implemented methodologies, is developed to guide the PSS providers to create new product-service offerings (Van Halen et al., 2005). Similarly, the methodology for effective implementation of a sustainable product and/or service development (SPSD) was proposed to guide manufacturers and providers to develop sustainable products and services (Maxwell & Van der Vorst, 2003).

The above findings indicate a lack of attention to the customer in order to purchase PSS. The existing PSS frameworks and methodologies barely guide the customer to evaluate and select the suitable PSS, however, it may help to understand how to assist PSS customers.

7.4.3 Purchasing process

Purchasing process is widely discussed in the literature. One of the original purchasing models has been introduced by Robinson et al. (1967). They proposed a sequence of actions that were frequently performed by an organization for the buying process in B2B. Similarly, Webster and Wind (1972) presented a purchasing process consisting of five sequential phases. The proposed purchasing processes commonly concern the major steps in any purchasing situation such as identification of the need, identification of specifications and quantity, search for possible sources and selection of supplier.

By considering the notion of PSS, it was essential to investigate whether the available purchasing processes would accommodate the situation of purchasing PSS or not. Customer capabilities in terms of operation, maintenance and service are seen to be one of the essential roles of the adoption of PSS (Baines et al., 2007; Plepys, 2003; Markeset & Kumar, 2005). Therefore, the traditional

purchase processes are lacking such a phase to identify the PSS customer capabilities and to ensure the customer capability to acquire PSS.

7.4.4 The Concept of Fit

The concept of fit emerged as a result of field study. In the literature, the concept of fit has been introduced in several research dominants. In Information Systems (IS) research, the concept of fit was used to describe the relationship between information systems and individual behaviour (Goodhue and Thompson, 1995). In social and behavioural sciences, Person-Environment (P-E) fit was adopted to measure the congruence between the values and the interest of the employee, the characteristics of the organisation and the value it provides (Morley, 2007).

By considering PSS customer's characteristics, the concept of fit is best to describe the relationship between PSS customers and the purchasing. It was found that the concept of fit has not receive the attention in the dominant of supply chain, particularly, purchasing activity.

7.5 The Perceived Values from PSS Offerings

The assessment of perceived value is highlighted in this research. Purchasing of a PSS involves the assessment of the offerings, which requires the assessment of the offered values. The result indicates that the perceived values are subjective in nature. After conducting the case studies, it can be observed that the participants expressed their perception regarding the PSS values from a personal view. Also, each participant from the same case study recognised the value he appreciates and thus, assessed the values differently, which ultimately may help PSS suppliers in creation of value and PSS development.

Some of the assessed values are common and identified widely in the literature review, such as quality, price and delivery. However, some PSS customers pay attention to specific values that may not be identified by the PSS suppliers. PSS customers need to take account of the intangibility of the offered values, as they may fail to capture the benefit of these values. We can see that by purchasing result-oriented PSS, as in the service contract, the PSS values may be found

beyond the information provided with the PSS. Customers of result-oriented PSS require more information about the supplier and the process utilised to deliver the required service.

7.6 Discussion of Data Collection

The exploratory nature of this study led to the adoption of the case study strategy to investigate the behaviour of the customer in the purchase of PSS. Case study research is one of the most appropriate strategies when conducting research with little evidence, and a negligible amount is known on the phenomenon. This case study research relies mainly on qualitative data. The researcher adopted various methods to collect the required data; a semi-structured interview, archival sources (e.g. documents and contracts) and observations. Therefore, the multiple sources of data allowed the researcher to triangulate the collected data to minimise the bias of the researcher and the participant. Moreover, the analysis of the data is inspired and modified from the theory building approach as proposed by Eisenhardt (1989). The researcher developed specific criteria to select the cases to be conducted to obtain a valuable result. The obtained result was then triangulated with the participants through expert feedback to enhance its validity and reliability.

In the validation of the developed framework, the researcher adopted the Repertory Grid Interviewing Technique (RGT) and the Analytical Hierarchy Process (AHP). RGT has been conducted to discover the unseen PSS values. This method has been quantified by applying quantitative measures (Frequency and Variability analysis). Although the RGT can be seen as a useful technique, it has a few issues.

- Advantages of Repertory Grid Technique:
    - A dynamic method to elicit and uncover the constructs (values) of the PSS offerings in this case.
    - Identify the important constructs for the participants rather than the researcher.

    - Use of the participant vocabularies rather than the researcher vocabularies.
    - Reduce the bias for both the researcher and the participants.
- Disadvantages of Repertory Grid Technique:
    - Participants may be confused as the RGT is based on a triading logic.
    - Different participants may come up with different constructs, which makes it difficult to apply the variability analysis.
    - Needs a substantial amount of effort to be spent by the researcher and the participants.

Regarding the Analytical Hierarchy Process (AHP), it has been applied on the implementation of the assessment of the customer's characteristics. The AHP was found to be useful as it provides pairwise comparisons. The need for the AHP was limited as it was required by the PSS customer to assess their characteristics. The AHP has been conducted based on group discussion session, as the assessment of the customer's characteristics requires the participation of the decision-making members in each case for this research. Moreover, the researcher was keen to conduct a feedback session after obtaining the final result.

7.7 Generalisability of Research Findings

Through the journey of this research, supported by the scope of the study, the author paid careful attention to the development of the research methodology as mentioned in Chapter 3. The data collection has been done in a systematic approach, starting from the review of the existing knowledge in the area of PSS, followed by data collection in practice. The identification of PSS customers' characteristics was carefully conducted to cover all PSS customers from the PSS categories as defined earlier in this study. Therefore, the obtained customers' characteristics can be applied to any PSS customer. The data were collected from PSS customers within five large organisations. The selection of the cases was based on identified criteria to provide a more general basis for

the final outcome. Even more, the analysis of the obtained result was carried out on a structured method to enhance the quality of the result.

The proposed PSS framework and the assessment process were validated through industrial experts from PSS customers' organisations. The proposed framework can be used by PSS customers from any sector in industry, as well as any other organisation to purchase PSS. The outcome of the research has been generalised across PSS customers from various industries. The framework was developed as a software tool to validate the outcomes. The case studies and participants were carefully selected. The case studies were chosen from different industries including healthcare, telecommunication, banking service and accommodation services. The result was validated by a feedback session from the conducted case studies. Finally, the RepGrid technique can be applied to capture the PSS values in another context, rather that purchasing a PSS.

7.8 Contribution to Knowledge

The literature revealed that most previous efforts in the PSS area focus on the planning, development and delivering PSS. In another words, research in PSS is from the perspective of the PSS suppliers, while barely any study has been done to assist customers when purchasing a PSS. The researcher investigated the available frameworks and methodologies to enhance his understanding which aided him to develop a decision-making framework to purchase a PSS.

7.8.1 PSS Supplier-Customer Fit framework

The primary contribution of this research is the development of PSS Supplier-Customer Fit framework (PSS S-C Fit). The proposed framework aims to help PSS customers to assess the PSS offerings by adopting the concept of fit. Therefore, assessment techniques and a tool are proposed. The perceived values of PSS offerings are seen differently by the customer and can be assessed subjectively and can change over the time. On the other hand, customer characteristics are present with different influences. Therefore, the

PSS S-C Fit framework fits the perceived values of a PSS to the customer's characteristics.

The developed PSS S-C Fit framework could be considered to be the first attempt in the field by adopting the concept of fit into the supplier selection method. The PSS S-C framework brings together the assessment techniques to the perception of the PSS values and customer characteristics and provides a holistic assessment process to improve the decision-making process for purchasing a PSS.

7.8.2 The dynamic nature of customer's characteristics

Regarding PSS customer's characteristics, PSS customer's characteristics were not clearly identified in a way to understand PSS customers. The literature revealed six generic customer characteristics that could describe the PSS customer. Therefore, this research contributes to knowledge by identifying nine characteristics that PSS customers in Saudi Arabia are likely to exhibit. These characteristics are; ownership orientation, environmental awareness, competence availability, operational ability, customers' resources, advantages orientation, affordability, business orientation and risk acceptance. The result revealed that customers' characteristics are dynamic and vary from customer to customer.

7.8.3 PSS assessment process

The assessment process is considered to be a contribution as it enhances the understanding of the steps of assessing PSS offerings. This process takes into account the customer's characteristics and the assessed PSS offerings values as major steps of the assessment. The process also illustrates the step of measuring the fit between the customer's characteristics and the assessed values. The PSS assessment would improve the available assessment process of the supplier selection.

7.9 Contributions to Industry

Purchasing practitioners in PSS customers' organisations also benefit from the result of this research. The research contributes to industry by proposing an appropriate technical tool to assess and select the suitable PSS.

7.9.1 PSS IT support tool

The developed PSS assessment tool contributes to industry by providing an assessment mechanism that can be used by purchasing practitioners to purchase PSS. There is an availability of supplier selection methods, however, these methods are incapable of demonstrating the relationship between the PSS offerings and customer characteristics. Common supplier selection methods stress the evaluation of the offerings based on rating and linear weighting approaches (De Boer et al., 2001), or Analytical Hierarchy Process (AHP) (Luo et al., 2009). These methods evaluate the purchasing based on predefined criteria such as price, quality and delivery, while the proposed PSS assessment tool includes a number of techniques to identify the PSS offering values that are to be considered. Furthermore, the RepGrid technique enables PSS customers to extract the PSS offering values in such a way to differentiate between the PSS offerings. Using the frequency and variability analysis would give PSS customer a deeper understanding into any of these values and which should be given more attention.

The assessment tool also facilitates assessment of customer characteristics based on the prioritisation level at the time of purchasing and the customer's current situation. The importance of the prioritisation of customer characteristics is that it provides the decision-makers within a purchasing department a larger picture of what they must consider in order to select an appropriate PSS supplier. Measuring the fit between the PSS offerings values and the customer's characteristics also helps purchasing practitioners to avoid any possible gap between their capabilities and the PSS requirements. The tool enables the PSS customer to review the suppliers ranking before applying the fit as well as after it. As a result, this gives the PSS customer the final decision of the selection of the supplier. Moreover, the fit measure provides a holistic

view by providing fit indices for each PSS supplier regarding the relative customer characteristics.

7.10 Fulfilment of Research Aim and Objectives

This section summarises how research aim and objectives are achieved from the derived findings.

The first objective was to identify typical characteristics exhibited by customers who have adopted or are likely to adopt PSS. This objective was achieved through several steps. First, the researcher started to investigate the concept of PSS to gain a deeper understanding from the existing literature review as well as its related concepts. PSS benefits and challenges were reviewed. The researcher observed that the concept of PSS has been originated from the PSS has originated from the Scandinavian research community and the first publication was by Goedkoop *et al* in 1999. Since then, the publication in the domain of PSS is increasing. In spite of the rapid growth in the publications in the domain of PSS, the focus of the publications was on how to help PSS provider to plan, develop and deliver their PSSs. Additionally, the researcher observed that there is a lack of efforts conducted in the area of PSS to support PSS customers to evaluate and purchase PSS.

The researcher started to investigate who PSS customer are? The existing literature provide successful examples of PSS as well as a number of case studies. Therefore, the researcher took advantage by extracting the common attributes of PSS customers. The extracted attributes represent the initial customers' characteristics to be considered.

The second objective was to capture and analyse the most relevant PSS frameworks and methodologies from the literature that can be used as a basis in the development of the framework. To achieve this objective, the researcher conducted a systematic literature review by identifying the key words related to the PSS framework and reviewed the key authors in the area of PSS. A number of framework and methodologies were selected to establish the basis of the PSS framework. An initial PSS framework was developed to provide a clear vision for the customer to purchase a PSS.

The third objective was to develop the customer-driven PSS framework. Five organisations participated in data collection to build a practical vision about how to purchase a PSS. The result was analysed based on robust data analysis procedures which involves data processing and coding. Customers' characteristics were validated with the participated key persons. The initial framework was modified to accommodate the emergent results. The framework emphasises the role of the customer's characteristics in the decision of purchasing a PSS. Additionally, the customer needs to identify the perceived values from the PSS offerings to select the most suitable PSS.

The fourth objective was to develop a tool to assess the PSS offerings. The researcher at this stage needed to support the developed framework with a tool that represents the framework to validate its usability. The developed framework at this stage was modified based on emergent concepts such as the concept of fit. The researcher also developed an assessment process for the developed framework. the developed process explains the process of PSS assessment that the customer needs to follow in order to purchase a PSS. The developed IT tool helps to ensure the validity of the framework. Java platform was used to programme the functionality of the tool. The tool was modified and tested several times to ensure its usability.

The fifth objective was to validate the PSS customer's framework. Five organisations were involved on the validation of the framework. the selection of the organisations was based on a number of criteria to ensure that IT tool provides rich results. The researcher presented the results of each case and discussed the results with key persons. A feedback sessions were held in each case with experts to discuss the results and modify the framework in needed.

7.11 Limitations of the Research

Although the achieved contribution of this study satisfies the aim and objectives of the research, due to the nature of this research there are number of limitations that need to be addressed. The research methodology adopted for this study is qualitative as mentioned in Chapter 3. The nature of the qualitative research makes it possible to fall victim to bias by the researcher and

participants alike. The researcher, however, followed a systematic approach to reduce the bias as much as possible. Regarding the gathered data from the literature review to identify PSS customers' characteristics, the researcher made significant effort to collate and understand the possible characteristics of PSS customers, which may be ambiguous, as the domain of the research tends to investigate the position of the PSS suppliers. As a result, failure to capture the full picture is possible even with the most thorough attempt.

Another limitation concerns the nature of the required data as it involves disclosing confidential data about the purchasing strategies in the visited organisation. Therefore, the collected data may be incomplete due to privacy issues and could affect the outcome of the field study. Additionally, to investigate purchasing PSS in the real world, a large amount data is required to cover all related aspects of the purchasing procedures in industry. However, the author pursued the correct methods to validate the final result through expert feedback from industry and academia. Moreover, there is another limitation regarding the scope of the field study. The field study has been conducted in one geographical location (Saudi Arabia) and thus the outcome of the field study may represent the current practice in industry in Saudi Arabia only.

The process to capture the potential PSS frameworks and methodologies provides valuable insight to understand the development of the required PSS framework. The analysis of selected frameworks and methodologies could affect the developed framework, as the concept of PSS is investigated from different disciplines and the author concentrated on the scope of the study. However, the analysis of the selected PSS frameworks and methodologies followed an adequate process to validate the developed framework.

The developed assessment tool could have some limitations. The test and validation phase of the tool is conducted in two steps. The researcher verified the logic of the tool and its calculations by using the tool several times to ensure that no errors would appear during the validation phase following which five case studies were selected. The selection of the case studies itself may be insufficient, as the selected cases represent one organisation from each sector

(governmental sector, telecommunication, banking services and accommodation services). Despite the variety of the selected cases, this may limit the outcome of the study. It should also be noted that the adoption of RepGrid as a data collection technique involves full interaction between the researcher and the participants and therefore, allows the possibility of bias of interpretation.

The last limitation is related to the design of the assessment tool. The author computerised the assessment process using Java platform as free licence programming software. The used calculations to measure the fit index are based on the resulting scores of the initial suppliers' scores. The final suppliers' assessment was achieved after a lengthy process and required complete involvement of the participants through several steps. Therefore, the quality of the given data by the participants may be affected due the time required to be spent completing the assessment process.

7.12 Conclusions

Manufacturers in developed countries today regard service activities as increasingly important. Not surprisingly, some manufacturing firms are strategically shifting from "product seller" towards "service provider". This led to the emergent of the concept of Product-Service Systems (PSS). Although there is widespread contemporary agreement on the relevance of PSS, it is apparent that there are divergent views on how this topic should be viewed from the PSS customers' side. in fact, there is a lack in the literature to consider the position of the customer to decide how to evaluate the PSS. The present study seeks to fill this gap by undertaking a literature review and analysis of how to help PSS customers to evaluate and select the appropriate PSS.

The research aims to help PSS customers by developing a framework that would help to evaluate and select among different PSS offerings. The research reveals a number of characteristics that define the PSS customers. These characteristics used to develop the PSS framework. The developed framework provides a comprehensive vision about how to evaluate the PSS offerings. The framework emphasises the significance of the assessment PSS based on its

perceived values. Additionally, the customer needs to prioritise his characteristics based on his needs and requirements. The concept of fit has been adopted in the developed framework. The role of fit emphasises that PSS offerings must fit the PSS customer characteristics. The framework can be seen as a useful strategy for PSS customers to evaluate and select the PSS that fit his characteristics.

7.13 Direction for Future Work

Based on the limitations described in the previous section and the experience gained by the researcher through this study, there exists an opportunity for potential improvement for future work.

The proposed PSS S-C Fit framework was applied to five case studies. However, it could be useful to apply the framework to more cases to cover the three PSS categorisations. The defence industry and oil and gas industry were not possible to access due their sensitive nature. Therefore, it could be very informative to consider the defence industry and oil and gas industry to improve and refine the framework. Additionally, there could be other factors that could influence the implementation of the framework.

The perceived values of a PSS were successfully assessed using the Repertory Grid Technique, while AHP was applied to assess the customer's characteristics. Future work could apply the RepGrid to customers' organisations to identify the most significant characteristics at the time of purchasing a PSS. Another possible avenue for future work could be to consider additional methods such as the Resource-Based View (RBV) to identify the customers' characteristics.

As we have seen, the PSS S-C Fit assessment was implemented in five case studies to help the customer to select the best supplier offerings from the same PSS category that fits his characteristics. The framework did not go further to select PSS offerings from different categories. However, the assessment process could be conducted by considering the required PSS, based on the three PSS categories. For example, the PSS assessment could be conducted if

the PSS was owned by the customers, use it or pay for a result. This might provide new insights to improve the PSS S-C Fit framework.

Fitness measuring in this study adopted a classical rating scale to compute the fit index for each supplier. Future research could apply other methods to measure the fitness degrees, such as Multi-Grade Fuzzy approach to improve the robustness of the suppler selection result.

Finally, it was observed that the implementation of the assessment process took a considerable length of time to obtain the result. Knowing that the number of assessors from the purchasing department in the case studies did not exceed four assessors in the majority of cases, future work should consider reducing the assessment steps.

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APPENDICES

Appendix A

Purchasing a Product-service system: Supplier-Customer FIT Tool Workbook:

Requirements and implementation.

Overview

Decision-making has been considered as a complex process in all fields at different levels (business, industrial, organisational and personal). On the other hand, the acquisition of complex combinations of tangible and intangible products (PSS) raises the complexity, as well as the risk of the decision-making of purchasing a PSS. This workbook introduces a Supplier Customer (S-C) FIT analytical tool to help decision makers in PSS customers' firms to assess and select the most optimum decision when purchasing a PSS. The PSS tool is computer-based programme, developed from a decision-making framework to help PSS customer to assess and select the best PSS offering.

Objectives

This workbook aims to assist practitioners in the buying departments of any organisation that are willing to adopt a PSS. Initially, the PSS offers will be assessed, based on the perceived values that the customer expects. Then, the organisational capabilities will be assessed from the other side to ensure that the customer is capable of adopting the offered PSS. Lastly, S-C FIT will be employed to assess the degree of fit between the offered PSS and the customer's capabilities.

Data collection

Repertory Grid (RepGrid) will be used as a data collection technique. The (RepGrid) is a structured interviewing technique to disclose the implied constructs by which PSS customers differentiate between the offered PSS, based on the offered values of the PSSs. RepGrid technique works to identify the values between the available suppliers and repeated until no meaningful

values appear. Therefore, from the selected three suppliers, two suppliers will be compared to the third supplier. The combinations of the selected suppliers will be changed accordingly. From example, supplier 1, supplier 2 and supplier 3 will be selected, then the assessor needs to answer the question:

"Can you think of anything that the two suppliers have in common that makes them different from the third?

This question aims to elicit the constructs of the suppliers (perceived values) without any interference from the interviewer. Figure A - 1 demonstrates the process of applying the rep grid interview over the participants, considering three PSS suppliers as an example. It can be seen that the process is iterative and each time the combinations of suppliers alters.

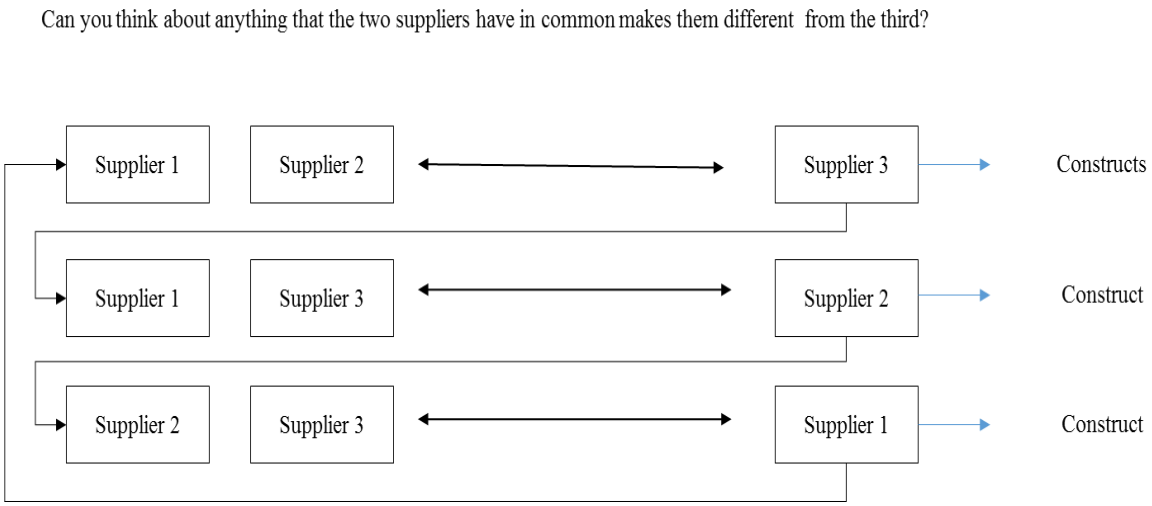

Figure A - 1: Repertory grid interview process

The elicited constructs then will be rated, based on 1 – 5 scale. The interviewee is also asked to rate all the suppliers on a scale of 1 to 5 against the elicited construct.

Participants

The implementation of the PSS tool requires the involvement of practitioners from the customer's organisation. This may involve people who are involved in the purchasing process from departments related to the purchasing tasks. For the purpose of this research, the researcher will be involved in conducting the

interview as part of the validation requirements. However, the PSS tool user can use the guidelines of this workbook, starting from phase 2.

Pre-Implementation outline

The interviewees need a guideline to use the PSS tool. This section explains in detail the process of conducting the required assessment phases for the proposed S-C FIT tool. Each phase requires specific input, in order to reach a desirable result. It must be noticed that the assessment process will be interview-based.

Introductory session and requirements

The most important part in the assessment process is to provide a complete view of the assessment tool for the interviewees. This is to ensure that the interviewee understands the aim of the tool and the expected questions to be covered in the interview. Moreover, pre-set questions will be asked to identify the position of the interviewees, his experience, the purchased/will be purchased PSS and the cost. It is essential to identify PSS's customer requirement in this phase. Thus, the customer will be asked to clearly identify what exactly he is willing to purchase and the purpose of that. This is also to help the interviewer to be more accommodating and confident during the interview.

Field to be filled before the implementation of the tool:

- What is your position in the organisation?
- How long have been working in this position?
- What PSS has your organisations purchased or willing to purchase?
- Could you tell me the cost of the purchase?

Interviewee position	Years of experience	Purchasing	Cost*

* This is not Compulsory field as the interviewee may not desire to share this information

Phase 1: PSS offerings assessment

This phase is mainly involved with the assessment of the perceived values of the PSS offerings. It is essential to provide element elicitation for the assessment process. According to purchasing policies, the customer requires at least three offerings to consider to use the PSS tool. Therefore, in this phase, the customer will be asked to identify the number of the available offerings by asking the question:

How many potential PSS offers (suppliers) would you like assess in the assessment process?

In addition, the number of assessors must be specified to process to the next step. However, in order to assess the perceived values, an appropriate technique must be considered to achieve valuable results. Moreover, perceived value weights will be calculated, based on a proper scale.

This step requires the following inputs:

- Location of results report file
- Number of PSS offerings
- Number of assessors

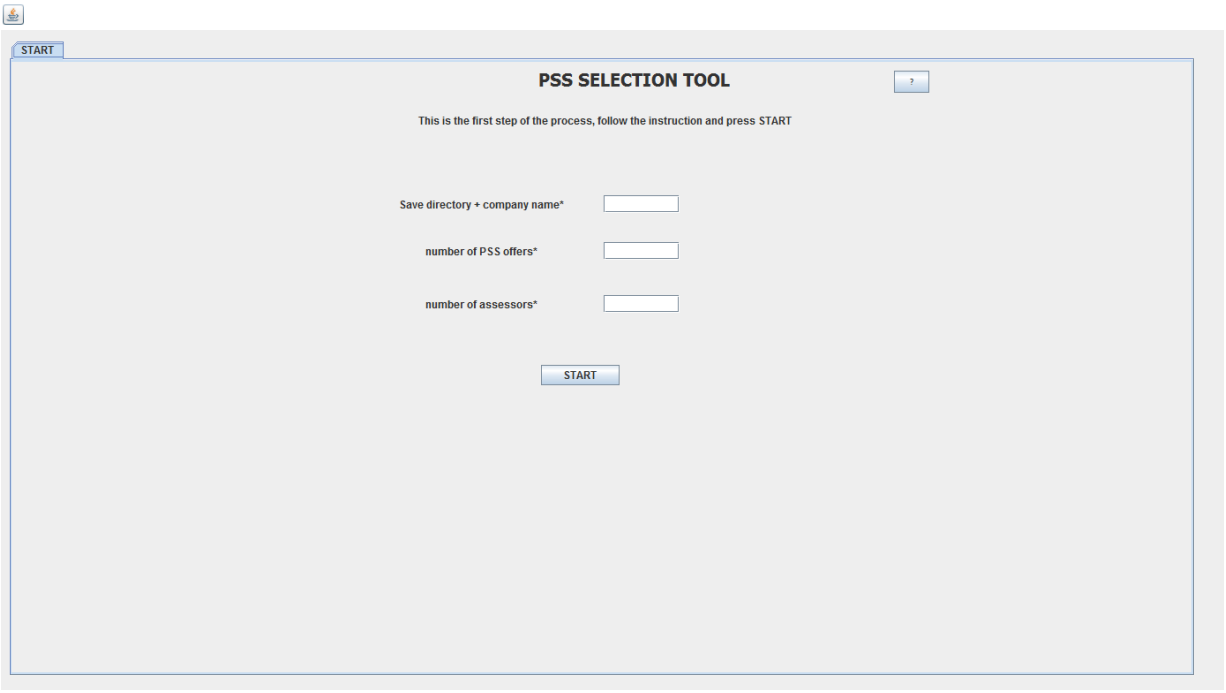

Figure A - 2: Screenshot for the data input screen (example)

Figure A - 2 shows an example of the screen that will appear during the assessment process. After entering the required inputs, it is necessary to press “START” button. Then, the next step screen shows the required fields to enter suppliers and assessor’s names or codes. It must me mentioned that for ethical consideration, real names are not required, instead supplier names can be referred to as “Supplier1” and the assessor name can be referred as “ Assessor 1” as shown in Figure A - 3.

This step requires the following inputs:

- Suppliers’ name or label
- Assessor(s) name or label

After entering the required inputs, all data will be saved, then click the button “REPGRID START” to start the next step.

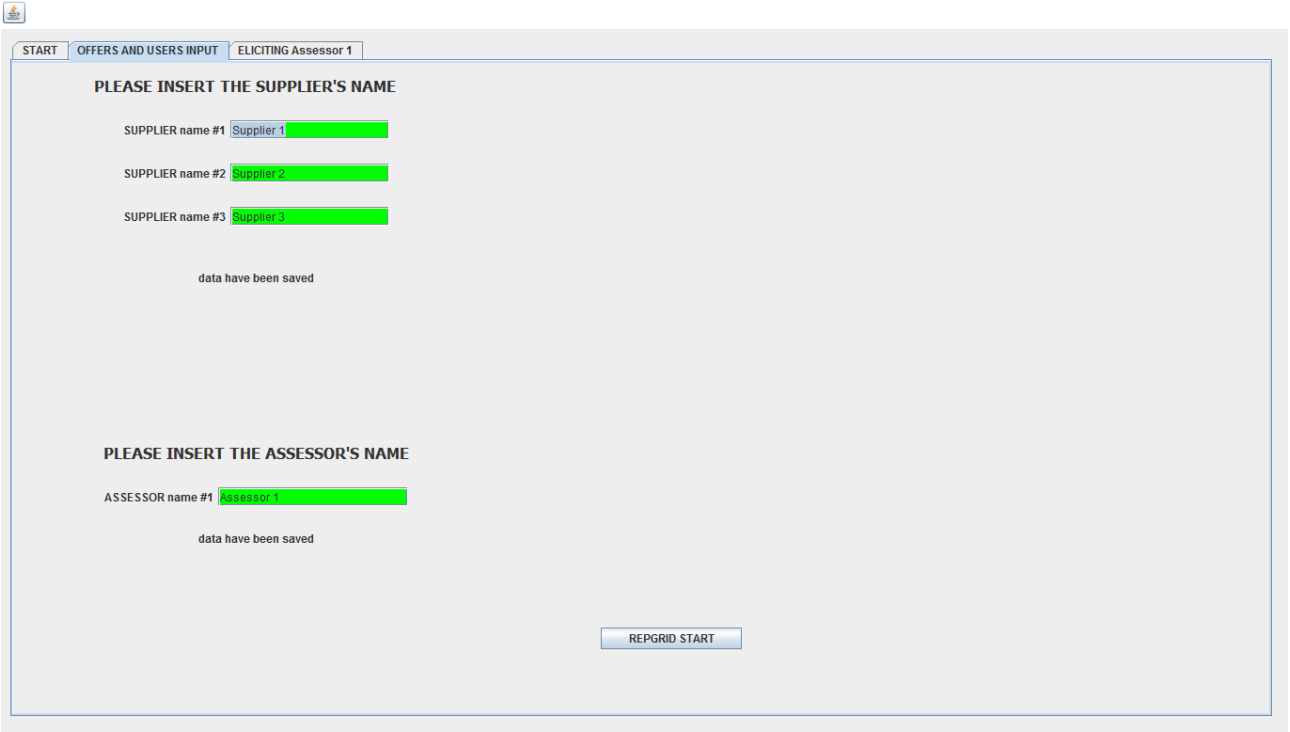

Figure A - 3: Screenshot of data entry

In the next step, the process of RepGrid will be conducted. The aim of this step is to elicit the constructs or perceived values from the PSS offerings. By pressing the “REPGRID START” button, the next screen will start, eliciting the construct by a combination of two suppliers against the third. The interviewee provides only on construct each time. The construct is then entered in the field assigned on the screen and the negative construct accordingly will be entered in the other field. For example, if the elicited construct was “good quality”, then the negative construct would be “poor quality”, in other words, the opposite. Figure A - 4 demonstrates an example of this step.

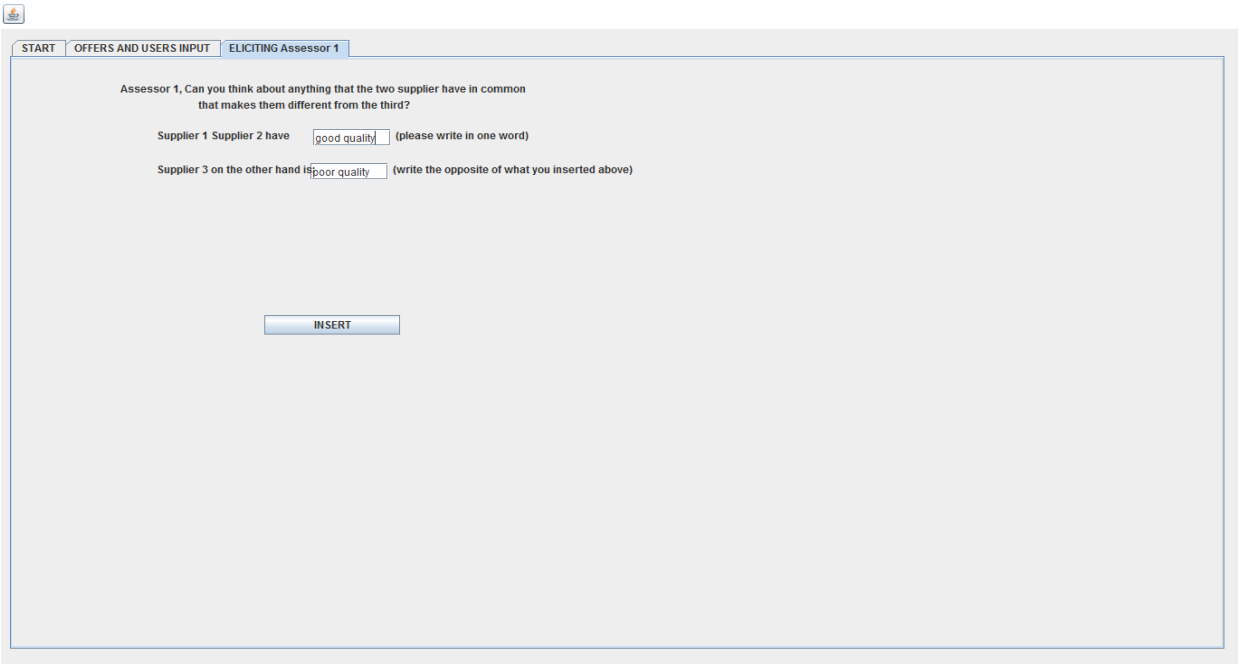

Figure A - 4: An example of REPGRID implementation

The next step is inserting the data provided by the interviewee by pressing the "INSERT" button. Then, the process will be repeated with another combination and the interviewee will be asked the same question. When all possible combinations have been covered, the process will start by developing the same developed combinations. The reason behind this is the fact that more than constructs can be elicited from the same combination. However, the RepGrid process can be stopped when the interviewee finds that no more constructs can be elicited by pressing the button "FINISH". When finishing the RepGrid process, the screen will show that the process is completed and the next step begins. The next step is to create value dimensions, which will start by pressing the button "CREAT THE VALUE DIMENSION". The aim of this step is to group the preferred values in one pole, as each construct has a negative construct. Figure A - 5 shows the elicited constructs, these constructs have opposite constructs, therefore, the user must select which of these construct he prefers. It should be noticed that the last construct was added as a built in construct in the tool for statistical purposes.

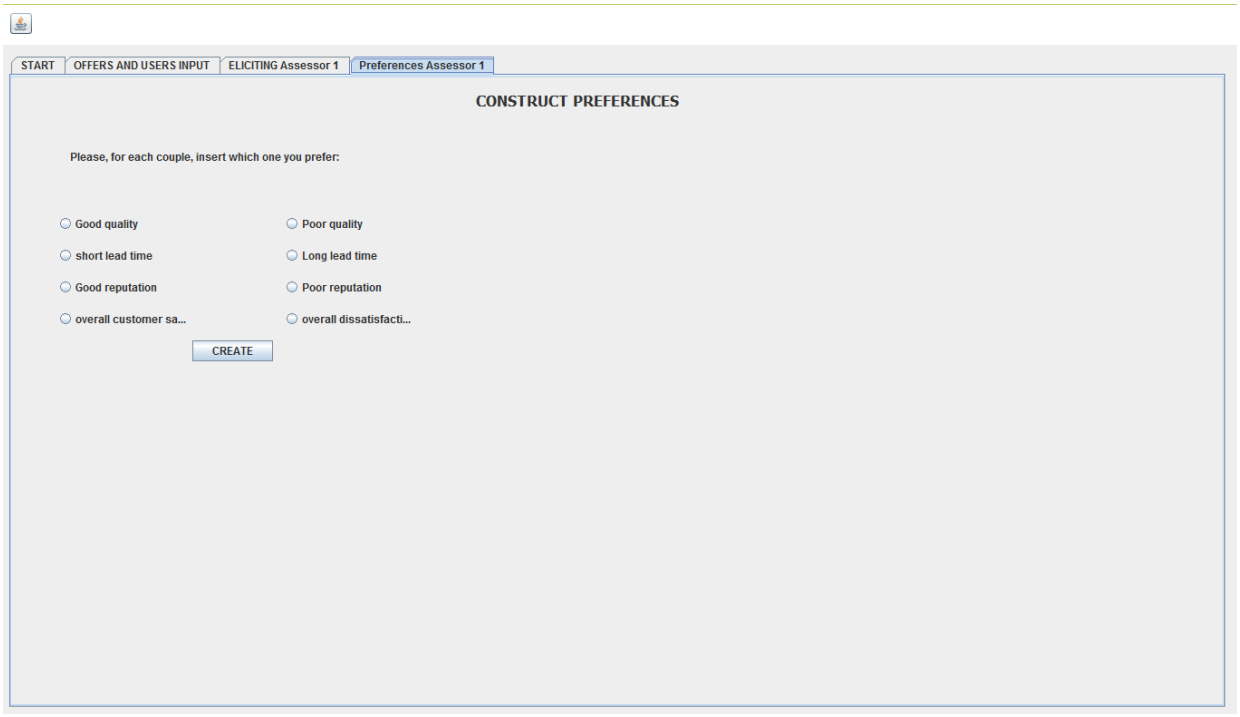

Figure A - 5: An example of construct preferences

After the construct preferences process, the next step is to rate these value dimensions. By pressing the button “CREAT”, a screen of the rating will appear, listing the elicited value on the left and showing all suppliers as elements. Figure A - 6 demonstrates the process of rating the value dimensions.

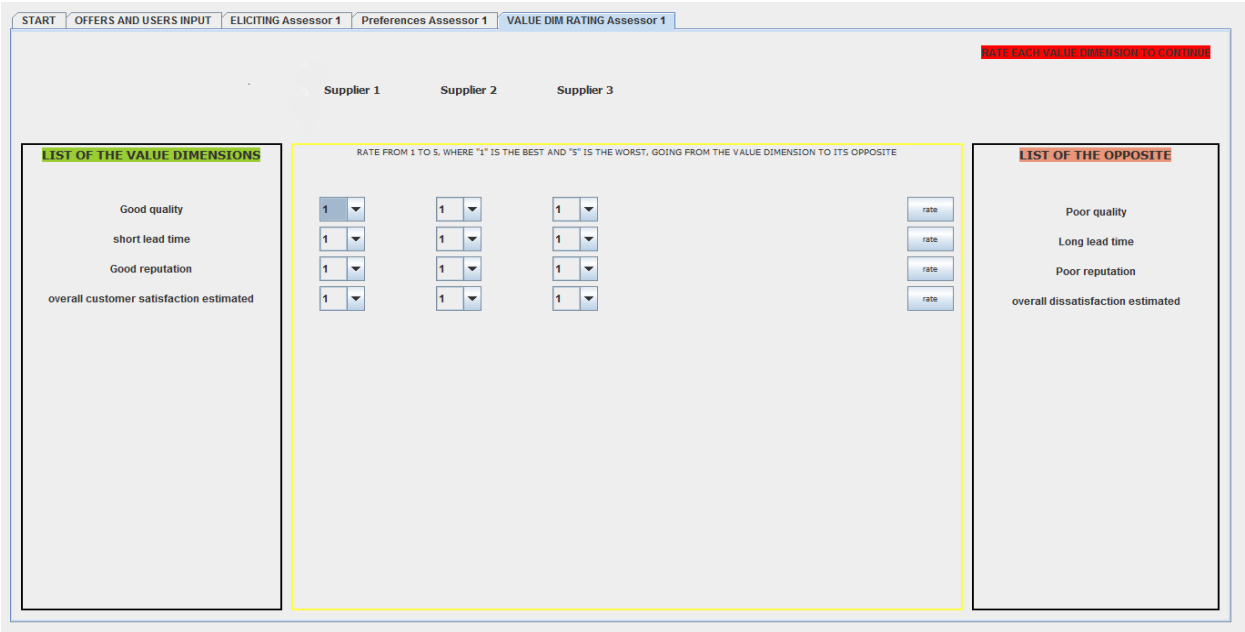

Figure A - 6: An example of the rating of the value dimensions

The screen will show all value dimensions and allows the interviewee to rate each value for each supplier, based on a scale from 1 to 5, where 1 is the best and 5 is the worst. For example, the first value in Figure 6 is given as “Good quality”, the interview must rate this value as provided from each supplier. Once all ratings are completed, the interviewee will be prompted in the screen by press to continue.

The next step in this phase is the categorisation of value dimensions as shown in Figure A - 7. In some cases, some values can be grouped under one category to achieve a reasonable assessment process. For example, for the elicited values of quality, reliability and durability, the three values can be categorised under the category PSS characteristics. The interviewee has to select the most appropriate category. It must be mentioned that the interviewee must carefully select an appropriate value dimension with related values, as these value dimensions will be used in the second phase of the assessment.

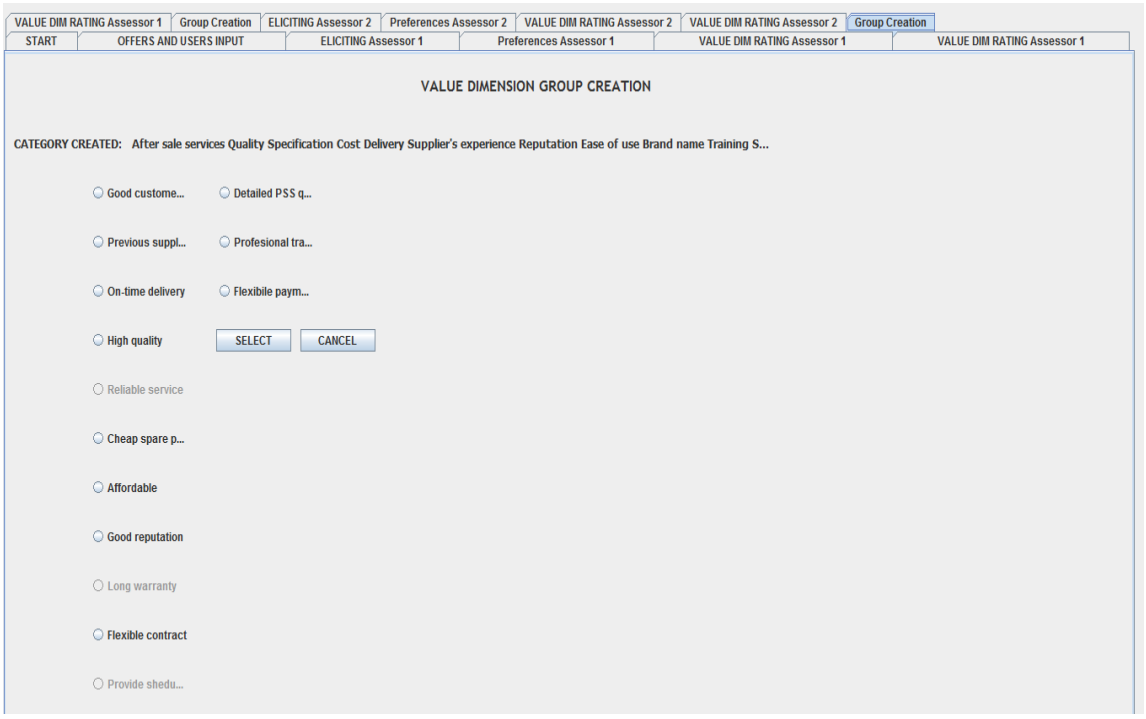

Figure A - 7: Value dimension creation

Phase 2: Customer characteristics assessment

After the assessment of the perceived values, the characteristics assessment takes place to assess the customer position, in terms of the capabilities he holds and his attitude. These characteristics have been developed, based on the most exhibited characteristics of PSS customers. This phase requires complete cooperation from the customer's firm. The analytical hierarchy analysis (AHP) will be used to conduct the capabilities assessment.

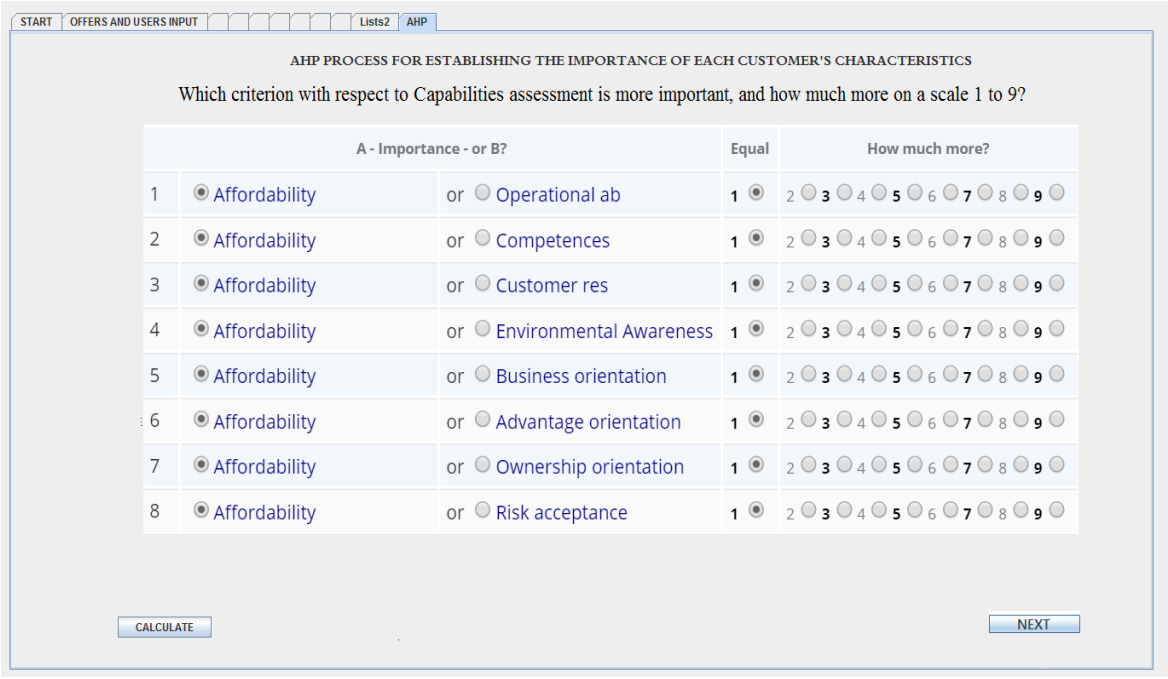

Figure A - 8: An example of customer's characteristics assessment

As shown in Figure A - 8, the customer needs to assess his characteristics (capabilities and attitude). Each characteristic will be compared with the other and the customer must provide the appropriate weight, according to his organisational situation.

Phase 3: The fitness assessment

The purpose of the FIT assessment is to assess the fitness degree between the PSS offerings and the customer related characteristics. In other words, how to extend the PSS offerings to fit the available capabilities or attitude of the customer. The first step in this phase is to determine the relativity between the

resulted value dimensions and the customer's characteristics. The customer is required to identify which customer characteristics are influenced by the value dimensions, which are created in the previous phase as shown in Figure A - 9. The customer needs to select either YES if there is a relativity or NO if not.

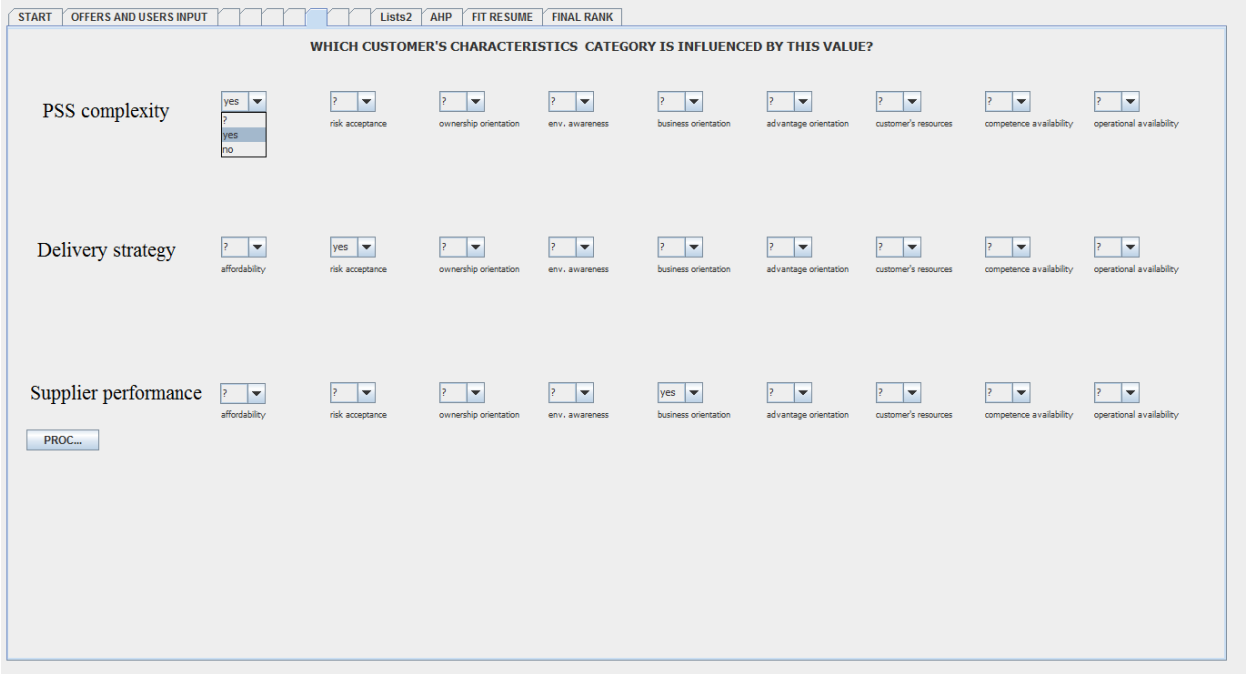

Figure A - 9: An example for assigning relativity

After completing this step, the next screen is to evaluate the level of fitness. For each supplier, the value dimensions, based on the relative characteristics are evaluated. The interviewee is required to measure the level of fitness as demonstrated in Figure A - 10. The given fitness measures are: very weak, weak, normal, strong and very strong.

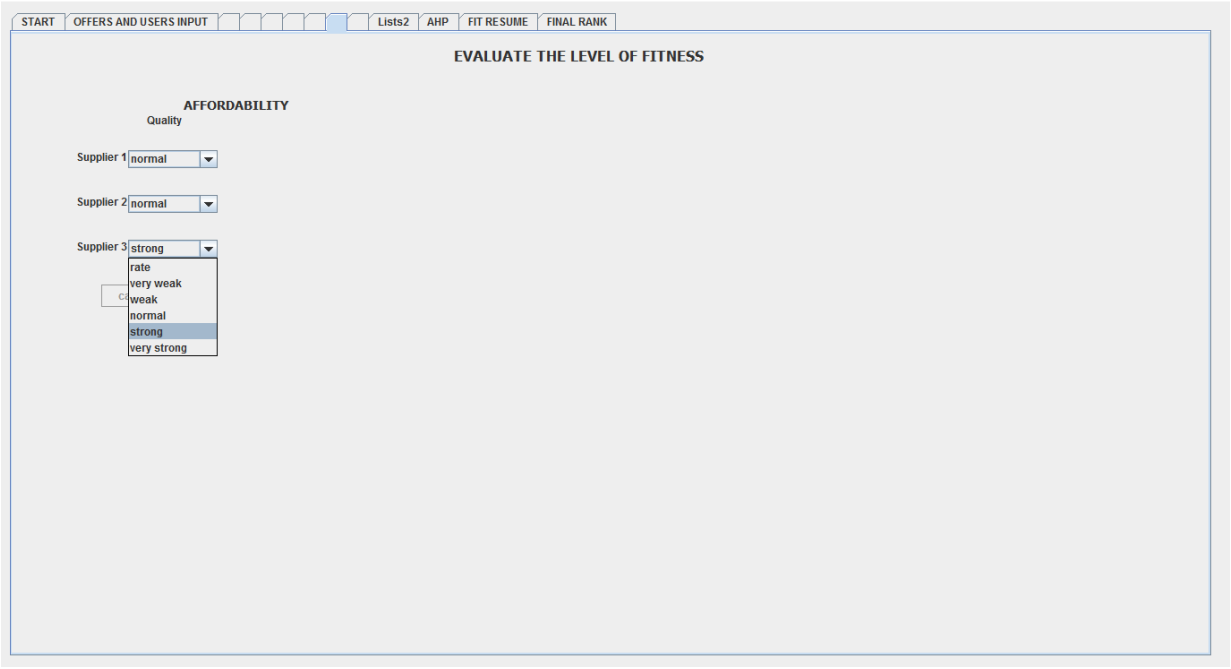

Figure A - 10: An example of fitness measurement

This phase determines the FIT indices, as shown in Figure A - 11, which give the customer a clear vision of what decision is the most appropriate to take regarding the PSS offerings. The next screen will show the fitness indices and the respective values, as well as the final ranking of the suppliers. The resulted scores of the fitness indices, clarify the position of the customer on the most appreciated values of the offerings and the degree of fitness, in relation to the characteristics he concerns.

Figure A - 11: An example of Fitness indices

The final ranking of the suppliers will be presented accordingly as shown in Figure A - 12. The customer in this case has completed the assessment of the PSS offerings based on S-C Fit framework, and the final selection has been achieved.

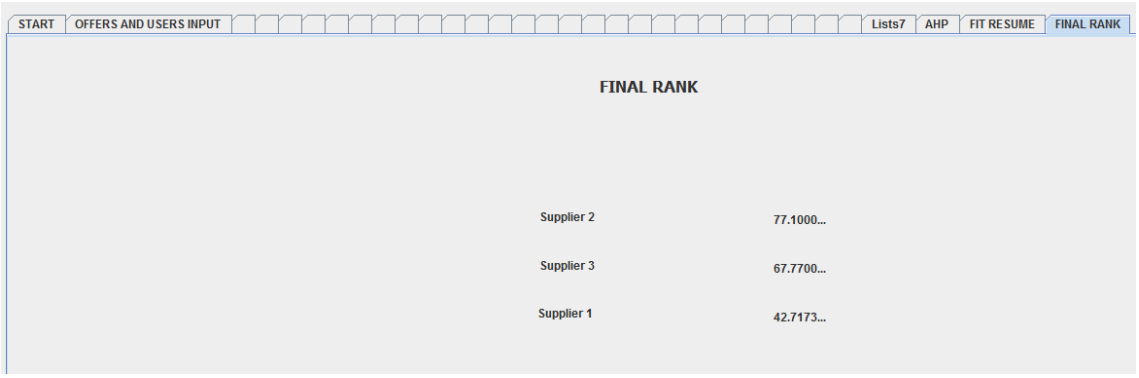

Figure A - 12: An example of the final ranking

Appendix B

Interview questions

Interview topic: Purchasing product-service systems

Interview duration: approximately 90 minutes

Interviewee position:

Years of experience:

Organisation type:

Tell me what your department does?
What type of products and services your department purchases?
How would your department purchase these products?
Tell me about the purchasing strategy, procedures, and/or policy your department applies in the process of purchasing products?
How do you identify your needs?
Who is involved in this stage?
What factors were taken into consideration during the needs identification?
Can you give an example of that?
What are the roles of the end-user?
How do you define the technical characteristics of the product you need?
Tell me about the critical factors that play a role in this stage.
How these factors play its role?
How do you define the technical characteristics of the service you need?

Tell me about the critical factors that play a role in this stage.
How these factors play its role?
How your core business plays a role in this stage?
How do you define your/end-user capabilities regarding the required product in terms of:
The available resources to install the product
If no resources, how to do so?
The available resources to operate the product
If no resources, how to do so?
What about the possibility of training the end-user?
The available resources to maintain the product
If no resources, how to do so?
Tell about the available maintenance levels that can be conducted by the end-user?
What levels end-users are capable to conduct?
In case of complex systems and inability of maintaining the product, how would you do?
The available resources to support the product
If no resources, how to do so?
How to ensure the availability of spare parts?
What action to be taken by the end of the life cycle of the product?
Who is involved?

What is the responsibility of the product provider?
Can you describe your attitude of the environmental issues during the use of the product until the disposal action?
Can you give me an example of a product that you purchased?
Considering the product/service you need and your capabilities, what other purchasing alternatives are possible based on your experience?
Can you explain in details these alternatives with examples?
What benefits your department/end user obtains from purchasing the product rather than leasing it?
How can you know that it is the best decision?
How your core business plays a role in your purchasing decision?
How can you ensure that the product you purchase is what you need?
Who is involved in this process?
How the product brand plays a role?
Tell me about the influence of the provider reputation on your evaluation.
To what extend the product characteristics (reliability, maintainability, complexity) affect your decision?
What additional services related to the product you request from the provider?
What reasons behind that?
Can you describe the process of delivering maintenance service? What reasons behind that?
How you evaluate the PSS offering?
Can you tell more?

What about assigning maintenance services to the provider or a third party?
Tell me about (Site visit, remote access, and site facility)
What values does the offer give you?
Tell me about your concerns regarding the acquisition of the product.
What about the associated risk?
Tell me about the position of your organisation regarding dealing with the purchasing?
Can you tell me the purchasing process in order to lease this product?
What reasons behind that?
What benefits you obtain?
In the event that the product is a complex technology and the user is unable to deal with (operation, maintenance,..) what are your options?
How Safety and environment consideration play a role in your decision?
Tell me about the delivery of the product?
Who is involved in the delivery process?
How to ensure the delivery of the required product?
How do you measure the performance of the product?
What are your responsibilities in this step?
What your organisation concerns in purchasing of a product?
Tell me about the experience of your department in terms of contracting for a product availability
Can you give me an example?

What makes you contracting for availability rather than adopting other purchasing options?
What is the process to contract for availability?
What benefits your department obtain by adopting this purchase strategy?
How do you ensure that the required result/performance is achieved?
How do you recognise the possible providers?
What is the procedure of searching for the possible providers/contractors?
What is the mechanism in order to contact the supplier?
Can you talk about your mechanism of contacting the original equipment manufacturer (OEM)?
How your previous experiences with product/service providers influence your selection of the provider?
How can you evaluate the providers?
What makes you select a product/service provider rather than another?
Tell me the process of drafting the final agreement
What steps you follow in order to draft a contractual agreement?
Who is involved in contract drafting process?
How negotiation process is performed?
When negotiation process takes place?
Who is involved in the negotiation process?
How would you explain sub-contracting management?
How would you describe your relationship with your contractor?

How contact points with the provider make difference?