CRANFIELD UNIVERSITY

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Enterprise Resource Planning System Implementation And Success Measurement : Case Study Of A Small To Medium Sized Enterprise

School of Applied Science

MSc by Research
Academic Year: 2012 - 2013

Supervisor: Dr Leon Williams, Dr. Jörn Mehnen
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ABSTRACT

It is widely believed that major financial benefits can be achieved by organisations implementing Enterprise Resource Planning software. It is also believed that such systems are a time consuming and a costly endeavour which can result in loss of resource and eventually failure of implementation. Furthermore not all companies have the technical competence or financial stability to take such a risk. Alternatively companies can be more modular in their approach in implementing such solutions, adopting one module at a time: the one that suits them best according to their financial and technical situation and so gradually work towards Enterprise Resource Planning implementation. A measurement technique is also required to track progress, success and failure of such a process.

As global trade routes become more affordable and the cost of shipping becomes marginalised compared to the overall cost of a product there is a direct impact on Small to Medium sized enterprises as they start competing with global businesses and not just locally. Enterprise Resource Planning or ERP's are one of the many tools that a company can utilise to enhance its efficiency and become more competitive however implementing such a technology is an expensive and risky undertaking.

This thesis aims to outline the systems and technologies that a SME can utilise to achieve such a goal using open-source software infrastructure while reducing the expenses and risk involved. It also points out a more "one step at a time" approach to such implementations, hinting that you implement only what you can afford in terms of time and resource and then build towards a bigger system when time and cash prevails hence having a gradual improvement to the overall ecosystem.

The observations derived in this paper are outputs of implementation of such technologies at a local SME acting as the case study. Results show that although such an approach can be helpful in bringing the development cost down, continuous efforts in improving the system and on-going systems support is required for the post-implementation phase to have a positive impact on the performance of the company.

Keywords: *Streamline Business Processes, Enterprise Resource Planning, ERP2*

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LIST OF ABBREVIATIONS

The following is a list of abbreviations and their prospective meanings used throughout the course of this research.

BPMN	Business Process Model and Notation
BPR	Business Process Re-engineering
CMS	Content Management System
COPICS	Communications Oriented Production Information and Control System
CRM	Customer Relationship Management
CSRG	Computer Science Research Group
DEC	Digital Equipment Corporation
EOP	Economic Reorder Point
EOQ	Economic Order Quantity
ERP	Enterprise Resource Planning
GPL	General Public Licence
IT	Information Technology
KPI	Key Performance Indicators
LTV	Lifetime Value
MPC	Manufacturing Planning and Control
MRP	Material Resource Planning
MRP	Material Requirements Planning
NPV	Net Present Value
PERT	Program Evaluation and Review Technique
ROP	Reorder Point
SME	Small to Medium Enterprise

LIST OF DEFINITIONS

MAGENTO | Magento is an open source e-commerce web application that was launched on March 31, 2008. Magento is a content management system (CMS) based on PHP and MySQL for web hosting service.

SUGAR CRM | SugarCRM, is a customer relationship management (CRM) system that is available in both open-source and Commercial open-source applications. Sugar's functionality includes sales-force automation, marketing campaigns, customer support, collaboration, Mobile CRM, Social CRM and reporting

SAGE LINE 50 | Sage Line 50 is a popular accounting software for small to medium sized enterprises.

DOWN SELECTION | To narrow the field of choices, especially, to choose an option from a range of available options using a scientific method.

1 BACKGROUND INTRODUCTION

The financial crisis starting August of 2007 had a ripple effect throughout the business community, especially within the Small to Medium Sized business community. Small companies are ever expanding and have a firm reliance on the underlying banking system, relying on overdraft facilities and business loans for cash flow management.

The case study is a Small to Medium Sized manufacturing firm having its manufacturing facilities in the UK. The company relies heavily on the banking system as it is trying to expand its business, as the banking system does not support its requirements for cash flow the company is seeking other ways to increase revenue.

The management have realised that there is untapped potential in undertaking a technology overview and want to upgrade company systems and policies, research has to be conducted in order to understand the optimisation procedures, technologies and implementation techniques involved.

The company has a history of technology failures as it has tried technology upgrades before. This is an opportunity to study the life cycle of technology upgrades from the time of system analysis to the time of system implementation. Research is going to be conducted in the area of Enterprise Resource Planning systems in order to realise the problems associated with implanting such systems within such volatile environments. As the case study has had implementation failures before this would also be a good opportunity to study reasons for such failures.

Enterprise Resource Planning (ERP) systems are defined as a type of information system designed to integrate basic organisational processes to deal with the problem of fragmentation between them (Koch C. & Baatz, 2001). Enterprise Resource Planning is a theoretical entity that integrates and streamlines dispersed organisational systems usually software in order to create a seamless business process throughout the organisation. There is

evidence that suggests that a fair number of these projects are unsuccessful and a large number do not provide the required output. Historically the development of the Enterprise Resource Planning terminology is intertwined with different events related to advances in the methods used in the manufacturing industry and can be understood in a chronological order. This research aims to collect valuable data by implementing the required modules of an Enterprise Resource Planning system, using a manufacturing firm as a case study, in order to research the impact of such software solutions. Moreover to have an indebt understanding of the problems associated with such implementations as claimed by researchers. More importantly the research wants to discover new knowledge which can further the cause of enterprise resource planning success.

In the 1960's the primary focus in manufacturing practice was the cost of production, hence industry was focused on solutions that could minimise cost and create high volumes of a product with the assumption that the economic situation would remain stable. Reorder point systems were the prime focus of software vendors which helped calculate economic order quantity and economic reorder point, ROP systems form part of manufacturing planning and control which was the prime focus for manufacturing during the era.

The 1970's saw the focus change from cost of production to marketing, this gave rise to target market strategies which emphasised greatly on better planning and production integration. As material resource planning (MRP) systems emphasised on forecasting, master scheduling, procurement and shop-floor control they emerged as the best fit solution for fulfilling this requirement and quickly became the industry standard, replacing the MPC philosophy. Technology vendors were quick to respond to the MRP need and became major contributors to its success. In 1972 IBM introduced COPICS (communications oriented production information and control system) which was an eight-volume publication followed by a software product which was to run on IBM Model 360 a main frame computer. In the same year SAP was born

by a group of engineers from Germany, a company which later became the dominant player in the ERP market.

With the rise of quality gurus in the 1980's the industry saw a shift in focus towards quality of products as a new competitive indicator. Manufacturers started focusing on greater process control, reducing the cost of overheads and world class manufacturing. To distinguish these new features from previous practices the term Manufacturing Resource Planning started to be used increasingly instead of Material Requirements Planning, as both acronyms were the same namely MRP, the term MRP II being used to clearly distinguish between the two. As a response to the new manufacturing practices, the industry was adopting the MRP II systems by introducing due date scheduling, procurement, detailed cost-reporting, closed loop scheduling and enhanced shop-floor reporting functionality.

The acronym ERP was first devised by the Gartner group in 1990 as a vision for next generation Manufacturing Resource Planning (MRP II) system (Wylie, n.d.). They proposed a system that provided a the company a real time view of its core business processes by integrating the various software functions being used in isolation. The distinguishing factor of this definition when applied to earlier systems like MAPICS from the 1980's was that such systems often failed to integrate all operational functions in a near real time fashion, for example transactions like inbound and outbound inventories etc. were summarised and applied to general ledger at month end rather than in real time. By late 1990's the Enterprise Resource Planning model had covered all core aspects of the manufacturing life cycle and businesses beyond manufacturing corporations started to use the newly proposed model.

By the year 2000 most of the basic operational functionality for manufacturing practices from the software perspective had come to a point of maturity. Major Enterprise Resource Planning software vendors began looking towards mergers so that they could either become or maintain their dominance in the industry. One such merger was the PeoplesSoft/J.D.Edwards merger announced on 2nd

June 2003, they are now the market leaders in the Enterprise Resource Planning software industry.

Open Source Enterprise Resource Planning software is amongst another important emerging solution in the software market. In the 1950's and 1960's, academics to facilitate collaboration amongst themselves would freely exchange software code, this in essence would give rise to the open source software methodology. Groups such as DECUS of the Digital Equipment Corporation (DEC) and SHARE of the IBM corporation for IBM 701 were formed to facilitate such collaboration amongst users. In the 1980's Richard Stallman a programmer from MIT AI lab formed the Free Software Foundation whose goal was to distribute a variety of software for free, this led to the formulation of the General Public Licence (GPL). Another such group the Computer Science Research Group (CSRG) of the University Of California Berkeley would then release "BDS Unix" which was the first open source operating system. The development towards more robust and scalable open source software continued with the advent of Linux, Apache, MySQL and PHP or LAMP systems in the 1990's. Combinations of software like these provided the required open source platform for the development of open source ERP systems.

Enterprise level organisations were the first to implement Enterprise Resource Planning systems and vendors were quick to exploit the gap in the market, as the gap narrowed attention turned towards selling such solutions to small and medium sized enterprise. According to UK government statistics (Ref) in 2013 there were an estimated 4.9 million private sector businesses with 99.9 per cent of them being an SME. In the same year an independent ERP consulting organisation, Panorama consulting, published a report comprising of data collected from a four month survey (September 2012 to January 2013) comprising of 172 respondents. The report indicated that 61% of the projects had duration overruns and 60% received less than 50% of ERP benefits, although it is important to note that out of the overall respondents 53% were Small to Medium sized businesses. Some 10% of businesses declared their Enterprise Resource Planning implementation a failure and 30% did not know

the outcome of the project. Assuming the same trends apply to Enterprise Resource Planning implementation within SME's and taking a conservative estimate of only 5% failure rate, then an estimated 240000 Small to Medium businesses are at risk of Enterprise Resource Planning implementation failure in the UK alone. Economically gloomy environments can also be a trigger for SME's to increase their IT budget in pursuit of improving capability, such environments can become catalysts for implementing ERP's and risk implementation failure.

The industry is now focusing on implementing Enterprise Resource Planning systems in SME's and as there is a high risk of failure, there is a corresponding requirement to research the processes involved in the selection and implementation of such systems. This research will investigate the following areas:-

1. Enterprise Resource Planning selection criteria identification for SME's;
2. Enterprise Resource Planning success assessment techniques for SME's;
3. Effects of Enterprise Resource Planning implementation on SME processes.

The research is divided into three distinct phases, the first being the scoping of literature for selection criteria, then implementation by selection criteria for data collection and finally scoping literature to select a suitable an assessment technique and to measure success of Enterprise Resource Planning implementation.

To identify the contribution of knowledge there is a need to scope the existing research, by using a literature review method. The reason for using literature review as a method is the requirement to understand and identify logically the gap and opportunity space and also to have an acknowledgement of what has already been done in the subject area. Depending on the outcome of the literature review there will be an implementation of the findings using a case study.

Any past experience of the case study with regards to the subject matter will be taken into account as part of the scoping phase. The case study will act as a platform for observation and the findings will be compiled as part of the validation phase followed by a discussion and conclusion statement. The limitation of the research is the duration and the finite number of observations that can be conducted.

There will be a systematic process undertaken to perform the literature review , the three key areas for interest were scientific journals, industry research publications and local knowledge. Scientific journals and industry research publications will be used to scope the scientific and industry background of the subject area while the case study will be used as a source of local knowledge to acknowledge the scientific facts.

Starting by narrowing down the subject area by using keyword search on Scopus and creating a list of the highly cited papers. Keyword search like "ERP" would bring about few thousand results hence the search was narrowed down to the last ten years.

After initial background scoping it was realised that the subject is further divided into key research areas which require in depth understanding. A literature scoping exercise was undertaken using Scopus which is a bibliographic database containing citations and abstracts for academic journal articles.

Table 1 Search terms used to scope scientific literature

Scopus Search Terms	Number of occurrences in search
Reasons for ERP implementation	281
ERP selection criteria	523
Organisational Classification in ERP selection	102
ERP selection criteria	523
Cost of ERP implementation	1359
ERP support structure	1248
software scalability and ERP	34
ERP success measurement	1022

After reading the initial abstracts and citations, relevant journals papers associated to these keywords are downloaded and read in further detail. The research will be primarily focused on journal papers from last 10 years however when required research previous to that is also taken into account, also surveys conducted by established consulting firms and research organisations are taken into account. The exercise resulted in the down selection of 82 journal papers which were studied in detail to form the literature review which follows.

2 AIM AND OBJECTIVES

The aim of this thesis is to implement an Enterprise Resource Planning system and measure its success for a Small to Medium Enterprise. The methods that are used during the course of this research can then be followed by other researchers and consultants to optimise and study business processes within Small to Medium Enterprise in an economically unstable environment to increase their productivity and business potential.

By using specific modules of Enterprise Resource Planning software, the research predicts to optimise and make seamless business processes using a local manufacturing SME as a case study, the desired outcome of the research is contribution towards knowledge within the field of business process optimisation for Small to Medium Enterprise.

The research objectives are as follows:

OBJECTIVES	SCOPE	GAP & OPPORTUNITY	IMPLEMENT	VALIDATE

1. To scope the research available in terms of business process optimisation using Enterprise Resource Planning software within a "cash stripped" Small to Medium Enterprise.

2. To identify the Gap and Opportunity space for advancing Enterprise Resource Planning research for SME's.

3. To implement the down selected data collection platform for research validation.

4. To validate the hypotheses in order to prove or disprove the research question.

The research starts with a strict scoping phase to ensure an overall understanding of ERP's and their implementation in SME's. This is done by doing an in-depth analysis of scientific papers on the subject by using a literature review as a method, as this is a widely established field words like

"SME" coupled with "ERP" were used parallel with a historic view of the company practices. Due to the complexity of the subject a literature review is the correct method to learn from previous scholarly experience. In order to ensure the robustness of the selection of technologies and implementation methods for the case study, interviews will conducted in order to gain an understanding of the inner workings of the case study and to incorporate previous experiences of the company within the selection criteria, this will ensure the robustness of decision making with any previous mistakes omitted. The overall software will evolve in several phases, after each phase a phase roll out will occur. Each phase will represent a certain aspect of business having an agile approach while being developed. Validation of research will take place by using the balanced scorecard approach, this will ensure research rigour of the results and successfulness of the methodology.

Research suggested that the company required three distinct business functions in their software infrastructure. In the first instance a customer relationship management system will be implemented, the aim being to improve interactions with customers and to create more of them by using technology to automate, synchronise sales, marketing, customer services and technical support (Shaw, 1991). By down selecting and interviewing respective CRM vendors a solution will be selected and implemented, training sessions on how to use the software will be given by the vendor. Customer data will be downloaded from other legacy systems using spread-sheets, cleansed for impurities and then uploaded to the new CRM system for use. Specific employees will be selected to use the system and training sessions will give to these employees by the vendor. In down selecting the CRM system an important factor for consideration is its ability to interact with other systems particularly with the e-business end of the Enterprise Resource Planning. The aim here is to feed data related to new customers and sales information from existing customers directly into the customer management system from e-commerce activity.

Secondly a sophisticated e-commerce system will be implemented providing the company with a customer facing system, this will act as the central system for the organisation. The aim here is to implement a system that encompasses company processes related to purchase of a product to its delivery. The system will also act as a company catalogue for its products and pricing information for internal staff members as well as its clients. The solution will also implement a number of customised software solutions to time consuming sales problems, the aim of customisation will be to reduce the mean purchase time of certain products by automating the sales process for those products. Pricing queries will also be redirected to the internet by asking customers to log on to the solution and to search for their respective products and view the prices online. This coupled with customisation, should lead to a reduction of time spent by in house staff on the phone. The system should also be able to feed valuable sales information to the CRM and also have the ability to interact with accounting packages. There will also be custom accounts for staff members whereby only the services they are accountable for will be visible by their login, for instance a sales representative will not be able to see the company sales figures or change the price of a product but will be able to give discounts on a sale to a certain extent. The incorporation of such security features will streamline processes within the case study allowing for higher efficiency and productivity.

After a phased roll-out of the e-commerce solution it is required that the solution works in-line with a legacy accounting system feeding it accounts data automatically. Keeping a legacy system will have two important implications, firstly the time required to implement the whole of the ecosystem will be reduced and secondly the overall investment in terms of training time and capital will be reduced to a minimum.

These individual software systems form subsets of the overarching Enterprise Resource Planning systems. The goal here is to optimise business processes within SME's that are cost conscious and struggling with human resource by implementing technologies that are cost effective in-terms of time, expertises

and investment. Implementing best fit systems for certain business processes like CRM and e-CMS, utilising already implemented technology like the accounting system will follow well established methods like phased development and roll-out combined with agile development in each phase. As the purpose of research has now been identified and the research has sufficient knowledge about the data collection platform predictions in form of hypotheses can be written down in the next chapter.

3 HYPOTHESES

In light of the aims and objectives the following is a list which details the hypotheses, these will be used as a way to measure success: -

H1 - If adequate training is provided to internal customers then there will be a considerable change in the consultant hours being spent on the system, such a change will be a good indicator of system success.

H2 - If all required internal and external customer processes are implemented then there will be a shift in the order placement procedure from manual to digital because of the introduction of a web interface for order placement.

H3 - If all required internal and external customer processes are implemented then there will be a reduction of order processing times because of the implementation of process automation.

H4 - If the customer relationship management system is used to market the new web interface then there will be a surge of new customers because of its capabilities of customer history tracking, digital marketing and funnelling.

Assuming the outcome of the project by means of the hypotheses presented the research aspires to obtain proof of principle by means of implementation and validation. The overall methodology of the research will be determined in the next phase, this will be an important phase as future researchers will follow the same pattern in order to achieve similar results, a good methodology will guarantee research repeatability while validation will conclude the suitability of such a methodology.

4 LITERATURE REVIEW

According to a 2013 survey published by SAP and Oxford Economics (Economics, 2013) comprising of 2,100 respondents from 21 countries into the trends of technology spending in Small to Medium Enterprise concluded that Small to Medium Enterprise, in order to accelerate growth, are expected to exploit global markets while facing fierce competition from larger multinational organisations. In the face of such competition smaller companies are investing in technology.

Some of the important findings from this research are as follows.

1. For the purpose of business expansion SME's are striving to grow beyond their home market while they are experiencing increasing competition on home turf.

2. SME's are forming alliances and business partnerships overseas. More than 50% of the respondents indicated they are trying to form alliances overseas.

3. More than 66% of companies within the survey were at some stage of streamlining their business processes hence recognising the need for business transformation with technology.

4. Almost 66% of the companies grade investment in technology as strategic investment with 35% as early adopters.

5. More than one-thirds cited that investment in innovative technology is the key for entering new markets.

6. Nearly 49% are actively hiring employees while 39% find it difficult to recruit people with the required skills.

In order to expand their businesses companies are investing and relying on technology to give them the competitive edge over bigger rivals as indicated by the survey. The purpose of this literature review is to scope the research available into such business process transformations and to recognise the

technologies available that can help make such transformations a success and to point out the risks of failure.

Although ERP's are a standard method of streamlining organisational processes there is indication in literature of a high failure rate of implementation. This research will utilise this opportunity to understand the operations of implementing an Enterprise Resource Planning system with a local SME acting as a case study. By using the first hand primary knowledge obtained, the research would be able to provide recommendations to improve Enterprise Resource Planning systems for SME's.

Companies can be compelled towards implementing an Enterprise Resource Planning for various different reasons, as reported out by (Shehab, Sharp, Supramaniam, & Spedding, 2004). These reasons can be high levels of inventory, mismatched stock, lack of coordinated activity, excessive need for reconciliation, flouting of controls, poor customer response levels, poor cost control, lack of efficiency and lack of a total visibility into the overall supply chain performance. This falls in line with the research conducted by SAP and Oxford Economics as companies try and streamline their business processes they will want to implement Enterprise Resource Planning systems.

Shehab et al.(2004) emphasise the significance of the Enterprise Resource Planning package selection phase and point out that the process is deceptively difficult. In order to select the best fit solution for the case study the performance capabilities of various software solutions have to be pre-assessed by firstly understanding the various selection criteria required to assess the particular size of the company and secondly to select the correct solution depending on the criteria identified.

In order to narrow down the scope of the research and to access its impact area it will be necessary to identify the category of the case study. Companies are usually defined in Europe by four types of naming conventions micro, small, medium and large. Each naming convention is usually defined by the number of personnel below a certain threshold and the amount of turnover a certain company generates annually. These variables can differ between different

countries or economic regions. According to the following table a company is called a Small to Medium Enterprise (SME) when it falls between the Small to Medium variable range.

Table 2 Classification of Small to Medium Enterprise with regards to UK and European standards, (19-Feb-2014, Nabeel Shaikh)

Classification	European Commission Europe. (People Count)	Department of Trade and Industry UK. (People Count)	European Commission in February 1996 Europe (Max Annual Turnover)	Companies Act of 2006 UK (Max Annual Turnover)
micro	1-10	0-9	2 million Euros	1.7 million Pounds
small	11-50	10-49	7 million Euros	8.2 million Pounds
medium	51-250	50-249	40 million Euros	41 million Pounds
large	>250	>250	> 40 million Euros	> 41 million Pounds

As the case study generates a maximum turnover of around 2 million pounds annual and has less than 49 employees it can be classed as an SME. There have been numerous studies relating the classification of an organisation with the software solution selection preferences.

One such research conducted by (Bernroider & Koch, 2001) has shown that the differences in the classification of an organization also defines the preferred characteristics in the selection criteria, according to them (Bernroider & Koch, 2001) SME's within the European economic region emphasise more on functionality, quality, price, speed of implementation and the ability to interface

with other applications where as they pay less importance to the characteristics of Enterprise Resource Planning supplier.

Another important survey was conducted into the adoption of ERP's by European mid-sized companies by (Everdingen, Hillegersberg, & Waarts, n.d.). The research was conducted to shed light on business policy made by major Enterprise Resource Planning vendors like SAP, Peoplesoft, JD Edwards, Oracle and Baan, these vendors till now had focused on large companies and were changing strategies and focusing on selling Enterprise Resource Planning packages to SME's. In the survey SME's were asked to indicate the three most important criteria of information system selection between the choices lowest cost, user-friendliness, fit with business procedures, scalability, support and training. The results showed that about one- half of the respondents identified "fit with business procedures" in their top three important criteria, this is because small businesses are usually customised dealing with specialist products and processes thus the software they adopt has to be flexible enough to adopt with their custom procedures.

Rao's case study of a SME in the Indian market (2000) pointed out that for a small company an Enterprise Resource Planning might be a difficult proposition in terms of cost and that information integration might be one of the factor why SME's are attracted towards a ERP implementation hoping it gives them the same level of business flexibility as a large enterprise. Rao further identified the criteria for the selection of an Enterprise Resource Planning system for a SME, which are affordability, domain knowledge of suppliers, local support, technical upgradeability and incorporation of latest technologies.

The research above provides us an insight into the selection criteria that SME's are considering before purchasing an Enterprise Resource Planning system, by summarising and narrowing all the different criteria the selection criteria can be deduced for the case study as follows.

1. Affordability of the technology, any costs associated with software either purchase cost or support cost.
2. Adequate support and training availability.

3. Scalability of the software, this is the technical scalability, upgrade ability and the interface ability of the software.

4. Fit with business procedures, the functionality of the software needs to be in line with the business procedures and processes of the company.

5. Software quality means how well the software complies with its functional requirements (Customizability) hence software of superiors quality can result in a more user-friendly solution.

6. The software should consist of the latest technologies.

7. The supplier should be well known in the ERP domain.

8. The speed at which the technology can be implemented.

The above criteria can be further grouped into selection parameters and then scoped in depth, this will allow us to establish the importance of each criterion which can then be used to select the data collection platform.

4.1 Cost

Haddara (Haddara, Engineering, & Elragal, n.d.) indicated that cost overruns are frequent in Enterprise Resource Planning projects within SME's hence this is one of the most important factor to consider carefully. (Haddara, 2012) reports that Enterprise Resource Planning customers could spend around three to seven times more money on the implementation and complementary services than on buying the initial software license. In general costs can be divided into direct or indirect costs, direct costs being those that are calculated at the beginning of the project and the latter is born out of unpredictability, the substantial escalation of costs often occurs because of unanticipated indirect costs, these costs can be customers asking to have unanticipated customisation requests that were not anticipated at the beginning of the project. The Price of a solution can be an aversely attractive proposition. Rao (2000) indicates that to sell an Enterprise Resource Planning solution it should have a price the customer finds attractive, hence clarity is required at the very beginning of the project as to what the customer is buying into. As SME's are usually cash stripped in an economically gloomy environment an attempt towards efficiency can result in failure of the project. This assumption is

confirmed by an important report by Consulting (2013) which states that out of 172 companies surveyed, 53% had already crossed their estimated budgets, 61% had already crossed their estimated schedule, which in turn affects the cost of the project. This then suggests that the costs of an Enterprise Resource Planning project for SME's should be closely studied before embarking on any sort of implementation.

At the arbitrary level the direct cost components at planning phase are hardware, license, training, consulting, analysis, implementation, maintenance and integration indirect cost components usually are customization, support, upgrades and continuous adaptation to processes. Cost than is the most unpredictable variable within the selection criteria of a ERP project for SME's effected by unpredictability and influenced by other variables in the selection criteria.

4.2 Support

There is value in staff members knowing how to manage, troubleshoot and in some cases find alternate solutions to their Enterprise Resource Planning infrastructure, the importance of such activity is discussed in research conducted by (Grant & Chen, 2005) and (Jain, 2010). Though at present there is not enough understanding about the requirements in terms of IT capability when it comes to Enterprise Resource Planning maintenance (Hecht, Wittges, & Krcmar, 2011), hence in the post implementation phase adequate support and continual training is required.

(Ahituv, Neumann, & Zviran, 2002; Nah & Delgado, 2006; Ng, Gable, & Chan, 2002, 2003) reported that supporting ERP's after the post implementation phase can be divided into a number of tasks, these tasks can range from non-technical to semi technical tasks. Non-technical issues can be answering preparing and performing user training, advising users of how to use the system, and serving as first contact for change requests. Semi technical questions can be solving user problems and analysing errors in the application, searching for Enterprise Resource Planning vendor bug fixes, bug reporting to the ERP vendor.

Another study on the post implementation capabilities required for Enterprise Resource Planning maintenance by (Hecht et al., 2011) reported that Enterprise Resource Planning support is often a case of having key users in the middle of the end users and the ERP support staff, this can reduce the reliance on outside help. Apart from the integration of key users, end user training, support for continual change, doing the most important change requests by down selection, continual changes with care of change method, change testing, management of modifications and extensions, identification and evaluation of software updates and IT project management for Enterprise Resource Planning upgrades all form part of the critical support requirements for Enterprise Resource Planning projects.

4.3 Scalability

Scalability of software is its aptitude to handle a growing amount of work or its ability to enlarge in order to accommodate that growth (Bondi, 2000). An Enterprise Resource Planning solution becomes the backbone of company infrastructure therefore it should be designed in a way that it has the ability to grow with the company. There are various dimensions to scalability that a company should consider before choosing a solution like administrative, functional, geographic, load and generation scalability. In these dimensions functional scalability is of great importance when it comes to ERP's as it offers a means to enhance the functional capabilities of a software solution when required as easily as possible. As the company grows it is more likely to have additions to its already existing functions, hence it will require the software to accommodate its new functions and processes. ERP's should also have a degree of horizontal and vertical scaling capacity, this means that the solution should be able to accommodate more nodes (interfaces) to the system and should have the ability to uptake more load when required. Scalability is a measure of the systems flexibility to handle different scenarios within the organization, it should grow when is required and scale back when needed, and hence scalability is highly dependent on the architecture of the system (Herzog, 2006).

4.4 Business Fitness

Business process re-engineering or BRP is one of the major hurdles when it comes to Enterprise Resource Planning implementation. BRP is designed to re-engineer the processes of the company with the provided process structure within the software (HJ & PRN, 1992), point out that companies need to be willing to realign their business processes with the new system with minimum software change requests. Rosario (, 2000) also recommends that a company be able to adopt the new system with minimum changes to avoid software errors while taking advantage of new version releases later in the system life-cycle. Hence the degree of business fitness of a solution can be calculated by comparing the amount of functionality provided by the software to the amount of functionality required by the company. This will differ from company to company and from scenario to scenario, the higher the degree of fit the less the implementation time and costs, and vice versa.

4.5 Customisability

As BRP is re-engineering of the business processes to fit the software needs, so customization is when the software is enhanced to fit the business needs. The easier it is to customise the product to the desired state the less time consuming and cost effective it is. (Aderet, 2000) points out that to allow the in-house IT personal or the consulting firm to customise Enterprise Resource Planning the vendor has to provide sufficient tools and utilities that will allow them to do so. Open source solutions however not only provide tools and utilities but also the underlying code, which makes the solution extremely flexible and customisable. Customizing an Enterprise Resource Planning software is different from bespoke or tailor-made software as it starts from a common well developed base system although a customised Enterprise Resource Planning is almost in all cases unique, where as a bespoke or tailor-made software is almost always written from scratch. The degree of fit determines the amount of customisation required, if a feature is not found on the out of the box system then that feature will have to be developed and integrated. The higher the degree of fit the lesser the requirement for

customisation hence the quicker the implementation and the lower the costs. It is important to understand that there are two distinct levels to customisability pointed out by (Herzog, 2006) those are high and low level customisation. The level of customisation required can have a direct impact on the overall cost of the system.

- High level customisation means to customise a software product with the tools and utilities given in order to align it with the business processes, these processes or procedures are usually unique for each client, there is no change to the software code at this level.

- Low level customisation means to make changes at code level, this requires the vendor to provide access to the code. Low level customisability allows for the solution to be more flexible though not all vendors will allow such intervention.

4.6 Latest Technologies (e-Commerce)

Technologies in Enterprise Resource Planning can be grouped into two distinct groups. Firstly are the ones that make up the architecture of the application. Secondly are the other ones that Enterprise Resource Planning draws upon such as e-Commerce. It is important to consider the types of technologies involved in the project in both groups. The technologies used in the software architecture will have a direct impact on the functional capacity of the system while consideration should be given to what sort of overall technological requirement does the Enterprise Resource Planning have. The case study required the major part of the software ecosystem to be web based and e-commerce enabled hence these two technologies have to be kept in mind while designing the system. Software technologies also have a bearing on user friendliness; the better the underlying technologies used the more opportunities the programmer has to make the system user friendly, stable and customizable this has an impact on user acceptance, training costs and operational costs (Herzog, 2006).

4.7 Market Share

Successfulness of a vendor in the market is an important indicator of the outcome of the project. The bigger the market share of the vendor the more likely it is that the project will succeed. Market shares are a direct consequence of the amount of projects a vendor has acquired, on each successful or failed project attempt the vendor will acquire valuable market knowledge and improve on and have a fix available for the type of problems that it came across while implementation. This can also result in more out of the box features hence minimising the degree of high or low level customisation required, it can also affect the amount of Business Process Reengineering required as it is more likely that the vendor has encountered this scenario before and has a function that fits the requirement. Market Share can also indicate programmer good will. The more programming ability available the less the cost of customisation and maintenance as more human resource is available per unit of work and the overall cost of such activity goes down. Open source software titles have a high market capture rate this is because vendors providing open source solutions have company policies that dictate openness about their code and technologies. This creates more programming and consulting ability and makes the prospects of bringing the overall cost of the solution down, hence making it more attractive.

4.8 Down Selection Process

The literature can be narrowed further and tabulated against the technologies on the market place and used for selecting the best fit solution to the case study. There is a need to devise a simple matrix against which the research can judge each technology to get a more accurate picture of software platform to choose. Based on the literature review a list of criteria has been laid out in Table 3 against which the research will measure the variables for selecting the correct software platform for data collection.

Table 3 Criteria for selection of software platform, (19-Feb-2014, Nabeel Shaikh)

Cost (Calculated in British Pound Sterling includes costs for Deployment, Software Licensing, Implementation, Hardware)	
1	0 to 4,999
2	5,000 to 9,999
3	10,000 to 14,999
4	>15,000
Availability of Support (Calculated consultant cost in British Pound Sterling per hour)	
1	0 to 9
2	10 to 19
3	20 to 29
4	> 30
Scalability (Calculated as according to the requirements of the case study)	
1	Scalable
2	Not Scalable
Business fitness	
1	Not Fit
2	Partially fit
3	Very fit
Customizability	
1	Customizable
2	Not Customisable
e-Commerce (If able to do e-Commerce)	
1	Yes
2	No
Market share (Calculated in percentage of the overall market)	
1	0 to 9
2	10 to 19
3	20 to 29
4	30 to 39
5	40 to 49
6	> 50

Table 4 Down selection of platform for data collection, (19-Feb-2014, Nabeel Shaikh)

Provider	Cost	Availability of Support	Scalability	Business fitness	Customizability	e-Commerce	Market share
SAP	4	4	1	3	2	1	6
ORACLE	4	3	1	2	2	1	3
CUSTOM	3	2	1	2	1	1	2
MI-COMMERCE	3	2	1	1	2	1	1
SAGE	3	3	1	2	2	1	4

Table 4 populates results against various platforms that are found suitable for this research. The findings suggest that a custom approach will be better, this means that this is going to use more than one technology supplier the alternative will be to rely on a singular entity such as SAP or ORACLE.

The primary reason for this approach is customisation. Software from a singular vendor can be rigid and not customizable to the level required by the case study, while researching software integration and realising the potential for better customisation can be a better way forward. This is also reflected in the company's history of previous failed ERP implementation attempts, while researching into the past implementation efforts customisation came out as the primary reason for failure.

The literature review has helped us put the subject into perspective both from the scientific and business standpoint. From a scientific standpoint the research has learned that there has been considerable research into different aspects of enterprise resource planning systems. There is a broad range of published literature available ranging from research into the reasons why organisations tend to implement such solutions, the risk factors involved in implementation, the requirements of post implementation, success measuring techniques and the advantages and disadvantages of such implementations. There are also a number of surveys from established vendors that give valuable data and statistics.

From a business point of view, even with the overwhelming amount of scientific data available on the subject there is a high risk of failure of implementation while having a high demand for technology. This is due to the fact that companies are trying to sustain themselves while having to compete with more established competitors. In some cases these organisations have little or no experience with technology implementations.

The literature review has been used as a means of down selecting the research platform which has brought out some interesting results. It has pointed out that the major reason why technology might be failing in Small to Medium Enterprise is due to the fact that a high degree of customisation is required while established vendors are unable to provide customisation to this degree.

While established Enterprise Resource Planning vendors like SAP are trying to profit from the problem, the software that they provide might not be the best fit solution, as smaller companies are usually working in a niche market the rigid framework provided by these software companies is sometimes not sufficient, due to the fact that software requires a high level of customisation in order to fit the company requirements. This was also the reason why two previous vendors were unable to provide such a solution to the problem.

However an alternative approach can be to implement software from different vendors rather than relying on one and having a high level of integration effort

between them. This will increase the amount of customisation that can be achieved. The experiment will focus on such an implementation and its results.

At this stage the research problem has been narrowed down and the literature surrounding it has been scoped. The gap and opportunity space will be defined in the next chapter followed by the aim, objectives and hypothesis. Once gap and opportunity is defined platform implementation will begin, the reason for this will be to collect valuable data for analysis. A discussion will be conducted on the data followed by recommendations.

5 GAP AND OPPORTUNITY IDENTIFICATION

Scoping through the scientific literature available it was established that there is a considerable amount of research available on every aspect of enterprise resource planning systems. However there is evidence to suggest that there is also a high failure rate of ERP implementations in industry. As the focus of large consulting firms providing such solutions changes from Enterprise level companies towards Small to Medium Enterprise, there is a gap in scientific research to provide a down selection method, implementation technique and a success measurement method specifically for Small to Medium Enterprise working under harsh economic conditions. This gap is due to earlier research not taking into account organisational differences and the effect that organisational size has on software solution implementation.

The functional requirements of large organisations can be different from Small to Medium Enterprise, for example the degree of customisation for larger organisations can be different from the degree of customisation required for smaller companies, the financial leverage that large organisations have over small companies is also different. Therefore the scientific literature needs to take these differences into account.

There is an opportunity to develop scientific literature keeping the Small to Medium Enterprise in mind. For this very purpose the research will focus on the implementation and customisation of Enterprise Resource Planning system for Small to Medium Enterprise in a harsh economic environment.

This research will be contributing to scientific knowledge by scoping scientific text using literature review as a method for technology down selection, implementing the platform for data collection, scoping further scientific text for a success measurement technique and compiling results for validation specifically for a Small to Medium manufacturing enterprise.

The study should now consider the research question in terms of aims and objectives, the purpose of this is to clearly and concisely define the overall purpose of the study.

6 METHODOLOGY

In most cases the high failure rate of Enterprise Resource Planning implementation is due to the lack of understanding of the correct methodology to use, hence a good methodology will stand between research failure and research success. A high degree of importance was given to select the correct methodology for a successful outcome of the research. The research was divided into a phased development approach with each phase following the agile method described in the diagram below, the aims and objectives of the research pointed out that a phased approach was most suitable for the case study.

Figure 1 Pictorial representation of Methodology,

(19-Feb-2014, Nabeel Shaikh)

As described in Figure 2 for every phase of the project there will be a technology down selection exercise, this will comprise of a literature review and interviews. The literature review will provide the information needed from the previous and current practices on the subject, while interviews (internal and external) will provide in-depth information on the structure of the case study. To have meaningful down section options to ensure down selection rigour the research has combining the knowledge gained from the literature review and the interviews. Having defined the gap and opportunity the solution will then be selected, using the agile software development technique followed by a phased roll-out of all the modules required. Validation is performed before each phased

roll-out by testing the required functions using alpha and beta tests of the solution, once satisfactory results are achieved the solution is handed over after sufficient training is given.
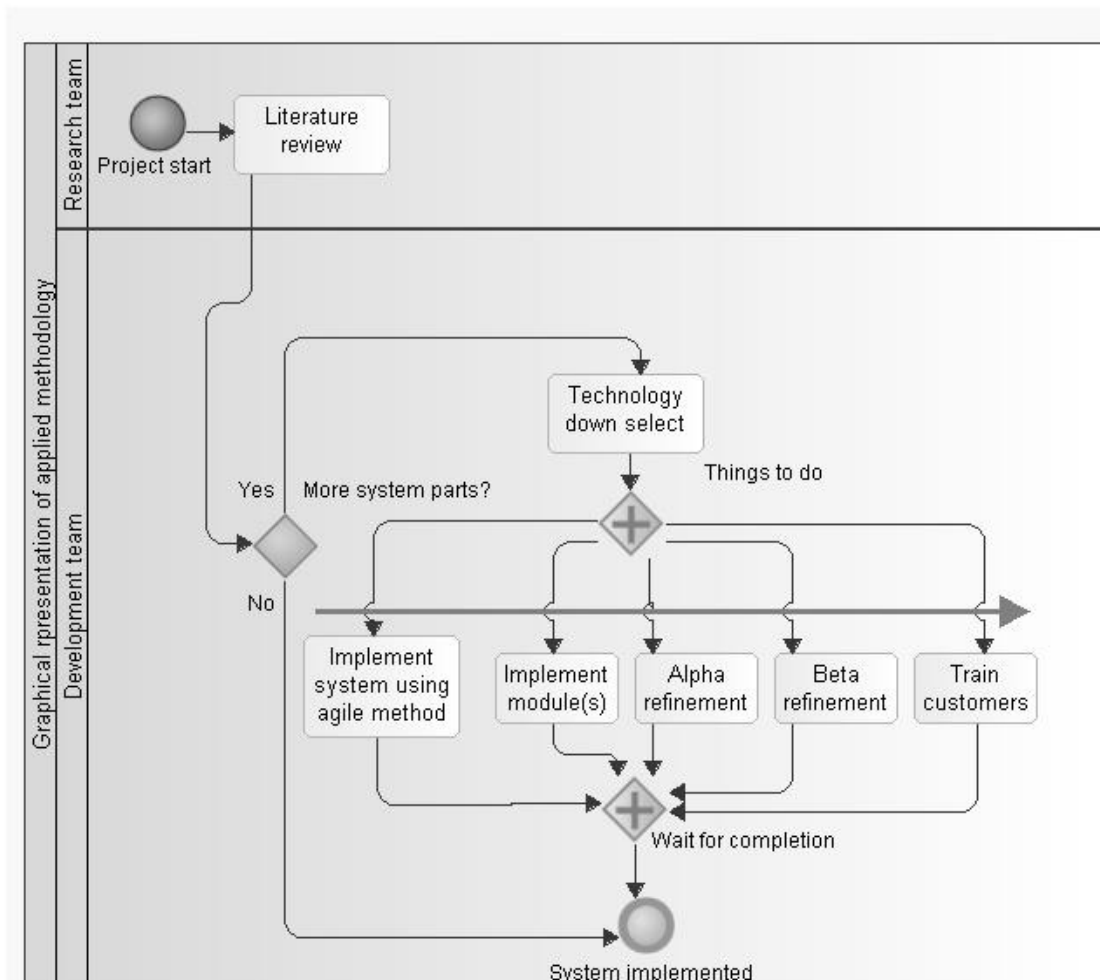
Figure 2 Graphical representation of research methodology,

(19-Feb-2014, Nabeel Shaikh)

Figure 2 shows the visual representation of the research process starting with a Literature Review for every phase and ending with system implementation before data can be collected for analysis.

This is a repetitive process hence after implementation of the first part of the system it is repeated over and over again until all constituent parts of the overall ecosystem have been implemented. Success of the phased approach often depends on the amount of human resources and investment at hand. Cash

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stripped SME's can have a strategy of selecting only the best fit system parts in line with their current financial situation and have a complete Enterprise Resource Planning system built over many phased roll outs, where each phase can be separated by a certain time interval, hence gradually building the Enterprise Resource Planning. This is different from the big bang strategy for software implementation where all system parts are rolled out at the same time.

The study has scoped the research available and down selected the platform for data collection and also the methodology involved in the overall research process. In the following phase the research will implement the platform for data collection in order to collect results for validation.

7 IMPLEMENTATION FOR DATA COLLECTION

The case study is a Small to Medium Enterprise having its manufacturing facility in the UK and builds products for the sports sector. Using distribution channels like courier services and distributors it provides its products to its direct or indirect clientele.

Having a thorough analysis of the working of the company and its functional history the research short-listed the missing business functions that were required for future sustainability and growth. These key business functions were identified through having interviews and brainstorming sessions with the executive committee and senior staff members. The outcome of these sessions identified deficiencies in the case studies current ecosystem with regards to its future requirements. The key requirements identified that the case study sought to achieve are listed as follows.

1. Having less reliance on its distributors creating more direct sales hence creating more profit per product.

2. Having a solid marketing platform whereby the company can have more direct contacts with its clients.

3. A system that can reduce the newly formed workload by creating automated sales.

The short-listing of business requirements helped narrow down the technology required in order to fulfil such business needs. At the highest level a content management, customer relationship management and e-Commerce system were required. The system requirements identified are subsets having Enterprise Resource Planning as there superset system. A conceptual framework was created as to how the company would function having these technologies in place. Different software were then studied and narrowed down, interviews were conducted with software vendors and final selections were made. Some of the key features that the software should have are as follows:

1. The software should be web based and capable of working through a web browser.

2. Different software components should be able to interact with each other forming a seamless business process.

3. All software components should comply with the business needs of the company.

Having the above features in mind interviews were conducted where different company executives pitched their products. Cost of products and the amount of customisation these products could undergo were the deciding factor for product selection, customisation being an important requirement. Open source products were considered as their cost of customisation is relatively low and their popularity being open source brings about more human resource in terms of software professionals hence prolonging their life span. Further the newly chosen systems should also be able to interact with legacy systems such as the companies accounting system.

Unlike the standard approach in Enterprise Resource Planning development which is to replace all working systems by a system bought from a single organisation like SAP the study followed a more unorthodox modular approach considering the software belonging to certain aspects of the company as a module for instance CRM systems for the marketing department, and then made sure that the systems in place were compatible and customizable with each other. This practice brings the overall cost of the product down as one is not controlled by any one organisation for future work or customisation. A high risk is also associated with relationships with the software vendor.. As the software eco system consists of components by different vendors strained relations with one vendor would not mean that the whole system is affected.

In this modular approach the CMS system was taken as a centre point. Reference to all other systems like CRM and accounting were held to be compatible with it. Magento was chosen as system of choice as it was open

source and had a degree of compatibility with all other systems in the proposed ecosystem.

7.1 Requirements Analysis

A three step requirements analysis was conducted. Firstly informal discussions were arranged with the company directors to understand the overall company vision. Careful consideration was given in understanding the perceived outcome of technology implementation.

Secondly the study examined previous success and failed attempts towards organisational optimization, informal interviews were held between the consultant and previous software firms involved. The purpose of such interviews was to understand what had gone wrong in previous attempts, inputs from a couple of organisations formed the basis of understanding for a system selection and implementation process, the two important factors identified are as follows: -

1. To decouple the solution into more flexible modules that can be installed when required as opposed to a singular more rigid system.
2. The requirement of a more flexible architecture in terms of customisation.

Thirdly after understanding that a system provided by a singular vendor would not work, it was decided that a mesh of systems would be required. Different software's belonging to different organisational departments would need to be integrated to form an overarching software eco system.

By researching the internet and studying different software capability the research shortlisted the suitable software, the method is described in some detail in Table 4. Interviews were held with different software vendors dealing with different organisational problems like accounts, marketing and sales. The outcome of these selections form the basis of section 0

7.2 Use Of Formal Methods

The research uses formal methods to abstract information for analysis, planning and experimentation. To identify different internal and external customers UML Use Case diagrams are used as a means of visual representation of customer interactions with the system.

Another formal method used is the Program evaluation and review technique (PERT), this is used as a means to measure research completion, and also the order of tasks in which they must be completed along with the corresponding time requirements. The purpose of using such a measure is to identify the gaps in using such measurement techniques in similar environments, and also to identify if such techniques are suitable for operational environments which are economically unstable.

To identify, model and graphically represent the business processes required in designing the overall system the research uses Business Process Model and Notation (BPMN). It is necessary to visually represent the required business processes involved in the study because the research can then identify and acquire the technologies that can overlay these processes. This helps in designing the overall eco system and insures that the system would comply with the underlying business process requirements.

7.3 The System And Its Composition

From the literature review it is apparent that the ill fit of the software systems can be one of the major causes of implementation failure, hence if a vendor is providing an integrated suite of software which does not meet the business processes and process flow then there is a high probability that the solution might not work. By definition Enterprise Resource Planning systems are software models belonging to different aspects of the company like accounts, CMS, CRM integrated together to form a seamless business process. If all of these software modules are provided by a single vendor with one ill fit module then there is a high chance of a ripple effect where by the whole system is disregarded by the organization. This was certainly the case found by the case

study as two previous attempts were disregarded. This method of buying 'off the shelf' Enterprise Resource Planning systems from a single vendor also overlooks the already existing systems that might be well regarded by the users (Garvey, 1999) as the vendor tends to replace these already existing systems with the ones they provides.

A better method of looking at such systems will be to have a more modular approach towards implementation, by analysing the current system and deciding if new modules can be incorporated and integrated with the current ones, also not relying on any one vendor for each new incoming module for example using SUGAR as a CRM solution and Magento as a CMS, both of which are from different vendors but best fit the requirements. The freedom to buy the best fit modules from a vendor of choice will increase the chance of user acceptability of the new technology while keeping the current modules will decrease the chance of user rejection. At this stage it is also crucial to analyse if the new modules and the current ones have the capability to communicate with each other, also deciding if the current ones are either sufficient to the requirements or upgradable and have the capacity to be integrated. The method also increases the capacity to customise each individual module, this is because a specific vendor might specialise in a certain aspect of an organizational life-cycle and the capacity for it to customise it further to the requirements of a company will always be greater than a vendor that has many different modules to maintain.

Before implementing the test platform there was a need to decide on the features that are required for building the enterprise resource planning system. Not all features are required by the case study at this point. The system shall be designed in a way that it has the capacity to take on more features as required by the organisation. Table 5 *lists the general features that are common in systems for SME's. The system will implement the features that are most required by the organisation at this stage, they are marked as Required. Though the system has the capacity for taking on new features, the ones that*

are Not Required currently. If they are required later on in the solutions lifecycle the system should have the capability to do so.

Table 5 General enterprise resource planning features for Small to Medium Enterprise, (19-Feb-2014, Nabeel Shaikh)

FEATURES	Required / Not Required
Accounting and financial management capabilities	Required
Project management capabilities	Required
Sales management	Required
Production management	Not Required
Warehouse management	Not Required
Procurement management	Not Required
Business intelligence	Required
Support for complex entity structures	Required
Support for automated updates of new tax regulations	Required
Supports granular roles and permissions	Required
Multiple currency support and ability to define own currency	Required
Supports currency conversion rates	Required
Supports automated currency conversion rates updates	Required
Automated alerts based on custom conditions	Not Required
Web interface with Ajax	Required
Ability to define multiple custom workflows	Required
Supports the creation of custom form fields on the fly through the interface	Required
Accepts substitute products	Not Required
Ability to define flexible product types	Required
Capability to define custom invoice schedule for different customers	Required
Capability to define custom volume discounts for each customer	Required
Capability to define custom Units of Measures (UOM) for each employee	Not Required
Ability to import products/customers/partners/employees/accounts from xml	Required
Goods tracking	Required
Expense sheet	Not Required
Employee expenses tracking and reporting	Not Required
Tax payments management	Required
Funds transfer and fund management	Required

Budget management	Required
Asset management	Not Required
Document management system	Not Required
HR contract management	Not Required
HR employee holidays and absence management	Not Required
Point of Sale	Required
Time and task management	Not Required
Ability to define custom views to show system data	Required
Ability to define new custom database objects through the user interface	Not Required
Define department structures and management structures	Required
Modules management interface	Required
Inbuilt chat utility	Not Required

7.3.1 The Customised Solution

Section 7.2 explains the use of BPMN for business process modelling. The next step is to identify the technologies that have the capabilities to encapsulate those processes. These technologies also have to work together and form a seamless business process, the end product will be a customised solution which is unique to the company.

A survey to choose the best possible technology was undertaken during the course of this research. Three primary factors were considered during the course of the survey, firstly the technologies should be able to communicate to form a seamless business process, and secondly they should be easily customisable in order to incorporate custom processes thirdly they should be cost effective.

Due to cost constraints and in the light of human check and balance communication between the CMS and Accounting solution was kept manual, however technologies are available like 'Holbi' that can integrate both CMS and Accounting at a cost. Figure 3 shows the overall solution architecture, is the figure the SUGAR CRM server is cloud based.

A cloud based system is one in which the hardware on which any software solution is hosted is remote, and is hosted on the internet to store manage and

process your data. The solution is then marketed as a service that a company can buy on a monthly or an annual basis. The advantage of such an approach is that the service consumer (In this case the case study) becomes decoupled with jargon of maintaining hardware and concentrates on using the service that is required. The down side is that the consumer has to rely on the service provider for that service; in case of hardware malfunction the consumer cannot access or play a part in rectifying the problem. The study found it easy to initiate the process of buying such a service and found no real difference in integrating the solution to the rest of the eco system.

Another important factor of a cloud based solution is the additional service that the service provider offers, this can be seen as an extension of in house staff. This is very important in tough economic environments as you want problems to be resolved quickly and having extra help useful.
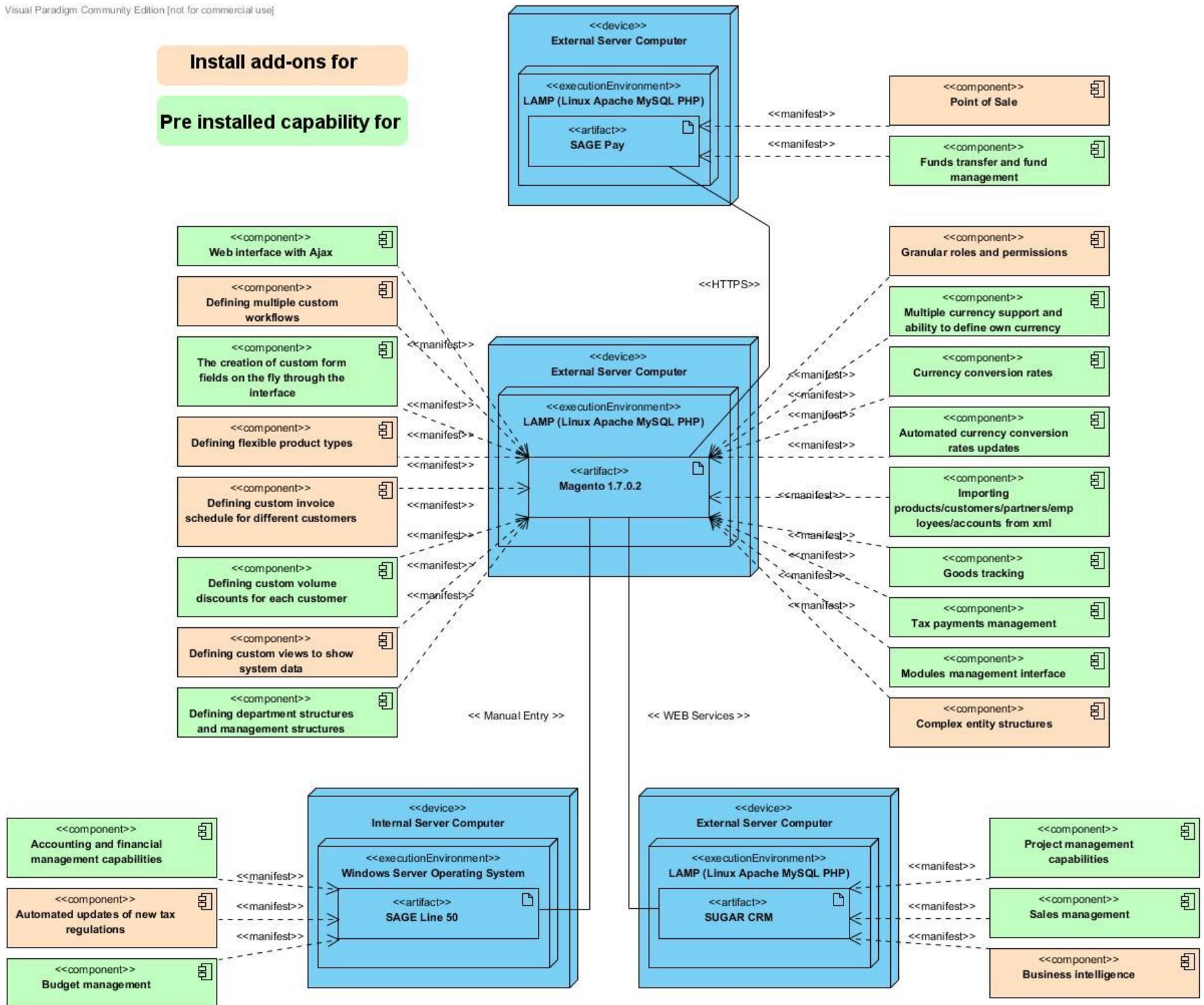
Figure 3 Visual representation of the customised solution, (22-Jun-2014, Nabeel Shaikh)

7.4 Project Management Perspective

Before starting, the research estimated the time required for the platform for data collection to finish and the probability that the platform be finished by a given date. Evaluating the time helps management predict other aspects of the platforms life cycle such as marketing and sales cycles. It was achieved by the program evaluation and review technique also known as PERT.

the tool was used because it uses three time estimates and is used in a more uncertain situation compared to other methods like critical path which are used in more certain conditions, where the time for each task can be calculated with more certainty, the final output of the tool would be a Z-Score which is the probability of the project finishing on time. The tool follows a simple step by step approach and is described as following.

7.4.1 Activity List

The *first step* is to make a list of all known tasks called an Activity List. Write down all the tasks that need to be achieved in order to complete the project to an acceptable level of detail, assign them an Activity ID, Name, Predecessor and Duration. The full activity list can be found at Appendix A, 1.1 Critical Path Activity Chart. The Activities on the list at Appendix A, 1.1 were compiled from a software requirements collection task. A document was provided by the case study detailing the initial requirements of the project.

7.4.2 Program Evaluation And Review Technique (PERT):

Step two is calculating the $Expected\ Time$ and $Variance$ of each activity, this is achieved by copying all the Activity ID's and their respective durations from Appendix A, 1.1 *Critical Path Activity Chart*, and assuming a three time estimate *a, m, b* on each activity. Here *a* is the optimistic time, *m* is the most probable time and *b* is the pessimistic time, the Duration estimate at Appendix A, 1.1 can be directly copied into the most probable time. The $Expected\ Time$ of each Activity ID is calculated by a simple formula described as Equation 1 and *Variance* as Equation 2. The final results of the calculations are shown in Table 5 as columns *t* for *Expected Time* and *v* for $Variance$.

$$Expected\ Time = T\epsilon = t$$

$$t = (a + (4 * m) + b)\ /\ 6$$

Equation 1 Expected Time for individual Activity in the activity diagram

After calculating the expected time for each individual Activity above calculated the Variance for each individual Activity as below.

$$Variance = v$$

$$v = (\frac{b - a}{6})^2$$

Equation 2 Variance for individual Activity in the activity diagram

All the individual times and variances are then presented in Table 6.

Activity	Activity ID	a	m	b	t	v
Research into Web Portal	1	5	10	12	9.5	1.36
Research into product packaging and dispatch software	2	3	5	5	4.7	0.11
Research into Customer Relationship Management(CRM) software	3	7	10	11	9.7	0.44
Customer Relationship Management(CRM) software implementation	4	3	5	7	5	0.44
CRM systems testing	5	2	5	6	4.7	0.44
CRM systems training	6	1	3	5	3	0.44
Portal implementation	7	20	50	53	45.5	30.25
Portal Unique Tool development	8	35	50	55	48.4	11.11
Customisation requests	9	15	20	22	19.5	1.36
Feature testing outcome	10	5	20	25	18.4	11.11
Web Portal bug fixing	11	5	15	20	14.17	6.25
Web portal management and knowledge transfer	12	3	15	15	13	4
CMS systems training	13	2	2	6	2.7	0.44
Product packaging and dispatch software	14	2	5	5	4.5	0.25

Table 6 represents the tasks that the project has to undergo in order for it to be deemed complete. These tasks are numbered and given their unique ID called the Activity ID. This is represented in the first column of the table. The column a represents the optimistic time m the most probable time and b the pessimistic time that these activities will take, the values of times a, m and b are assumptions based on the experience of the consultant. Once these values are populated then expected time and variance is calculated by the simple formula in equation Equation 1 and Equation 2.

7.4.3 PERT Sketch

Step three is creating a PERT Sketch from the Activity List found at Appendix A, 1.1 *Critical Path Activity Chart*. A sketch is a diagrammatic visualisation of each task and its predecessors on the activity list. The is done by starting off with the Activity ID with no predecessors and then sketching all the activities to create a diagram that shows each activity preceded by its predecessor from left to right. The advantage of undertaking this exercise is that one can visualise which activity needs to be done before another can start (as some are dependent on others) and which ones can be done in parallel to each other. The following Figure 4 demonstrates in a visual way the project start to finish process. Each circle represents an Activity or deliverable within the project and each number within the Activity is an Activity ID, please note each Activity can be undertaken by one or more and each Activity can represent a varying number of tasks.

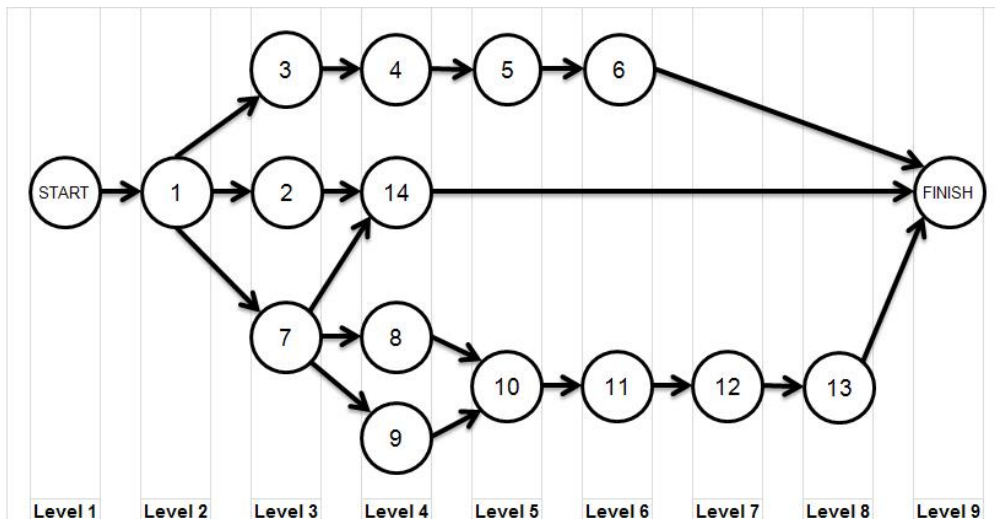**Figure 4 Graphical representation of critical path with respect to Appendix A Figure A 1,**

(19-Feb-2014, Nabeel Shaikh)

The value of the diagram shown above is that one can group the tasks into workable chunks called activities and then pre-assess the sequence of these activities. One can also access which activities can be done parallel to each other resulting in a more manageable implementation phase. This is a

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repeatable method and should be followed by researchers in order to access implementation success.

7.4.4 PERT Diagram

A PERT diagram is created from the sketch in *step three* by plotting the $Expected\,Time$ against each Activity ID and doing a forward and backward pass. It is important to note that these values are rounded to 0 decimal point. The aim of this exercise is to find the activities that have zero slack time, slack time being the time that a task in the project can be delayed. Hence tasks with zero slack form the critical path and in this case, tasks with Activity ID's 1,7,8,10,11 12 and 13 form the critical path as they all have zero slack time. The critical path also defines the maximum number of days that the project is going to take. This information is then extracted from the last task on the critical path, the experiment is predicted to finish the implementation phase of the platform in 152 working days as they are the number of days at which task with Activity ID 13 would finish. The following Figure 5 represents the PERT diagram for the implementation phase of the research, each box consists of Activity ID in the middle and the upper right corner represents the number of days each activity will take from the start of the implementation phase for example Activity ID 3 will take 20 days from the start of the implementation phase to complete.
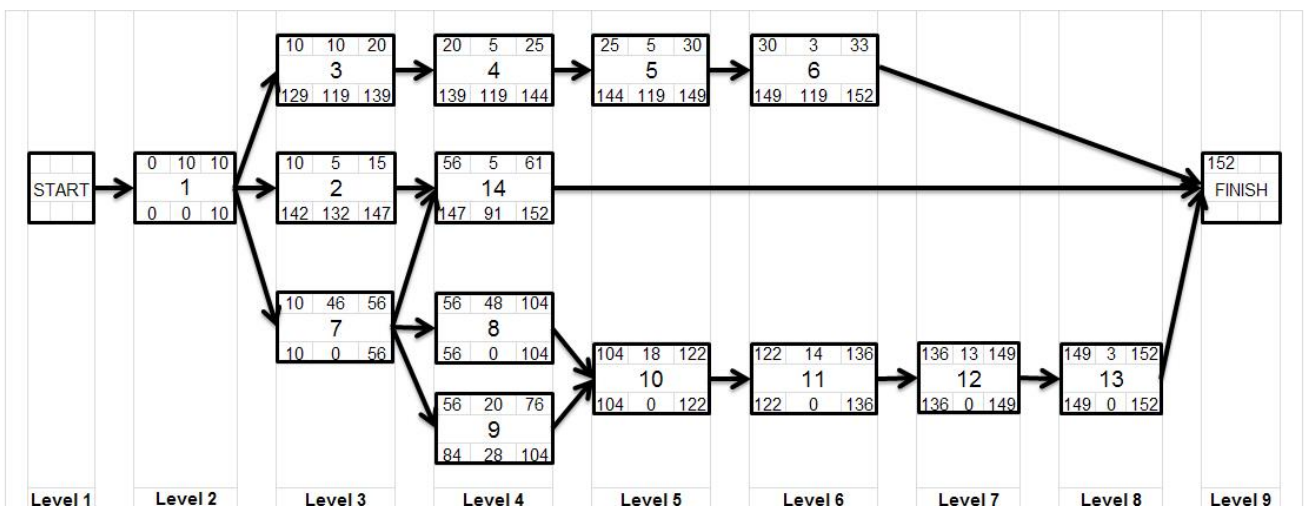
Figure 5 The calculation of critical path using PERT,

(19-Feb-2014, Nabeel Shaikh)

7.4.5 Identification Of Critical Path

As the critical path is the one which has the least amount of slack time in the PERT diagram, the Critical Path will be the activity with ID 1 > 7 > 8 > 10 > 11 > 12 > 13. Figure 6 shows the critical path in the form of a PERT Sketch, the project will have to keep a close eye on the time associated with these tasks hence Figure 7 shows the PERT diagram with activates associated with the critical path with their respective durations in unit days.
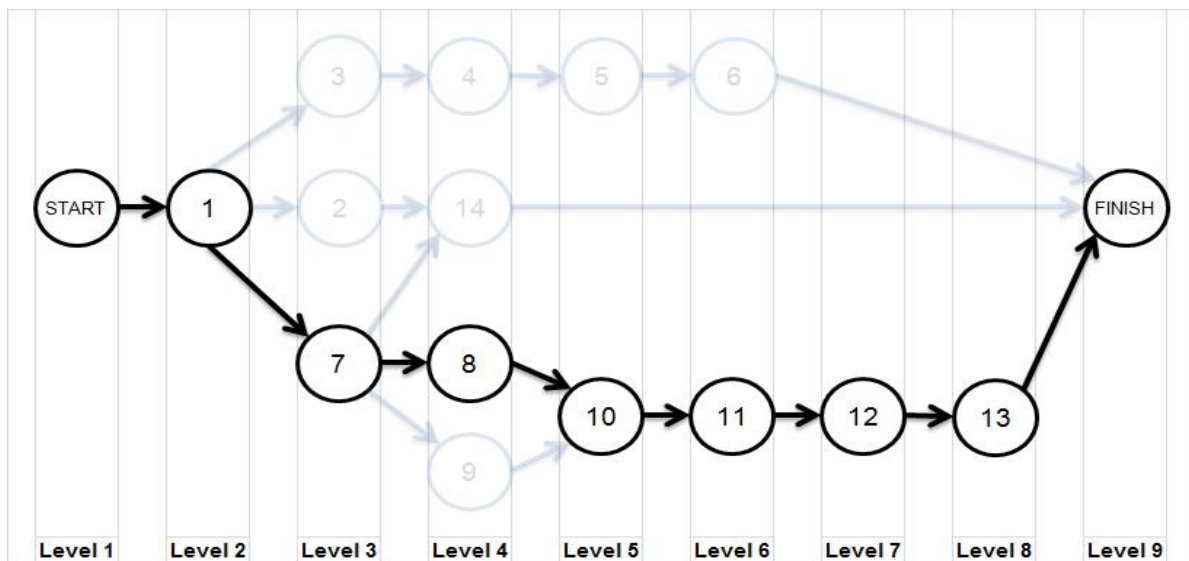
Figure 6 The Activities that form the Critical Path in the form of a PERT Sketch,

(19-Feb-2014, Nabeel Shaikh)
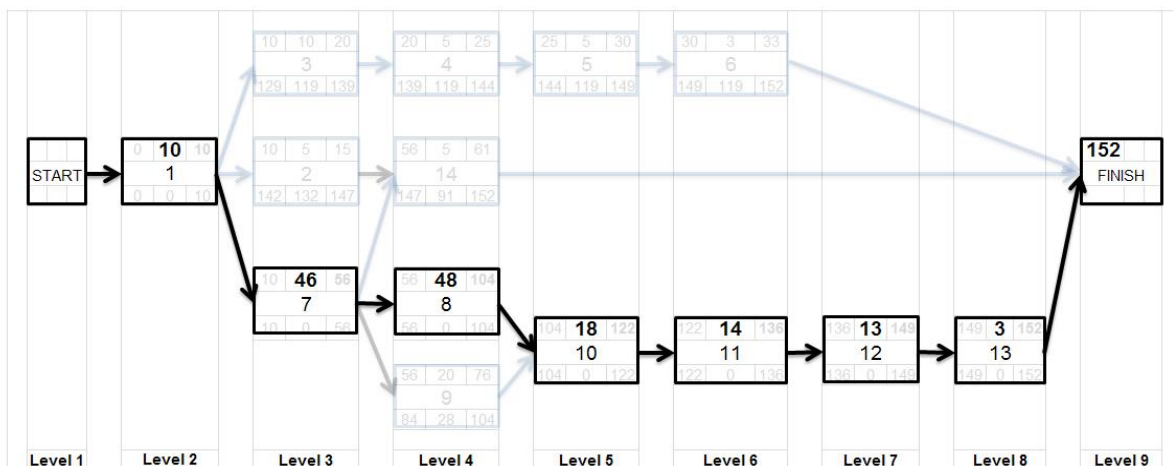
Figure 7 PERT diagram showing the Activity ID with their respective durations,

(19-Feb-2014, Nabeel Shaikh)

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7.4.6 Predicted Processing Time Along Critical Path

Along the critical path it is important to know the time in days that it will take to finish a task with a certain Activity ID. This is described visually in Figure 8, the time it will take to finish task 1 is 10 days, the time it will take to finish task 1,7,8 is 104 days and the time it will take to finish the either platform is 152 days.
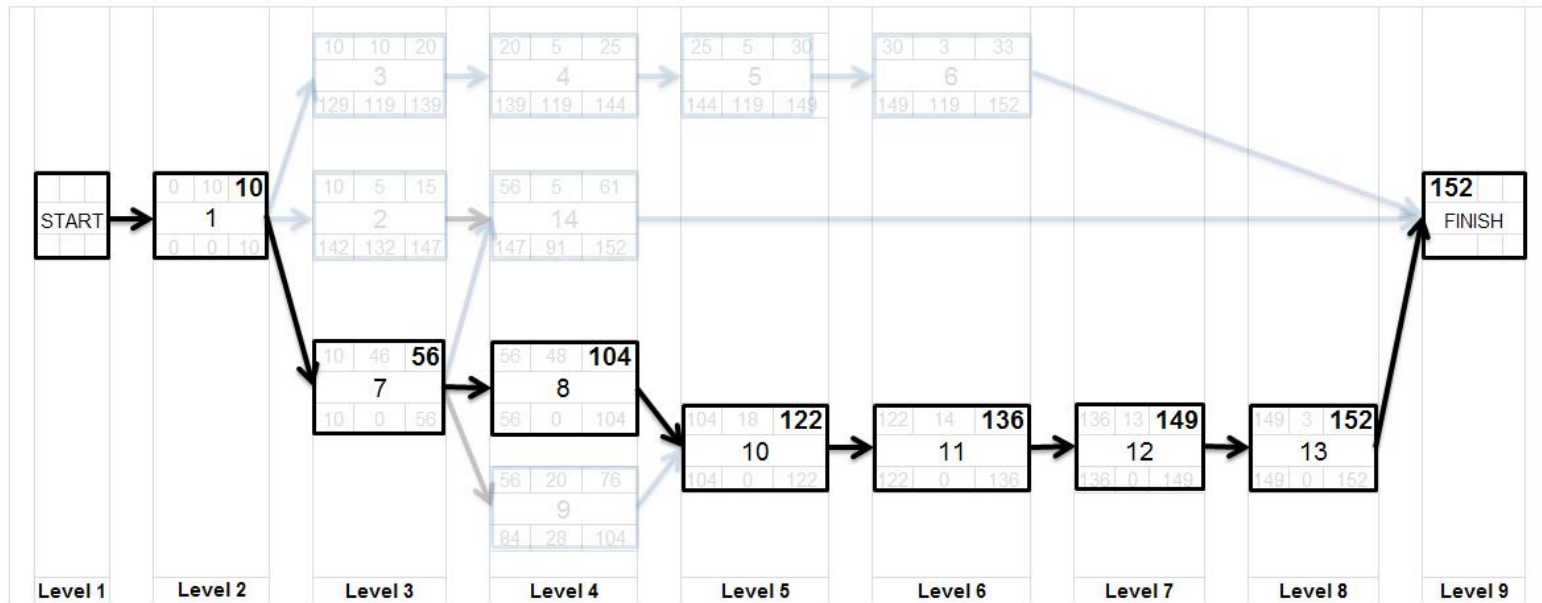
Figure 8 Time to finish tasks with Activity ID's on a critical path,

(19-Feb-2014, Nabeel Shaikh)

7.4.7 Project Standard Deviation

S*tep two* had calculated the variance for every activity, Equation 3   calculates the project variance. , Taking the variances from Table 6 and adding them together is *step five,* this is because know the Activity ID's belonging to the critical path. Taking the standard deviation of the project variance at Equation 4 gives us the amount of days that the project can be over or under the expected date of delivery which is calculated as $\pm$ 8.03 Days, this means that the project will complete between 144 and 160 days.

$$Project\ Variance = \sigma_{p^2}$$

$$\sigma_{p^2} = Sum\ of\ the\ Variances(v)\ along\ the\ Critical\ Path$$

Equation 3 Project variance along the Critical Path

Critical Path = 1❭7❭8❭10❭11❭12❭13

$$\sigma_{p^2} = 1.36+30.25+11.11+11.11+6.25+4+0.44$$

$$\sigma_{p^2} = 64.52$$

$$Standard\ Deviation = \sigma_p$$

$$\sigma_p = \sqrt{\sigma_{p^2}}$$

Equation 4 Project standard deviation

$$\sigma_p = \sqrt{64.52}$$

$$\sigma_p = 8.03$$

The project standard deviation is going to be $\pm$ 8.03 Days

7.4.8 Z Score

Step six will be the last step towards the calculations, it is known now that the project will finish in 152 days and there is a possibility that it either finishes early or later by $\pm\, 8.03$ Days, hence it is required to know the per cent probability for it finishing in 152 days, for this reason the Z-Score is devised as expressed in Equation 5.

Z Score = (Due date – Expected date) / Project Standard Deviation

$$z = \frac{x - \mu}{\sigma_p}$$

Equation 5 Standard score of the project

Start date = 15 / 10 / 2012

Due date = 01 / 06 / 2013 = 165 days

Expected date = 14 / 05 / 2013 = 152 days

z-score = (165 – 152) / 8.03

z-score = 1.62

Using a normal distribution table at Appendix A, 1.2 the project gets the z-score value which is 0.9474, this means that there is a 94.74 % probability that the project will finish by the due date.

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7.4.9 Definition Of Milestones

Milestones are tasks that have to be achieved in order for the overall platform to be deemed complete. Due to the use of a PERT sketch all the defined activities have to occur in a particular time space, the time space forming a sequence left to right. To achieve a task higher in the list it would require to achieve all the tasks preceding to it, hence the final tasks in any sequence would form a milestone. Tasks with Activity ID's 6, 14 and 13 form the milestone list for the platform described visually in Figure 9 , for data collection the ideal scenario would be for all the milestones to be achieved.
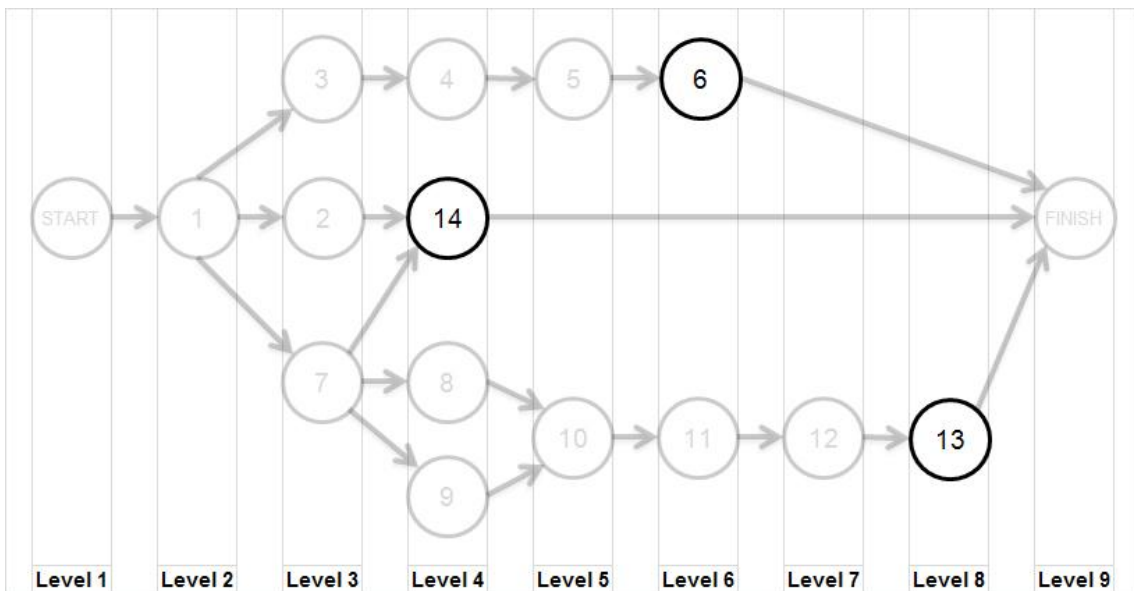
Figure 9 Activity ID's that are milestones,

(19-Feb-2014, Nabeel Shaikh)

7.5 Customer Classification

Broadly speaking enterprise resource planning systems are composed of two basic components, the software that creates the business processes and the users that interact with it in order to follow these processes. This section explains the interaction of these users with the software within the case study. The users are known as customers to the system, and have two type of customers internal and external interacting with the system.
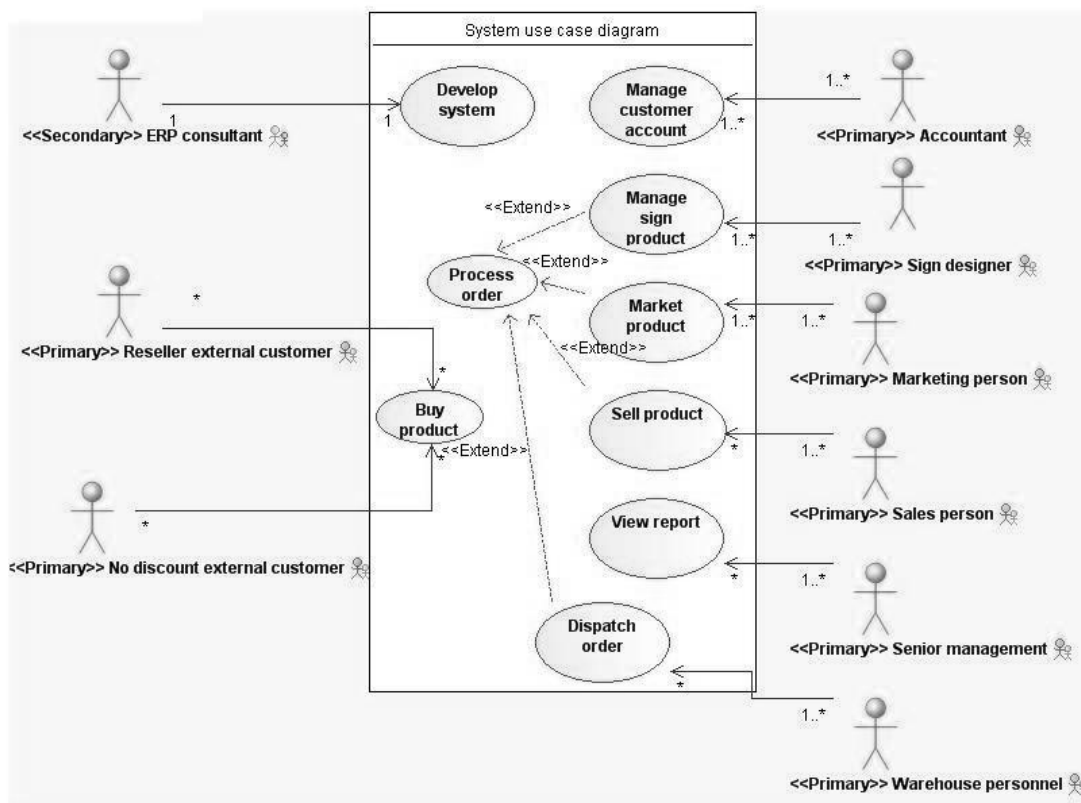
Figure 10 High level use case diagram depicting the type of customers interacting with the system,

(19-Feb-2014, Nabeel Shaikh)

Figure 10shows diagrammatic representation of the interaction between different user groups and the software infrastructure. It is important to identify the various customer groups in the construction of the platform, this is

necessary as the processes within the infrastructure are constructed to serve the customers identified.

7.6 Internal Customers

Internal customers are ones that work within and for the organisation. In this scenario internal customers are divided into 7 groups having different functions within the organisation. These groups have vital roles to play and are important to the success of the overall system. The introduction of technologies in order to maintain and improve the processes within the organisation will lead to business process re-engineering and will have a direct impact on internal customers as they will have to learn, change and adopt the new ways of doing things.

The new system will have to fulfil the requirements posed by each customer group, the seven groups comprise namely accountants, sign designers, marketing personnel, sales personnel, senior management, warehouse personnel and logistics personnel all come under the internal customer category. Each group was studied carefully to figure out the current processes and practices they follow and the requirements and expectations they have with the new system. Business process re-engineering also gave us a window of opportunity to re-engineer the processes that were a cause of bottlenecks in the system.

7.6.1 Accountants

The business processes required by the accountants are described in Figure 11. This group is primarily responsible for handling affairs of revenue for the organisation such as giving certain amount of credit to a particular customer. Accountants are one of the groups that will undergo business processes re-engineering, as there procedures will be changed in-order to gain efficiency and maximum benefit from the system. A new level of automation will also be provided in order to assist accountants to ease the efforts.
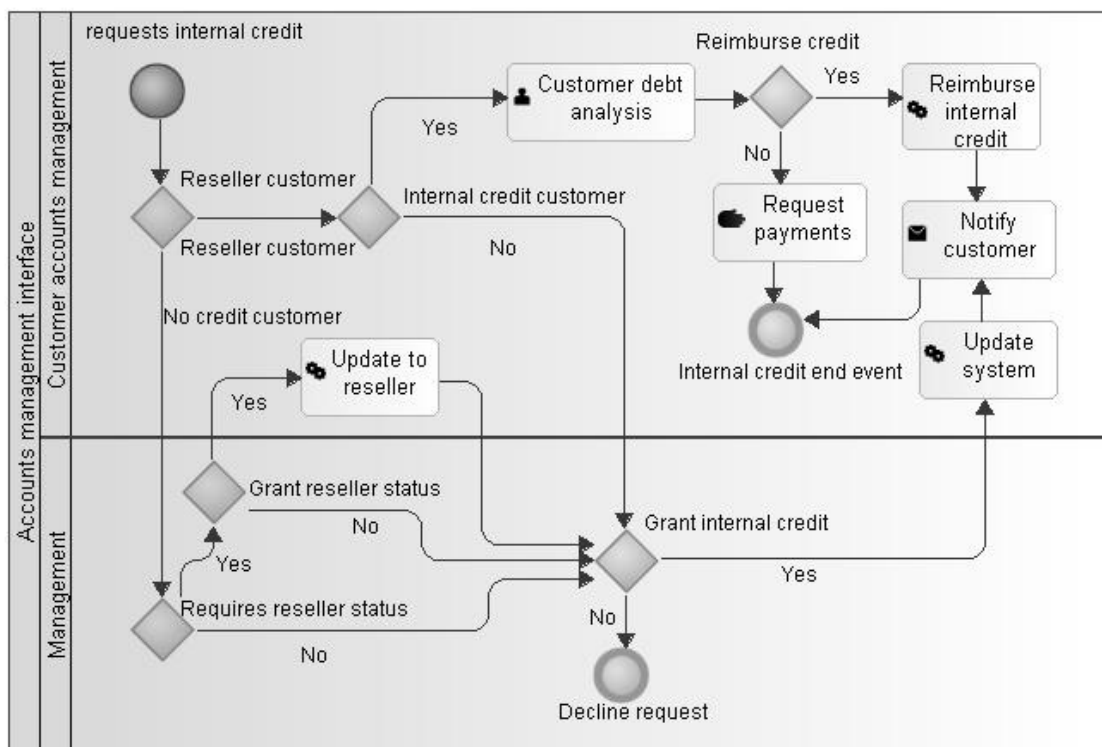
Figure 11 BPMN diagram depicting system processes requirements involved in managing external customer accounts,

(19-Feb-2014, Nabeel Shaikh)

7.6.2 Sign Designers

Sign design is a big revenue stream for the case study therefore the solution needs to take the requirements of the department into consideration. These requirements are laid out in the business process diagram described in Figure 12. The department is responsible for digital media editing using software like photo-shop and converting these into physical signs that can then be used for publicity purposes for businesses. Keeping track of the order records, which include digital media and sign dimensions is a concern for the department as it previously had no automated way for placing orders. All orders at present are taken by telephone or email, wrong dimensions and incorrect media are often the cause of wrong order placement.
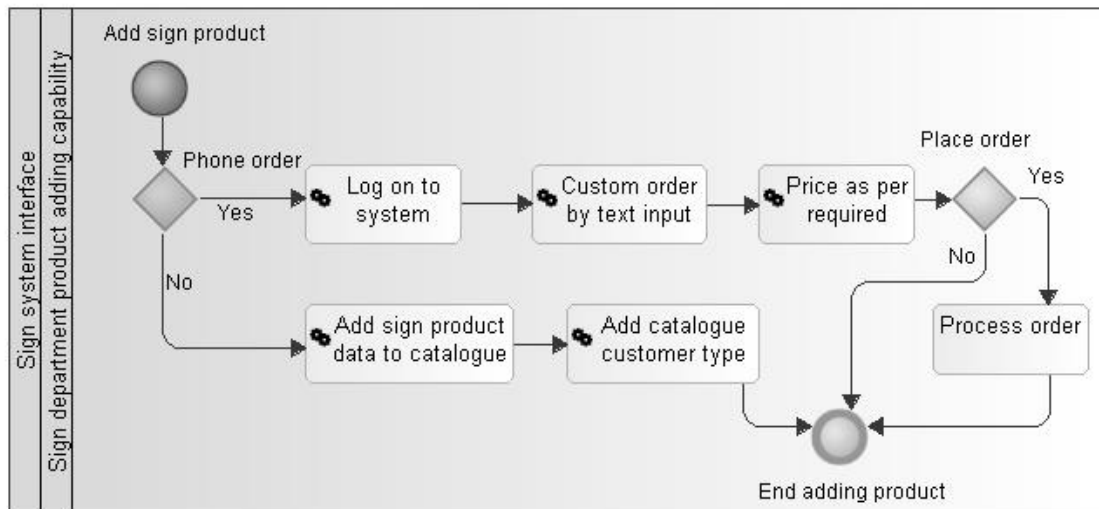
Figure 12 BPMN diagram depicting system process requirements by sign designers to process a sign product,

(19-Feb-2014, Nabeel Shaikh)

7.6.3 Marketing Personnel

Due to the target industries behavioural patterns and the shortage of a robust marketing strategy the case study is relying on two marketing personnel, these people sometimes also switch roles between sales and marketing. Moreover this industry usually dictates that the sale of a product depends on a good relationship with the customer which might mean spending time at the customer end building a relationship. Maintaining relationships with the customer(s) consumes most of the time and the group has little time to explore new avenues, moreover the department is technology starved having little or no knowledge of technology driven modern marketing methods. Figure 13 describes the desired business process for the case study.
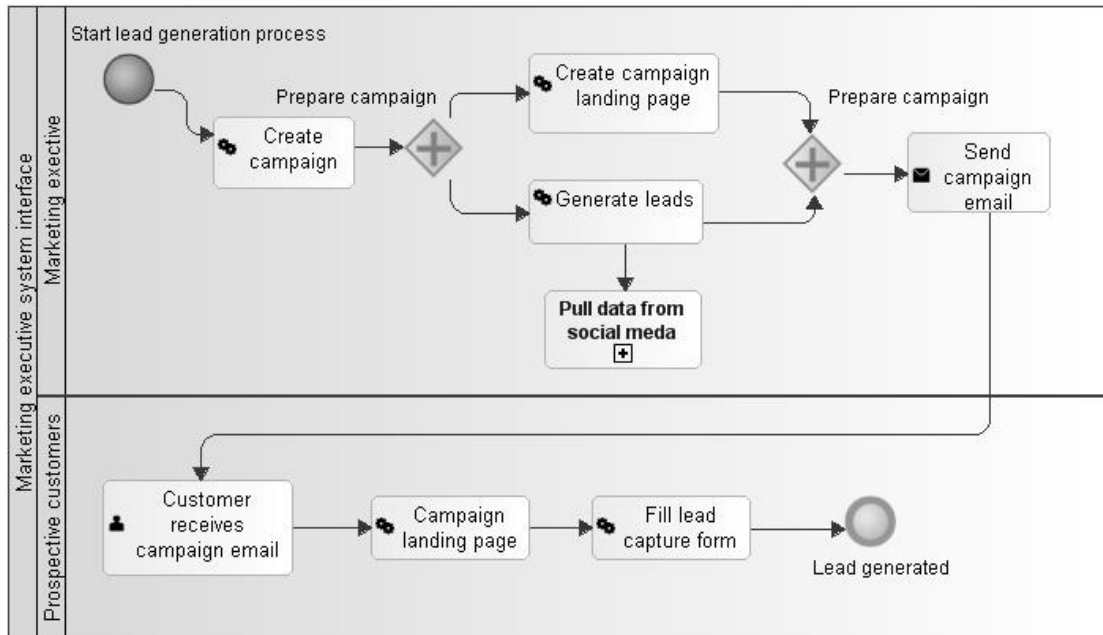
Figure 13 BPMN diagram depicting system process requirements for marketing a product to external customer,

(19-Feb-2014, Nabeel Shaikh)

7.6.4 Sales

The sales department is responsible for taking orders, payments and seeing them through until the time the orders are sent out. A number of orders do not go out on time due to lack of coordination between the sales department and warehouse manufacturing department. Customers lose confidence in the production capability and timely delivery of orders, the company eventually loses sales. The importance of getting this corrected is paramount, hence the requirements were studied carefully and are shown in regards of the Figure 14.
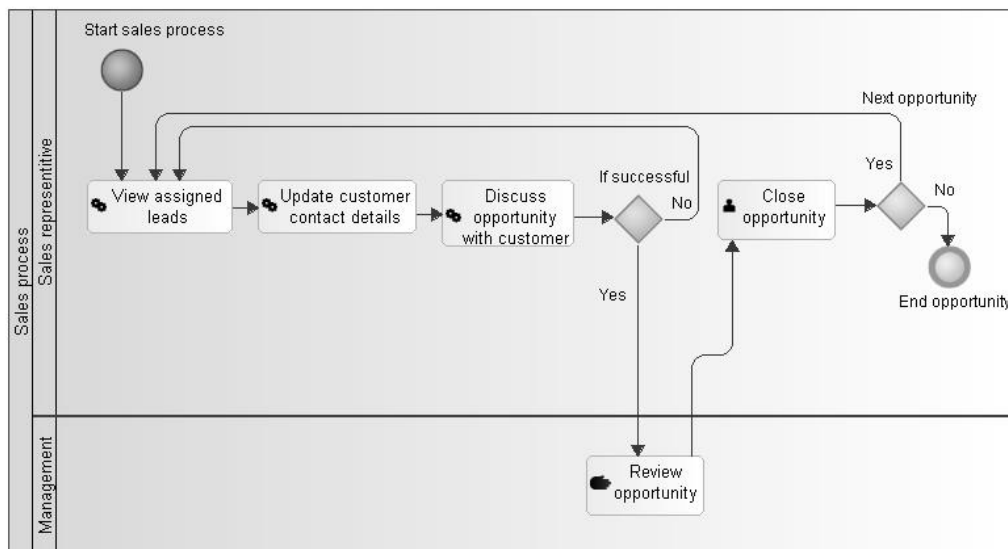
Figure 14 BPMN diagram depicting system process requirements for processing a sale,

(19-Feb-2014, Nabeel Shaikh)
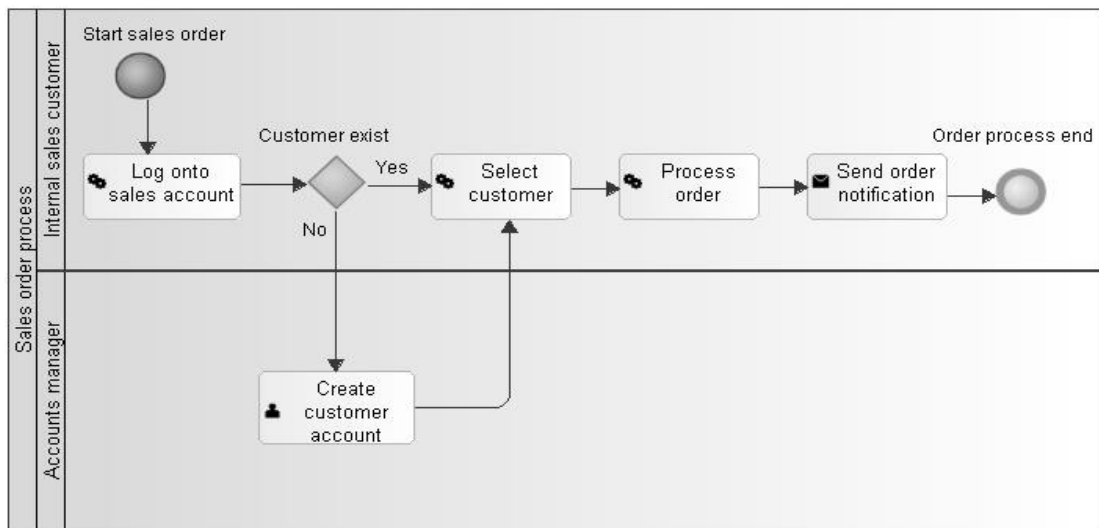
Figure 15 BPMN diagram depicting system process requirements for processing a sales order,

(19-Feb-2014, Nabeel Shaikh)

7.6.5 Senior Management

Senior management is usually responsible for making high level decisions that impact the rest of the layers within the company. Positive decisions make a positive impact and vice versa; they are usually designers of company policy. However in a high pressure environment like this case study due to the lack of personnel or due to the overall inefficiency of the ecosystem, the senior management has to take time out of its role continuously diving into other roles, usually marketing. As the senior management is responsible for overlooking the company and is responsible of keeping an eye on the overall progress, their involvement with other sections of the organisation means that the company will lose sight of important high level decisions and may also result in overall decline of efficiency and growth.
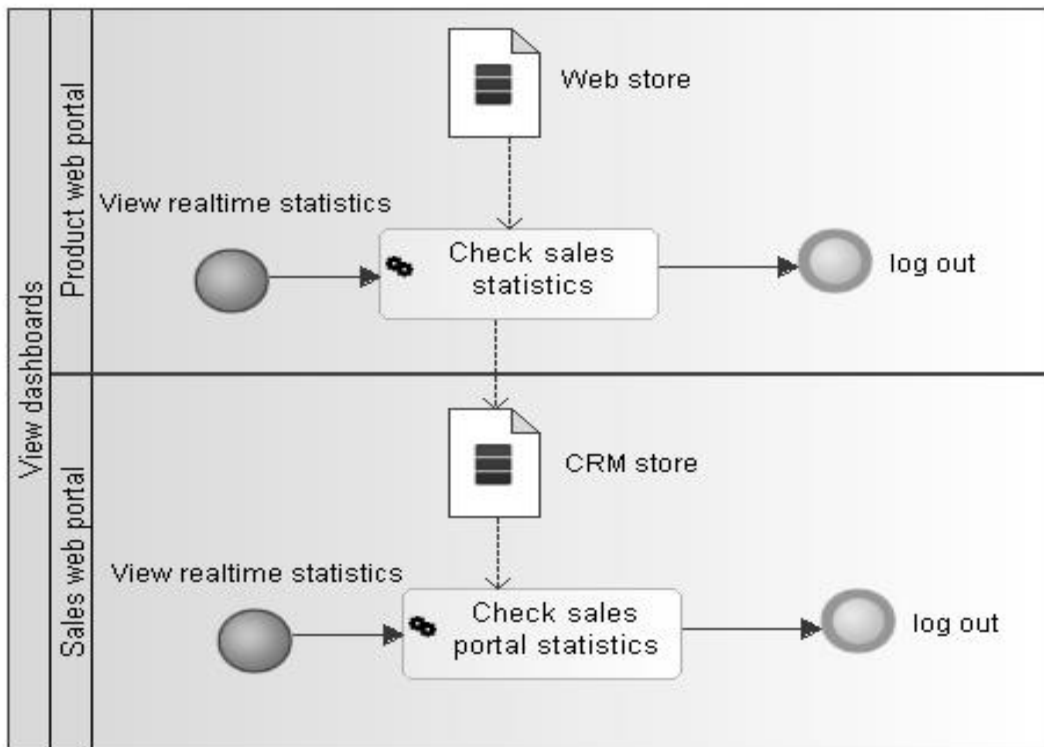
Figure 16 BPMN diagram depicting system capability for real-time reporting,

(19-Feb-2014, Nabeel Shaikh)

7.6.6 Warehouse Personnel

The manufacturing unit is responsible for checking the orders received, manufacturing required products, packing and passing on the products to logistics personnel on time. They are also responsible for maintaining stock levels of components required for producing ad hoc orders. When an order is placed the system will be able to print out a copy of the order to alert the manufacturing department automatically. It is also required that the system gives adequate stock management capability so that warehouse personnel can manage the stock levels hence always maintaining a healthy manufacturing environment.

Figure 17 BPMN diagram depicting system process requirements for processing an order by the internal warehouse customer,

(19-Feb-2014, Nabeel Shaikh)

7.6.7 Logistics Personnel

The logistics personnel are responsible for delivering orders to the respective customers. Multiple companies are involved in the operation depending on where the order is going as not all companies provide feasible delivery rates for country wide and overseas delivery, hence different companies are to be used for different locations. The system can integrate different services for this purpose hence overcoming the requirement. Logistics also means delivery of

goods to the manufacturing facility and not just delivering to the customer, hence the system requires accommodating these requirements.

7.7 External Customers

External customers are the ones that are external to the organisation bringing it revenue. This is the group that one will normally associate as customers. In the case study there are two main types of external customer's resellers and regular "no discount" customers. One of the main reasons to do a technology upgrade exercise is to make the interactions with this customer group easier and also to make the experience of purchasing a product more comfortable for them, this will in turn increase profitability and market value for the company. In order to create such an interface the requirements of the external customers must be taken into consideration before deployment of an Enterprise Resource Planning system.

It is critical in current technological paradigm to have technology that interfaces with customers over the internet. The business case for such an interface with external customers is that you can market your organisation to physical areas that are beyond your business reach. Customers are then able to purchase your products over the internet with little or no need of a sales team or without having much physical interaction. This opens new avenues for business and profitability. It is therefore necessary a company understand its customers and their requirements in detail.

7.7.1 The Reseller External Customer

The reseller customer is an external customer whose business model is based on reselling products produced by other manufacturers. The gross profit margin made by a reseller customer is the difference between the selling price of a product by the manufacturing company and the selling price of the same product by the reseller hence placing the manufacturer in direct competition with the reseller customer. The case study gives its resellers a discounted value on each product sold by them in return of a target number of sales of a product by the reseller. Reseller customers constantly require discounted amount for products, hence the system should accommodate for an interface that provides that functionality. Figure 18 expresses the business process requirements posed by the reseller customer for the case study.
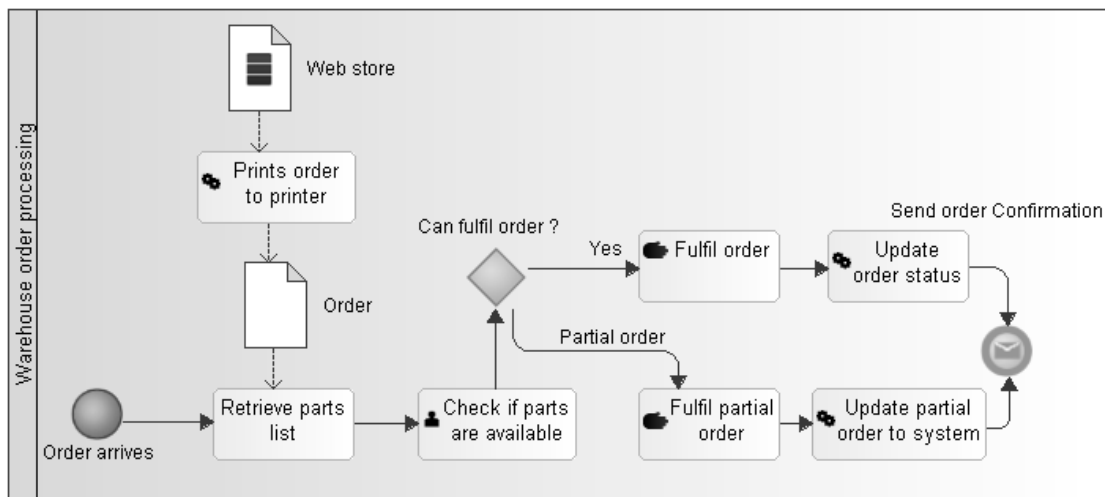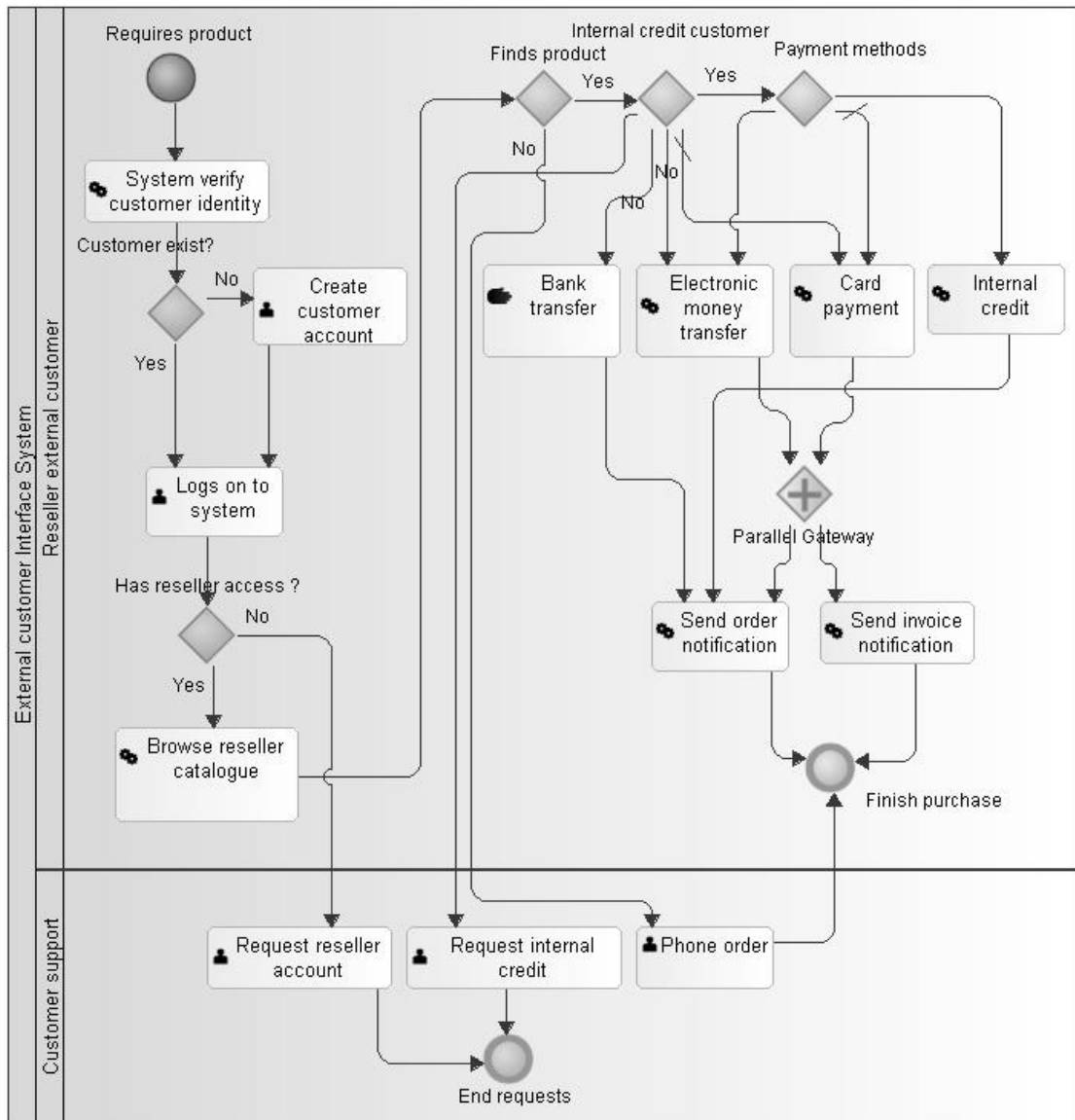
Figure 18 BPMN diagram depicting system process requirements for processing an order by the external reseller customer,

(19-Feb-2014, Nabeel Shaikh)

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7.7.2 No-Discount External Customer

No-discount customers are different from resellers as they do not receive any special discounts while purchasing a product. The purchase pattern can be just a onetime buy or a more regular occurrence. An interface to such customers over the internet can open new revenue streams for the company. Marketing practices can then be adjusted to beyond the companies natural business boundaries. Such an interface can also create more direct business hence reducing the reliance on resellers.
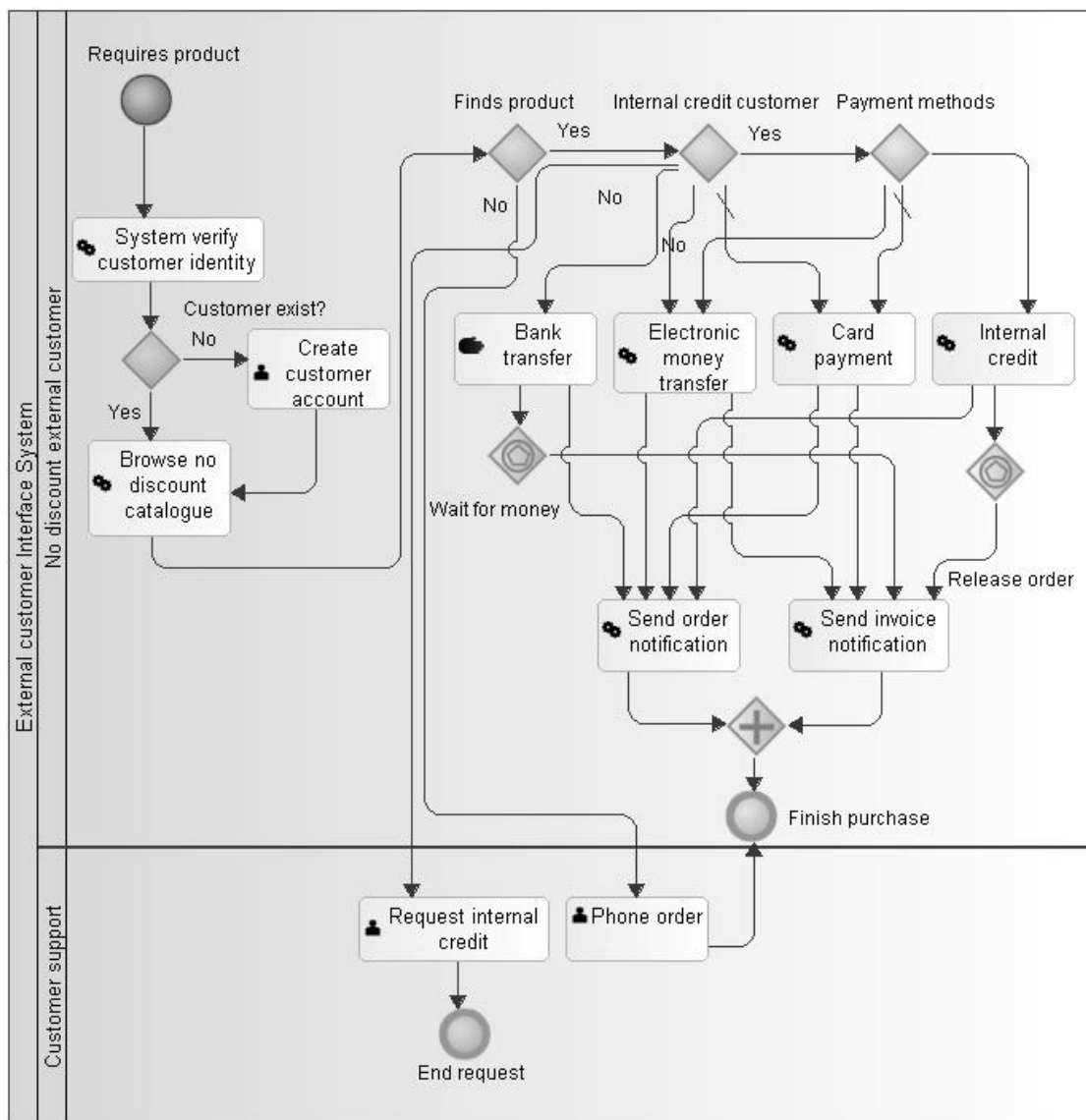
Figure 19 BPMN diagram depicting system process requirements for processing an order by the external no discount customer, (19-Feb-2014, Nabeel Shaikh)

7.8 ERP Effects On Internal Business Processing Times

The benefits of better coordinated communication between the different internal customer groups and efficient collaboration with external customers are well established. ERP's are software automations of such activity, they collect data inputs in a highly standardised form in order for organisations to automate communication and integrate information across a wide range of business functions (C.K.M.Lee Linda Zhang & Au, 2009), this improves overall business process efficiency resulting in improved process times after Enterprise Resource Planning implementation. A 2007 study by Aberdeen group into the role of ERP's in globalization, found that organizations that implemented ERP's were able to achieve 66% improvement in reduction of turnaround time from order to delivery (Jutras, 2007). ERP's can also result in business process re-engineering, hence weaving out unwanted processes, bottlenecks and procedure duplication.

The role of customisation is also central to the overall process time reduction, lengthy procedures can be customised and automation can take over physical tasks. Observation of the case study suggested that there were physical tasks being repeated that could be automated in order to free the human resource that can be utilised more efficiently. Furthermore by doing the process electronically the time required to do the task can be reduced to a minimum. One major problem is buying an item with multiple combinations on the phone with a sales representative, such products can be customised and software automation can take over the purchase process from the sales representative freeing valuable human resource utilisation while reducing purchase time and error.

7.9 Coverage Of Individual Requirements For A Process

A process from an ERP's perspective is a series of customer or software automated actions taken in order to achieve a particular business goal. ERP's are a collection of software processes customised to individual business requirements. Importance should thus be given to individual process customisation requirements. Although modern Enterprise Resource Planning solutions are marketed to work out of the box, research on the case study has revealed that such solutions will fail solely because of the lack of customisability of processes within the out-of-the-box Enterprise Resource Planning solution. Some standard processes are acceptable while others would require customisation to individual organisational needs.

7.10 Innovation And Learning

Before the upwards and onwards phase of Enterprise Resource Planning implementation there is a transactional phase where the knowledge of how to make use of the system needs to be transferred to internal customers. The innovation and learning phase measures the internal customer's ability to effectively use the systems functions. Putting a measure on how well they can manage the system is an indicator of implementation success.

The level of training courses measured by the time or expenses spent can be a useful indicator (C.K.M.Lee Linda Zhang & Au, 2009). Enterprise Resource Planning systems are typically implemented with the help of external consultant. The longer the external help the more capital investmen is required. Hence companies desire the transfer of working knowledge of the system to its internal customers as quickly as possible in order to reduce the reliance on external consultants. The aim is to minimise capital investment. Hence to measure successful transfer of knowledge, the evolution over time of the number of consultant days spent within the case study on training should be plotted. If the consultant days drop significantly then it may be concurred that internal customers are coping well with the system and the implementation can thus be deemed successful.

7.11 Identification Of Key Users And Training

To sustain a small company in the software implementation perspective it is of paramount importance to identify key users and retain them. These are also sometimes called power users. These users are those that have a certain amount of knowledge of the organisation and its processes and are also well versed with technology. Hence they become the central figure in sustainability of software projects in organizations especially right after the implementation phase as other users can ask them for help rather than going to the consultant, increasing the cost of training.

7.12 Financial Perspective

Enterprise Resource Planning implementation in an ideal scenario is a predicted capital investment. Implementation of such solutions usually ends up with more investment required then predicted. Such software solutions are implemented on a long-term basis, usually covering many alterations over the life span of the software. Insight into past decision making has to be taken into account when going into further iterations of the software. This is to ensure that the organisation doesn't make the same mistake over again. Hence cost over runs can serve as an indicator for feedback purposes with a view towards evaluating the quality of past decision making (C.K.M.Lee Linda Zhang & Au, 2009). There can be cases where staff members are missing training sessions and hence are not familiar with certain features of the Enterprise Resource Planning, creating low impact, negative deviations of actual costs verses budgeted costs may indicate why there is lack of system awareness and inefficiency of system use within staff members. Vice-versa positive deviations would mean deficiency in either staff competence or inadequate training.

7.13 Legacy Systems

Legacy system's mean a technology which is outdated, Bennett defined legacy systems as "large software systems that companies don't know how to cope with but that are vital to the organisation" (Bennett, 1995). As ERP 's can be defined as a synchronous use of a set of software functions designed for

individual internal customer groups, where each group can have either an integrated or separate set of software functions. From the perspective of Enterprise Resource Planning implementing and due to varying definitions about legacy systems the study will define legacy software in the Enterprise Resource Planning domain as software that already exists in the ecosystem of the case study. This is the software the newer Enterprise Resource Planning system proposes to replace. Following industry practice it will be standard to buy out of the box Enterprise Resource Planning packages for SME's, replace the current legacy systems and customise the new features to the customer requirements.

However looking at software as a set of synchronous functions used for overarching automation then there will be parts of the organisation running legacy systems where these functions already exist, in other words opting out of a legacy system for a brand new Enterprise Resource Planning system is repeating partially what is already there. There needs to be close investigation of these systems in order to investigate there compatibility and intractability with the newer system's.

There are a number of issues when dealing with legacy systems, (Ambler, 2000) states that legacy systems may have legacy databases or data stores that may or may not be designed by legacy languages. As ERP's require connectivity with all underlying software subsets, connecting to legacy databases can be difficult. If a legacy system is kept within the overarching software infrastructure without connecting it to other systems, it will be required to punch valuable data into the system manually in order to keep the overall flow of data. Such a system will really on system data fluidity and introducing human negativity towards the system can cause overall system failure. As ERP's are meant to reduce manual labour and improve efficiency this technique will result in the loss of precious man-hours and introduce dirty data into the system (Pallmann, 1999).

Providing customer support to legacy systems can be another bottle neck, however as mentioned in the financial perspective internal customers while

working with a system for a long periods of time get used to the system hence have sufficient knowledge to maintain that part of the solution. Due to the amount of issues attached to legacy systems it is a common practice to have a default assumption to opt out of legacy systems and implement new technology in SME's, this practice was evident from the study made into the historical technology review of the case study.

In this case study a research review of current technologies suggested that a legacy accounting package could be integrated into the overall software ecosystem hence reducing the need of a more modern system, a decision was taken to keep the system and integrate it into the overarching software infrastructure. This suggests that the SME's legacy systems can be more manageable compared to legacy software in an Enterprise because of the fact that there is a higher probability of it being used in abundance compared to a one off highly customised solution for an enterprise.

7.14 Internal Customer Retention Rate

Internal customers or employees are essential for organisational success. Retention rate is the ability to retain these employees over a defined period of time. A low retention rate can have a direct impact on the implementation and handover phase of ERP's for SME's. This is due to the fact that one would require training and investment on every new employee. Also absentees can cause a crucial part of the system being dis-functional. In this case study customer relationship management systems form part of the vision of the company to encourage customer growth, a dis-functional CRM will lead to a lack of such growth.

A low employee retention rate can be caused by various factors, Herzberg's system of needs makes an attempt to classify these factors by segmenting them into motivators and hygiene factors. Motivators can be unexpected bonuses that can stimulate desire to excel, whereas hygiene factors are expected working conditions. Internal customers for ERP's are identified as the employees that are interacting with the system hence the retention rate will be calculated amongst those employees.

The effects of an employee leaving the company are outlined by studies conducted by (Cascio, 2006; Mitchell T.R., 2001). The studies shown that costs due to low retention rate for an employee being replaced can be as high as 50-60% of the employee's annual salary, whereas total cost of turnover can reach as high as 90-200% of the employee's annual salary. The variables associated with these costs can include candidate interviews, new hire training, the recruiter's salary, separation processing, job errors, lost sales, reduced morale and a number of other costs to the organization, hence affecting overall organisational performance. A struggling SME would not have the financial ability to take on such costs.

7.15 Content Management System Down Selection

The software ecosystem will have a web based content management system at the centre of its operation. Hence in order to select the correct system it has to fulfil certain criteria. The system should not only be able to deal with the requirements of CMS but also be able to communicate with other systems in the software ecosystem. The CMS will also act as an e-commerce platform able to perform sales, and manage customer accounts.

7.16 Customer Relationship Management System Down Selection

A CRM system will be built into the software ecosystem for marketing, customer management and will be web based. For these purposes research into the technologies available coupled with interviews of different companies took place. One of the criteria for selecting a CRM is that it should be able to communicate with the content management system hence getting data of any sales being made on the CMS.

7.17 Pictorial Representation Of The System

Figure 20 represents the web interface of the system that allows customers internal and external to initiate processes related to product purchase. The aim here is to reduce the workload on staff by allowing customers to self-service. The interface also hosts unique tools for furthering the cause of the speed of "purchase process" and "ease of purchase". This should allow a considerable amount of time to be saved by the organisation, also due to the automation of the processes the process error rate should be reduced.
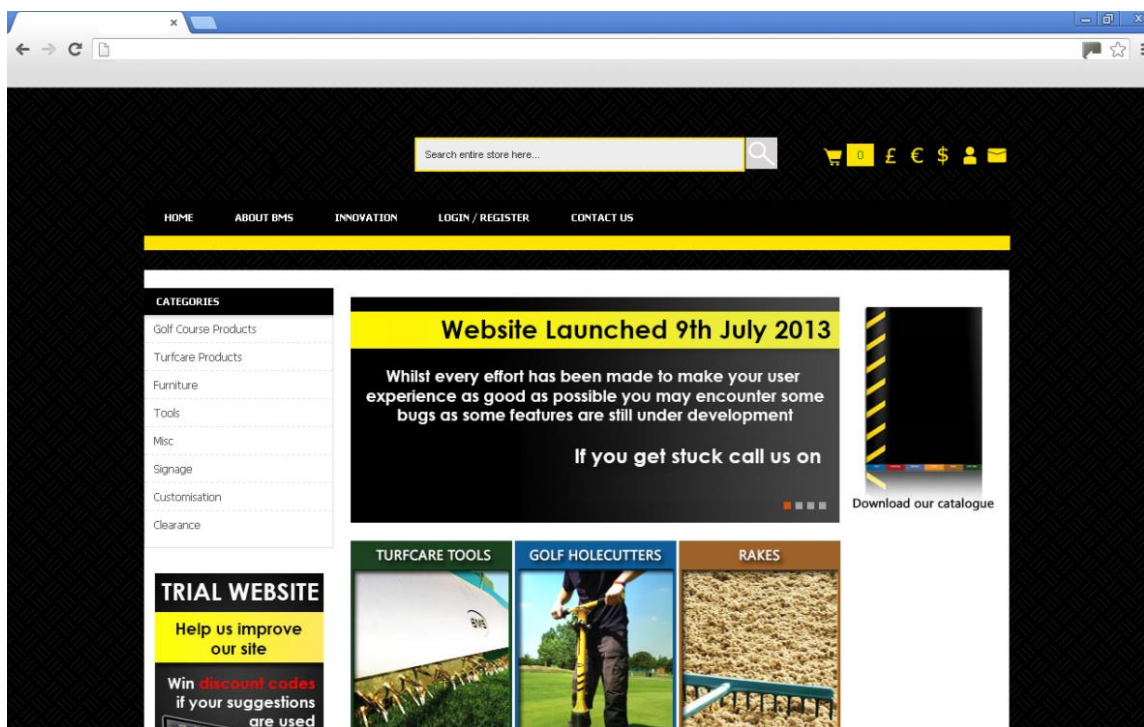
Figure 20 Representation of the business end of the system,

(19-Feb-2014, Nabeel Shaikh)

During the research it was noticed that due to the ever changing functional situation the smallest of advancement in technology makes a considerable amount of impact on the workload of individuals. The evolution of the search functionality shown in Figure 20 is a good example of such advancement, the more an individual external customer is able to find a product on the web portal the less likely the chance of the customer calling internal sales staff. This is very useful in releasing strain from an environment where time is a scarce resource.

The evolution of the system is evident in Figure 21 as the image has evolved from Figure 20. This is evidence of internal customers taking over the system from the consultant. Internal customer training is an important indicator of system success.
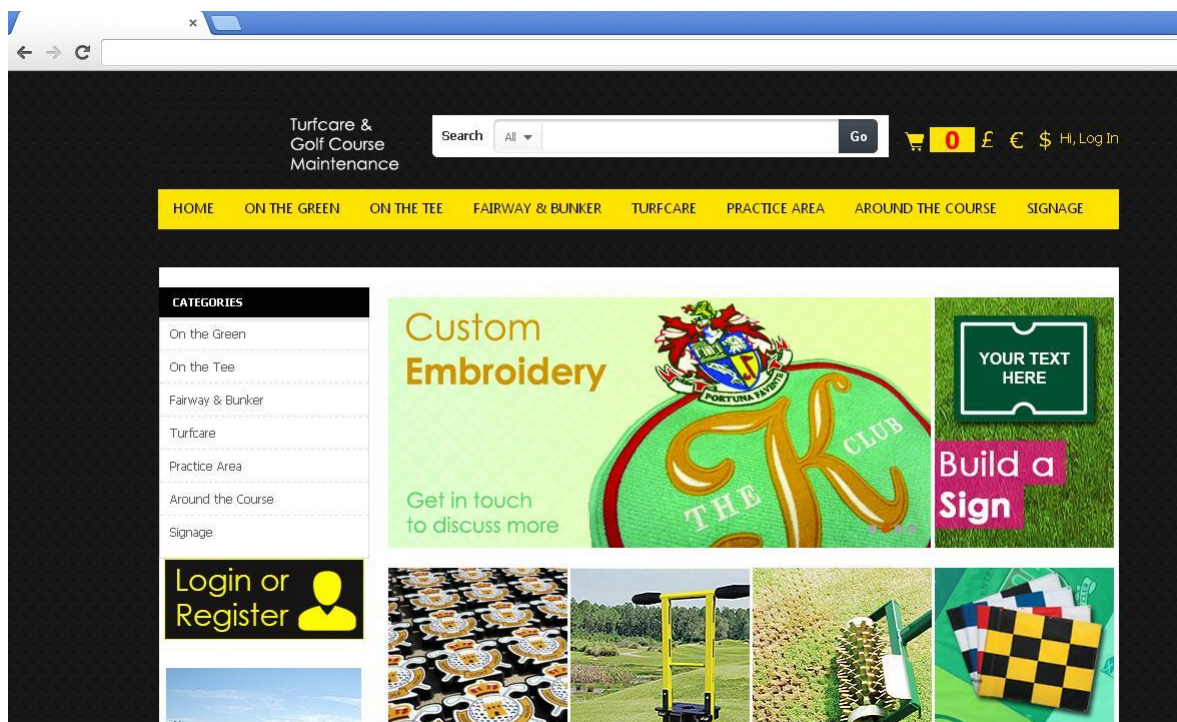
Figure 21 Addition of customised tools for the purpose of reduction of processing time, (19-Feb-2014, Nabeel Shaikh)

Identifying and retaining internal customers who have the capability of maintaining changes to the system should be the corner stone of company policy, this is due to the fact that the company becomes reliant on technological advantages such as the advanced search function shown in Figure 21. These functions require continuous maintenance and updating, although not all internal customers will have the knowledge to do so, hence retaining technological knowledge by employing and retaining the diverse set of human capability is important.

It is important to separate internal customers from external customers and the resources that they can access. This separation is achieved through administrative policies and logins. Figure 22 shows the login screen to this

interface, internal customers like administrators, sales and support staff use this to get higher degree of administrative power over external customers.

The senior management controls, decides and distributes certain functional requirements using these administrative consoles. For this purpose certain roles are made within the system like sales person, administrator and warehouse operative. Each role has certain administrative privileges allowing them to gain access to certain resources within the system. The senior management assigns these roles to internal customers allowing them to function within their assigned area. This create process and workflow allowing the internal customers to gain access to the information that is important to them while shielding them from unnecessary information that is irrelevant to their role in the organisation.
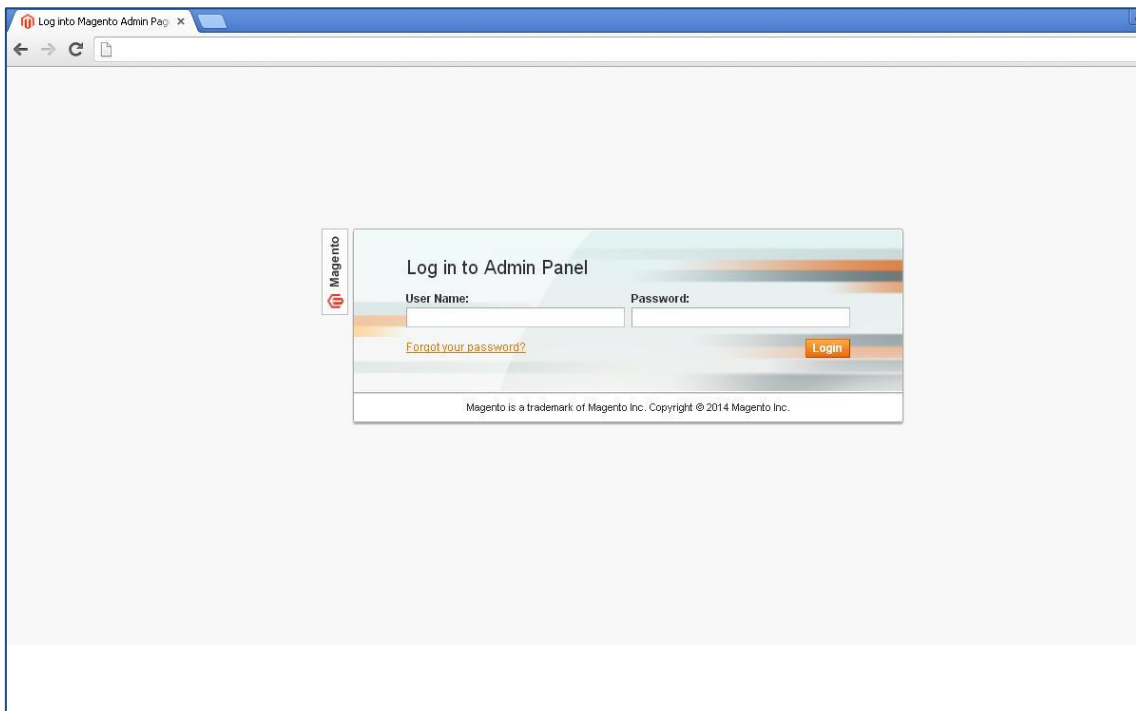
Figure 22 Customer login for Admin, Sales, Support and Support staff,

(19-Feb-2014, Nabeel Shaikh)

External customers can access their own accounts while the administrators depending on their access policy can access one or more external customer accounts. This is due to the fact that one will require the capability of ordering

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on behalf of external customers. A sales representative while on customer site needs this functionality to order a product for the external customer.

It is also important for the software to be customised according to the needs of the organisation. Customisation is what makes the software unique to the case study. Figure 23 represents the customer interface for creating signs, it is a set of dropdowns, and each dropdown has a sign picture associated with it. The pictures overlap to form a type of sign that the customer can order through the interface. This will reduce the sales person time used over the phone and the chance of human error as there are hundreds of combinations available for purchase. The software solution needs to be selected carefully in order for it to be able to do such customisations. This can exponentially increase the chance of software acceptance and project success.

Figure 23 Process customisation for purchasing sign products,

(19-Feb-2014, Nabeel Shaikh)

The manufacturer has three important business propositions which are the cornerstone of this business. These are creating flags, signs and pins. All three have been converted into software tools as shown in Figure 23 Figure 24 and Figure 25. Figure 24 represents customer interface for creating flags, it is a set of dropdowns, each dropdown has a flag picture associated to it. The pictures overlap to form a type of flag that the customer will then order through the interface.

Figure 24 Process customisation for flag products,

(19-Feb-2014, Nabeel Shaikh)

Different external customer groups also have different pricing structures, this is shown in Figure 23 as there is a discount if the products are purchased in quantity. In Figure 24 there are no discounts on the products this shows that different external customer groups like general customer and resellers have different discounts associated to their accounts. This feature will further reduce the workload on internal customers as they do not have to tackle with the problem of checking each customer group against their respective pricing structure, rather this process is automated.

Automation of these tools also links the external customers directly to the internal warehouse staff as the products purchased online go directly to the picking list, removing the need of a third person in the middle.

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Figure 25 Process customisation for Flag pins, (19-Feb-2014, Nabeel Shaikh)

Figure 25 is a custom tool used to create flag pin's. A flag pin is a pole on which a flag can be hoisted onto. It has several hundred combinations, different flags are hoisted onto different flag pins and each flag pin can then have a combination of its own. Purchasing such a product over the phone is time consuming and costly as it takes up sales person time and also can lead to process errors. The purpose of such a tool is then to reduce processing time and customer error rate.

Accepting card payments online need the integration of certain services to the website. SAGE Pay was selected as a payment gateway for the website.
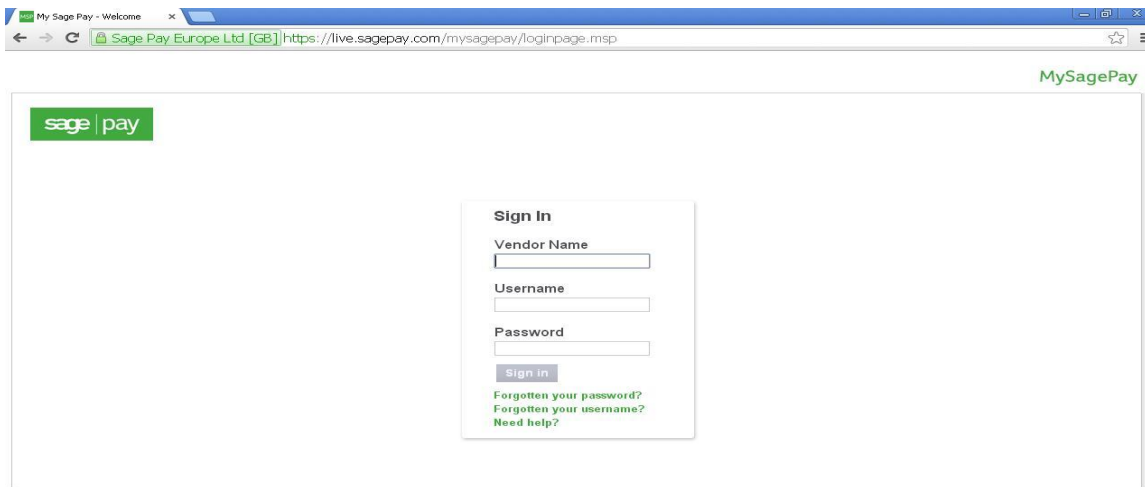
Figure 26 Payment gateway integration, (19-Feb-2014, Nabeel Shaikh)

Figure 26 and Figure 27 represents the integration with SAGE pay, which is a payment module used for basic accounting and card payments.
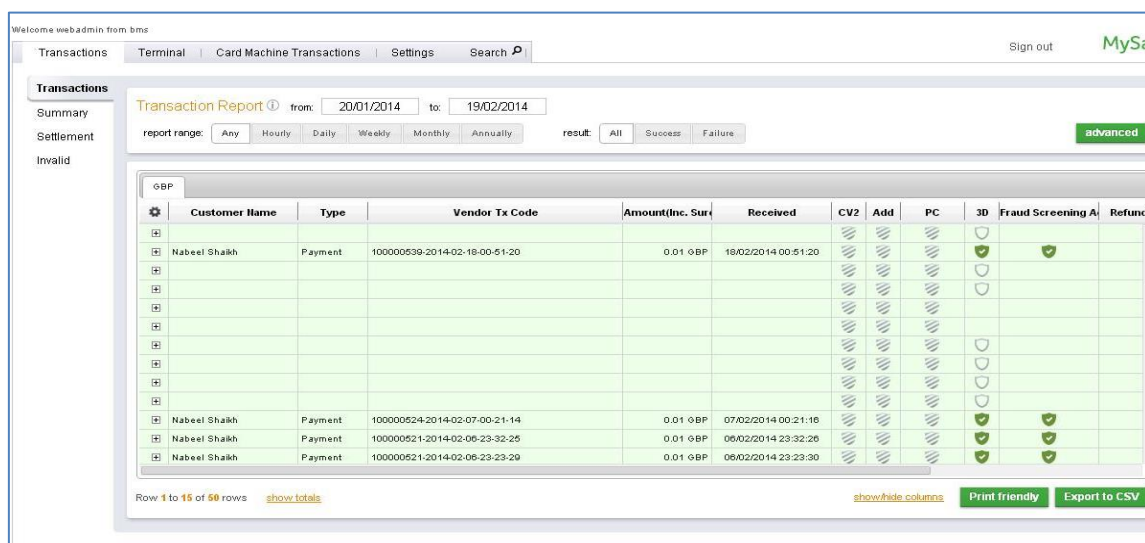
Figure 27 SAGE Pay Payment system, (19-Feb-2014, Nabeel Shaikh)

Figure 27 demonstrates test orders being placed on the website and payments coming through to SAGE Pay accounts, this shows how the website was tested for online payment integration. Integration of the SAGE module also means that the external customer has the capability to order products online through card transactions and having its products being picked up by warehouse staff in the

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form of a picking list. By taking out the extra sales person from these processes from the middle of the transactions the process has become faster and more efficient.

Figure 28 shows content management system integration with customer management system and data creation at the CRM end.
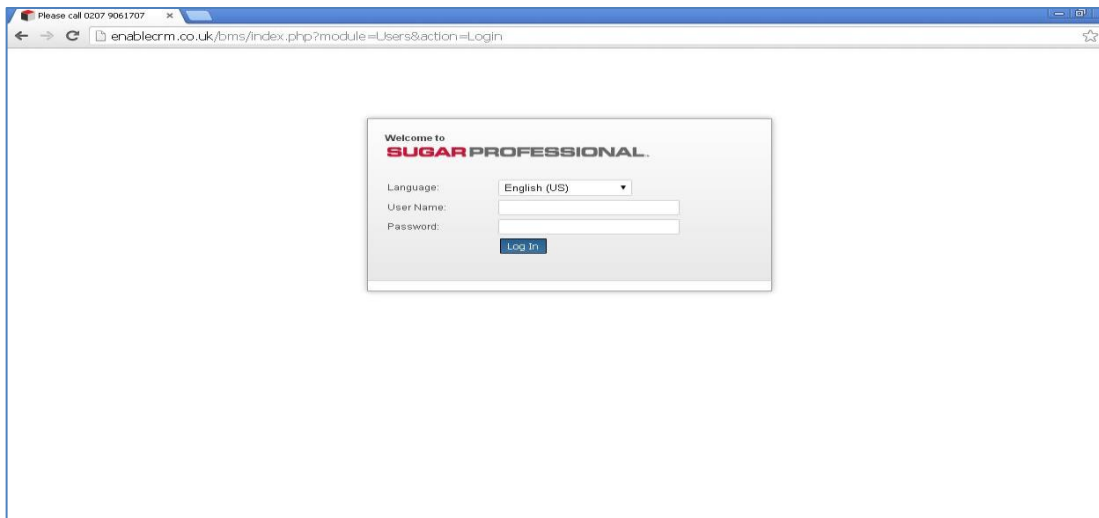
Figure 28 Integration to sugar CRM, (19-Feb-2014, Nabeel Shaikh)

Figure 29 shows how data is being generated by the customer management system which can be further used to market and increase potential sales.
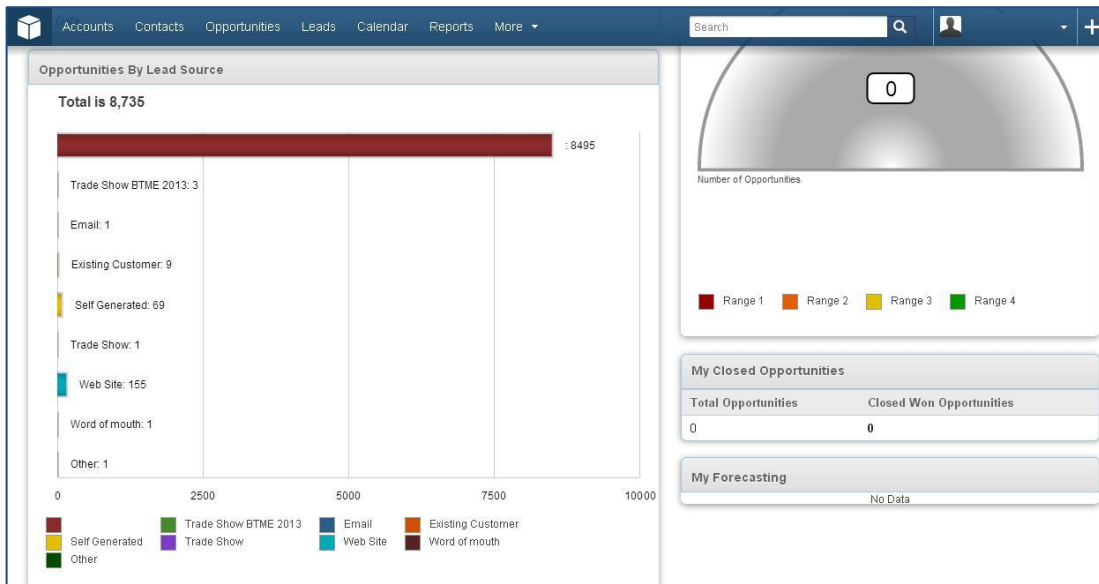
Figure 29 Marketing software showing website orders,

(19-Feb-2014, Nabeel Shaikh)

Figure 30 shows potential new customers, these are not current customers but are ones that have shown interest in a product on the web interface. The data can be used by the company to contact individual customers and potentially increase revenue.
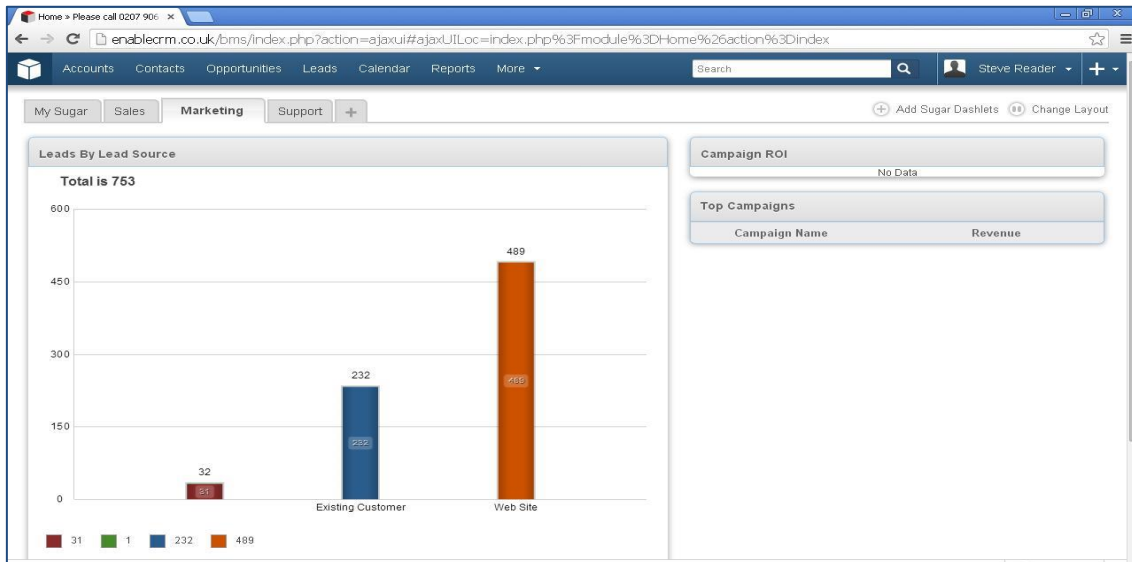
Figure 30 CRM showing marketing data, (19-Feb-2014, Nabeel Shaikh)

Figure 31 shows the content management system creating orders after the product has gone live.
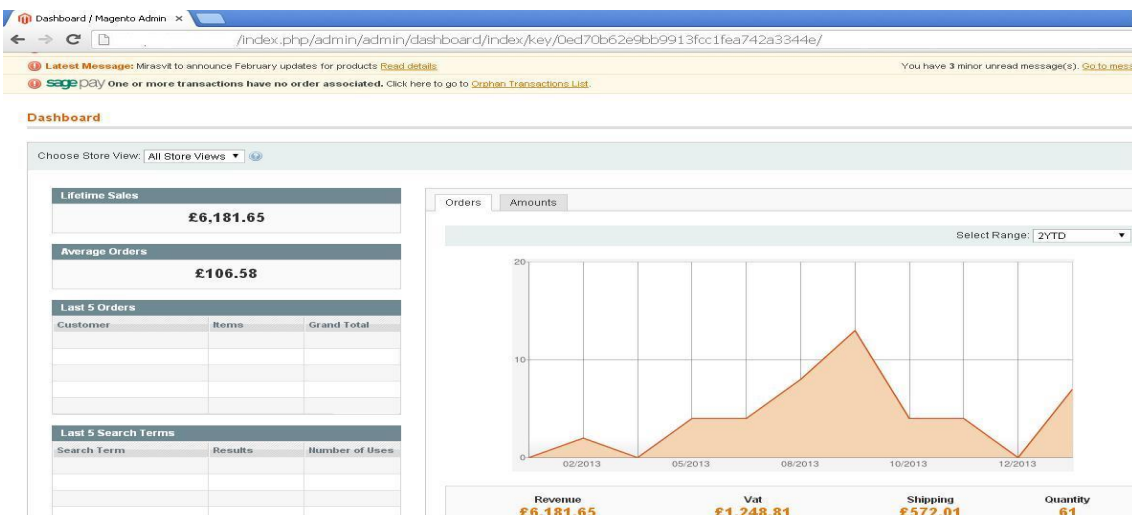
Figure 31 Magento dashboard showing sales, (19-Feb-2014, Nabeel Shaikh)

Financial reporting is an important feature of the platform as it can provide on click updates of the whole ecosystem. This is demonstrated in Figure 30 and Figure 31 where it gives an update about the potential new customers and the

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sale to date. These reports are tools that are meant for middle and higher company management to track the performance and make forecasts.

7.18 Ecosystem Maintenance

Distributing the ecosystem into different subsets of software poses a greater maintenance challenge after that the system has been developed and handed over. This is due to the fact that you have to communicate with a host of companies compared to just one company in the event of software malfunction. This also means that you have to maintain relationships with all software vendors involved in the development of the system, this approach of maintenance is not sustainable in an economically tough environment as lack of human resource and higher degree of workload per person makes it almost impossible to sustain.

To overcome this problem a singular consulting firm was hired to overlook the whole of the system. This approach hands over the maintenance aspect of the software system to only one company, hence have a singular communication point in case of software problems. The consulting firm is then responsible to communicate with software vendors to resolve the problem; the consulting firm would also have its own technical expertise at hand which is an additional advantage of this approach.

Another important thing to consider in keeping the cost of maintenance down is to retain power users within the company; these are people with technical knowhow of the system and are capable of resolving most non-technical issues without any external help. Loss of such internal customers will mean more external help required hence pushing the cost of maintenance higher. To help internal customers cope with most questions the research focused on developing a "how to" guide, the aim was to reduce reliance on external consultants and keeping maintenance costs down by developing a knowledge base to help answer the most common maintenance related questions.

8 ERP SUCCESS MEASUREMENT

After careful consideration of different software systems and their scientific down selection the study has implemented the solution for the purpose of data collection. While implementing these systems it has had a chance to closely study and monitor the human and software interactions, company statistics and the problems that are faced by Small to Medium Enterprise on a day to day basis. While trying to implement the system some of the problems that the research has faced are already presented in the current scientific literature but there are also new findings. As the software goes through its life cycle and becomes more stable for use, it gives value to the scientific rigour that was used while selecting it in the first place.

For this data to be presented there is first a need to understand the different ways it can be analysed and hence require the understanding of the current scientific literature surrounding the subject. The purpose of this exercise will be to understand the success measurement techniques used to measure such systems and then choose the best technique for the case study. This chapter is firstly going to scope such scientific literature by means of a literature review and then present the data in a suitable format according to the findings. This will ensure data present ability which is better fit for Small to Medium Enterprise and should also give the findings more research rigour.

Implementing an Enterprise Resource Planning is a technical challenge which may also require Business Process Re-engineering (BPR).The result is either a successful transformation of a company with more efficient processes or failure with loss of time and resource, there is sufficient evidence that the latter is a common occurrence in industry (DAVENPORT, 1998). It is estimated that over 70% of these projects do not deliver anticipated outcomes (Al-Mashari, 2000). A report by the Standish Group sheds light on the high frequency of software project failures within industry. They claimed that on average 178% were over budget, they take 2.5 times longer to implement than intended and deliver only 30% of committed goals (Record, 1995). In China alone over 1000 companies have implemented ERP, MRP or MRP2 systems since 1980 (Zhang, 2005).

ERP success measurement models have mostly evolved from information systems success evaluation models, this is because ERP's are classed as a breed of information system (IS) (Klaus H. & Gable, 2000).

DeLone McLean I/S model is one of the most cited models in success measurement approaches (DeLone & McLean, 1992, 2002, 2003) the model is based on six independent measures of success those are net-benefits, user satisfaction, intention to use, service quality, system quality and information quality. This is a user-centric approach evaluating user satisfaction in Enterprise Resource Planning success measurement.

The Gable's "A Priori Model" is a measurement model using five constructs and forty-two sub-constructs. This model was born out of an inventory survey and the tests originally showed that the ERP success was dependent on the size of the organization REF. The model used (DeLone & McLean, 2003) measures as a starting point and later combined associated measures from (Gable, Sedera, & others, 2003), by combining the two models constructs like "USE" could be omitted REF and identification and inclusion of new measures related to enterprise systems was made possible.

The Ifinedo (2006) model was an extension of (Gable et al., 2003), the author through empirical evidence revealed that businesses tend to associate the quality of implemented technology with the success of their organization. Gables model was insufficient with regards to these aspects of enterprise resource planning systems design and important measures like Vendor/Consultant Quality were added, as vendor or consultants are responsible to put these systems in place. The second added dimension was work group impact. According to (Myers B.L., 1996) information system models should incorporate work group impact. The idea being that work group like teams contributes to Enterprise Resource Planning successfulness.

(Markus & Tanis, 2000) based their model on emergent process theory which assumes that the outcomes of goals people try to achieve are often different from the ones intended, sometimes they are better and sometimes worse. More specifically they based their model on a framework designed by (Soh & Markus,

1995). They proposed that the process of implementation be divided into phases, the outcome of one phase feeding into the next. This they proposed will reduce the chance of failures because each phase generally would involve a different set of people, hence isolating problems of a group from the other the framework also directs attention towards communication deficiency between groups. Their model consists of 4 phases namely: Project charting (decisions defining the business case and solution constraints); the Project configure & roll-out (getting system and end users "up and running"); Shakedown (stabilizing getting rid of bugs getting to normal operations); and Onwards and Upwards (Maintaining, supporting users, getting results, upgrades). The output of each stage feeds as an input to the next. Unlike other models this model provides a theoretical framework for analysing retrospectively and prospectively each phase of the implementation cycle.

Continuing on the work by Markus & Tanis (Tan & Pan, 2002) presented a model for measuring enterprise success their model comprised of three measures: infrastructure success, infostructure success, knowledge success. They argued that infrastructure success i.e. the technological systems should be implemented successfully in the first instance hence providing a stable platform for infostructure success. Infostructure success would mean the provision of useful and accurate information to the system which, in turn, forms the basis of knowledge success giving the organization enhanced organizational integrity and responsiveness.

Unlike the post implementation models the Ex-ante evaluation model (Stefanou, 2001) evaluates the best fit Enterprise Resource Planning solution before implementation phase. The aim is to model the requirement in terms of cost, benefits and risks: strategic- organizational estimations of ROI/Value/Business case for Enterprise Resource Planning implementation ex-ante. The model is an instrument in evaluating all the important stages of implementation and predicts the future outcome hence helps managers to predict the best direction for the company. A simple model based on user satisfaction like the one

suggested by (Montazemi, Cameron, & Gupta, 1996) is just not sufficient for complex software projects like Enterprise Resource Planning implementations.

Information systems are an implementation of businesses processes technologically, hence different individuals are performing different processes within their job specification with the help of the technology provided by the information system. Task technology fit (TTF) measures to which degree the implemented technology is helping the individual perform the task they are assigned (Goodhue & Thompson, 1995). TTF measures acceptance with three different dimensions task, ERP (technology) and user. (Smith, 2001) adopted the original model from Goodhue and added two new success indicators "Perceived Usefulness" and "User Satisfaction" in line with (Ives & Olson, 1984) and (DeLone & McLean, 1992). In this model poor TTF results will contribute to a low level of user satisfaction and vice versa.

There are other models that are similar to the ones described above. One such conceptual framework is the (Zhang, 2005). Zhang's model is influenced by Ives model (Ives & Olson, 1984) . Zhang took the Chinese electronics and home appliance companies as a case study and described the relationships between organizational environment, user environment, Enterprise Resource Planning system environment, Enterprise Resource Planning vendor environment, and Enterprise Resource Planning post-implementation success. (Seddon, 1997) is another research concentrating on specific aspects of IS success such as relation of the size of the organization and the success achieved (Sedera., 2003) and (Wu & Wang, 2007) investigated into the viewpoint in success measurement approaches.

There are models that also describe failure factors of Enterprise Resource Planning systems and point towards the type of things that might go wrong while trying to implement such a system, a couple of such researches are (Wong, Scarbrough, & Davison, 2003) and (Sar & Garg, 2012). Ada states that the Enterprise Resource Planning systems are integrated software suit typically provided by a vendor. SAP is a good example of such a vendor with numerous studies on how to implement such systems seamlessly, (Francalanci, 2001).

Most of the success measurement models described above except (Markus & Tanis, 2000) concentrate on evaluation of a ERP once it is implemented, judging if a system implementation is successful and to what extent. The Balance Scorecard - a framework to structure the relevant key performance indicators for performance measurement (Kaplan & Norton, 1992, 1993) serves as an evaluation of the entire Enterprise Resource Planning project and is an important addition to the existing Enterprise Resource Planning measurement tools (Brand, 1999), it can be used to set targets and access a system even before the system has been conceptualised. The balance score card evaluates business processes in four perspectives: financial; internal process; customer and innovation; and learning. Hence when applied to Enterprise Resource Planning it can account for a wide range of effects (Martinsons, Davison, & Tse, 1999). Each section has indicators related to itself and the different sections are linked according to the cause-effect relationship. This is crucial as one can plan an entire Enterprise Resource Planning implementation knowing what needs to be achieved at the business level and link it to the technology and how it needs to function, having a top to bottom view of the Enterprise Resource Planning before the project has started.

Success measurement models	Financial perspective	Customer	Internal	Innovation and learning
Balanced score card	✓	✓	✓	✓
DeLone McLean I/S model	X	✓	✓	✓
Gable's "A Priori Model"	X	✓	✓	✓
Ifinedo	X	✓	✓	✓
Stefanou, 2001	✓	✓	✓	✓
Goodhue, 1995	X	✓	✓	✓

Figure 32 Table shows the different models which cover the same perspectives, (19-Feb-2014, Nabeel Shaikh)

Figure 32 shows the different perspectives that the success measurement techniques covers and use the balanced scorecard technique for data representation as in terms of Small to Medium Enterprise so that it is easy for Management to understand. This is very important as in a "cash stripped" environment the work load per person is greater than that of in a stable environment, due to this any method which is complicated might not work.

8.1 Financial Perspective

This perspective looks at the overview of the overall financial investment that the project has incurred. It also gives us a perspective on what the financial budgets were at the beginning of the project and what were the actual outcomes of those predictions. With regards to the compliance with budget almost all areas incurred a slight increase in spending as shown in Table 7

Goal	Measure				
	Cost centre	Maintenance		Training	
	Cost category	budget	actual	budget	actual
Compliance with budget	Hardware absolute	600	1200	0	0
	Hardware change	0	600	0	0
	Software absolute	0	1290	0	700
	Software change	0	1290	0	700
	Consulting absolute	20,000	21,000	0	0
	Consulting change	0	1000	0	0

Table 7 Showing the costs associated with the project for a period of 12 months, (19-Feb-2014, Nabeel Shaikh)

Table 7 shows that there had been changes during the implementation of the data collection platform, hence the costs associated to the overall project changed, this is not a good indicator as it means that factors that were not known at the outset have occurred during the course of the research. Researching into these factors is important as this might help explain the failure rate and bring about new knowledge as well as future research potential.

8.2 Project Perspective

The project perspective will measure the project management decisions taken during the course of the project. The purpose is to access if such predictions are useful for the purpose of such projects under the given conditions or are affected by factors not know at the beginning.

For the reasons stated above this perspective is going to measure the difference between the predicted project PERT diagram to the actual PERT diagram, actual being the measurement of what actually happened against the predictions.

8.2.1 Measuring Predicted Versus Actual Time To Meet Milestones

The time difference between the predicted time and actual time taken to reach each milestone in the project is described in Graph 1. The figures show that all three had delays which were outside the predicted boundary, even though redundancy was added in all predictions.

This shows that technology related projects within Small to Medium Enterprise can be affected by more than the factors described in the literature review. Environmental factors such as internal customer retention rate can have an effect on milestone time.

Graph 1 Extra time taken to complete each milestone,

(19-Feb-2014, Nabeel Shaikh)

8.2.2 Evaluating The Efficiency Of The Project Organisation

Graph 2 describes the frequency of employees leaving the company during and after the implementation phase of the project. The employees who were counted were those who were directly interacting with the software.
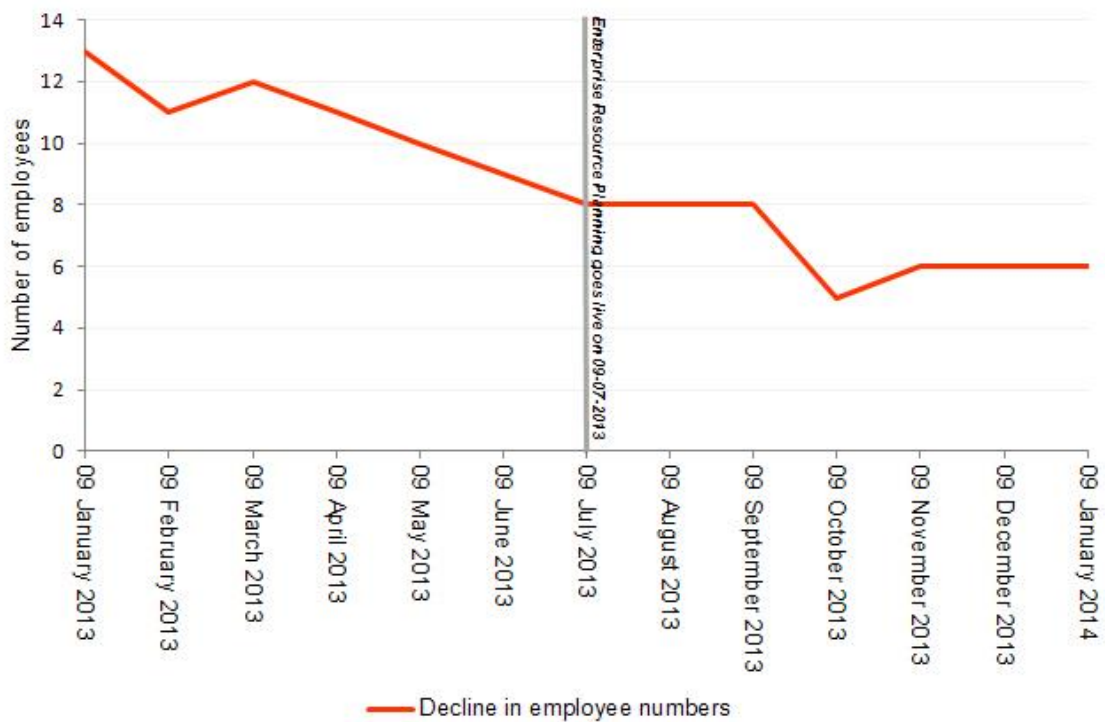
Graph 2 shows the decline in employee numbers throughout the course of the project,

(19-Feb-2014, Nabeel Shaikh)

Previous research shows that Enterprise Resource Planning software can have a positive effect on the employee ability of internal customers. The research shows that if an SME cannot retain internal customers during implementation phase then it can have a direct impact on the implementation phase itself, this is evident from Graph 1 and Graph 2 as the decline in internal customer population had a direct impact on time and cost.

8.3 Customer Perspective

The customer perspective accesses the changes that the software has bought in terms of addition of processes and the value generated because of the additions of such processes.

8.3.1 Existing Processes Versus Newly Implemented Processes

Implementing solutions such as enterprise resource planning systems brings about new business processes and ease of use to its users, internal and external. Graph 5 shows the increase of utilization of the newly implemented processes right after the go live stage compared to only the utilization of original processes before the go live stage.
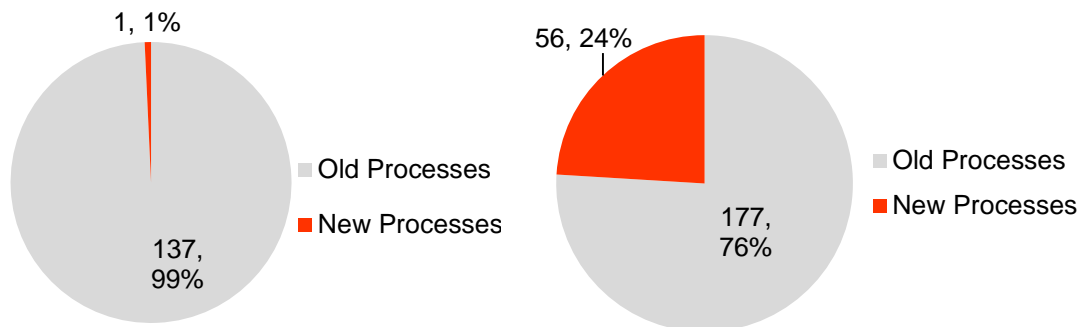
Graph 4 Coverage of newly introduced processes before project go live stage, (19-Feb-2014, Nabeel Shaikh)

Graph 4 Coverage of newly introduced processes after project go live stage, (19-Feb-2014, Nabeel Shaikh)

This shows customer uptake of the newly implemented technology and also indicates success of implementation. This also means the increase in overall frequency of business processes after the implementation.

Graph 4 shows the coverage of business processes used by external customers before project go live stage, it shows that out of 138 business processes almost all of the processes used until the go live stage were pre implemented.
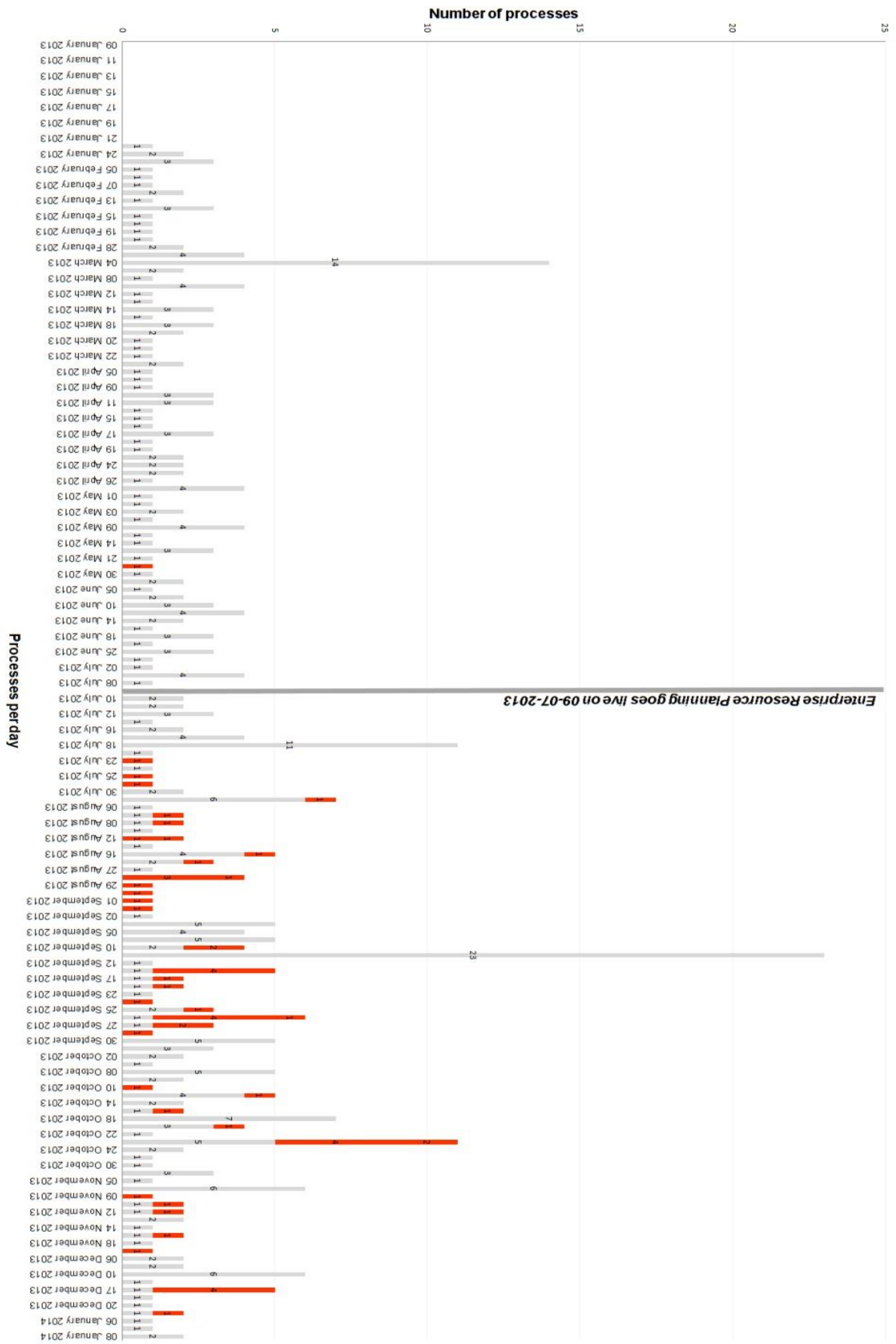
Graph 5 The red marks depict the newly introduced processes and their frequency of use, (19-Feb-2014, Nabeel Shaikh)

Graph 4 shows firstly that there is an overall increase in the process frequency from 138 business processes before project go live to 201 business processes after go live, out of the 201 business processes 24% were newly implemented.

This shows the positive trend in the uptake of technology by users after the project opened for business. It also shows that newly added technology is not only being used and accepted by its users but is also increasing its share of the overall business processes. As reliance of the technology grows and the confidence in it increases it is expected that this positive trend in technology uptake grows as well.

8.3.2 Impact Of Technology Implementation On Revenue Generation

By optimizing its internal processes the overarching aim of a Small to Medium Enterprise in a tough economic environment is to increase revenue in order for it to survive. For such technologies to be worthwhile for SME's not only should the newly implemented technology increase the productivity of the company by providing it with new processes and techniques to achieve its goals but it should also contribute to new revenue streams.

The red marks in Graph 6 show the orders going through the new system compared with the grey which are orders going through older methods. As each order has a certain value associated to it these orders are also contributing to the increase of overall orders and in new revenue stream for the company.
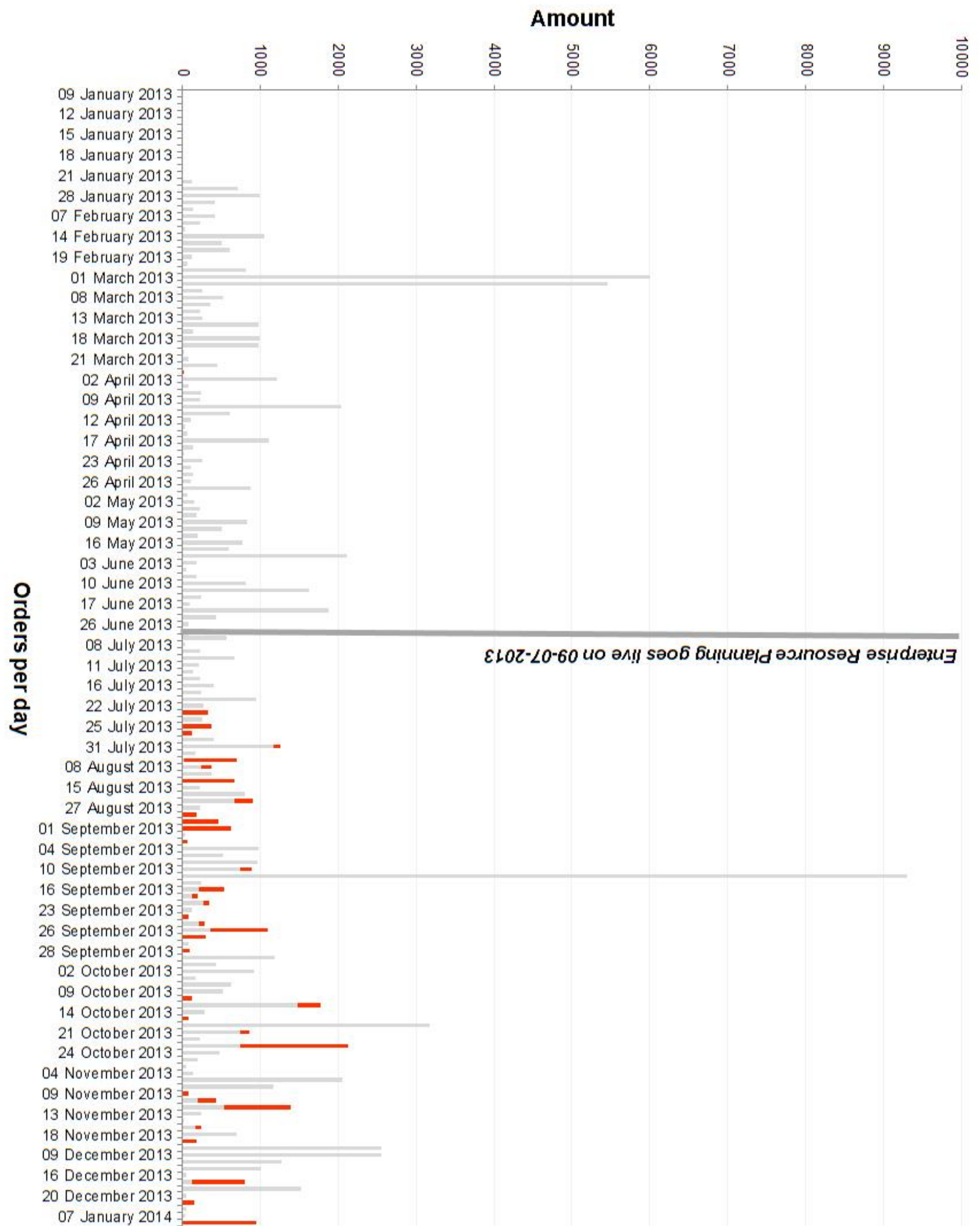
Graph 6 The red marks depict orders through the new system and the amount they generate, (19-Feb-2014, Nabeel Shaikh)

0.5 %

99.5 %

Order value
New order valu
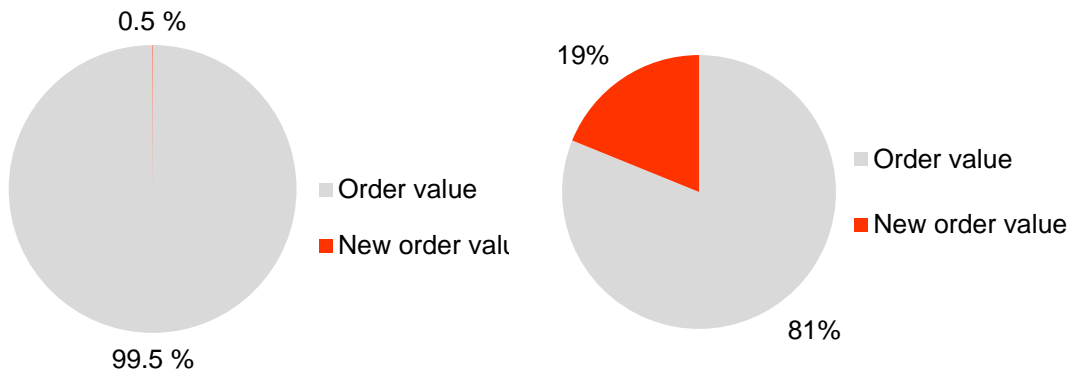
Graph 8 Percentage value of orders going through new system compared with the old system before project goes live,

(19-Feb-2014, Nabeel Shaikh)

19%

81%

Order value
New order value

Graph 8 Percentage value of orders going through new system compared with the old system after project goes live,

(19-Feb-2014, Nabeel Shaikh)

Graph 8 shows a representation of the per cent value of orders going through the system by means of the new software compared with the older methods before the software go live date. It shows that all of the value generated is by older methods. Graph 8 also shows order value of the next six months after the software has gone live, it shows that 19% of all value generated was through the newly implemented software. Due to company policy the numbers cannot be disclosed however there was an overall increase by 37% in order value and almost a 500% increase on new order value.

This proves the impact of the new system as it has generated new revenue streams for the organisation and much required revenue in an economically gloomy environment. It is predictable that these revenue streams will increase overall profits as the company markets itself with the help of the newly established system.

8.4 Internal Process Perspective

This perspective analyses the improvement in the process(s) due to the implementation of the new system. For the purpose of data collection the study has chosen a particular process that was a cause of bottleneck in terms of time and effort. Graph 9 shows the time it took to complete the process before the implementation and after the implementation of the software. For the purpose of data collection it has chosen 6 data points after and before the software went to the live stage.

The results show that before the enterprise resource management system was implemented the process took an average of 6 minutes to complete and after implementation the same process took an average of 1.16 minute(s) to complete hence saving an average of over 4 minutes every time this particular process occurs. This proves that improvement in processing time has occurred due to the implementation of the system.
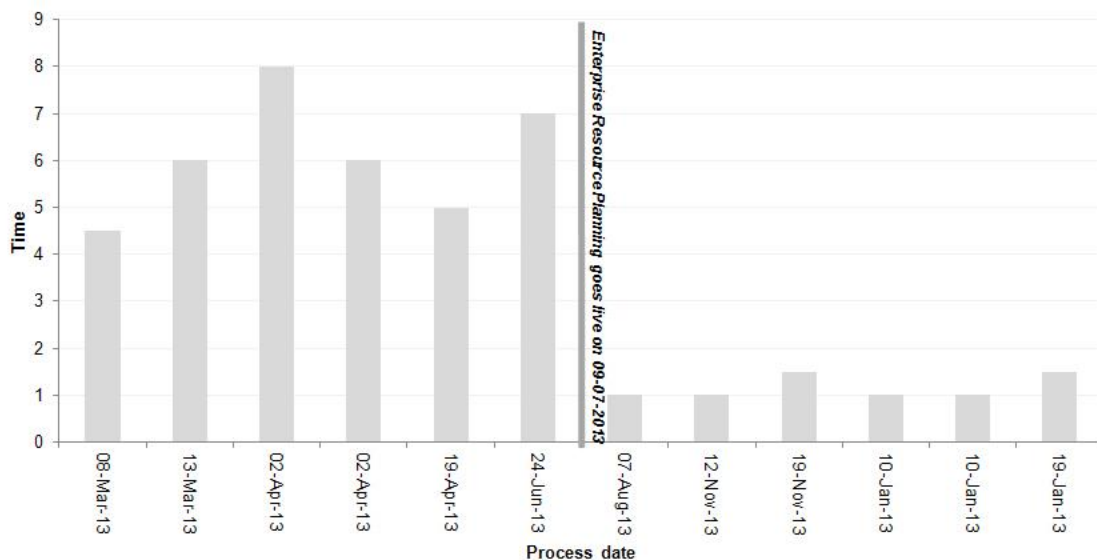
Graph 9 Time taken by a single process before and after software implementation, (19-Feb-2014, Nabeel Shaikh)

8.5 Innovation And Learning Perspective

The software once implemented should come to a stage of maturity within the boundaries set by the company. The company needs to take over the workings of the software from the software consultant. Hence measuring the time the consultant has spent building the software before and after implementation is a good indicator of how well this transformation has occurred. If the time spent by the consultant after software implementation date doesn't reduce or remains constant this means that there is something fundamentally wrong with the system and the company requires keep investing resources for the software to work. In such scenarios the life span of the software will be short lived eventually resulting in complete loss of system as the company will be spending more money towards the development of the system compared to the profitability that it will create.

Graph 10 depicts the consultant time spent during the course of a year before and after software implementation in an 8 hour day format. It shows that the consultant time has reduced as soon as the software goes live in the second half of the graph. However due to the rapid loss of staff there is a rise in consultant time in the last quarter of the graph due to training of new staff members. It is important to note that the consultant is the researcher during the course of this study. In Graph 10 the researcher has switched roles to software consultant and is observing himself for data collection.
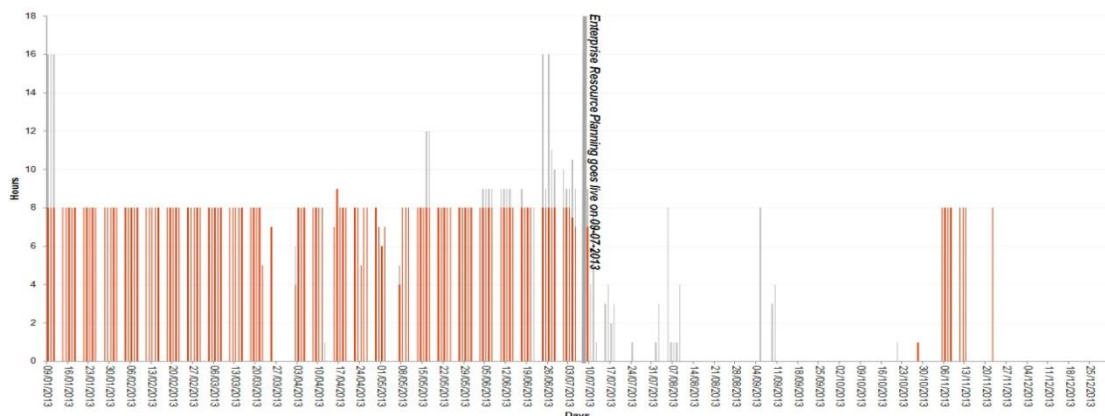
Graph 10 The red lines represent an 8 hour day spent by the software consultant, (19-Feb-2014, Nabeel Shaikh)

9 DISCUSSION

The research conducted into improving the prospects of survivability of a Small to Medium Enterprise in an economically gloomy environment by implementing enterprise resource planning software has yielded some interesting results. As the market place for implementing ERP's for enterprise level organisations becomes competitive, attention has diverted towards supplying software for Small to Medium Enterprise (SME's) as this is a relatively untapped market.

This research has provided a unique opportunity to study such changes closely in the market and understand the problems associated with such implementations. It is also worth mentioning here that through the course of this research, in accordance with the definition of organisational classification described in more detail in Table 2, the organisation fluctuated from a Small to Medium Enterprise to a Micro Enterprise. Hence the techniques described in this research for organisational optimisation are not only applicable to Small to Medium Enterprise but are also valid for Micro Enterprise. It was also a unique opportunity to input new knowledge into the research area and to tackle the unknowns of the subject by implementing an enterprise resource planning solution.

Firstly by using a literature review method the study scoped if such software implementations are the way forward for improving the organisation. By further investigating the literature it gave us an opportunity to highlight the different variables involved in selecting the correct platform for data collection. After down selecting the platform a set of predictions in the form of hypotheses were written down. This was in the light of the literature review and the knowledge of the subject that was gathered at that time.

At the core of these hypotheses it was predicted that the solution will improve the performance of the company which will in turn bring about greater profitability and a competitive edge during economic downturn. In order to collect data and to research if the hypotheses were correct and if they

correlated with the platform down selection, the experiment was implemented in the doing phase.

Thirdly in another scoping exercise by means of a literature review of the data collection methods available. The reason for this was to judge which data collection methods are more useful in the light of software implementations for a Small to Medium Enterprise, as some can be very complex and out of context of the scenario and finally the study compiled results in the form of perspectives of an organisation covered in the success measurement phase of the project.

Hypothesis H1 predicted that an indicator of a good system is one that will see that consultant time reduce over a period after the implementation of the system if complete. Graph 10 shows the data for consultant time on the project being reduced after the implementation is complete there are some spikes in the last quarter of the graph showing more consultant time being utilised as more training is required due to lack of staff members. The overall prediction is however correct and can be deemed a true prediction.

Hypothesis H2 predicted that if the majority of customer processes are implemented using the web interface then there should be a shift in usage and process figures from manual phone orders to web orders. Taking load off the much strained staff members. This shift is evident as shown in Graph 4 and there is an increase in new process usage from 1 per cent to 24 percent, this proves the fact that there is a shift in customer behaviour with more orders being placed online.

Hypothesis H3 predicts the reduction of process time because of automation of processes, Graph 9 depicts the reduction of a process before and after implementation of web interface. Before implementation the process took an average of 6 min's when it was done manually while now it's done in 1.16 min's. This is clear reduction of process time hence improving system performance.

Hypothesis H4 predicted that there will be an increase in new customers, even though the research was not conclusive about how many new customers had been attracted because of the new system, what is evident from Figure 30 is the

increase of potential customers, the system made more than 400 new leads or potential customers.

This has shown us that the impact of such a system on a struggling company can be enormous. It can make a difference of organisational failure or potential for success. However it has also shown us that the costs associated with the system need to be studied beforehand as they can fluctuate through the course of the project causing potential delay and the internal customer retention rate needs to be monitored carefully as shown in Graph 2 because if one choses too many too quickly then there is a high risk of project failure.

10 CONCLUSION AND RECOMMENDATIONS

The focus of the research presented in this thesis is on how to optimise Small to Medium Enterprise in an economically challenging environment. The results have shown that by implementing software technologies there was a 19% increase in the amount of revenue generated over the first six months after the solution went live. There were also other advantages towards the working of the organization such as the time taken for certain processes improved by 4 minutes and the uptake of technology by users went up to 24% of the overall transactions in the first six months of implementation.

The research took a balanced score card approach as a data collection method in order to judge the different perspectives of the organisation then scoped the different methods used in the subject area by means of a literature review and found the balanced score card to be more appropriate for the scenario. The importance of this approach in a Small to Medium Enterprise is its clarity towards data collection and the ease by which it can be read by senior management. This is very important as in a pressured environment, higher management can relate to the report.

The study implemented the platform for data collection using a host of technologies rather than using a singular technology or vendor. By narrowing down the required modules, judging which vendor suites each of them and integrating these with each other meant one can reuse already implemented technology, hence reducing time and cost of implementation and also reduce the time to uptake technology. This method of platform implementation was unorthodox but highly successful. Ours used a combination of Magento, SugarCRM and SAGE accounting systems.

The Methodology of the research was studied carefully as it stood as the back bone structure of the overall research process from initial literature review to data collection phase. In designing the methodology it identified that the implementation phase would be a phased roll out as different sections of the

platform had to cater for different purposes with separate roll out stages for each module.

Before it could come to a point of selecting the correct technologies for platform implementation and data collection the study had to come to an understanding of the literature surrounding the subject area. For this purpose it used a literature review as a method. Then identified the core parameters cost, support, scalability, business fitness, customisability, latest technologies and market share that were required for the down selection and development of the platform for the implementation phase of the project. The scoping of the literature meant increasing the chance of a successful outcome.

Each method in the research was selected carefully to fulfil the purpose of a particular area interest. The correct selection of these methods can be justified due to the successful outcome of the results; however there are observations that have contributed to new knowledge but which require more research and validation.

The contribution towards scientific knowledge and the contribution towards knowledge to industry are the two dimensions that this research has contributed towards. By creating a methodological approach resulting in a technology process the research has been able to answer the question "*can technology help sustain Small to Medium sized organisations in a tough economic environment",* is has contributed to science by following the scientific method in pursuit to answer this question. The method can be repeated in similar environments to improve organisational efficiency. This has also helped identify crucial new areas of research like the relationship of customer retention rate and its effects on the project implementation phase.

On the technology front it has identified that it can develop capabilities such as:

1. Handling internal and external customer process requirements.

2. Handling specialised process requirements.

3. Minimising the software licence costs overall.

4. Having major capability for customisation.

5. Minimising the effects of process re-engineering by utilising existing software rather than replacing them.

6. Minimised training costs.

7. By building the solution around an e-commerce platform enhancing ERP availability capability.

It has also identified the software limitations such as:

1. The creation of an additional IT support role.

2. Further customisation will require consultant support hence involving more investment.

3. At least one process flow will require manual entry for the process to complete.

4. Requires internal customer involvement for the process to keep working.

5. Requires constant upgrades and improvements for the software to be all encompassing.

6. Upgrades will require external consultant support because of the highly customised nature of the software.

By designing and following the implementation methodology Small to Medium Enterprise can implement software that can cover a substantial number of customer processes with minimal effort while knowingly reducing the chances of failure and attain the following functionality:

1. Managers can attain high-level reports and an insight of business performance.

2. Reduction of work load for internal customers.

3. External customers have the ability to buy products without interacting with sales staff.

4. Customisation produces ease-of-buy for certain high combination product types.

5. Automation allows for better organisational flow.

6. Improvement in customer satisfaction.

Technically this is also an affordable system with potential to change organisational output, efficiency and profitability. The competing Enterprise Resource Planning systems for SME's are expensive in terms of licenses and availability of consultants while the system has partially free licenses and the consultant cost is minimal because of the abundance of human resource available. Further building ERP's around open source e-commerce system enables one to market an organisation beyond the local business boundary.

The methodology can also have a profound effect on technology failure rates in SME's as this can reduce the costs associated with software implementation. This also has the capability to reduce bottle necks at an affordable budget on the other hand it gives struggling businesses the opportunity to implement such technology to grow their business beyond their usual geographic business boundary.

The aim of this thesis was to implement an Enterprise Resource Planning system and measure its success in a Small to Medium Enterprise. The research has followed the step by step process that had been laid down in the aims and objectives, in order to achieve the desired outcome.

There is a potential gap in understanding the human behavioural aspects and there effects on enterprise system implementations, current research suggests that there is potential advantage when it comes to internal customer retention rate as one can retain more employees by implementing such a system. The research has indicated the effects on implementation while having a low internal customer retention rate.

The association of low internal customer retention rate and its effects on enterprise resource planning systems especially in the implementation phase is

a potential area of research. This can be valuable for understanding which implementation methods are best suited for Small to Medium Enterprise because Small to Medium Enterprise continuously struggle to maintain internal customers.

It is also important to note that organisations can fluctuate in classification, during the course of this research the case study fluctuated from Small to Medium Enterprise to Micro Enterprise, hence the methods and results are applicable to both organisational classifications.

Another area of research which is a potential gap within the subject matter is the training and the transfer of knowledge between employees. In Small to Medium Enterprise due to low internal customer retention rates transfer of knowledge between leaving and joining internal customers is important. Further research needs to be conducted in the area to construct a framework for such knowledge transfer. This framework needs to set the rules, guidelines and policies which can govern internal customer knowledge transfer.

Finally for future researchers the advice is that more research can be directed towards the business scorecard method for data presentation for Small to Medium Enterprise. Not only can this be used as a method for data representation but it can also be used as a method for system improvement and further system implementations. The importance of this method over other methods is in its simplicity of use and its clarity of assessment by managers. Further research is required to understand its different uses in such an environment.

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APPENDICES

Appendix A contains the Critical Path Activity chart that was first devised to judge the length of the project it also has a Normal Distribution table which was used to calculate the Z-Score. Appendix B contains the data that was compiled during the course of the project and thus depicts the real data.

1 Appendix A

1.1 Critical Path Activity Chart

Activity ID	Name	Predecessor	Duration	a	m	b
	Research phase		25	15	25	28
1	Research into Web Portal		10	5	10	12
2	Research into product packaging and dispatch software	1	5	3	5	5
3	Research into Customer Relationship Management(CRM) software	1	10	7	10	11
	CRM implementation phase		13	6	13	18
4	Customer Relationship Management(CRM) software implementation	3	5	3	5	7
5	CRM systems testing	4	5	2	5	6
6	CRM systems training	5	3	1	3	5
	CMS implementation phase		172	85	172	201
7	Portal implementation	1	50	20	50	53
8	Portal Unique Tool development	7	50	35	50	55
9	Customisation requests	7	20	15	20	22
10	Feature testing outcome	8,9	20	5	20	25
11	Web Portal bug fixing	10	15	5	15	20
12	Web portal management and knowledge transfer	11	15	3	15	15
13	CMS systems training	12	2	2	2	6
	Further technology Implementation		5	2	5	5
14	Product packaging and dispatch software	7,2	5	2	5	5
	a = Optimistic Time					
	m = Most Likely Time					
	b = Pessimistic Time					

Figure A 1 Critical Path activity chart showing the Duration, Optimistic, Most Likely and Pessimistic time in unit working days.

1.2 Normal Distribution Table

z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990
3.1	0.9990	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9992	0.9993	0.9993
3.2	0.9993	0.9993	0.9994	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9995
3.3	0.9995	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997
3.4	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9998

Figure A 2 Normal distribution table used for calculating z-score
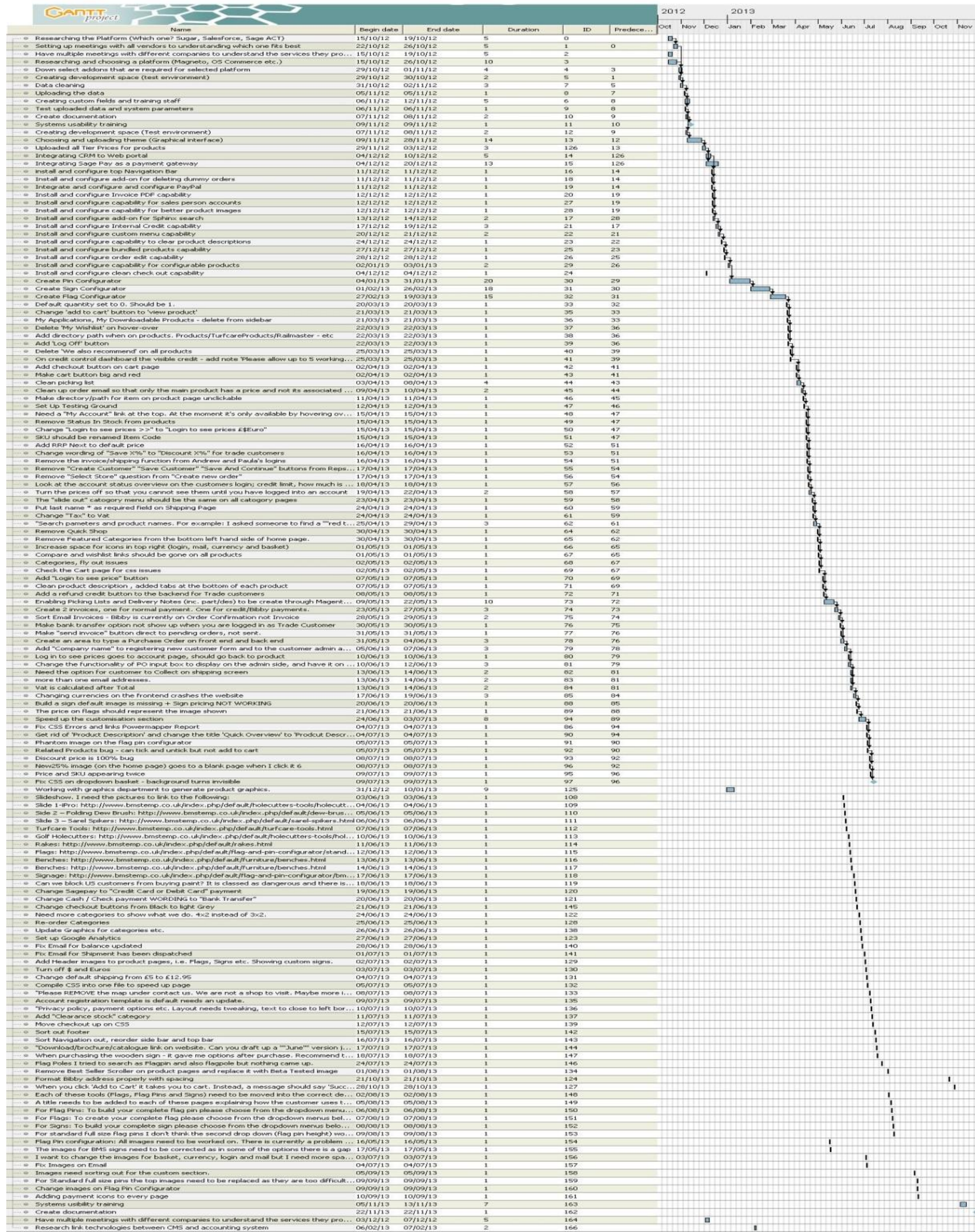
2 Appendix B

2.1 Project Gantt Chart

Figure A 3 Project Gantt chart

2.2 Project Gantt Chart Excel Version

Name	Begin date	End date	Duration HRS	Who's doing the task
Research phase			**29**	
Research into Customer Relationship Management(CRM) software			**10**	
Researching the Platform (Which one? Sugar, Salesforce, Sage ACT)	15/10/2012	20/10/2012	5	Nabeel
Setting up meetings with all vendors to understanding which one fits best	22/10/2012	27/10/2012	5	Nabeel
Research into product packaging and dispatch software			**5**	
Have multiple meetings with different companies to understand the services they provide (Metapack etc.)	15/10/2012	20/10/2012	5	Nabeel
Research into Web Portal			**14**	
Researching and choosing a platform (Magneto, OS Commerce etc.)	15/10/2012	27/10/2012	10	Nabeel
Down select addons that are required for selected platform	29/10/2012	02/11/2012	4	Nabeel
CRM implementation phase			**15**	
Customer Relationship Management(CRM) software			**11**	
Creating development space (test environment)	29/10/2012	31/10/2012	2	Nabeel
Data cleaning	31/10/2012	03/11/2012	3	Nabeel
Uploading the data	05/11/2012	06/11/2012	1	Nabeel
Creating custom fields and re-training staff	06/11/2012	13/11/2012	5	Nabeel
CRM systems testing			**1**	
Test uploaded data and system parameters	06/11/2012	07/11/2012	1	Nabeel
CRM systems training			**3**	
Create documentation	07/11/2012	09/11/2012	2	Nabeel
Systems usability training	09/11/2012	10/11/2012	1	Nabeel
CMS implementation phase			**210**	
Portal implementation			**52**	
Creating development space (Test environment)	07/11/2012	09/11/2012	2	Nabeel
Choosing and uploading theme (Graphical interface)	09/11/2012	29/11/2012	14	Nabeel
Uploaded all Tier Prices for products	29/11/2012	04/12/2012	3	Nabeel
Integrating CRM to Web portal	04/12/2012	11/12/2012	5	Nabeel
Integrating Sage Pay as a payment gateway.	04/12/2012	21/12/2012	13	Nabeel
install and configure top Navigation Bar	11/12/2012	12/12/2012	4 hrs	Nabeel
Install and configure add-on for deleting dummy orders	11/12/2012	12/12/2012	1 hrs	Nabeel
Integrate and configure and configure PayPal	11/12/2012	12/12/2012	2 hrs	Nabeel
Install and configure Invoice PDF capability	12/12/2012	13/12/2012	2 hrs	Nabeel
Install and configure capability for sales person accounts	12/12/2012	13/12/2012	2 hrs	Nabeel
Install and configure capability for better product images	12/12/2012	13/12/2012	0.5 hrs	Nabeel
Install and configure add-on for Sphinx search	13/12/2012	15/12/2012	2	Nabeel
Install and configure Internal Credit capability	17/12/2012	20/12/2012	3	Nabeel
Install and configure custom menu capability	20/12/2012	22/12/2012	2	Nabeel
Install and configure capability to clear product descriptions	24/12/2012	25/12/2012	1	Nabeel
Install and configure bundled products capability	27/12/2012	28/12/2012	1	Nabeel
Install and configure order edit capability	28/12/2012	29/12/2012	1	Nabeel
Install and configure capability for configurable products	02/01/2013	04/01/2013	2	Nabeel
Install and configure clean check out capability	04/12/2012	05/12/2012	1	Nabeel
Portal Unique Tool development			**53**	
Create Pin Configurator	04/01/2013	01/02/2013	20	Nabeel
Create Sign Configurator	01/02/2013	27/02/2013	18	Nabeel
Create Flag Configurator	27/02/2013	20/03/2013	15	Nabeel
Customisation requests			**28**	
Default quantity set to 0. Should be 1.	20/03/2013	21/03/2013	1	Nabeel
Change 'add to cart' button to 'view product'	21/03/2013	22/03/2013	2 hrs	Nabeel
My Applications, My Downloadable Products - delete from sidebar	21/03/2013	22/03/2013	3 hrs	Nabeel
Delete 'My Wishlist' on hover-over	22/03/2013	23/03/2013	2 hrs	Nabeel
Add directory path when on products. Products/TurfcareProducts/Railmaster - etc	22/03/2013	23/03/2013	1 hrs	Nabeel
Add 'Log Off' button	22/03/2013	23/03/2013	4 hrs	Nabeel
Delete 'We also recommend' on all products	25/03/2013	26/03/2013	2 hrs	Nabeel
On credit control dashboard the visible credit - add note 'Please allow up to 5 workings days for credit limits to be updated following cleared receipt of funds'	25/03/2013	26/03/2013	5 hrs	Nabeel
Add checkout button on cart page	02/04/2013	03/04/2013	4 hrs	Nabeel
Make cart button big and red	02/04/2013	03/04/2013	2 hrs	Nabeel
Clean picking list	03/04/2013	09/04/2013	4	Nabeel
Clean up order email so that only the main product has a price and not its associated products	09/04/2013	11/04/2013	2	Nabeel
Make directory/path for item on product page unclickable	11/04/2013	12/04/2013	1	Nabeel
Set Up Testing Ground	12/04/2013	13/04/2013	1	Matt
Need a My Account" link at the top. At the moment it's only available by hovering over the little man icon (not very obvious)"	15/04/2013	16/04/2013	2 hrs	Nabeel
Remove Status In Stock from products	15/04/2013	16/04/2013	2 hrs	Nabeel
Change Login to see prices >>" to "Login to see prices £$Euro""	15/04/2013	16/04/2013	2 hrs	Nabeel
SKU should be renamed Item Code	15/04/2013	16/04/2013	1 hrs	Nabeel
Add RRP Next to default price	16/04/2013	17/04/2013	2 hrs	Nabeel
Change wording of Save X%" to "Discount X%" for trade customers"	16/04/2013	17/04/2013	2 hrs	Nabeel
Remove the invoice/shipping function from Andrew and Paula's logins	16/04/2013	17/04/2013	5 hrs	Nabeel
Remove Create Customer" "Save Customer" "Save And Continue" buttons from Reps logins"	17/04/2013	18/04/2013	4 hrs	Nabeel
Remove Select Store" question from "Create new order""	17/04/2013	18/04/2013	4hrs	Nabeel
Look at the account status overview on the customers login; credit limit, how much is spent, available credit	18/04/2013	19/04/2013	1	Nabeel
Turn the prices off so that you cannot see them until you have logged into an account	19/04/2013	23/04/2013	2	Nabeel
The slide out" catogory menu should be the same on all catogory pages"	23/04/2013	24/04/2013	1	Nabeel
Put last name * as required field on Shipping Page	24/04/2013	25/04/2013	2 hrs	Nabeel
Change Tax" to Vat"	24/04/2013	25/04/2013	3 hrs	Nabeel
Search pameters and product names. For example: I asked someone to find a ""red tie on flag"" and they could not find this product. The same issue applies to several other products. What is the solution to this?""	25/04/2013	30/04/2013	3	Nabeel
Remove Quick Shop	30/04/2013	01/05/2013	4 hrs	Nabeel
Remove Featured Categories from the bottom left hand side of home page.	30/04/2013	01/05/2013	3 hrs	Nabeel
Increase space for icons in top right (login, mail, currency and basket)	01/05/2013	02/05/2013	2 hrs	Nabeel
Compare and wishlist links should be gone on all products	01/05/2013	02/05/2013	4 hrs	Nabeel
Categories, fly out issues	02/05/2013	03/05/2013	4 hrs	Nabeel
Check the Cart page for css issues	02/05/2013	03/05/2013	3 hrs	Nabeel
Add Login to see price" button"	07/05/2013	08/05/2013	4 hrs	Nabeel
Clean product description , added tabs at the bottom of each product	07/05/2013	08/05/2013	1	Nabeel

Feature testing outcome			30	
Add a refund credit button to the backend for Trade customers	08/05/2013	09/05/2013	1	Nabeel
Enabling Picking Lists and Delivery Notes (inc. part/des) to be create through Magento + hard copies	09/05/2013	23/05/2013	10	Nabeel
Create 2 invoices, one for normal payment. One for credit/Bibby payments.	23/05/2013	28/05/2013	3	Nabeel
Sort Email Invoices - Bibby is currently on Order Confirmation not Invoice	28/05/2013	30/05/2013	2	Nabeel
Make bank transfer option not show up when you are logged in as Trade Customer	30/05/2013	31/05/2013	1	Nabeel
Make send invoice" button direct to pending orders	31/05/2013	01/06/2013	2 hrs	Nabeel
Create an area to type a Purchase Order on front end and back end	31/05/2013	05/06/2013	3	Nabeel
Add Company name" to registering new customer form and to the customer admin and admin pages"	05/06/2013	08/06/2013	3	Nabeel
Log in to see prices goes to account page, should go back to product	10/06/2013	11/06/2013	4 hrs	Nabeel
Change the functionality of PO input box to display on the admin side, and have it on order confirmation and invoice templet	10/06/2013	13/06/2013	3	Nabeel
Need the option for customer to Collect on shipping screen	13/06/2013	15/06/2013	5 hrs	Nabeel
more than one email addresses.	13/06/2013	15/06/2013	2	Nabeel
Vat is calculated after Total	13/06/2013	15/06/2013	1 hrs	Nabeel

Web Portal bug fixing			17	
Changing currencies on the frontend crashes the website	17/06/2013	20/06/2013	3	Nabeel
Build a sign default image is missing + Sign pricing NOT WORKING	20/06/2013	21/06/2013	1	Nabeel
The price on flags should represent the image shown	21/06/2013	22/06/2013	1	Nabeel
Speed up the customisation section	24/06/2013	04/07/2013	8	Nabeel
Fix CSS Errors and links Powermapper Report	04/07/2013	05/07/2013	4 hrs	Nabeel
Get rid of 'Product Description' and change the title 'Quick Overview' to 'Prodcut Description'	04/07/2013	05/07/2013	3 hrs	Nabeel
Phantom image on the flag pin configurator	05/07/2013	06/07/2013	2 hrs	Nabeel
Related Products bug - can tick and untick but not add to cart	05/07/2013	06/07/2013	5 hrs	Nabeel
Discount price is 100% bug	08/07/2013	09/07/2013	5 hrs	Nabeel
New25% image (on the home page) goes to a blank page when I click it 6	08/07/2013	09/07/2013	2 hrs	Matt
Price and SKU appearing twice	09/07/2013	10/07/2013	5 hrs	Nabeel
Fix CSS on dropdown basket - background turns invisible	09/07/2013	10/07/2013	2 hrs	Matt

Web portal management and knowledge transfer			18	
Working with graphics department to generate product graphics.	31/12/2012	11/01/2013	9	Kirsty
Slideshow. I need the pictures to link to the following:	03/06/2013	04/06/2013		
Slide 1-iPro: http://www.bmstemp.co.uk/index.php/default/holecutters-tools/holecutters/i-pro-golf-hole-cutter.html	04/06/2013	05/06/2013	0.5 hrs	Matt
Side 2 – Folding Dew Brush: http://www.bmstemp.co.uk/index.php/default/dew-brush-c-w-aluminium-handle.html	05/06/2013	06/06/2013	0.5 hrs	Matt
Slide 3 – Sarel Spikers: http://www.bmstemp.co.uk/index.php/default/sarel-spikers.html	06/06/2013	07/06/2013	0.5 hrs	Matt
Turfcare Tools: http://www.bmstemp.co.uk/index.php/default/turfcare-tools.html	07/06/2013	08/06/2013	0.5 hrs	Matt
Golf Holecutters: http://www.bmstemp.co.uk/index.php/default/holecutters-tools/holecutters.html	10/06/2013	11/06/2013	0.5 hrs	Matt
Rakes: http://www.bmstemp.co.uk/index.php/default/rakes.html	11/06/2013	12/06/2013	0.5 hrs	Matt
Flags: http://www.bmstemp.co.uk/index.php/default/flag-and-pin-configurator/standard-flags.html	12/06/2013	13/06/2013	0.5 hrs	Matt
Benches: http://www.bmstemp.co.uk/index.php/default/furniture/benches.html	13/06/2013	14/06/2013	0.5 hrs	Matt
Signage: http://www.bmstemp.co.uk/index.php/default/flag-and-pin-configurator/bms-signs.html	17/06/2013	18/06/2013	0.5 hrs	Matt
Can we block US customers from buying paint? It is classed as dangerous and there is not cost effective solution to send to US	18/06/2013	19/06/2013	0.5 hrs	Nabeel
Change Sagepay to Credit Card or Debit Card" payment"	19/06/2013	20/06/2013	0.5 hrs	Nabeel
Change Cash / Check payment WORDING to Bank Transfer""	20/06/2013	21/06/2013	0.5 hrs	Nabeel
Change checkout buttons from Black to light Grey	21/06/2013	22/06/2013	1 hrs	Matt
Need more categories to show what we do. 4x2 instead of 3x2.	24/06/2013	25/06/2013	1	Matt
Re-order Categories	25/06/2013	26/06/2013	0.5 hrs	Matt
Update Graphics for categories etc.	26/06/2013	27/06/2013	1	Matt
Set up Google Analytics	27/06/2013	28/06/2013	3 hrs	Matt
Fix Email for balance updated	28/06/2013	29/06/2013	2 hrs	Matt
Fix Email for Shipment has been dispatched	01/07/2013	02/07/2013	2 hrs	Matt
Add Header images to product pages, i.e. Flags, Signs etc. Showing custom signs.	02/07/2013	03/07/2013	0.5 hrs	Matt
Turn off $ and Euros	03/07/2013	04/07/2013	0.5 hrs	Nabeel
Change default shipping from £5 to £12.95	04/07/2013	05/07/2013	0.5 hrs	Nabeel
Compile CSS into one file to speed up page	05/07/2013	06/07/2013	1 hrs	Nabeel
Please REMOVE the map under contact us. We are not a shop to visit. Maybe more info could be placed here to make international visitors feel more comfortable.""	08/07/2013	09/07/2013	1 hrs	Matt
Account registration template is default needs an update.	09/07/2013	10/07/2013	3 hrs	Matt
Privacy policy	10/07/2013	11/07/2013	4 hrs	Matt
Add Clearance stock" category"	11/07/2013	12/07/2013	1	Matt
Move checkout up on CSS	12/07/2013	13/07/2013	1 hrs	Matt
Sort out footer	15/07/2013	16/07/2013	3 hrs	Matt
Sort Navigation out, reorder side bar and top bar	16/07/2013	17/07/2013	4 hrs	Matt
Download/brochure/catalogue link on website. Can you draft up a ""June"" version just for online purposes	17/07/2013	18/07/2013	2 hrs	Matt
When purchasing the wooden sign - it gave me options after purchase. Recommend that these options are presented first.	18/07/2013	19/07/2013	3 hrs	Matt
Flag Poles I tried to search as Flagpin and also flagpole but nothing came up.	24/07/2013	25/07/2013	0.5 hrs	Matt
Remove Best Seller Scroller on product pages and replace it with Beta Tested image	01/08/2013	02/08/2013	1 hrs	Matt
Format Bibby address properly with spacing	21/10/2013	22/10/2013	1 hrs	Matt
When you click 'Add to Cart' it takes you to cart. Instead, a message should say 'Successfully added to cart'	28/10/2013	29/10/2013	0.5 hrs	Nabeel

Unique tool management			1	
Each of these tools (Flags, Flag Pins and Signs) need to be moved into the correct departments.	02/08/2013	03/08/2013	1 hrs	Matt
A title needs to be added to each of these pages explaining how the customer uses the tool. The title needs to be above the drop down options and must stand out. I suggest using the below text:	05/08/2013	06/08/2013		Matt
For Flag Pins: To build your complete flag pin please choose from the dropdown menus below. Your product code and price will be displayed once you have chosen your options.	06/08/2013	07/08/2013	0.5 hrs	Matt
For Flags: To create your complete flag please choose from the dropdown menus below. Your product code and price will be displayed once you have chosen your options.	07/08/2013	08/08/2013	0.5 hrs	Matt
For Signs: To build your complete sign please choose from the dropdown menus below. Your product code and price will be displayed once you have chosen your options.	08/08/2013	09/08/2013	0.5 hrs	Matt
For standard full size flag pins I don't think the second drop down (flag pin height) works well. Can we swap the 3rd drop down around with the 2nd drop down? This would make the process more user friendly.	09/08/2013	10/08/2013	4 hrs	Matt

Image changes and improvements			4	
Flag Pin configuration: All images need to be worked on. There is currently a problem displaying the full size tournament pins as they look too short.	16/05/2013	17/05/2013	4 hrs	Kirsty
The images for BMS signs need to be corrected as in some of the options there is a gap	17/05/2013	18/05/2013	4 hrs	Kirsty
I want to change the images for basket, currency, login and mail but I need more space as the current icons are too small.	03/07/2013	04/07/2013	3 hrs	Matt
Fix Images on Email	04/07/2013	05/07/2013	3 hrs	Matt
Images need sorting out for the custom section.	05/09/2013	06/09/2013	1	Matt
For Standard full size pins the top images need to be replaced as they are too difficult to understand. The actual connection need to be shown.	09/09/2013	10/09/2013	3 hrs	Matt
Change images on Flag Pin Configurator	09/09/2013	10/09/2013	4 hrs	Matt
Adding payment icons to every page	10/09/2013	11/09/2013	3 hrs	Matt

CMS systems training			8	
Systems usibility training	05/11/2013	14/11/2013	7	Nabeel
Create documentation	22/11/2013	23/11/2013	1	Nabeel

Further technology Implementation | | | 7 | |

Product packaging and dispatch software			7	
Have multiple meetings with different companies to understand the services they provide.	03/12/2012	08/12/2012	5	Nabeel
Integrate it with the web portal			N/A	
Research link technologies between CMS and accounting system	06/02/2013	08/02/2013	2	Nabeel
Implement link between CMS and accounting system			N/A	

3   Appendix C

This appendix is dedicated to customisation examples. All of the images have been redacted to secure sensitive information and customer identity.

3.1   Custom Email For Account Creation
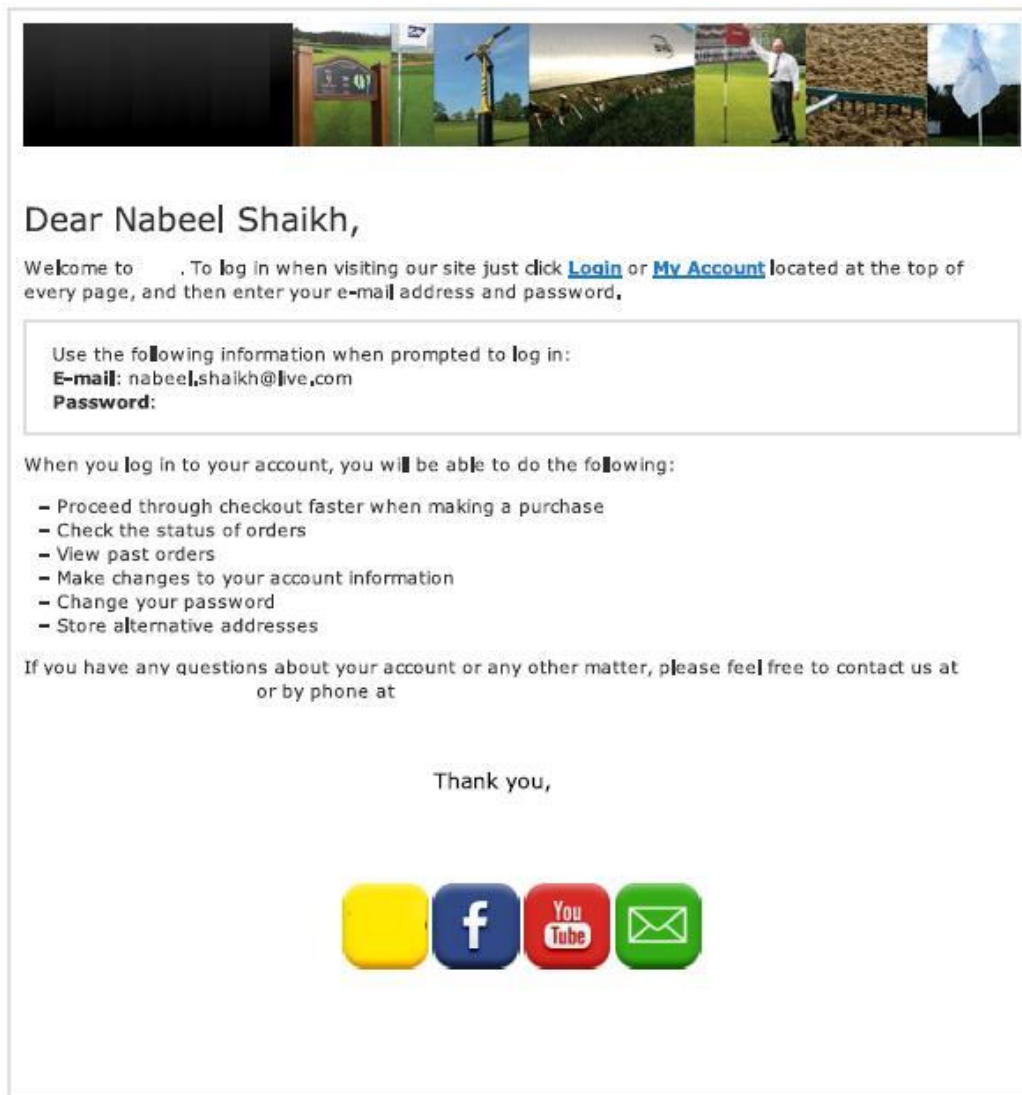
This is the email that the customer receives when he/she first registers to the website. The consultant had to customise it to suit the needs of the case study.

3.2 Email Confirmation For Order By Credit Card

Hello, Nabeel Shaikh

Thank you for your order from   Once your package ships we will send an email with a link to track your order. You can check the status of your order by **logging into your account**. If you have any questions about your order please contact us at **info@**   or call us at Monday – Friday, 8am – 5pm GMT.

Your order confirmation is below. Thank you again for your business.

Your Order #100000561 (placed on 3 March 2014 23:54:07 GMT)

Billing Information:	Payment Method:
Nabeel Shaikh 9 Cardington Road Bedford, MK420BN United Kingdom T: 07914419665	Credit Card or Debit Card CC Type: **VISA** CC Number: *********9217

Shipping Information:	Shipping Method:
Nabeel Shaikh 9 Cardington Road Bedford, MK420BN United Kingdom T: 07914419665	Arrange Own Collection (07,30 - 16:30 GMT)

Item	Sku	Qty	Subtotal
TestProductOne	TestProductOne	1	£0.01
		Subtotal	£0.01
		Shipping & Handling	£0.00
		Grand Total	**£0.01**

Thank you,

The system gives the customer various options for order payment, these depend on the type of customer. If the customer pays by Credit Card then this is the email received which is customised to the needs of the case study.

3.3 Email Confirmation For Credit Card Invoice

Hello, Nabeel Shaikh from

Thank you for your order from   You can check the status of your order by **logging into your account**. If you have any questions about your order please contact us at **info@**   or call us at
Monday – Friday, 8am - 5pm PST.

Your Invoice #100000290 for Order #100000561

Billing Information:

Nabeel Shaikh
9 Cardington Road
Bedford, MK420BN
United Kingdom
T: 07914419665

Payment Method:

Credit Card or Debit Card

CC Type: VISA

CC Number: *********9217

Shipping Information:

Nabeel Shaikh
9 Cardington Road
Bedford, MK420BN
United Kingdom
T: 07914419665

Shipping Method:

Arrange Own Collection (07.30 – 16:30 GMT)

Item	Sku	Qty	Subtotal
TestProductOne	TestProductOne	1	£0.01
		Subtotal	£0.01
		Grand Total	**£0.01**

Thank you,

If the customer pays by Credit Card then this is the invoice email that the customer receives.

3.4 Email Confirmation For Order By Internal Credit

Hello, Nabeel Shaikh

Thank you for your order from   Once your package ships we will send an email with a link to track your order. You can check the status of your order by **logging into your account**, If you have any questions about your order please contact us at **info@**   or call us at Monday – Friday, 8am – 5pm GMT,

Your order confirmation is below. Thank you again for your business.

Your Order #100000559 (placed on 3 March 2014 23:28:45 GMT)

Billing Information:	Payment Method:
Nabeel Shaikh 9 Cardington Road Bedford, MK420BN United Kingdom T: 07914419665	Internal Credit

Shipping Information:	Shipping Method:
Nabeel Shaikh 9 Cardington Road Bedford, MK420BN United Kingdom T: 07914419665	Arrange Own Collection (07.30 - 16:30 GMT)

Item	Sku	Qty	Subtotal
TestProductOne	TestProductOne	1	£0.01
		Subtotal	£0.01
		Shipping & Handling	£0.00
		Vat	£0.00
		Internal Credit	-£0.01
		Grand Total	**£0.00**

When the customer pays by internal credit this is the email that is received. These emails are customised to the requirements of the case study.

3.5 Email Confirmation For Internal Credit Invoice

Hello, Nabeel Shaikh from

Thank you for your order from   . You can check the status of your order by logging into your account.
If you have any questions about your order please contact us at info@   com or call us at
Monday – Friday, 8am – 5pm PST.

Your Invoice #100000288 for Order #100000559

Billing Information:

Nabeel Shaikh
9 Cardington Road
Bedford, MK420BN
United Kingdom
T: 07914419665

Payment Method:

The debt arising from this invoice has been
assigned to:
Bibby Factors International Ltd
Packington House, 3–4 Horsefair,
Banbury, Oxon, OX16 0AA
U.K. Tel +44 1295 672920.

Payment should be to BIBBY FACTORS
INTERNATIONAL LIMITED and sent by cheque to
this address or by direct bank transfer to:

Barclays Bank Plc, Corporate Banking,
48b - 50 Lord Street,
Liverpool, L2 1TD

Account No. 40533211
Sorting Code 20-51-01(Swift Code BARCGB22)

Quote as a reference your supplier's name and
invoice number. Payment to any other party
will not constitute a valid discharge of the
debt. If this invoice is found to be incorrect in
any respect Bibby Factors International Ltd
should be notified immediately.

Shipping Information:

Nabeel Shaikh
9 Cardington Road
Bedford, MK420BN
United Kingdom
T: 07914419665

Shipping Method:

Arrange Own Collection (07.30 - 16:30 GMT)

Item	Sku	Qty	Subtotal
TestProductOne	TestProductOne	1	£0.01
		Subtotal	£0.01
		Vat	£0.00
		Internal Credit	−£0.01
		Grand Total	**£0.00**

Thank you,

Invoice email received by the customer when paying by internal credit. This
email is customised to the liking of the case study.

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3.6 Email Confirmation Of Order By Bank Transfer

Hello, Nabeel Shaikh

Thank you for your order from   Once your package ships we will send an email with a link to track your order. You can check the status of your order by **logging into your account**. If you have any questions about your order please contact us at **info@**   **.com** or call us at Monday – Friday, 8am – 5pm GMT.

Your order confirmation is below, Thank you again for your business,

Your Order #100000558 (placed on 3 March 2014 23:04:30 GMT)

Billing Information:	Payment Method:
Nabeel Shaikh 9 Cardington Road Bedford, MK420BN United Kingdom T: 07914419665	Bank Transfer Payment Please make payment to the relevant bank details below :- Brit Santander Sort Code: 09-02-22 Account No: IBAN: BIC (SWIFT):

Shipping Information:	Shipping Method:
Nabeel Shaikh 9 Cardington Road Bedford, MK420BN United Kingdom T: 07914419665	Carriage

Item	Sku	Qty	Subtotal
i-PRO Golf Hole Cutter	50094	1	£695.00
i-Pro blade option iPro Hole Cutter c/w Clay Blades			

	Subtotal	£695.00
	Shipping & Handling	£12.95
	Vat	£141.59
	Grand Total	**£849.54**

Thank you,

If the customer can do bank transfer payments, this is the email a customer will receive when doing such a payment.

3.7 Email Confirmation Of Invoice By Bank Transfer

Hello, Nabeel Shaikh from

Thank you for your order from   . You can check the status of your order by **logging into your account**.
If you have any questions about your order please contact us at **info@**   **.com** or call us at
Monday – Friday, 8am – 5pm PST.

Your Invoice #100000287 for Order #100000558

Billing Information:

Nabeel Shaikh
9 Cardington Road
Bedford, MK420BN
United Kingdom
T: 07914419665

Payment Method:

Bank Transfer Payment

Please make payment to the relevant bank details
below :-

Santander

Sort Code:

Account No:

IBAN:

BIC (SWIFT):

Shipping Information:

Nabeel Shaikh
9 Cardington Road
Bedford, MK420BN
United Kingdom
T: 07914419665

Shipping Method:

Carriage

Item	Sku	Qty	Subtotal
i-PRO Golf Hole Cutter	50094	1	£695.00
i-Pro blade option			
iPro Hole Cutter c/w Clay Blades			

	Subtotal	£695.00
	Shipping & Handling	£12.95
	Vat	£141.59
	Grand Total	**£849.54**

Thank you,

When a customer pays by bank transfer this is the invoice email produced.

3.8 Email Confirmation Of Order By PayPal

Hello, Nabeel Shaikh

Thank you for your order from   Once your package ships we will send an email with a link to track your order. You can check the status of your order by **logging into your account**, If you have any questions about your order please contact us at **info@**   **com** or call us at Monday – Friday, 8am – 5pm GMT,

Your order confirmation is below. Thank you again for your business.

Your Order #100000560 (placed on 3 March 2014 23:33:36 GMT)

Billing Information:	Payment Method:
Nabeel Shaikh 9 Cardington Road Bedford, MK420BN United Kingdom T: 07914419665	**PayPal Website Payments Standard** **Payer Email:** nabeel.shaikh@live.com

Shipping Information:	Shipping Method:
Nabeel Shaikh 9 Cardington Road Bedford, MK420BN United Kingdom T: 07914419665	Arrange Own Collection (07.30 - 16:30 GMT)

Item	Sku	Qty	Subtotal
TestProductOne	TestProductOne	1	£0,01
		Subtotal	£0,01
		Shipping & Handling	£0,00
		Grand Total	**£0,01**

Thank you,

The customer has the facility to pay by PayPal, this is the order confirmation email that is received when paying by PayPal.

3.9 Email Confirmation Of Invoice By PayPal

When paying by PayPal an invoice confirmation is generated and the above email is what the customer will receive.

3.10 Packing Slip For Order Postage

Packingslip # 100000077
Order # 100000629
Order Date: 11 Mar 2014

Sold to:	Ship to:
Nabeel Shaikh 9 Cardington Road Bedford, MK420BN United Kingdom T: 07914419665	Nabeel Shaikh 9 Cardington Road Bedford, MK420BN United Kingdom T: 07914419665

Payment Method	Shipping Method:
Internal Credit	Arrange Own Collection (07.30 - 16:30 GMT) (Total Shipping Charges £0.00)

Qty	Products	SKU
2	BMS Signs	BMS_Signs-SBGCCUSTXT-STCU STXT
	Choose your plate size: 1 x Sign Plate 8 x 6 £12.95	SI1
	Choose your text and background colour: 1 x CUSTOM £3.50	STBGCUS
	Choose your text: 1 x CUSTOM £0.00	STXTCUS
	8x6 Ground Stake Options 1 x Standard Aluminium Stake 19" £3.99	AS19

Custom text and background colour:
Custom text and background colour:Custom text and
background colour:Custom text and background
colour:Custom text and background colour:Custom
text and background colour:
Custom text:
Custom text:Custom text:Custom text:Custom
text:Custom text:Custom text:Custom text:Custom
text:Custom text:Custom text:Custom text:Custom
text:Custom text:Custom text:

For the warehouse staff to pack the orders they need a Packing Slip this is generated by the system. The packing slip shown in this example is customised to the liking of the case study.

3.11 Picking List For Order Postage

Picklist # 100000629
BMS Internal Order # 100000629
Order Date: 11 Mar 2014   Processed By : james at : 2014-03-11 22:25:41

BMS CUSTOMER DETAILS:	DELIVER TO:
Nabeel Shaikh 9 Cardington Road Bedford, MK420BN United Kingdom T: 07914419665	Nabeel Shaikh 9 Cardington Road Bedford, MK420BN United Kingdom T: 07914419665

Qty	Products	SKU
2	BMS Signs	BMS_Signs-SBGCCUSTXT-STCU STXT
	Custom text and background colour: Custom text and background colour:Custom text and background colour:Custom text and background colour:Custom text and background colour:Custom text and background colour: Custom text: Custom text:Custom text:Custom text:Custom text:Custom text:Custom text:Custom text:Custom text:Custom text:Custom text:Custom text:Custom text:Custom text:Custom text:	
2	Sign Plate 8 x 6	SI1
2	Standard Aluminium Stake 19"	AS19

COMMENTS	INTERNAL INFORMATION:
No Comments	No Of Items:_____ Despatched Date:_____ Packed By:_____

The warehouse staff requires a list of products that they need to pack when the order arrives. This is the pickling list that the system generates for this purpose. The Pick list has been customised to the liking of the case study.

3.12 Custom Internal Order Screen

The case study requires the addition on PO Number field which is shown at the lower left corner of the screen. The software doesn't come with this feature hence had to be developed.

3.13 Custom Customer View Grid

The view customer grid required an addition field called Company / Club, the system does not come with such a field and had to be customised.

3.14 Custom Customer Information View Form

The Company / Club field had to be added to the customer accounts section in order for certain processes to be complete.

3.15 Custom Admin Customer Internal Credit Form

The internal credit module needed to be added in order for the customer to have the additional functionality of customer credits.

3.16 Custom Customer Registration Form

The customer registration screen needed to be modified to add Company / Club field.

3.17 Custom Front End Billing Screen

The invoice email functionality was added to satisfy customisation needs.

3.18 Custom Front End Payment Options

Depending on the type of customer there can be multiple payment options.