

**Enterprise Resource Planning (ERP) adoption in a  
hybrid service and manufacturing Small and Medium-  
sized Enterprise (SME): an action case study**

**Chinedu Anthony OFOEGBU**

**Salford Business School  
University of Salford, Salford, UK**

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## ***Dedication***

It is with great pleasure, that I dedicate this thesis to my wife, Lilian Kudzie Kumire-Ofoegbu, my five years old daughter, Uchechukwu Ruvarashe Audrey Ofoegbu and son Daniel Chinedu Kudzaishe Ofoegbu who throughout the course of this study patiently supported me. My little girl, as I call my daughter, always understood that 'Daddy was doing his research'.

Finally, I also dedicate this thesis to my lovely late mother, Augustina Uchechukwu Ofoegbu, who would have been very proud to read this work.

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## ***Declaration***

This thesis contains material which the author has used before in the following publications:

Griffiths et al. (2013). The Real SAP Business One Cost: a case study of ERP adoption in an SME. *International Journal of Management Practice*, 6(2), 199 - 215.

Ofoegbu et al. (2011). *Themes and challenges for service management solutions in Small and Medium Enterprises (SMEs)*. Paper presented at the UKAIS 2011 conference, Oxford.

## ***Abbreviations***

The following abbreviations are used in this thesis:

BPI – Business Process Improvement

BPR – Business Process Redesign

ERP – Enterprise Resource Planning

GDP – Gross Domestic Product

HVAC – Heating, Ventilation and Air Conditioning

IS – Information Systems

KMS - Knowledge management systems

KTP – Knowledge Transfer Partnership

M&E – Mechanical and Electrical

MRP – Material Requirement Planning

SAP - Systems, Applications and Products in Data Processing

SME – Small and Medium-sized Enterprise

UK – United Kingdom

## ***Definitions***

The following terms have specific meaning in this thesis:

***Enterprise Resource Planning systems (ERP systems):*** An ERP system according to Saini et al. (2013) is an enterprise wide packaged software system that helps an organisation like an SME to manage and effectively use its resources (materials, human resources, finance and so on) by providing an integrated solution for its information processing needs.

**Business process evaluation -**

***HVAC:*** HVAC is the acronym for **H**eating, **V**entilation and **A**ir **C**onditioning. HVAC is often referred to by industry professionals to be exclusively defined as thermal comfort and air quality (2009).

**Information processing:** Information processing can be defined as the collection of tasks and activities involved with the creation, processing, transfer, storage, retrieval and application of information (Desouza et al., 2008).

**Information Systems (IS):** Information systems can be defined as the overall information processing in an organisation, this includes the associated human players and the information technology used to achieve the goal (Ammenwertha et al., 2003).

**Material Requirement Planning (MRP):** Is a production, planning and inventory control system, usually software based, used by organisations to manage manufacturing processes.

***Spraybooth:*** A spraybooth is a painting technique where a device sprays a coating of paint or ink onto a surface through the air, within an enclosure.

***Small and Medium-sized Enterprise (SME):*** For the purpose of this study the HM Revenue and Customs classification of an SME is adopted, which defines an SME as an organisation with

fewer than 500 employees and either an annual turnover not exceeding €100million or a balance sheet not exceeding €86million (Customs, 2008).

## ***Abstract***

There is a growing need for understanding business process re-engineering within SMEs such as the service management companies and this calls for more research focusing on Enterprise Resource Planning (ERP) and implementation. The aim of this study is to highlight the impact of an in-depth business process analysis during the pre-adoption and implementation of an ERP system in a hybrid service and manufacturing Small and Medium-Sized Enterprise (SME). Service management SMEs are identified as lacking in research focus especially in service operations, and in hybrid organisations that combine manufacturing and service provision.

The study extends the existing knowledge in business process analysis and ERP adoption research by drawing upon the interpretive action case and Organisational Information Processing Theory (OIPT). The emphasis is on the impact of appropriate business process analysis during the pre-adoption decision making of an ERP system in a hybrid service and manufacturing SME. Primary data was collected using an online survey with 72 customer responses, questionnaires for in-company observations and third party meetings conducted at an SME in the North West of England, UK.

OIPT specifically states that organisations are structured around information and the flow of information in order to minimise uncertainties. The theory suggests the use of information processing needs and information processing capabilities of an organisation to find an optimal performance. The theory however made no suggestion of how to find this optimal performance. Customising OIPT as the theoretical framework, the current study identified two variables a) *information processing needs* and b) *information processing capability* of the case organisation and used Value Stream Mapping (VSM) to analyse both variables in order to obtain an optimal fit during IS/IT pre-adoption decision making. The current study takes an original approach by combining and customising OIPT with VSM to the needs of the current study. It also highlights existing wastes in the business process and areas of improvement are suggested while mapping the information processing needs and information processing capabilities of the organisation.

The study used action case methodology to provide a rich insight into business process analysis and ERP pre-adoption in a hybrid service and manufacturing SME. The current study was

conducted over a period of two years from January 2010 to December 2011. The author was fully immersed into the study as both a participant and a researcher. The action case provided an environment where information processing needs and information processing capabilities as well as the application of VSM could be studied while analysing the resultant implications. Using action case, the current study was able to focus on pre-adoption decision making and monitored the initial impact of action on the case. The key finding is that OIPT and VSM are compatible and offer an opportunity of closing the weaknesses of not being able to identify the optimal fit when using OIPT alone during business process analysis.

The contributions to knowledge are: i) Modification of OIPT in the form of OIPT2.0 to reproduce the current state as well as develop the future state value stream to suggest the optimal fit between the information needs and capability of an organisation. ii) Emphasis on extensive scoping during an IS/IT pre-adoption process aids the identification and adoption of an ERP system which best fits the business process and also suggests areas of the business process which could benefit from improvement. iii) The study also creates more awareness of action case methodology by demonstrating how it provides a rich insight into the process of ERP pre-adoption decision making in a hybrid SME. iv) Recommendation is made to the definition of hybrid service and manufacturing SME.



## ***Chapter One: Introduction to the research problem***

### ***1.1 Introduction***

The primary focus of this work is to explore the business process analysis practice at the pre-adoption and implementation stages of an Enterprise Resource Planning (ERP) system in hybrid service and manufacturing Small and Medium Sized Enterprise (SME). The SME is classified as *hybrid* as a result of its business processes being neither wholly service oriented nor it being wholly manufacturing oriented, rather the business process combines both service and manufacturing elements. Specifically, this study focuses on three main themes: the specialist hybrid service and manufacturing business processes in an SME; business process analysis using Value Stream Mapping (VSM); and Organisational Information Processing Theory (OIPT), which are largely under-investigated themes in hybrid SMEs.

This chapter will problematize the importance of SMEs to national economies and go on to establish the uniqueness of the hybrid service and manufacturing business processes in the heating, ventilation and air conditioning (HVAC), spraybooth and the Mechanical and Electrical (M&E) service sector. Subsequently, this chapter will present an understanding of service management ideas and issues relating to business processes and ERP adoption and implementation within hybrid service and manufacturing organisation. Business processes and their role in ERP system implementation are also introduced in this chapter. The scope of the thesis is outlined and emphasis is placed on the use of Value Stream Mapping and Organisational Information Processing Theory, which are introduced and their importance highlighted. These themes lead on to discussion of the justifications for the research questions, anticipated contributions to knowledge and structure of the thesis.

### ***1.2 SME and hybrid service and manufacturing management***

Small and Medium-Sized Enterprises (SMEs) constitute more than 90% of businesses in the UK and also employ 59% of the private sector workforce (Department for Business, 2011, Kumar et al., 2009, ONS, 2010a, Blackburn et al., 2013). The importance of SMEs to a country's economy is not unique to the UK alone, as according to European Commission (2013), Saunders et al. (2014) and World Bank Institute (2004) other European and international countries are similar

in that SMEs represent between 97% and 99% of all enterprises and between 50% and 70% of total employment (Mutula and Van Brakel, 2006). This indicates the consistent dominance of SME's contribution to these economies over recent years. An SME was defined in 2008 as an organisation with fewer than 500 employees and either an annual turnover not exceeding €100 million or a balance sheet not exceeding €86 million (Customs, 2008). A more recent definition of SME was given by the European Commission in 2013 as an organisation with 10 to 250 employees and a turnover above €2 million but not exceeding €50 million (European Commission, 2013). For the purpose of this study the European Commission's classification of an SME is adopted.

Manufacturing activities are relocating to competitive labour markets and an increasing number of SMEs are outsourcing some of their activities to service industries (Chen et al., 2011, Voutsina and Mourmant, 2010). They are outsourcing areas of activity where they lack technological know-how (Abdul-Halim et al., 2012), such as equipment servicing and maintenance. In general, the impact of service management on the UK economy, for example, constitutes 74% of the UK Gross Domestic Product (GDP) (ONS, 2010) and in 2013 this figure has increased to 80% (ONS, 2014).

### ***1.3 Research motivation, context and constraints***

Whilst the GDP figure mentioned in section 1.2 includes both private sector and government services, customer expectations in terms of service quality provision are increasing, regardless of the type of service and the provider's size (Hung et al., 2014). Consequently, innovation in service industries has placed emphasis on improvements in service quality, customer management, service management and operations management (Hertog et al., 2010), all of which could further impact the GDP figures. These innovations in service management are increasingly driven by the need to improve service, and are made possible using the latest information technology tools such as an ERP system, mobile devices, and increasingly web integrated e-business systems. In support of the argument for innovation in service management, Asif de Bruijn *et al.* (2009) and Xu and Zhao (2010) argue that a traditional focus

on customer satisfaction alone is no longer sufficient for assessing the quality of services provided to customers.

Increasingly, SMEs are finding themselves in a situation where their core mission is expanded due to the necessity to be competitive and as a result, organisations that start out by offering service only tend to diversify to manufacturing or those that were in manufacturing expand to service offerings (Neely, 2008, Oliva and Kallenberg, 2003, Griffiths et al., 2013).

This diversification into manufacturing from a service only business strategy, presents unique challenges for these 'hybrid' SMEs – namely business process alignment and integration – where business process automation and ERP systems are often used to help the integration of these (Cheng et al., 2010). There is therefore a need to explore the specific challenges faced in the hybrid industry when they adopt and implement an ERP system.

In order to establish a clear understanding of the HVAC, spraybooth and Mechanical and Engineering (M&E) services' uniqueness, an understanding of the general service and manufacturing sector is required. A service-oriented process does not have a physical output made from the transformation of raw materials while a manufacturing oriented process uses raw materials as bill of materials to produce a physical output. Despite available literature which clarifies ERP pre-adoption decision making in manufacturing business process and that of a service business process (Buonanno et al., 2005, Ram et al., 2013), little is known about the hybrid business process.

The lack of research in VSM application in the hybrid business process and the complexity of combining both service and manufacturing business processes support the current study's justification for studying the impact of business process analysis using Value Stream Mapping in implementing an ERP system. One of the challenges faced by the specialist service (HVAC) management industry could be the lack of adequate research which evaluates the needs in relation to systems implementation. This lack of adequate research in the hybrid service and manufacturing business process is in comparison to the manufacturing sector, which is relatively more popular, in terms of research focus than the service sectors which will be discussed in the literature review chapter.

The term "hybrid" in this study refers to an organisation whose business strategy involves both;

- a) Specialist service on equipment on the customer's site and
- b) Manufacturing of the materials used in carrying out the specialist service.

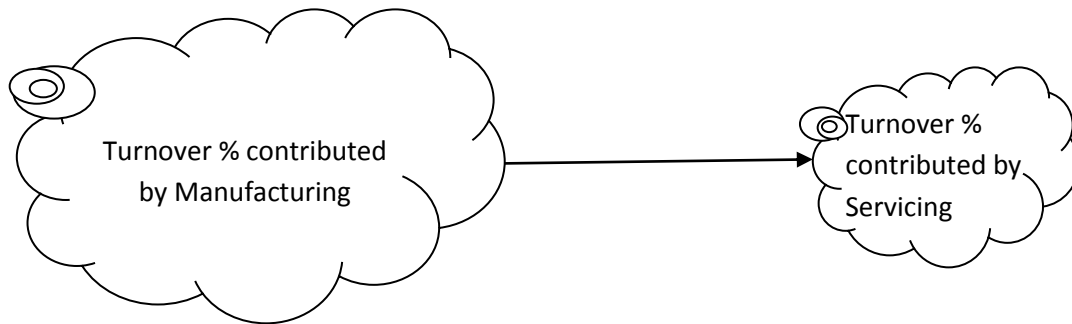


Figure 1.1: Typical hybrid business composition

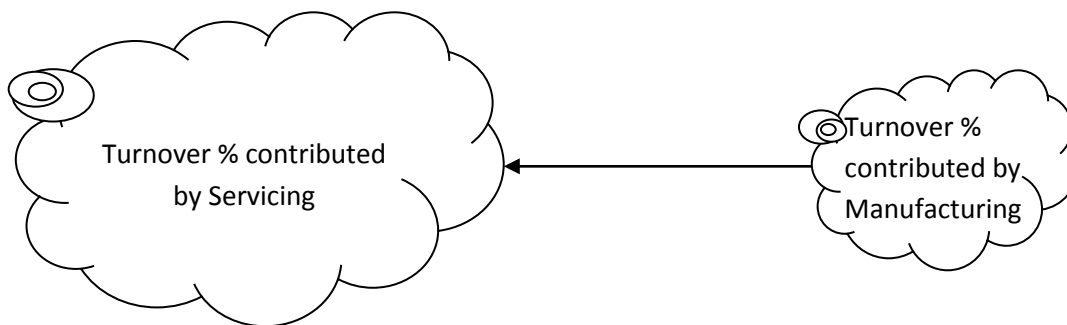


Figure 1.2: Hybrid business composition referred to in this study

Figure 1.1 above, illustrates that a larger percentage of a business turnover comes from manufacturing and is the most popular type of hybrid organisation. According to Neely (2008) and Visnjic and Van Looy (2011), globally over 60% of manufacturing firms now offer services with the share of service sales reaching 31%. In figure 1.2, however, a larger percentage of the business turnover comes from service when compared to manufacturing. An example of a large hybrid organisation is Rolls-Royce Aerospace which evolved from pure manufacturing of aero engines to also provide maintenance and overhaul services (Neely, 2008). However, the scope of this study is to examine SMEs, in particular one case of a hybrid service and manufacturing SME which specialises in HVAC (Heating, Ventilation and Air Conditioning) servicing and filter

manufacturing. In this hybrid service and manufacturing SME, a larger percentage of its business and turnover comes from service and a smaller proportion from manufacturing.

On the one hand, it has been suggested that business process analysis help reduce waste in manufacturing SMEs (Faisal et al., 2012) however, there is little known on how business process analysis can help service oriented SMEs during an IS/IT pre-adoption decision making or during business process re-engineering. The existing literature (Panayiotou et al., 2015, Beheshti et al., 2014) documents how to improve the process of adopting an ERP system in especially manufacturing business process in order to have a successful implementation. Meanwhile, a few have suggested the impact of business process analysis in ERP system adoption in the manufacturing SME (Panayiotou et al., 2015). In comparison to the amount of research covering the manufacturing business process, not much has been done in the service oriented business process analysis (Papazoglou et al., 2008), especially while adopting and implementing an ERP system.

The ERP system adoption and implementation is an expensive and a complex process and organisations anticipate carrying this out once and to last a long time, the current study is interested in the details of the pre-adoption decision making and is therefore focusing on a single case. Another constraint identified from the current study is that the researcher had two years of the Knowledge Transfer Partnership (KTP) duration within which access to the case SME is granted in order to complete the process of data collection.

#### ***1.4 Background and role of the researcher and the KTP***

This research started as a KTP (Knowledge Transfer Partnership) between the University of Salford and the case organisation. The case organisation, having identified that their current system was inefficient in satisfying their business needs, supported an extensive study to be carried out through this partnership. As a result, the researcher was employed by the University of Salford to carry out the research on the business processes of the case organisation and the pre-adoption and implementation of a suitable ERP system capable of supporting the case SME's business needs. The current SME, as stated in 1.3 above, is a business type that started off as a service SME but to make it more strategic, diversified into manufacturing hence

operates a service and manufacturing business strategy. The researcher previously worked in a similar role with another UK university where he successfully used business analysis to align the ERP system to the business processes. The study satisfied two needs being a KTP, the organisation's practical need to obtain the most suitable ERP system and the university's need to research the process of obtaining the most suitable ERP system focusing in particular on the pre-adoption decision-making.

### ***1.5 Business process analysis in an SME***

Evolving from Material Requirements Planning (MRP) systems in the 1970s (Chung and Snyder, 2000), Enterprise Resource Planning (ERP) has played an important role in IT for over forty decades (Chung and Snyder, 2000). ERP, as defined earlier, is an industry term for the broad set of activities supported by multi-module application software which, when implemented successfully, helps a manufacturing or a service organisation manage the important parts of its business (Huang and Palvia, 2001, Beheshti et al., 2014, Panayiotou et al., 2015).

Although ERP systems have become an essential part of many SMEs, unlike past information system applications, these are off-the-shelf solutions that impose their own business process logic on the adopting company, often forcing companies to change the way they do business (Huang and Palvia, 2001, Beheshti, 2006). Therefore the lack of redesigning of the business processes before adopting and implementing an ERP system could pose a challenge to many SMEs wishing to adopt and implement an off-the-shelf ERP system. This is more critical for a hybrid service and manufacturing business process. Huang and Palvia (2001) and Voordijk, Stegwee and Helmus (2005) recognised a decade ago that from an organisational perspective, the lack of business process analysis and business process redesign may hamper ERP system adoption and implementation in an SME. A survey conducted by Trunick (1999a) identified that approximately 20% of implementations failed. However, a more recent survey conducted in 2013 suggested that this figure has grown to about 67% of ERP system implementations failures due to improper analysis (Garg and Garg, 2013) of both business processes and ERP functionalities. It can therefore be deduced that regardless of the size of the organisation there is need for adequate business process analysis. According to Gargeya and Brady (2005), some of

the reasons for ERP failure is the lack of: mapping functionalities to business processes; project team/management support; user training; dealing with organisational diversity; planning/budgeting/development and; adequate testing. Voordijk *et al.* (2005) however, in their study gave no practical indication regarding how lack of business process analysis affects the whole experience of ERP adoption in an SME. In a more recent study, Ekman *et al.*, (2014) identified that the migration from a legacy system to the adoption of an ERP system requires the adaptation of the present and future business processes. During the implementation of an appropriate ERP system, SMEs must understand its value-added business processes (Ekman *et al.*, 2014) which can be achieved by carrying out a business process analysis. Hence, there is the need to investigate how business process analysis impacts the overall experience of ERP system pre-adoption and implementation in an SME, such as a hybrid service and manufacturing SME.

Garg and Garg (2013) have suggested that with the high rate of failure of ERP systems implementations, researchers are driven to investigate the factors underlying failure and how to mitigate these failures. It is therefore necessary to evaluate how business process analysis, if conducted properly before the adoption and implementation (pre-adoption) of an ERP system, could ensure greater likelihood of success of the whole ERP adoption and implementation process. Huang and Palvia (2001) and Nkhoma *et al.*, (2014) suggest the use of a case study for studying how variables such as business process analysis may impact ERP system adoption and implementation. In light of the above, an action case approach will be used in this research, and will be further justified and discussed in the methodology chapter.

### ***1.5.1 Organisational Information Processing Theory***

In terms of the importance attached to organisational data and information, the success or failure of information processing cannot be left to chance but requires a thorough study of the organisation's structure and business processes (Burke, 2003). Information processing has been defined by Tusman and Nadler (1978) as the gathering, interpreting and synthesizing of information by organisations for strategic decision making. SMEs require information to be processed in order to make more information available, while also reducing the need for unnecessary information. It was recognised as early as 1991 that Organisational Information

Processing Theory requires the translation of strategic information needs, business processes and environmental conditions into their respective implications for information processing (Egelhoff, 1991).

Organisational Information Processing Theory contends that in order to achieve successful ERP adoption and implementation, organisational structures must match the information processing requirements which arise as a result of the complexities of the business activities and the operating environment (Meijboom et al., 2007). Therefore, there is a link between information processing theory and business process analysis.

It could also be argued that an SME can increase its labour capacity in order to adequately process information, hence there is an important need for SMEs to invest in a robust information system such as an ERP system. Some of the theories used in information systems research considered in this work are Theory of Critical Success Factor, Actor Network Theory, Technological-Organisational-Environment (TOE) framework, Technology Acceptance Model (TAM) and Organisational Information Processing Theory (OIPT). Organisational Information Processing Theory was chosen as the best fit for the current study and the reason will be further justified in the literature review chapter.

This research will seek to use Organisational Information Processing Theory to understand uncertainties such as the difference between the amount of information required to perform a specific task and the amount of information the organisation uses to perform the same task. This will be achieved using Value Stream Mapping to map out the current state of information capability in the case study organisation and the future state with respect to information flow of the business as justified and discussed in the literature review chapter. The use of Value Stream Mapping is as a result of its ability of identifying areas of waste and identifying the exact information required to perform specific tasks.

## ***1.6 Research problem, questions, objectives and contributions to knowledge***

So far this chapter has outlined the main issues faced by the hybrid service and manufacturing organisation. The special case of HVAC industry and the action case of Alpha have been introduced as the ability to evaluate and adopt an IS/IT system which is capable of using the information processing needs and information processing capability of the organisation to find



an optimal performance of the business processes. The theoretical lens to this work through OIPT and VSM has also been introduced. This section will discuss the main research problems in relation to the themes of this research. The research problems: the specialist hybrid service and manufacturing industry; business process analysis using Value Stream Mapping and; Organisational Information Processing Theory in an SME are identified as areas which are under-researched, and as a result forms a focus of this research. Relevant research questions are outlined in order to help focus the discussion, and anticipated contributions to knowledge are identified. A graphical representation of this research is provided in relation to a conceptual framework.

### ***1.6.1 Research problem: Specialist hybrid service and manufacturing industry***

As ERP systems become more common and are in increasing demand by organisations such as hybrid service and manufacturing SMEs, it is argued that the integration of ERP systems into the SME's business process is mostly partial (Hakkinen and Hilmola, 2008). Partial implementation of ERP systems at its core leans that not all functionality is being utilised to the best advantage of an organisation and may be interpreted by some users as failure of the overall ERP implementation. It has been suggested that ERP systems adoption in SMEs has lagged behind implementations in larger companies (Haug et al., 2010). Although a substantial amount of academic research has been done on the implementation of ERP systems in large organisations across the globe, small and medium-sized organisations have not received similar attention (Saini et al., 2013). Hybrid service and manufacturing SMEs have not been well studied as a special case. The focus of this study is therefore on the implementation and customisation of an ERP system in a hybrid service and manufacturing SME.

When a search was conducted in October 2014 on the 'Emerald' database using the search term 'ERP Implementation' a total of 292 journal articles were found, however, when the search was further refined to return studies on ERP implementation in service related studies, no result was found. When a similar search for 'ERP Implementation' was conducted on the 'Business Source Premier' database, a total of 349 journal articles were found but upon refining the search to show ERP implementation in service related studies only one result was returned. This result

was titled 'Antecedents of ERP in service firms' by Oghazi (2014) and investigated the adoption of ERP systems within service firms by a survey.

This supports the contention that there has been little academic research in this area, despite a growing need from commercial stakeholders such as SMEs, who are investing heavily in this software (Oghazi, 2014) and from ERP software vendors who are continually developing new software products. The integration of service business and manufacturing business is increasing due to the growing need for businesses to adapt and develop their internal supply chains (Chung and Snyder, 2000, Neely, 2008, Oliva and Kallenberg, 2003) and so far little research has been published in this area. This supports the justification for the current study and its contribution to the academic literature on ERP pre-adoption and implementation in the hybrid service and manufacturing industry.

### ***1.6.2 Research problem: Business process analysis in an SME***

Chan et al. (2009) argue that the implementation of an ERP system is complex and requires a more systematic approach in order to ensure ERP systems are robust enough to support organisations' dynamic business goals. Saini *et al.* (2013) also suggested that with the growth in the number of SME businesses, the need for superior technology as well as planning tools drives a demand for ERP products which can cater for these requirements. HassabElnaby, Hwang and Vonderembse (2012) support this view, further suggesting that there is a need for research into the impact of ERP implementations on an SME performance and efficiency, with the aim of supporting the growth in SME businesses, as mentioned earlier in section 1.2. In an attempt to investigate this, Kokolakis, Demopoulos and Kiountouzis (2000) investigated the role that business process analysis could play in Information Security (IS) and Security Analysis and Design (IS-SAD). Researchers have also identified that business process analysis equips the researcher with visibility of activities that can be improved (Winkelmann and Weiß, 2011), which can be applied to ERP adoption and implementation in hybrid service and manufacturing SMEs. Agreeing with the above, Kokolakis *et al.* (2000), only focused on IS security and design. This research will therefore carry out an investigation into existing literature on business process analysis and will aim to contribute to the literature on how business process analysis enhances

the process of ERP systems pre-adoption and customisation in hybrid service and manufacturing SMEs.

The analysis of business processes for the purpose of pre-adoption and implementation of ERP systems generally occurs when an organisation recognizes that current business processes and procedures are inefficient in handling their current and/or future strategic needs (Chen, 2001). This study therefore attempts to understand the impact of business process analysis on the pre-adoption and implementation of an ERP system.

### ***1.6.3 Research aim and questions***

The aim of this study is to provide rich insight into the complex process of ERP implementation in a hybrid service and manufacturing SME. This will be conducted using an exploratory action case of an organisation in HVAC industry.

The specific questions addressed in this research are:

- 1: How does **business process analysis** using Value Stream Mapping impact the implementation and customisation of an ERP system in a hybrid service and manufacturing SME?
- 2: How can an SME benefit from the use **of OIPT in an ERP implementation** for an SME?
- 3: How does business process automation affect a **hybrid service and manufacturing SME**?

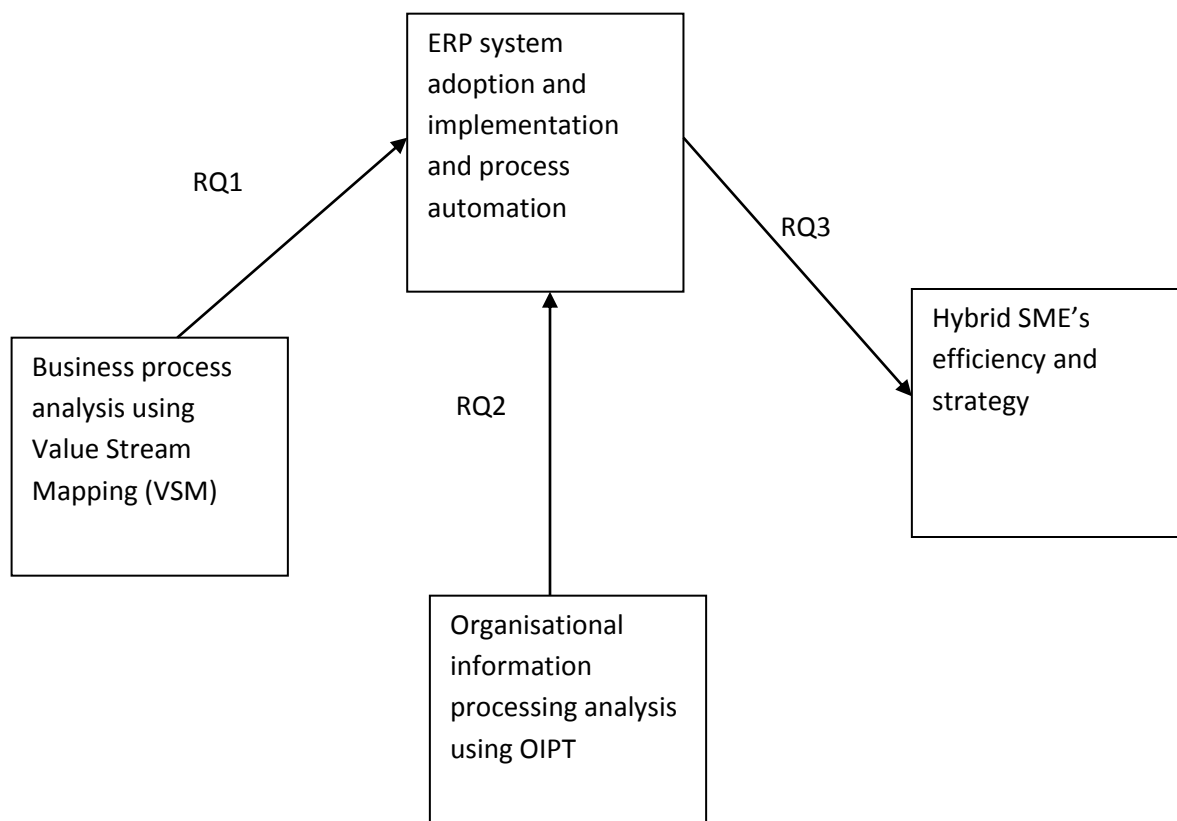


Fig. 1.3 Conceptual framework indicating relationship between VSM, Business process analysis and organisational efficiency

Figure 1.3 is a representation of a conceptual map, which highlights the four areas of concern for this study and in doing so sets out the boundaries of the research focus. Business process analysis using Value Stream Mapping (VSM) contributes to the understanding of the needs and expectations of an organisation, and is often applied when adopting and implementing an ERP system. Furthermore, the automation of business processes and the adoption of an ERP system are also thought to impact on the organisation's business processes and strategy. The conceptual frame work suggests that in order to gain a better understanding of the business processes and as a result achieve a successful process automation and ERP adoption, an understanding of the organisational information processing needs and organisational

information capabilities is required which can be gained using OIPT. As a result of the adoption of suitable ERP system and leaner business processes, organisational efficiency and the organisation's strategy are also believed to be impacted. This conceptual framework will be used to study the inter-relationship of the three themes: specialist hybrid service and manufacturing industry; business process analysis using Value Stream Mapping and; organisational information requirements and capability using Organisational Information Process Theory (OIPT). Methodologically, this study will use action case (as justified later in the methodology chapter).

#### ***1.6.4 Research Objectives***

Based on the research aim and questions above, this research has several objectives, each of which contributes to addressing identified gaps in the literature. These objectives are as follows:

1. To contribute to the use of OIPT and tools available for researchers for evaluating ERP systems pre-adoption.
2. To investigate the process of ERP pre-adoption decision-making in a hybrid service and manufacturing SME using Value Stream Mapping.
3. To contribute to the understanding of business process analysis and its influence on ERP systems pre-adoption decision making in the hybrid service and manufacturing industry.
4. To contribute to knowledge about the use of action case methodology.

#### ***1.6.5 Original contribution to knowledge***

##### ***OIPT***

This study contributes to the theory of IS/IT pre-adoption decision making in an SME to close the gap in knowledge by generating new knowledge and understanding of the IS/IT adoption processes adopted by SMEs using OIPT. The identified gap as mentioned earlier in this chapter is the ability of a hybrid SME to evaluate and adopt an IS/IT system which is capable of using the information processing needs and information processing capability of the organisation to find an optimal performance of the business processes. Although the study considered theories such as Technology Acceptance Model (TAM), Technological-Organisational-Environment (TOE) and Information Systems Success theory, these theories as suggested by Damanpour and Schneider

(2009) emphasises on the SME adopting the IS/IT system as the key role. Klein and Sorra (1996) however suggested that the fit of IS/IT system with the organisation is rather more important. Wisdom, Chor, Hoagwood and Horwitz (2013) argued that there is actually no known theory of IS/IT pre-adoption. From Wisdom et. al (2013) and Klein and Sorra (1996) arguments above, the importance of this study is based on the lack of a pre-adoption decision making theory which focuses on fit of business process and the fact that limited attention has been given to OIPT and the IS/IT pre-adoption decision making, particularly in hybrid service and manufacturing SMEs.

The current study draws on OIPT and VSM's contextualisation to offer a different theoretical perspective of the IS/IT pre-adoption decision making process. The current study was motivated by a theoretical need for improvement of the OIPT in order to make it more usable when suggesting the fit between information processing needs and information processing capability for performance of the business process. Therefore, the study extends the current limited scope of IS/IT pre-adoption decision making from its relatively over-concentration on traditional IS adoption methods such as TAM and TOE to the more stream-lined perspective offered when VSM is introduced into OIPT. The suggested approach sees IS/IT pre-adoption decision making as a socio-technological process.

Practically, the current study will help SMEs to understand their real levels of information needed and the capabilities of the various human and non-human elements as well as suggesting a tool where both variables can be processed to obtain the fit and arrive at optimal performance of the SME's business processes. This study will contribute to the existing knowledge on the application of OIPT since it is one of the few empirical studies which adopt OIPT by suggesting the enhancement of OIPT. The current study's enhancement to OIPT could suggest how OIPT can be adapted to meet future areas of studies.

### ***Hybrid service and manufacturing industry:***

Given that there is little research on ERP pre-adoption and implementation in the hybrid service and manufacturing industry, this research seeks to add to the existing research by suggesting a definition of the hybrid service and manufacturing SME's business process and also emphasising the issues they face in adopting and implementing ERP systems. The study also discussed

process features identified as essential by the hybrid service and manufacturing SME but not supported by standard ERP systems.

### ***Business process analysis in an SME:***

The need for more research about the use of tools and techniques such as business process re-engineering as a means to successfully adopt and implement IS solutions, such as ERP systems, was highlighted by Balzarova, Bamber, McCambridge and Sharp (2004) and Kemp and Low (2008). Reijers (2006) also identified the need for further research into the question of whether business process efficiency of an organisation can be measured on a process level, a departmental level or at an organisational level. Doherty and Terry (2009) argued that organisations struggle to achieve business advantage from their IT investments and suggested that focusing upon the role of IS capabilities could lead to leveraging sustainable improvements from IS initiatives. This study will contribute to the existing literature by providing greater understanding of the impact of business process analysis on the pre-adoption and implementation of an ERP system in specialist hybrid service and manufacturing organisations. This will be done through the use of a theoretical lens such as OIPT.

The contribution to knowledge and the contribution to practice are further discussed in more details in chapter six of this study.

## ***1.7 Thesis structure***

In this introductory chapter the action case organisation based in the HVAC sector has been described in terms of the hybrid service and manufacturing SME. The action case business strategy has been presented as a research area, also presented is how this area differs from research in either service or manufacturing processes. It therefore offers an opportunity for original contributions to knowledge.

For clarity an outline of the remaining chapters of the thesis is provided below:

Chapter 2: Literature review; this chapter will evaluate relevant literature within the given research area. The relationship of the literature to the three stated themes will also be

discussed in detail – business process analysis; hybrid service and manufacturing SMEs and; use of OIPT for ERP implementation. The literature will also be used to justify the theoretical approach adopted with a view to confirming the applicability of the theory to the research problem.

Chapter 3: Research methodology; the research methodology and justifications for the choice of interpretive action case study will be discussed. Furthermore, data collection tools and philosophic assumptions will be discussed, as well as research evaluation conducted using Klein and Myers (1999) interpretive research evaluation guidelines.

Chapter 4: Data Analysis; as a result of this work being based on an action case, this chapter will discuss the application of theories and methods in the case study in order to highlight how the methodology has been used to collect and analyse the data gathered. This chapter will also discuss the data in relation to the three themes which are: the specialist hybrid service and manufacturing business processes in an SME; business process analysis using Value Stream Mapping (VSM); and Organisational Information Processing Theory (OIPT).

Chapter 5: Discussion; the three themes will be discussed in light of the findings from the data analysis, whilst integrating other arguments put forward by other researchers as was documented in the existing literature.

Chapter 6: Conclusions; this chapter will summarise the findings from the research and present the conclusions for this work. Using Walsham's (2006) guidelines, the research questions will be re-visited with a view of highlighting the contributions to knowledge and practice. The chapter will also discuss the limitations of this study and the analysis in relation to the conceptual framework. Finally, future directions for research will also be discussed.



## ***Chapter Two: Literature Review***

### ***2 Introduction***

Chapter one introduced the reasoning behind the researcher's contention that greater attention needs to be paid to business process analysis and business process re-engineering in order to understand their impact on adoption and implementation of ERP systems, and IS solutions in general, within a hybrid service and manufacturing SME. Using the existing literature, this chapter seeks to establish an understanding of how business process analysis has been used in IS automation within various industries, and moreover how business process is unique within hybrid SME.

This chapter is largely organised around the three core interrelated themes of this study – hybrid service and manufacturing SMEs, business process analysis and Organisational Information Processing Theory in ERP adoption.

#### ***2.1 Information Processing***

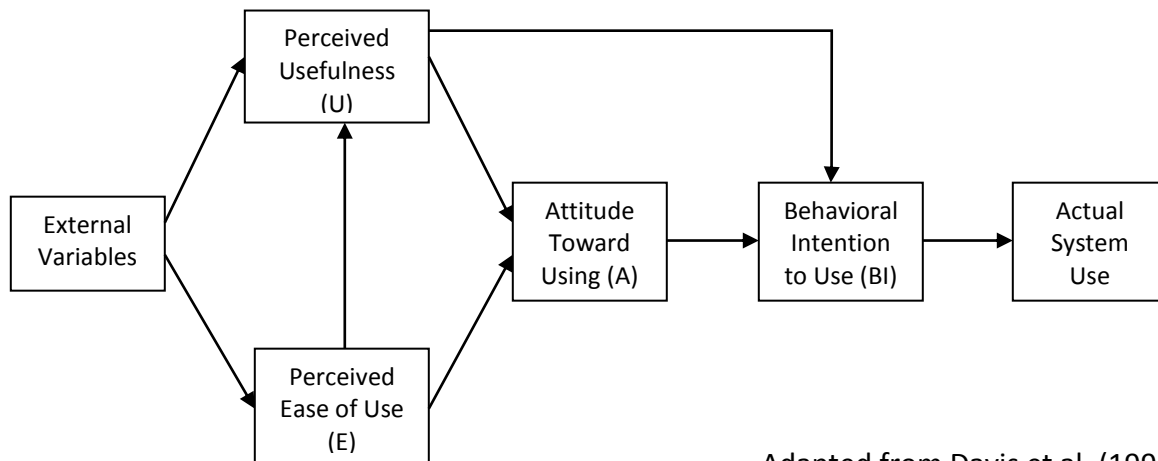
IS/IT is recognised as one of the main factors that affects the operation of an SME, this could either be positively where IS/IT systems are used to streamline the business processes or negatively if the IS/IT systems do not deliver the intended potentials (Chau, 1996, Laudon and Laudon, 1999). The term IS/IT adoption as defined by Bose and Luo, (2011) involves the management of planning, designing, implementing and measuring the chosen IS/IT system. In the case of an off-the-shelve IS/IT solution, adoption can be defined as the management of planning, identification of the suitable system, implementation of the chosen solution and measurement of the outcome of the implementation. In order to adopt an IS/IT system which delivers the intended benefits, a suitable framework is required to provide the study with a structure to link the theoretical tools. Technology Acceptance Model (TAM) predicts the intended user's acceptance of an IS/IT system and the way it could be used to fulfil business process activities (Au and Zafar, 2008).

Authors such as Oates (2006), Perez (2000) and Halldorsson (2015) have argued that theories can be used to shape a case study. Use of an existing theory can help the researcher to choose the case, decide the type of data to collect and, questions to ask, and determine which themes to consider during data analysis (Oates, 2006, Halldorsson et al., 2015, Powell and Hendricks, 2009). Some of these theories are 'Organisational Information Processing Theory'; 'Theory of Critical Success Factor'; 'Actor Network Theory' and 'Information Processing Theory' (Oates, 2006, Pittaway et al., 2004).

### **2.1.0.1      *Technology Acceptance Model (TAM):***

The Theory of Reasoned Action (TRA) suggests that people form the intention to adopt a technology based on what they believe is the consequence of the adoption (Ajzen and Fishbein, 1980, Mishra et al., 2014). From TRA, Davis (1986) developed the Technology Acceptance Model (TAM) which attempts to provide reasons why individuals choose to adopt or not to adopt a particular technology when performing a task. TAM as a theory has been used in many educational settings to explain acceptance (Baker-Eveleth et al., 2007, Cheng-Chang et al., 2005, Ndubisi, 2006, Teo and van Schaik, 2012) due to its strength of providing quantifiable variables for understanding predispositions of adoption. Other studies have adapted and applied TAM to many different technologies which include spreadsheets (Mathiassen, 1991), voicemail (Straub et al., 1995) and object oriented technologies (Hardgrave and Johnson, 2003).

According to the theory of TAM, two variables impact adoption and these are perceived usefulness and perceived ease of use (Davis et al., 1998). From (Davis, 1989), perceived usefulness, as the first variable, refers to the extent to which an individual believes that the use of a particular technology could enhance their job performance. The second variable, perceived ease of use, refers to the extent to which an individual believes that the use of a particular technology could be free of mental and physical effort (Davis, 1989). TAM can be represented graphically as below showing how external variables directly feed into perceived usefulness and perceived ease of use. The diagram indicates that both variables of TAM directly impact on the actual system usage by impacting on the attitude towards using the IS system and behavioral intention to use the IS system.



Adapted from Davis et al. (1998)

TAM suggests that if an adopted system enhances a user's performance and does not greatly increase the effort required to perform a particular task, it is then considered useful as well as easy to use. The user will also be more likely to agree to adopt the information system. The validity and reliability of the variables in TAM have been supported by many studies (Adams et al., 1992, Doll et al., 1998, Hendrickson et al., 1993). It is also suggested that the reasons for users to undertake new initiatives are similar to the reasons for introducing a new IS system (Umarji and Seaman, 2005). As a result, TAM variables 'perceived usefulness' and 'perceived ease of use' would still be relevant when trying to anticipate users that will adopt a particular IS system.

TAM has been criticized by Bagozzi (2007) as not taking into account emotions as a predictor of both users' attitude towards the act of using the new IS system and the users' actual behavior. Another major criticism of TAM research according to Legris, Ingham and Colletette (2003), is that it has been predominantly applied while studying office automation software but lacks research in business process application software.

From Wallace and Sheetz (2014), TAM attempts to explain system users choice to adopt or not to adopt a particular IS system when performing a task. Also from Davis' (1989) illustration of TAM, the two variables which impact adoption focuses on the individual without any emphasis on the organisation. From Wallace and Sheetz (2014) and Davis' (1989), it can be argued that TAM concentrates its application in the post adoption of an IS system and user behavior towards adoption. For users to decide to use or not to use an IS system, the IS system will have

been implemented. This theory from its application favors the acceptance of a technology already chosen for adoption and if TAM is adopted in a pre-decision making study, it could be tailored to provide the information capability of the organisation. It however, does not provide any means to support the gathering or understanding of the information requirements of the organisation which is required when deciding the most suitable technology for adoption. As discussed from literature above, from an organizational perspective, TAM's emphasis is on the behaviors of users towards adoption, like most adoption theories, but fails to consider whether the system is the optimal system based on requirements, capabilities and business processes (Venkatesh and Bala, 2008).

### **2.1.0.2      *Diffusion of Innovation Theory:***

The theory of Diffusion of Innovation developed by Rogers (1962), aims to explain how over time, an information system gains acceptance and diffuses through a specific group of users. The theory suggests that the individual processes of adoption and diffusion can be incorporated as component parts of the larger process of a social change (Labay and Kinnear, 1981). According to Zaltman and Lin (1971), the theory can be developed to provide a summarized paradigm of the social process that provides a perspective on this relationship. The basic components from an IS adoption perspective are (i) the innovation itself, that is, some new IS/IT system; (ii) an individual who decides to adopt the innovation, as a result exhibiting an innovative behaviour; and (iii) the diffusion of the innovation through a social system. The discussions and application of diffusion of innovation theory has focused on the attributes of innovations and the measurement of adopters' perceptions of these attributes (Labay and Kinnear, 1981, Ostlund, 1974, Rogers and Shoemaker, 1971). The most commonly considered attributes are:

- The degree to which the IS/IT innovation is perceived as being superior over other potential IS/IT systems or those it is to replace;
- The risk associated with the adoption of the innovation;
- The ease of use of the IS/IT innovation;
- The degree to which the innovation conforms with the business strategy and past experiences while adopting IS/IT systems;

- The extent to which the potential IS/IT system can be trialled before adoption

From the above discussions, the theory is used to understand how a particular IS/IT system is adopted across by the individuals intended to use the system. Although the theory considers the mapping of the intended innovation with the business process, it however does not emphasize the understanding of the requirements from a business perspective before the adoption of the innovation (Scarborough et al., 2015). It however focuses on how individuals accept an adopted or possibly an implemented IS/IT innovation.

### ***2.1.0.3 Technological-Organisational-Environment (TOE) framework:***

Technological-Organisational-Environment (TOE) framework was developed by Tornatzky and Fleischer (1990) and was used to examine the adoption of IS/IT systems at firm-level. The core concepts of the framework are the inclusion of technological, organisational and environment variables which has made TOE advantageous over other adoption models (Gangwar et al., 2014). The use of TOE in a research study is as a result of its strength which lies in the framework's ability in value creation from technology innovation and adoption perspective (Hossain and Quaddus, 2011, Oliveira and Martins, 2010, Ramdani et al., 2009). TOE therefore provides a holistic picture for user adoption of technology, user involvement, impact of the technology on value chain activities and also develops better organisational capabilities using the technology (Wang et al., 2010, Salwani et al., 2009). The ability of TOE to provide a structure which can be used to better understand the organisational capabilities of using the technology as discussed above makes TOE a suitable theory when discussing general IS/IT adoption. However, in IS/IT pre-adoption study, emphasis is not only on information capability but also on information requirements which is not defined within the scope of TOE. TOE's main focus is on the technological context, organisational context and environmental context which presents both opportunities and constraints while adopting an IS/IT system (Tornatzky and Fleischer, 1990, Zhu et al., 2004). The non-inclusion of organisational requirements, which is a focus in IS/IT pre-adoption decision making, makes TOE framework unsuitable for IS/IT pre-adoption decision making discussion.

### ***2.1.1 Organisational Information Processing Theory (OIPT)***

There are a number of authors who propose that it is useful to view organisations as information-processing systems (Egelhoff, 1991). Some theorists have attempted to understand organisations by describing them as communication systems, decision making systems, or systems that have to cope with uncertainties (Egelhoff, 1991). Organisational Information Processing Theory as applied to organisations generally includes the gathering of data, the transformation of data into information, and the communication and storage of information in the organisation (Tushman and Nadler, 1978). Although definitions of the concept of OIPT vary and for certain purposes the distinctions may be important, they can all be subsumed under the broader notion of information processing.

Some of the known underlying assumptions of the theory of Organisational Information Processing are firstly, that the model is applicable to organisations with unstructured information processing activities. An organisation with disparate ERP systems, which do not communicate or integrate with each other, is termed as unstructured information flow. If the organisation had structured and organised information processing activities, then there could be minimal or no need for the introduction of an information processing system such as an ERP system. Secondly, OIPT assumes that the key factors involved in information processing are top managers.

*The model applies to organisations whose information processing activities are characterized as informal and opportunistic; where the key actors are top managers. The model does not apply to organisations with organized and institutionalized information-processing activities where the key actors are top managers and scanning and interpretation staff (Wang and Chan, 1995).*

In an organisation with organised and institutionalised information-processing activities, information-processing activities are perceived as being more complex and involving a greater number of steps. Firstly, employees carefully search the environment to gather required information (Wang and Chan, 1995). Secondly, employees apply available formal interpretation methodologies to analyze the meanings of the information collected, which could be manual or automated using ERP systems. Thirdly, employees communicate the interpreted information to

the section of the organisation or customers requiring the analyzed information. Fourthly, the analyzed information is either accepted or rejected, wholly or in part (Wang, 1991).

Valiris and Glykas (2004) argue that methodologies based on organisational theory add more elements to business modelling and analysis by addressing the need to focus on people (as agents), their accountabilities, roles, interactions, activities and use of available resources. This, in some way, has defined managerial input by stating controls, responsibilities and resources. OIPT involves three important concepts, which are: information processing needs, information processing capability, and the fit between the two to achieve optimal performance (Premkumar et al., 2005).

Organisations have continually identified the need for quality information to enable them cope with uncertainty in the business environment and to improve their ability to make informed decisions (Premkumar et al., 2005, Stock and Tatikonda, 2004). Gattiker and Goodhue's (2004) study suggested OIPT as a valuable means to understand ERP systems. They used a case study to provide evidence that the concept of interdependence could be important in predicting the impact of ERP, particularly at local level. This could pose a challenge for organisations which might have experienced failed attempts in the past to mitigate this issue.

Uncertainty in the business environment stems from the complexity of the environment and from its dynamism, or the frequency of changes to various environmental variables (Premkumar et al., 2005). This is typical for service management companies where processes differ significantly from manufacturing. In addition, the processes in service management companies are dynamic from one customer site to the other. Organisations generally adopt two strategies to cope with uncertainty and increased information needs: firstly they develop buffers to reduce the effects of uncertainty on their business; and secondly, they implement structural mechanisms and information processing capabilities to enhance the flow of information and thereby reduce or even eliminate uncertainties. A common example of the first strategy within the service industry is building a time buffer into the time required for an engineer to carry out a job on a customer's site in order to reduce the effect of uncertainty in the quality of services delivered. Within manufacturing an example of this is including safety buffers in the product design to account for uncertainty in the product's working conditions, such as possible wastages and damages while producing the products. An example of the second strategy, mentioned by

Premkumar *et al.* (2005), is the redesign of organisational business processes and the implementation of integrated IS that improve the flow of information and reduce uncertainty within various parts of an organisation (Gattiker and Goodhue, 2005).

Cooper and Wolfe (2005a) support this view, because they argued that ERP adoption activities vary with the extent of uncertainty; therefore the greater the uncertainty, the more information processing is required for effective performance of processes. The current research is informed by OIPT by adopting the second strategy to redesign the service company's business processes and implementing an integrated Information System (IS) solution to improve information flow and process efficiency.

Although this theory does not categorically define the scope of managerial input, it however provides the opportunity of adopting one of its dimensions to understand how leadership input during pre-adoption and post implementation may contribute to the success of the ERP system within an HVAC service organisation.

OIPT was used by Cegielski *et. al.* (2012) to understand how an organisation's information processing requirements and capabilities combine to affect the intention to adopt an information system. Although they employed this theory within a supply chain, it is arguable that a supply chain is a type of service management organisation. Therefore, this theory is applicable to evaluating the question of how an organisation's information processing requirements and capabilities combine to affect the intention to adopt and implement an ERP system in a Heating, Ventilation and Air Conditioning (HVAC) service organisation.

### ***2.1.2 Information Systems Success Theory (Theory of critical success factor)***

The Information Systems Success Theory, as proposed by DeLone and McLean (1992), concentrates on three dimensions. These are system quality; information quality; and service quality as the main success factors of an information system (Zhou, 2011). Like the name suggests, the Information Systems Success Theory concentrates on aspects that can be used in measuring the success levels of an information system. The Information Systems Success Theory has been predominately applied in examining the critical success factors of different types of website adoptions (Zhou, 2011). The application of this theory in ERP adoption and



implementation in a hybrid service and manufacturing SME could be difficult because of the complexity and dependant factors related to ERP adoption and implementation.

Wickramasinghe and Karunasekara (2012) attempted to use the Information Systems Success Theory as an integrated view under the three dimensions mentioned above to evaluate an ERP systems adoption and implementation. In their research, they focused on ease of use, system flexibility, system reliability, the ease of learning and system features. The theory, however, is not applicable when used in reviewing human factors, such as managerial and user input, as an important factor for system adoption and implementation success. In their research Dezdar and Ainin (2011) confirmed that top management support are among factors that positively relate to successful ERP implementation. Human input in systems adoption includes the management input during the selection of the adopted ERP system, as well as the level of support and authority exerted after implementation to ensure that users understand the adopted and implemented ERP system and its limitations. Zhou (2011), as a result of findings from work such as Dezdar and Ainin's (2011), combined the Information Systems Success Theory with the technology acceptance model and Trust theory to mitigate such soft issues such as managerial inputs and perception of the proposed system by users when adopting an information system. Dezdar and Ainin's (2011) findings indicate that when there is some sort of focus on managerial and user input while adopting an information system, then Information Systems Success Theory alone will not be sufficient. Although Zhou (2011) successfully combined Information Systems Success Theory with technology acceptance model to mitigate soft issues such as managerial input and perceptions, it however does not explain how to handle the information processing capability obtained from the soft factors. The current study places emphasis on information requirements and information capability. Due to Zhou's (2011) combined theory focusing only on systems success from a soft factor perspective without consideration on the capability of the soft factors in terms of the system usage, this combined theory is therefore not suitable for the current study.

### **2.1.2.1      *Limitation of Organisational Information Processing Theory (OIPT)***

This section discusses the Organisational Information Processing Theory's limitations in providing the fit between information processing needs and information processing capability in a pre-adoption decision making of an IS/IT system. The theory was developed with the concept to explain variations in organisational design and structure (Galbraith, 1973). From Galbraith's perspective, the ability of a team to perform an IS/IT adoption task differs with the level of associated uncertainties. With the reference to IS/IT adoption, the development of the theory is from a post-adoption of an IS/IT perspective. In today's rapidly changing IT environment, OIPT as it is does not provide adequate explanations of how to obtain the fit between information processing needs and information processing capability (Daft and Lengel, 1986) especially in an IS/IT pre-adoption decision making. The theory having been studied in IS/IT adoption research however, shows that it only suggests the need for a fit but lacks in providing a means for matching information processing needs and information processing capability (Cooper and Wolfe, 2005b, Daft and Lengel, 1986) to provide that desired fit for optimal performance.

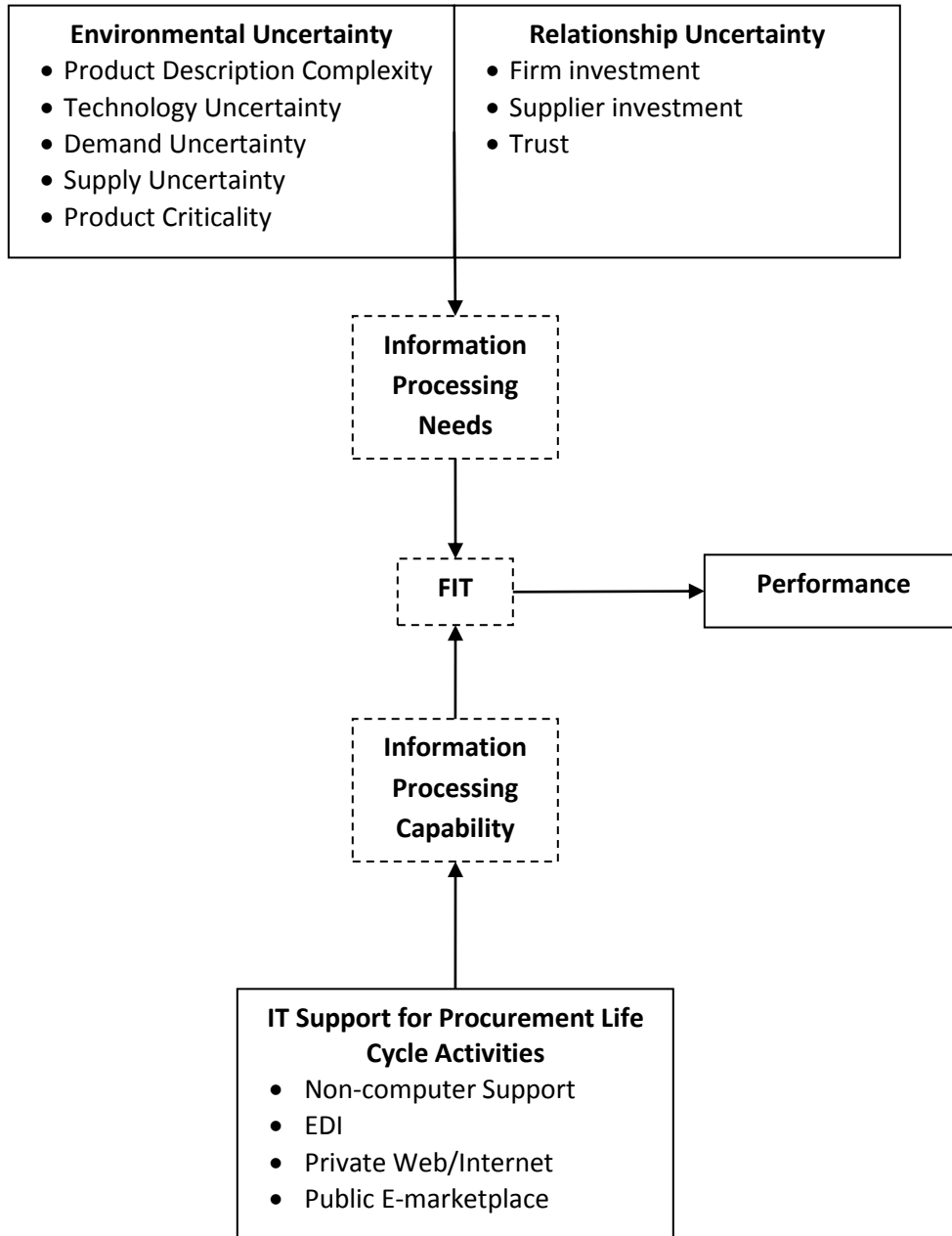


Figure 2.1 Adapted from Premkumar et al. (2005)

The framework of OIPT as proposed by Premkumar et al. (2005) accommodates the three main concepts of OIPT which are: 1) information processing needs, 2) information processing capability and 3) the fit to obtain an optimal performance. From the OIPT framework as suggested by Premkumar et al. (2005) – see figure 2.1, the theory suggests the importance to find a fit, it however does not suggest how to obtain the fit between information needs and

information capability in order to obtain optimal performance. There is therefore a need to adapt the theory of OIPT in order not to only suggest the need to find the fit but to also provide those adopting the theory possible approaches to follow in order to find the optimal fit. As mentioned in section 1.6.5, although the study considered theories such as TOE, Information Systems Success Theory and Actor Network Theory, these theories emphasises that the key role in IS/IT adoption is whether the SME adopts the system (Damanpour and Schneider, 2009). This makes these theories generic and unsuitable in practice especially in an action case study. A differing perspective was given by Klein and Sorra (1996) who suggested that the fit of IS/IT system with the organisation is however more important. Wisdom, Chor, Hoagwood and Horwitz (2013) argued that there is actually no known theory of IS/IT pre-adoption. From Wisdom et. al (2013) and Klein and Sorra (1996) arguments above, the importance of this study is based on the lack of a pre-adoption decision making theory which focuses on fit of business process and the fact that limited attention has been given to OIPT and the IS/IT pre-adoption decision making, particularly in hybrid service and manufacturing SMEs. The adapted version of OIPT known as OIPT2.0 will be further discussed in the discussion chapter.

## ***2.2 Business process analysis***

Business process analysis support documentation and communication of “as-is” business processes as well as defining ‘to-be’ representations of future business processes for software development (Winkelmann and Weiß, 2011), business process reorganisation projects (Hammer and Champy, 1992) and systems implementations. A business process, as defined by Valiris and Glykas (2004) and Tsaih and Lin (2006), is the identification and modelling of important related business tasks and activities in an organisation, such as a hybrid service and manufacturing SME, and is carried out through the activities of a group of personnel whose duties are inter-dependent. Business process analysis therefore describes the logical sequence of activities, resulting products and services, required resources and data, and the organisational units involved (Lindsay et al., 2003). This logical sequence of activities can be taken further by questioning why the contractual relationships, operations and processes of the organisation are carried out in the way they are (Valiris and Glykas, 2004).

In order to conduct business process analysis effectively, there should be a basis upon which the analysis is focused. Some researchers have focused on business process analysis from the perspective of customer value (Porter, 1985, Hvam and Have, 1998). However more recent research, such as that conducted by Tsaih and Lin (2006), argues for focusing business process analysis on both customer value and the business strategy as a better approach. This will support the achievement of both organisational strategic outcomes and satisfy customer-centred values.

Since business processes elaborate how work is carried out within an organisation, SMEs are continually striving to improve their business processes with an aim to improve organisational performance and efficiencies (Gulledge and Deller, 2009). Therefore, it is important to review some of the methods available for the analysis of business processes.

### ***2.2.1 Business Process analysis methods***

There are various methods that have been adopted by researchers to analyse business processes and these methods include Six Sigma and Value Stream Mapping, which are discussed in more detail in this subsection.

#### ***2.2.1.1 Business process analysis using Six Sigma***

Six Sigma has been discussed by a number of authors but was defined by Tjahjono et al. (2010) as a business strategy that focuses on the improvement of customer requirements, business productivity and financial performance. Markarian (2004), also contributing to the definition, describes Six Sigma as a top-down methodology which requires detailed analysis, fact-based decisions and a controlled plan to ensure continuous quality control of a process. Gremyr and Fouquet (2012) took a different view, and they argued that Six Sigma on its own is not sufficient to analyse business processes and is more effective when used alongside other process analysis methods. A more comprehensive definition is provided by Tjahjono *et al.* (2010), who define Six Sigma as a set of statistical tools, an operational philosophy of management, a business culture and an analysis methodology which makes use of scientific methods, with all of these aspects overlapping. With the definition from Tjahjono *et al.* (2010), Six Sigma is a quality initiative which supports the reduction of variations in a process and helps to reduce the cost of products

as well as processes. Therefore, it is considered a quality management tool (Deshmukh and Chavan, 2012) rather than business process reengineering method.

### **2.2.1.2 Business process analysis using Value Stream Mapping (VSM)**

The lean thinking paradigm developed by Toyota was created as a holistic approach to manufacturing business processes (Womack and Jones, 1996a). This was motivated by the need to strengthen the implementation of Toyota's lean principles; increasingly holistic approach for mapping and evaluating business processes have been developed (Rother and Shook, 1999, Jones and Womack, 2002), and this is called Value Stream Mapping (VSM).

VSM is argued to be an essential tool in analyzing how various activities impact on the overall business process (Hines et al., 1999, Lasa et al., 2008a). VSM has also been conceptualised as a tool to make an organisation's business processes leaner by reducing activities that do not add value to the product or service (Shararah, 2013). VSM is therefore defined as the process of making a production or service business process lean. This is done by eliminating or minimizing functions and activities that do not add value to the product or service being delivered (Garcia, 2002) using the customer's definition of value (Shararah, 2013).

Using VSM, waste within the business process is highlighted and opportunities for improvement identified (Garcia, 2002, Lasa et al., 2008a). Where value is not being added to a service process, there is possibility that it could be adding cost instead. Using VSM, activities and actions that do not add value to the service process are first identified and then can be eliminated or minimized (Dennis et al., 2000, Garcia, 2002, Lasa et al., 2008a).

Garcia (2002) highlighted how various tools can be used to conduct VSM, such as hand drawing, MS Visio and MS Excel, although he discouraged the use of Autocad. Among the newest drawing tools which can be used to visualise data for VSM is 'Edraw'. Edraw gives the user an advantage in representing the data gathered compared with other visualisation tools. Although MS Visio could be used in a similar way, it does not provide the same flexibility which Edraw offers in representing the data to visualise business processes. Among the advantages Edraw provides is the ability to use the same tool to develop process flows and system design maps.

A link is thus established between business process analysis using VSM and process automation using ERP systems, as illustrated in the conceptual framework.

### **2.2.2.1 VSM and other methods for systems redesign**

Although a multitude of applications have been developed in recent years for use across industries, such as service distribution and manufacturing, VSM's roots are mainly grounded in the analysis and improvement of business process environments with disconnected flow lines (Lasa et al., 2008a). To enable accuracy and clarity in practical application, VSM can be broken down into five phases and carried out by a dedicated team for the purpose of applying VSM to a specific business process (Rother and Shook, 1998). These phases are:

- identification and selection of a product family;
- representation of the current state mapping;
- representation of the future state mapping;
- defining how the future state can be put in practice and drafting a working plan; and
- implementation of the working plan.

Rother and Shook (1998) also made it clear that guidelines are needed for the definition of the future state map and the lean framework provides these guidelines to outline how this map should be drawn. These guidelines are summarized below:

- The production rate must be determined by the rate of demand for the product. Touch time, also known as Takt time, defines the exact time taken to complete an activity within the business process and the concept of Takt time reflects such a rate.
- Establishment of continuous flow where possible (unique product transfer batches).
- Employment of pull systems between different work centres when continuous flow is not possible.
- Only one process, called the pacemaker process, should command the production of the different parts. This process will set the pace for the entire Value Stream.

Other methods may be used in business process improvement, however whether the other methods specifically focus on improvement and redesign of the service and manufacturing system, as is in the VSM application context, has not been indicated. A literature review conducted by Lasa *et al.* (2008a) shows that methods currently used in some areas do not cover the same framework as VSM does, and neither do they cover the same objectives nor the same level of completion of target business processes of service/manufacturing (hybrid) systems design. Below is a summary of some of the established methods for modelling business processes and their characteristics.

A well known method used for modelling business systems is process mapping, which involves creating a flow chart of the types of activity being undertaken at each time point during the process (Hines and Rich, 1997). Hines and Rich (1997) have supported this technique for two reasons: firstly, because it is based on the measurement and analysis of quantitative data (Hammer, 1990); and secondly, it can be flexibly applied using the various languages spoken across the globe thereby making it practical and useful (Baudin, 2002). However, process mapping is arguably too generic and not properly suited to modelling complex hybrid service and manufacturing systems (Kateel *et al.*, 1996).

Icam DEfinition Zero (IDEFO) is another method that can be used for process mapping. It is specifically orientated towards and developed for the manufacturing industry and as a result is best suited to typical manufacturing processes (Lasa *et al.*, 2008a). In order to describe the activities of the manufacturing system in a hierarchical way, this method carries out a structured analysis which is a data flow approach to system design (Lasa *et al.*, 2008a). It fails, however, to accommodate the analysis of quantitative data from the production process since it is explicitly a qualitative method (Wu, 1996).

It has been shown from the discussion of characteristics above that VSM is grounded in the manufacturing and service industries, and has a more robust application method compared with other methods used in re-engineering business processes.

VSM has been applied in various areas of manufacturing industry, Hines *et al.* (1999) and Grewal (2008) are among authors who have used VSM to identify and eliminate waste in the production



industry, whilst Brunt (2000) and Abdulmalek and Rajgopal (2007) used VSM for process improvement and re-engineering in a steel manufacturing industry. Emiliani and Stec (2004) used VSM for process improvement in leadership development and McManus and Millard (2002) applied VSM in product development and in the re-engineering of aerospace manufacturing firms.

Despite the usefulness of VSM as evidenced by the studies cited above, researchers have also suggested that it has some limitations. Chitturi *et al.* (2007) explored VSM's limitations from practical view-point, finding issues such as VSM's difficulty to handle different family types when mapping operations in job shop operations. That is operations that deal with one-of-a-kind or short-run output like goods or services (Bassett, 1991), using standard VSM. Chitturi *et al.* (2007) agreed, however, that to get the best out of VSM, information gathering should be tailored to suit the industry and the business process being re-engineered. In their research, they adopted a method of collecting data from the last to the first operation (bottom to top), in contrast to this research which adopted a top to 'bottom approach'. Although the 'bottom to top' is a good approach it was not adopted for this research because of its service orientation. Had this research been a production-based study then collecting data from the last to the first operation might have been suitable because in production, the output (the product) is defined. Unlike in service where the service rendered to the customer involves multiple variables such as the uncertainty of items required to successfully carry out the service. Chitturi (2007) also argued that the future state of the business is not certain and could fall short of being achievable. Poor planning and assumptions made during the design of the VSM future state, and in software developments, could lead to unachievable goals.

#### **2.2.2.2      *Justification for using VSM***

Like Value Stream Mapping, Six Sigma focuses on improvements from the customer's perspective, that is, eliminating activities that do not add value to the product or service delivered to the customer (Antony et al., 2005). Essentially eliminating activities termed as waste from customer's point of view. The high level of investment required to implement Six Sigma and the organisation's lack of resources in providing statistical-related training for its staff are the main weaknesses associated with Six Sigma (Deshmukh and Chavan, 2012). Although Six

Sigma has been successfully implemented in large organisations there is less documented evidence of its implementation in SMEs, and therefore it tends to be unpopular among SMEs (Antony et al., 2005).

Section 2.2 discussed business process analysis, identifying Six Sigma and Value Stream Mapping (VSM) as the popular methods of carrying out business process analysis in information systems studies. Other methods of process analysis mentioned are IDEFO and Process Mapping. The justification for selecting Value Stream Mapping is in its ability to allow the user to analyse processes from the perspective of value to the process. Another justification from this section is the ability to use VSM in mapping the current business process and the production of a value stream diagram of the future state business process. Section 2.3 will then discuss the hybrid service and manufacturing business process and enterprise resource planning systems.

Methodologically and conceptually, VSM is adding a conceptual understanding at a lower level of data abstraction when compared to OIPT which provides overarching organisational view of information needs and capabilities. In the current study, conceptually, VSM is operationally strengthening OIPT when it comes to data analysis and visualisation as it comes with a predefined codes and notations. The particular attraction of VSM to this study is that the data collection allows its synergy with OIPT.

### ***2.3 Specialist issue within the hybrid service and manufacturing industry***

So far this chapter reviewed the literature on theories related to IS/IT pre-adoption decision making process and while considering the need for a suitable fit based on the theory of OIPT discusses the second theme, business process analysis. The consideration of a need to obtain the fit and the discussion on business process analysis strengthens the argument for the inability of OIPT, as it is, providing the fit between the two variables as mentioned earlier. This section discusses the third theme, the hybrid service and manufacturing SMEs, highlighting why the need for further study into this area. Jamshidi *et al.* (2009) highlight the opportunity for future research in the area of service process automation using IS systems such as SAP Business One.

SAP Business One is an affordable, adaptable and easy-to-implement business management system designed by SAP to specifically meet the needs of emerging and dynamically growing SMEs (SAP, 2014). As an ERP system, it enables businesses to manage on-demand access to critical real-time business information through one single system containing financial, customer relationship management, manufacturing, and management control capabilities (SAP, 2014). SAP Business One enables rapid employee productivity, as well as empowering managers to make reliable business decisions and stay ahead of the competition. This is argued by SAP (2014) as being one of the best fit ERP systems with an embedded service function for SMEs. This forms the scope of this study with a focus on SAP Business One.

Traditional methods such as 'object-oriented' and 'component-based' methods are widely criticised as being inadequate to support the challenges of service-oriented companies, especially in analysis and design (Jamshidi et al., 2009, Olaf et al., 2004, Arsanjani et al., 2008, Arsanjani, 2004). Jamshidi *et al.* (2009) proposed a method '*that automatically specifies the architecturally significant elements of service model work product*'. Their method uses the service model at analysis level and produces a design for the artefact. In contrast to traditional methods which focus on system appearance, the method of Jamshidi *et al.* (2009) architecturally ensures that the required interrelation and dependencies between various service functions are established and maintained in the design of an IS system.

The focus of architectural dependency during the design of an IS system could be applicable within a hybrid service and manufacturing HVAC industry but has not been validated in a hybrid business process. Which could contribute to why attempts at service process automation using IS systems like SAP Business One have been seen as failures within the hybrid service and manufacturing industry. There is, however, a rapid change in the IT industry and this change is expected to continue into the future at a rapid pace (Benamati and Lederer, 2001). As a result, there is a need for HVAC service industries to invest strategically in technology by, for example, adopting ERP systems, which support the growth and expansion of organisations.

Furthermore, some authors argue that IS solutions, such as SAP Business One ERP software, often lack the functionality needed by SMEs because these solutions were originally designed for a different type of business model, and therefore business process reengineering is essential

to provide a good fit with their business requirements (Light et al., 2001, Ofoegbu et al., 2011, Griffiths et al., 2013, Martin et al., 2008).

HVAC service companies are increasingly identifying this need to improve the services they deliver and to make savings through gains in efficiency, thereby making a comprehensive ERP solution imperative. Peppard and Ward (1999) argue that emphasis on business processes is important in selecting an IS solution, and in a more recent study, Vathanophas (2007) also identified business process analysis as a major factor in successful IS adoption and customisation. The lack of existing research could also explain the failure to identify and implement appropriate ERP applications within the service hybrid sector (Asif et al., 2009).

The Service Management Digital Edition (2010) publication suggests that the field service industry, which includes HVAC, has learnt from previous lessons about ERP system implementation. One of these is the need to adequately manage change resulting from process reengineering during system implementation, in order to ensure that there is adequate involvement of the workforce during system implementation. This could be done by discussing the ERP system adoption and implementation with the workforce and keeping them informed of the benefits available to them and to the business, as well as the associated risks and constraints. This argument is supported by the conventional change management theory such as Cummings and Worley (2014), Handel (2014) and Andriopoulos and Dawson (2014).

### ***2.3.1 What is the service industry?***

The service industry includes a range of specialist businesses and differs from manufacturing or production. In this section, service management will be defined to provide a clear understanding of the nature of the service industry and enable a more focused understanding of the specialist hybrid service and manufacturing sector being addressed in this research.

Service management has these characteristics as suggested nearly 25 years ago by Gronroos (1990) as:

- understanding the utility or value customers receive by consuming or using the offerings of the organisation and how services alone or together with physical goods or other kinds of

tangibles contribute to this utility that is, to understand how total quality is perceived in customer relationships and how it changes over time;

- understanding how the organisation (personnel, technology and physical resources, systems and customers) will be able to produce and deliver this utility or quality;
- understanding how the organisation should be developed and managed so that the intended utility is achieved; and
- making the organisation function so that this utility or quality is achieved and the objectives of the parties involved (the organisation, the customers, other partners, society, etc) are met.

Service operation is defined by Gronroos (2000) as processes consisting of a series of activities where numerous differing resources are used in direct interaction with a customer, in order to provide solution to a defined customer's problem. A more recent definition of service was provided by Lusch and Vargo (2006) as the application of specialized knowledge and skills through processes and activities for the benefit of another entity such as a customer. The two service definitions above clearly identifies that the utilization of one's resources for the benefit of another entity can precisely be given as the definition of service. Another important aspect to note from Gronroos's (2000) definition of service is that there should be a defined problem from the customer requiring a solution. Based on the inclusion of the utilization of differing skills in solving a defined customer's problem, the definition from Gronroos (2000) best suits the current study.

To clearly distinguish service management processes from manufacturing processes, the definition and understanding of manufacturing processes is necessary. Manufacturing processes are defined by Karana *et al.* (2009) as the process whereby things are made using materials, tools and labour for use and sale. Chen and Fan (2012) defined the manufacturing process, from a semiconductor manufacturing perspective, as the inclusion of several processing steps using materials to produce a semiconductor. The two definitions of the manufacturing process above include various intermediary processes required for the production and integration of the product components. The definition by Karana *et al.* (2009) includes the application of raw

materials, labour and tools such as specialised machines to produce an output for use. This favours a hybrid service manufacturing SME who manufactures an item and uses the same item to carry out specialised services for a customer.

The service management definition, however, makes no mention of products being produced, and rather emphasizes on utilities being delivered to and received by customers, and how that process may be improved while meeting customers' needs. This distinction is important because it marks out the generic business process of manufacturing as different to that of a generic service business process, and this research is based on a hybrid of these two processes.

Using the above definition of service management, examples of service delivery include activities such as routine maintenance of equipments for a customer and response to customer issues, which are either planned or scheduled on demand and are particular to every service management process. Service management operations broadly include activities undertaken by public sector organisations such as the police, postal services and ambulance services. In the private sector, service organisations include those which carry out mechanical and electrical maintenance, specialist servicing of customer equipment, such as HVAC and spraybooths.

Conaty (2012) looked at hybrid from the perspective of funding provided to service organisations through public sector collaboration with non-profit organisations, and identified that there are challenges when adopting a model for such hybrid organisation. It is important to note that this study is not using hybrid in the same sense as mentioned by Conaty (2012). In order to achieve differentiation, manufacturing firms around the world are increasingly providing services (Cova and Salle, 2008). This shift from typical manufacturing to providing elements of service is as a result of growing increase in the revenue coming from service (Kowalkowski et al., 2011). The most common form of hybrid SME is where an SME, whose business strategy is manufacturing-based, diversifies into service in order to give itself an edge over its competitors. Through doing this, the SME makes its primary business strategy manufacturing and service secondary. The other form of hybrid which this work focuses on is where an SME with a core service business strategy diversifies into manufacturing in order to achieve differentiation and is referred to in this study as **hybrid service and manufacturing SME**. Although this might be assumed as being similar, the main difference is that with a shift

from complete service focus to service being primary and manufacturing complementing, implies there is a need to balance the right level of customer-centric and product-centric (Davies et al., 2006, Galbraith, 2002, Homburg et al., 2000). This balance should also be maintained in the ERP system adopted in order to ensure a balance between business strategy and organisational configuration (Gebauer et al., 2010).

### ***2.3.2 Overview of ERP systems***

An understanding of ERP systems is required in order to ensure that ERP system functionalities are correctly established and that their functionalities are not over-exaggerated or underplayed. This section discusses the historic background to ERP systems and outlines the functionalities included in most standard ERP systems available off-the-shelf. This leads into section 2.3.3 which discusses the motivation behind ERP system adoption in hybrid service and manufacturing SMEs.

#### ***2.3.2.1 Introduction to ERP systems***

When implemented successfully, ERP systems link all areas of the service company, including financial systems, stock management, order management, human resources and stock distribution to customers and external suppliers into an efficient integrated system with real-time data available to users (Al-Mashari et al., 2003, Beheshti et al., 2014). The potential benefits for manufacturing companies adopting an ERP system include visibility of raw materials and finished goods, an increase in operating capital as a result of holding optimal quantities of raw materials and stock (Xue et al., 2005). Other benefits include the availability of information about the customer ordering history which can be used for a more efficient forecasting of raw material and finished goods (Escalle et al., 1999, Marvel et al., 2005, Kakouris and Polychronopoulos, 2005).

Although large organisations, such as Eastman Kodak and Cisco Systems, have benefited from implementing ERP systems, many organisations are coming to terms with the realisation of discovering that their ERP implementations have not yielded the expected results (Kanaracus, 2013, Trunick, 1999a, Cummings, 2011, Gargeya and Brady, 2005, Beheshti et al., 2014).

Expectations raised by the resellers, companies who resell ERP systems, have either been exaggerated or the resellers have failed to properly scope and understand the business process requirements of the intended users (Beheshti et al., 2014). A study conducted by Trunick (1999a) indicates that approximately 40% of all ERP systems implementations can be described as being partially implemented and approximately 20% of attempted ERP implementations are labelled as complete failures, as judged subjectively on the perspectives and expectations of the stakeholders. A more recent statistic according to Kraemer (2012) suggests that between 55% and 75% of ERP systems implementation are perceived as failure due to their inability of meeting expected results.

### **2.3.2.2      *Evolution of ERP systems***

In order to gain a better understanding of the reasons why it is essential to adopt and implement appropriate ERP systems in a hybrid service and manufacturing SME, a fundamental understanding of the evolution of ERP systems is required. ERP systems are the vehicles through which an organisation can achieve a seamless integration of processes across functional areas with improved workflow, standardization of various business processes, improved order management, accurate accounting of inventory and better supply chain management (Jacobs and Bendoly, 2003). Although this understanding of ERP systems is based on the original concept of ERP systems usage which is typically from manufacturing (Chen, 2001), service and logistic organisations are increasingly adopting ERP systems in order to benefit from business process improvements and re-engineering (Beheshti et al., 2014). ERP systems functionalities are constantly evolving and expanding to accommodate the differing types of businesses that adopt these systems. Having originated primarily from material resource planning (MRP) in the early 1980s, MRP systems expanded to become company-wide systems capable of handling not just material planning and control, but also planning and controlling almost all of the organisation's business processes (Chen, 2001). ERP systems started to gain popularity in 1994 when a German-based company produced a system called SAP with release R/3 as its next generation software. In the following years companies started to invest billions into ERP systems offered by SAP and other ERP system developers such as Oracle, JD Edwards and Microsoft (Xue et al., 2005).



While the names and functional abilities of ERP systems may differ from one software vendor to another, a typical ERP system integrates the functions illustrated in figure 2.3 by allowing its modules to share and transfer information seamlessly and centrally within a single database.

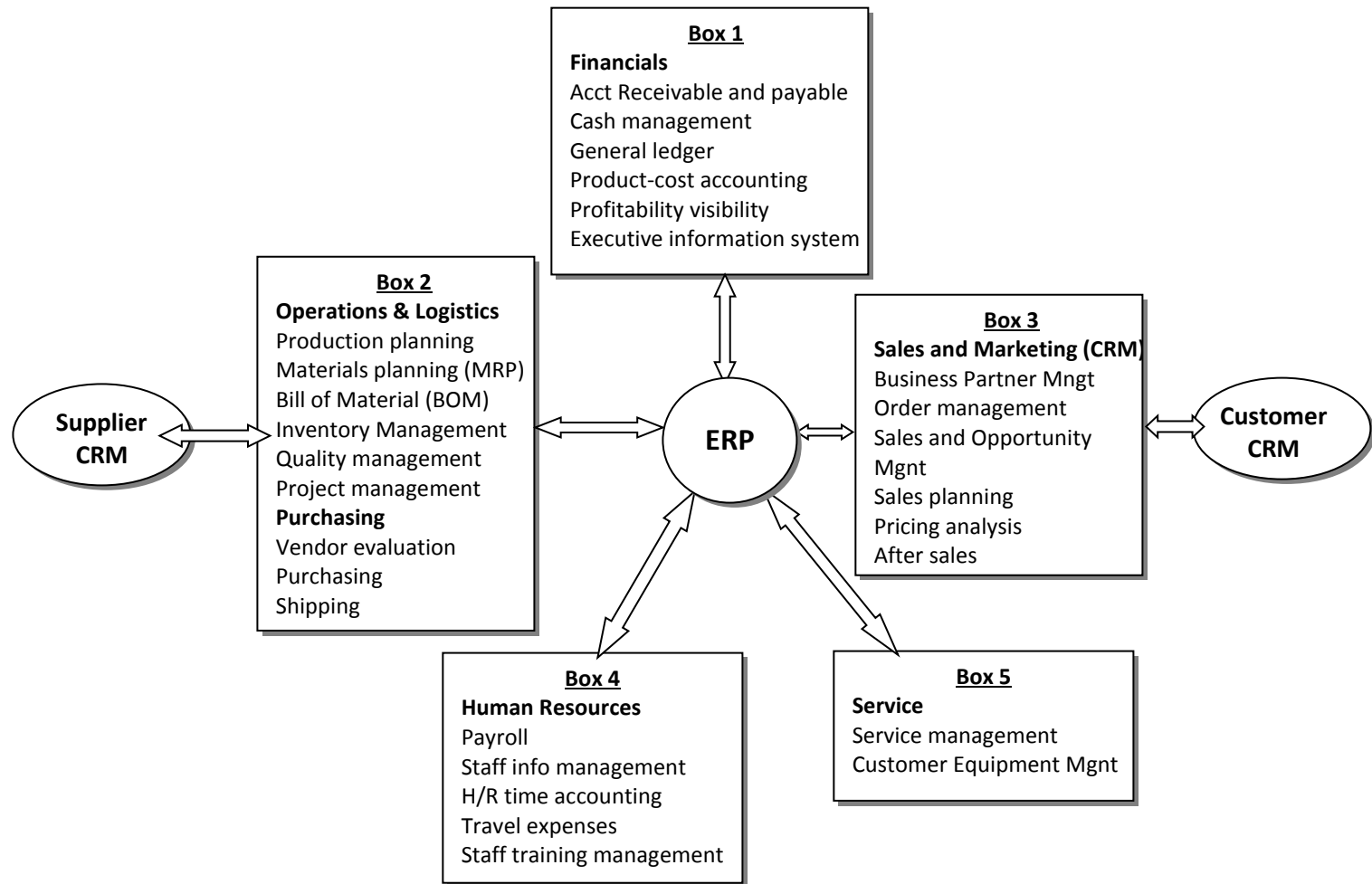


Fig 2.3 An overview of ERP systems  
Adapted from Chen (2001)

In box one there are six functionalities which work together to provide robust financial functionality. 'Account receivable and payable' is the first and is the part of the ERP system that keeps track of invoices sent and payments received. 'Cash management' is the second aspect of the ERP system which provides it with visibility of the opportunity cost of having cash as compared to reinvesting it. 'General Ledger' is the third aspect of the system and is where the source and target accounts are set up which drive the various transaction in the ERP system. The fourth aspect is product-cost account and this is based on the accounts set on the General Ledger (GL), which also provides visibility of associated expenses. The fifth aspect is profitability, visibility of which provides more information about the costs associated with making a product or delivering a service, and as a result provides a true account of the profit associated with that product or service. The final common functionality is the Executive Information System, which provides the management group with visibility of the information they require to make strategic managerial decisions.

The next group of functionalities in box two are purchasing, operations and logistics which relate directly with the supplier. Suppliers are managed using the customer relationship management (CRM) functionality within an ERP system. The first attribute under operations and logistics is production planning which involves the administrative processes within a manufacturing business. It also incorporates the notion that sufficient raw materials, staff and other necessary items should be made available to ensure that the finished goods are ready on specification and within the required time. The next functionality is the bill of materials, which specifies the components and specifications of each component required to manufacture a particular item to specific requirements and under certain constraints. Material planning involves making a forecast to ensure that raw materials are available in time from the right suppliers. Quality management and project management are parts of the ERP system that ensure that adequate planning is put into the production cycle to ensure that finished goods conform to the required specifications and standards. Purchasing involves the management of procurement from suppliers, management of these suppliers and prompts payment in accordance with the contract.

In box three, the third group of attributes is sales and marketing, which constitute a major element of ERP systems and serve as the customer relationship management (CRM) functionality, which deals with customer's records and contacts, customer orders and customer satisfaction. Business partner management is the functionality within an ERP system that holds the customer's data. Order management involves taking orders from the customer and ensuring they conform to the customer requirements as well as being delivered within the specified time frame. The next attribute is sales and opportunity management, which handles the relationship between business partner data, business partner customer order history and the forecasting of future orders. Pricing analysis ensures that pricing is strategic and is geared towards the profitability of the item being sold. Finally, after sales is the function within the ERP system that allows the organisation to maintain customer satisfaction level in order to retain and to win new business so as to achieve business growth and strategic expansion (Rigopoulou et al., 2008).

### ***2.3.3 Hybrid service and manufacturing SME motivations for implementing an ERP system***

There are different motivations to consider when discussing the pre-adoption and implementation of strategic information systems in HVAC hybrid service and manufacturing industry. These motivations can be categorized as being strategic, organisational, managerial or technological in nature. When the motivation for an SME's implementation of an ERP is reviewed, focus should be on the organisation's environment in order to ensure the motivation run in parallel with its objectives, ensuring the efficient and effective management of the organisation's resources (Snider et al., 2009, Beheshti et al., 2014). For this to be effective in the HVAC service and manufacturing industry, the goals and objectives should be clear.

In the previous chapter, section 1.2 highlighted the importance of SMEs to the economy of a nation. For the purpose of this study, the primary criterion for identification as an SME is an organisation having less than 250 employees (Hong and Jeong, 2006). Since SMEs contribute much to the UK economy and economies around the world, it is of interest for them to succeed and as ERP systems may support them to improve their efficiency, there is need to study these ERP systems.

Innovation in service industries has placed an emphasis on improvements in service quality, customer management, service management and operations management (Hertog et al., 2010). With this recent innovation in service industries, there is an increasing reliance on using IT systems to improve service operation processes and service delivery. Most research studies conducted within the service operations industry do not address methods of evaluating business needs (Balzarova et al., 2004, Kemp and Low, 2008, Reijers, 2006, Woo, 2007) and none have evaluated business needs in terms of those specific to hybrid service and manufacturing HVAC SMEs. This lack of addressing methods of evaluating business needs could underlie the failure to identify appropriate ERP applications (Asif et al., 2009) and could also be extended to this hybrid service and manufacturing industry.

Enterprise Resource Planning (ERP) software is often lacking in functionality because ERP solutions incorporate business models different from that of the implementing organisation, therefore creating a need for business process reengineering to ensure good fit (Light et al., 2001). Another challenge faced by the specialist service and manufacturing HVAC management industry is the lack of research to evaluate their particular needs in system implementation, as compared to the manufacturing industry and other service industries. Johnston (2005) argued that of thirteen papers on service management which were reviewed, only three covered service management operations, highlighting that there is a need for more research to be carried out in the area of service management operations (Kim and Soo, 2010, Johnston, 2005, Frei, 2006, Wan and Chan, 2008, Lofberg et al., 2010).

This study also reviews the literature on the successes and difficulties associated with mapping a service organisation's business processes and activities to identify system features in specialist hybrid service and manufacturing SMEs. Asif *et al.* (2009) further suggested that the traditional focus on customer satisfaction is no longer sufficient for assessing the quality of services provided to customers. The research conducted by Asif *et al.* (2009) also explored the impact of mapping an organisation's business processes on identifying and implementing service management applications in practice using a suitable model. The expectation is that this study will contribute to the understanding of how service quality to customers could be improved.

This section presented a discussion of the challenges faced by hybrid service and manufacturing management SMEs in their current operating market. The two challenges are the lack of documented:

- 1) Method of conducting business process analysis and
- 2) Process of identifying and implementing suitable ERP system in the hybrid service and manufacturing SME.

In order to understand how these challenges could affect the identification and implementation of ERP systems, the two challenges listed above need to be investigated to establish how each could affect successful identification of service solutions in this specific industry. The points identified in the next section highlight the inadequacies of SAP Business One, despite it being one of the most popular ERP systems implemented by SMEs.

#### ***2.3.4 Challenges within hybrid service and manufacturing management SMEs***

Specialist hybrid service and manufacturing industries, unlike most typical service or manufacturing industries, require ERP and IT solutions that address the service-specific tasks which a contemporary manufacturing application would fail to provide. For example, among the many routine issues faced by the specialist hybrid service and manufacturing industry is the need to adequately match the hours paid to field engineers with the hours invoiced to customers. This is specific to the service industry, unlike the manufacturing industry, which is able to account for the time and components in a manufacturing process (Helo et al., 2008) using the bill of materials. This is an issue which is unique within the specialist hybrid industry HVAC and M&E because of the variation in time taken to perform similar tasks on different customer's sites. Moreover, although there could be identical equipment models on a customer's site, their corresponding parts could be significantly different, and these need to be accounted for within a single sales order, unlike in manufacturing.

Due to the particular practices undertaken by organisations in the service management field a number of good practice models have been developed, most notable is perhaps the international standard for service management ISO/IEC 20000. This was necessitated by the need for service management organisations to reconcile the desire to provide the highest

possible quality of service and the commercial pressures to achieve the effectiveness and efficiency required to maintain profitability (Ottewill et al., 2000). The ISO/IEC 20000, formerly known as BS15000, is the first standard for service management (Wan, 2009). Although a British standard, it has been adopted worldwide and provides a mechanism for mitigating the service management needs discussed above.

The increasing reliance of the service management industry on information technology indicates that the vast majority of organisations considering operating in a competitive market are increasingly reliant on some form of information systems (Grant et al., 2014, Bayrak, 2013). These systems could be as simple as electronic calendars and spreadsheets, for smaller operators, to web based service applications and mobile device supported solutions (Tarantilis et al., 2008). The need for integration of the overall business and information systems' strategies highlights that information held in these systems is a vital organisational asset which provides value for the organisations' stakeholders. There are a number of frameworks which help in developing best practice in IT for the purposes of IT governance, which include the ISO 27000 series, Control Objectives for Information and related Technology (COBIT®), and the IT Infrastructure Library (ITIL). ITIL is focused on best practice in IT service management and was developed by the UK government. COBIT, on the other hand, aims to offer a high-level governance and control framework and was developed by an independent organisation, the IT Governance Institute (ITGI). The third related framework is the ISO 27000 series, which focuses on information security management and is published by the International Organisation for Standardization (ISO). All of these high level frameworks highlight the importance of conducting a thorough evaluation of business needs and their application of these frameworks in selecting the most appropriate IT solutions for the organisation. Whilst the process of selection is only one of several management stages, the current research will focus on this area.

In addition to IT best practice models, a number of researchers, including Fulton and Hon (2010), Towers, Knibbs and Panagiotopoulos (2005) and Velcu (2007), are in favour of conducting business process analysis before adopting and implementing IT solutions in the manufacturing industry. However, little has been done to mitigate such challenges in relation to identifying and implementing appropriate IT solutions for service based SMEs. Poon and Wagner (2001) indicated that an estimated 70% of IT systems implementations were considered

a failure. The London Ambulance Service, a service organisation, also experienced failure in implementing an IS system (The Computer-Aided Despatch System), resulting in the loss of lives (Beynon-Davies, 1999). Another example of information systems adoption failure is the 2003 Child Support Agency IT System within the National Health Service (NHS) (Waterson, 2014). According to the latest report from the National Audit Office (NAO, June 2013), 98% of the anticipated benefits of several NHS IT adoptions are yet to be realised. Therefore, this indicates that many implemented IS solutions, even in service management, have failed to fulfil all or part of the objectives of their implementation, and amongst the factors that could be attributed to this is the selection of an unsuitable solution in relation to the organisations processes and goals.

Since service management has been defined as the provision of utilities, the problem of selecting the right service management solution is therefore specifically applicable in the service industry. Hence, for service SMEs to be more efficient there is a need to implement a service management application which supports activities for various business processes in the organisation. With some exceptions most research conducted to date concludes that previous failed attempts at the implementation of IS systems in the same organisation deter these organisations from implementing new information systems (Fu et al., 2006). This trend, which is also evident in service organisations, leads to most organisations seeing the identification and implementation of technology which suits the organisation's business process as a potential risk.

The provision of a scientific process for ERP system selection could address this problem and also increase management confidence in ERP pre-adoption and implementation overall. The provision of a scientific process for ERP selection can aid to support the argument by Asif *et al.* (2009) that management inability to trust the process of an IT system adoption and implementation was also responsible for some IT systems implementation failures. The mapping of organisational requirements to solution features and functionalities could increase management confidence in the process of IT systems adoption, and in this way such scientific model provides a tool for measuring requirements against how various solutions fit.



### ***2.3.5 Factors that affect successful identification and adoption of a suitable service management solution***

A number of studies have addressed successes and failures in adopting and implementing appropriate IT solutions, but have failed to consider systematic approaches to mapping business process requirements to the potential solution features. Yu (2005) focused on IS/IT adoption success in terms of the effectiveness of a system post-implementation, and proposed that the use of systematic approaches in selecting ERP systems is a crucial indicator of successful system implementation. Velcu, (2007) supports this view that the journey of system implementation does not end with the 'going live' of the system. Most studies conducted to date are focused on factors that inhibit the implementation of IS systems used in automating processes within SMEs, rather than factors that improve or increase the chances of a successful ERP adoption. A number of these factors are discussed below:

Management 'buy-in': Fu et al. (2006), Fulton and Hon (2010) and Tsinopoulos and Bell (2010), while focusing on management buy-in, ease of use of the system or application and general human factors, fail to critically analyse how system features were matched to business process activities during the selection or pre-adoption of the IS system. Knowledge management systems (KMS) user motivation theory, defined as the degree to which system usage is self-determined by the KMS user (Malhotra and Galletta, 2003), suggests that KMS user motivation precedes success in systems implementation. Both academic literature and industry surveys propose that for systems adoption, user motivation is of great importance in achieving successful implementation of an organisation's chosen IS solution (Coombs et al., 2001).

Implementation history (success/failure): While it is a priority for an organisation to identify the most suitable application for its business processes, past failures in systems implementation become a hindrance for future implementations. Trunick, (1999b) found that about 40% of system implementations, including ERP system implementations, achieve only partial implementation and roughly 20% are classed as complete failures; this implies that about 40% or less of organisations that implement ERP systems fail to use the full ERP package. Ptak and Schragenheim (2004) also suggest that between 60% and 90% of implemented systems (including ERP systems) are ultimately ineffective in relation to the implementation objectives. A

more recent statistic from Candra (2012) suggested that about 70% of ERP implementations fail to deliver the expected benefits. Failures associated with systems implementation are not specifically associated to SMEs only; rather the literature suggests that leading multinationals such as FoxMeyer Drug, Dell Computers, Boeing, Mobil Europe, Kelloggs and Nestle have experienced failed ERP systems implementations or suffered from ineffective systems implementations (Yu, 2005). Other examples of failed ERP implementation are Avantor Performance Materials and the US Air Force, which abandoned their ERP implementation after spending one billion dollars on the project (Ram et al., 2014). However, the picture is not entirely negative since some organisations, such as Eastman Kodak (Stevens, 1997), Panasonic, Hewlett-Packard (Yu, 2005) and Cisco Systems (Chen, 2001), have defined their ERP systems implementations as being successful. With this in mind, the scepticism of managers is understandable, and management 'buy-in' is of great importance in system implementation, as managers play a vital role in both deciding and enforcing business process standards to various users.

Inadequate project scoping: The current research also focused on the importance of project scoping in selecting the most appropriate solution, by investigating and addressing both broad and specific issues to be addressed by the system being implemented (King and Newman, 2009). To identify the most appropriate solution for a service management process, rigorous scoping clarifies what the organisation expects of the solution. The vendor also benefits from this scoping process through better understanding of the organisation's particular needs so that they can demonstrate how their system best meets these needs. Duggan and Blayden (2001) proposed that difficulties encountered from the perspective of operations in terms of organisational business processes and maintenance of the ERP system can be mitigated by better scoping during the identification of an ERP solution. This could also explain why organisations have described their experience of ERP systems implementations as failures. While this was a finding of this study, other research also supports this, suggesting that failure in operations (business processes) from implemented ERP system can be linked to inadequate scoping at the beginning of the project (Duggan and Blayden, 2001). This raises a question about how this can be solved. There is therefore the need for a method which involves the potential users of the system during the scoping process to better understand their needs and the users'

technical knowledge which can be used in analysing the potential system features when presented by the resellers. This may provide a means to encourage input from users and gain employee commitment to involvement in the IS product selection process. Some organisations conduct a general scoping process, however this process has to be undertaken by individuals knowledgeable about IT as well as those with knowledge of business processes and understanding of the organisation's objectives. Therefore, effective project scoping requires both system knowledge and in-house expertise or expertise within the project team.

Lack of adequate vendor knowledge: O'Reilly and Paper (2009) and Grant et al. (2014) looked at vendors' motivations and goals in relation to developing an IT solution which focuses on electronic customer relationship management for an international van-based service company. Although implementation failures have not always been linked to vendors, the authority noted that vendor knowledge of both the system being implemented and of the company's business processes is of great importance to achieving successful implementation and use of the system. The main reason for this is that a large number of ERP systems and IT solutions more generally are being developed, sold and implemented by vendors known as partners (Fjermestad and Romano, 2003, Kennedy, 2006) without adequate knowledge of the business processes of the SME adopting the ERP system. For example, SAP, as one of the world's leading providers of ERP software solutions for SMEs, delivers its software solutions only via partners, of which they have more than 2400 certified partners ([www.sap.com](http://www.sap.com)). It is therefore of great importance to an SME to know before choosing a partner what knowledge of the system the partner has and how knowledgeable they are about their service operations and overall business processes (Grant et al., 2014, Daneshgar et al., 2013).

Section 2.1 discussed the theory of OIPT in relation to IS/IT pre-adoption decision making, section 2.2 discussed business process analysis using VSM and how this can improve the process of ERP adoption in the hybrid service and manufacturing SME. Section 2.3 discussed the hybrid service and manufacturing SME, why it is unique and the challenges it faces while adopting an IS/IT solution such as an ERP system. The rest of this work will discuss the process of ERP adoption using the four cyclic phases presented by Bose and Luo, (2011), that is using action case, plan, design the appropriate solution, implement and measure the outcome.

### ***2.3.6 Stages of the pre-adoption and implementation of IS/IT system***

The identification, adoption and implementation of a suitable IS/IT system, involves a number of stages which will be discussed below as adapted from (Yang et al., 2015a, Sun et al., 2015). The five action case IS/IT adoption steps follow the recommendations from (Sun et al., 2015) and are as follows:

**Stage 1 – ERP organisational readiness:** In this early stage, the aim is to assess the advantages and disadvantages of adopting the proposed IS/IT system (Labay and Kinnear, 1981). Also in this stage, a clarification of long term priorities of system features is made based on the strategy of the organisation, why an organisation wants to adopt a specific IS/IT system and whether it is achievable or not. The purpose of this stage is to identify gaps of business strategy and IS/IT infrastructure (Ofoegbu et al., 2011) and the result from this stage is used to ensure that there is a genuine need for the system as well as suggest based on structured analysis which potential systems to consider.

**Stage 2 - ERP selection:** At this stage, the organisation commences the process of selecting an appropriate IS/IT system as well as the implementation partner. A number of authors have focused on implementation from a technical perspective only (Sudhaman and Thangavel, 2015, Jovicic et al., 2012) however, for an SME without in-house technical expertise, the selection of the software is equally as important as the knowledge of the implementation partners (Griffiths et al., 2013). As the pre-adoption stage, this stage involves a number of sub-stages following Yang et al. (2015a) and they are as follows:

**Decision to adopt or reject:** Using a structured process of analysis, IS/IT systems identified as potential systems are analysed to closely map each potential system to the feature requirements of the organisation. The more structured this stage is the more likely an optimal system will be identified (Pan and Jang, 2008), however because of the nature of an SME, the role of the owner/manager and their commitment to a solution is critical to the final decision (Griffiths et al., 2013). To make this process structured and consistent, a feature analysis grid can be developed where features are assigned weights (Ofoegbu et al., 2011). The extent to

which each potential system meets each of the features can then be measured accurately to ensure that there is consistency when assessing how potential system meets each of the required features. The cost associated to each potential system is also analysed on the feature analysis grid to ensure a cost effective solution is proposed (Son et al., 2014). Data from the structured process is used, by the analysing team, to make a decision to adopt or reject each potential system. Result from this stage aids the identification of the most optimal system which is presented to management for confirmation (Nwankpa, 2015, El-Mashaleh et al., 2015).

**Confirmation and sign off:** It is important to identify the IS/IT systems process owners (Kilic et al., 2014), an example is the managing director, as in the case of SMEs, who is the overall owner and has the final sign off (Mahato et al., 2006). In this stage the proposed system is presented to the various departmental process owners for approval and sign off (Almahamid and Awsi, 2015). These departmental process owners observe how the potential system meets their requirements and based on the information provided decide whether to sign off or reject the solution (Umble et al., 2003, Langenwalter, 2000). If rejected, then the process returns to the evaluation stage but if signed off, then the potential solution is presented to the overall system owner.

**Evaluation of implementation partner:** Although the evaluation stage considers IS system suppliers, an assessment of the possible IS/IT systems is also carried out to ascertain the level of knowledge each implementation partner has with regards to the organisation's business processes (Efe, 2016). This is of particular interest for an SME which does not have an in-house technical support team therefore outsources the main IT support to a third party IT provider (Yang et al., 2015b). At this stage if a solution is perceived as suitable but the implementation partner fails to demonstrate adequate knowledge of the SME processes, the system could be rejected (Yadav and Sharma, 2015).

**Stage 3 – ERP Implementation:** After the sign off, the next stage is the planning of the implementation to ensure it causes little or no disruption to the business (Umble et al., 2003). A number of implementation methods are considered such as 'big bang' and 'phased' implementation (Nagpal et al., 2015). The implementation of a new IS/IT system such as an ERP

system also presents an opportunity to cleanse existing data before they are transferred into the adopted ERP system to ensure the organisation adapt to the system (Benders et al., 2006). Upon implementation and customisation of the adopted system, system users are trained on how to use the system to accomplish their various duties.

**Stage 4 – ERP final preparation:** This stage importantly ensures that the processes, system and stakeholders are prepared for the system go-live. According to Gullledge and Simon (2005), the final preparation stage is intended to cover major risks such as integration and stress tests. The reason for the tests above is to ensure system capabilities, system availability in the event of a disaster, user confirmation of system functionalities, user training and go-live cutover plan.

**Stage 5 – ERP Live run:** An assessment of system performance is conducted through performance monitoring and stakeholder feedback. Sun et al. (2015) suggests that performance should be monitored on a continuous periodic interval. This stage includes the repairs of identified system issues and ensures the continuous improvement concept so that system performance can be monitored and improved (Robey et al., 2002). This stage also allows the further customisation of the solution to achieve added benefits from the adopted system.

The above stages are based on the stages that reflects on those applicable within the system pre-adoption process.

#### ***2.4.1 Organisational Information processing theory and application to present study***

The theories of Critical Success Factor and Actor Network Theory are some of the other theories used in information systems research and have contributed greatly towards understanding of various aspects of information systems. Actor Network Theory (ANT) approach has been used to inform IS research by providing a framework applicable while analysing human and nonhuman entities in any context Greenhalgh and Stones (2010). ANT has the ability to treat individuals and technology from the same perspective as well as consider the interrelationships that occur in the complex networks in which the networks exist (Makkonen et al., 2012). Within the interpretive epistemology, ANT presents a common element used to interpret the role of IT

alongside the process that outlines the relationship and interconnection between IT and individuals through the meanings associated to them by people (Myers and Walsham, 1998). Although the current research considered the above theories used in other information systems research, the current study however, is informed by the OIPT, which is discussed in more detail below.

OIPT was used as the theoretical framework to understand the information processing needs, information processing capability and the fit between the two, in order to obtain optimal performance in the action case organisation.

The theory identifies three important concepts which are: information processing needs; information processing capability; and the fit between the two to obtain optimal performance (Premkumar et al., 2005). Organisations have continually identified the need for quality information to enable them cope with business environmental uncertainty, and also to improve their ability to make more informed decisions (Premkumar et al., 2005, Stock and Tatikonda, 2004). Gattiker and Goodhue (2004), in their investigation, suggested OIPT as a worthwhile means for understanding ERP systems and used a case study to provide evidence that the concept of interdependence could be important in predicting associated impacts of ERP, particularly at local level. This has been a big challenge for the company under study in this research, with various attempts in the past being made to mitigate this issue, which links back to the theory. Business environmental uncertainty stems from the complexity of the environment and dynamism, or the frequency of changes to various environmental variables (Premkumar et al., 2005). This is typical within the service management industry where processes differ significantly to manufacturing and services required differ from one customer's site to the other. Organisations generally adapt two strategies to cope with uncertainty and increased information needs: firstly, they develop buffers to reduce the effect of uncertainty on their business; and secondly, they implement structural mechanisms and information processing capability to enhance the flow of information and thereby reduce or even eliminate uncertainties. A common example of the first strategy within the service industry is building time buffer into the typical time required for an engineer to carry out a job on customer's site to reduce the effect of uncertainty in quality of services delivered. Within manufacturing, an example of this is adding safety buffers into product design to account for uncertainty in

product working conditions such as wastage and damages. An example of the second strategy, as mentioned by Premkumar *et al.* (2005), is the redesign of organisational business processes and the implementation of integrated information system that improve the flow of information and reduce uncertainty within various parts of an organisation (Gattiker and Goodhue, 2005). Cooper and Wolfe (2005a) argued that ERP adoption activities varies with the extent of uncertainty; thereby the more uncertainty, the more information processing required for effective performance of the processes. The current research was informed by this theory therefore, the adaption of the second strategy to redesign the service company's business process and implementation of an integrated information system to improve information flow and staff efficiency.

Although this theory does not categorically define the scope of managerial input, it does allow the adoption of one of its dimensions to help understand how leadership input during adoption and after implementation could contribute to the success of the ERP system within a HVAC service organisation. Valiris and Glykas (2004) argued in favour of this, by stating that organisational theory-based methodologies add more elements to business modelling and analysis by addressing the need to focus on people (as agents), their accountabilities, role, interactions, activities and use of available resources. This in some way has defined the managerial input by stating controls, responsibilities and resources.

OIPT was also used by Cegielski *et. al.* (2012) to access how an organisation's information processing requirements and capabilities combine to affect the intention to adopt an information system. Although they used this theory within a supply chain, it is arguable that a supply chain is a type of service management organisation and hence will suit the adoption of this theory. The adoption of OIPT allows an evaluation around how an organisation's information processing requirements and capabilities combine to affect the intention to adopt and implement an ERP system in a HVAC service organisation.

#### **2.4.2 Information Processing Needs**

The information processing needs of an organisation are defined as the detachment between the information needed and the information available for making decisions within the organisation (Premkumar *et al.*, 2005). This observation means that there is a gap between the



information an organisation requires and the information available to it and this gap creates uncertainty. To further understand this gap and uncertainty, Koh et. al. (2006) demonstrated that an organisation's internal culture plays critical roles in determining whether an ERP system adoption was successful or not in a service organisation. As a result, this study aims to reduce these uncertainties through the implementation and usage of information systems in the decision-making process to adopt an ERP system. For example, the action case hybrid service and manufacturing firm, Alpha, utilises information to support service quality improvement initiatives, aimed at improving their service and manufacturing business processes and streamlining the entire business process.

It has been argued that the adoption and implementation of an ERP system enables a hybrid service and manufacturing SME to manage its resources in an efficient and effective way. Certain resources, such as materials, human resources and finance, are used efficiently, and provides an integrated solution for the organisation's information processing needs (Voordijk et al., 2005). Therefore, an ERP system facilitates the efficient flow of information between various processes in a hybrid SME.

OIPT is used in the current study as the theoretical framework to understand the information processing needs and information processing capability as a means to achieve optimal performance in the chosen study organisation. The understanding of information processing needs, information processing requirements and information processing capability allows input from management and users.

## **2.5 Summary**

This chapter has explored the existing literature in relation to the three themes of this thesis. First of all the chapter documented the key differences between utilities that are offered by service-focused operations and productions that are used in general manufacturing sector. The special case of hybrid organisations that combine both services and manufacturing such as exemplified by HVAC SMEs are also discussed.

The ERP implementation literature is appraised and the overwhelming negative evidence from the literature is highlighted. A number of theories for ERP systems implementation are

discussed such as Lean Six Sigma and Value Stream Mapping. Value Stream Mapping is selected since it is more applicable for an SME sector for the current study.

The use of the Organisational Information Processing Theory is compared to Information Systems Success Theory as a relevant theory, which provides a theoretic lens for the current study. OIPT is going to be used to provide a framework for data discussion and analysis in the later chapters.

The next chapter, chapter three, establishes the research strategy which will be applied to this study.

## ***Chapter Three: Research Methodology***

### ***3 Introduction***

Previous chapters introduced the research problem and provided an overview of existing knowledge as identified in the literature. This research methodology chapter justifies and describes the way the current study was conducted.

This chapter is structured as follows: firstly the consideration of the choice of research philosophy and approach, then it proceeds to provide the justification for the paradigm adopted. The chapter then explains why the action case study was chosen as the preferred research methodology for this work, as well as providing details of the design and context. The data collection via observations, interviews, meetings and other documented sources is considered next, then the account of OIPT and its application in this work. The rest of the section deals with the analysis of the empirical material, the research limitations and the ethical considerations within this work. The chapter ends with an evaluation of this research using the Klein and Meyers' (1999) framework for evaluation of interpretive studies.

#### ***3.1 Research Approach and Philosophy***

Researchers have to be clear on their choice of a paradigm, the three research paradigms considered for this work are positivist, interpretive and critical pluralist (Caelli et al., 2003). The associated criticisms are also discussed in order to present the justification of the selected research paradigm.

Examining a phenomenon through events requires the consideration of the interaction of different variables such as information capability of the people and systems requirements that impact on the phenomenon. The unsuitability of applying positivist and critical pluralist philosophies, as discussed later in this chapter, relates to the inability of these two philosophies using a non-human agency theoretical perspective as shown in table 3.1. In order to answer the research questions, this research will involve users who are contributors to the decision making process of identifying and adopting a most appropriate IS/IT system.

### 3.1.0 Research Paradigms

A compelling research question is one of the most important considerations in any project and each possible research question requires the use of an appropriate research approach to produce high quality evidence, relevant for the research question (Broadbent and Unerman, 2011). In order to place this research in its epistemological, ontological and paradigmatic context, the philosophical stance and choice of research approach will have to be explicitly expressed (Biedenbach and Muller, 2011). In IS research there has been an extensive debate amongst academics, regarding which research approach is most suited for use while carrying out IS research. Some have argued in favour of positivist approach, whilst others have argued in favour of interpretive approach (Oates, 2006, Moore, 2010). The three main philosophies, which constitute the base of modern research are positivism, interpretive and critical social science (Myers, 2009, Neuman, 2000). Chua (1986) also agrees with these classifications of research epistemologies. The characteristics of these three philosophies, approaches or paradigms are presented in Table 3.1, the individual options are discussed in detail below.

Table 3.1: Adopted from Guo and Sheffield (2008)

| <b>Research Paradigm</b>       | <b>Positivist</b>  | <b>Interpretive</b>  | <b>Critical pluralist</b>  |
|--------------------------------|--|--|--|
| <i>Theoretical perspective</i> | Utility  | Human agency   | Power relations  |
| <i>Concerns</i>                | To discover universal laws that can be used to predict human activity                    | To uncover socially constructed meaning of reality as understood by an individual or group | To uncover socially constructed meaning of reality as understood by an individual or group   |
| <i>Assumptions</i>             | Objective world which science can measure and 'mirror' with expert, privileged knowledge | Inter-subjective world which science can represent with concepts and indicators;           | Material world of structured contradictions and/or exploitation which can be objectively known only by discourse on tacit ideological biases |

|   |   |   |   |
|---|---|---|---|
| <i>Perspective of researcher</i>            | Stands aloof and apart from stakeholders and subject matter so that decisions can be made objectively | social construction of reality<br>Becomes more fully involved with stakeholders and subject matter to achieve a good understanding of the stakeholders' world | Active involvement with stakeholders to surface illusions and to implement alternatives that will improve their world |
| <i>Goodness or quality Criteria</i>         | Conventional bench- marks of 'rigor'; internal and external validity; reliability, objectivity        | Trustworthiness and authenticity;<br>Fit with social norms and values   | Historical context; erosion of ignorance and misapprehensions; sincerity of beliefs; action stimulus                  |
| <i>Initial Knowledge Management example</i> | Holsapple and Joshi (2004)  | Orlikowski (2004)   | Pozzebbon and Pinsonneault (2006)   |

### **3.1.1.0                      Positivism**

Oates (2006), Moore (2010) and Orlikowski and Baroudi (1991) all emphasized that an IS research is positivist if the researcher is strictly empirical and emphasizes what they directly experienced while carrying out the research. Positivists therefore attempt to use theories to enhance the understanding of phenomena. Auguste Comte (1798–1857) is associated with the positivist philosophical position which underlies much of scientific reasoning (Moore, 2010).

As highlighted in table 3.1, positivism is summarised by Biedenbach and Muller (2011) as being objective, assuming one reality, using traditional scientific approaches and often quantitative methods. Positivism assumes that the highest form of knowledge is scientific knowledge, and that scientific knowledge comes from studying directly observable and measurable events (Moore, 2010).

There is also the assumption that developing statistical measures of observations and studying the behaviour of an individual are of paramount importance for positivism (Creswell, 2008). The researcher who is positivist reflects on the need to examine causes that influence outcomes, such as having identified problems being examined in experiments (Creswell, 2008). Positivism can then be understood as the application of scientific methods to solving information system problems (Hirschheim, 1985, Siponen, 2005) and proposes that meaningful statements are only those which can, in theory at least, be verified (Ryan et al., 2002). Positivism places high value on the principle of replication and this replication occurs when studies are conducted using a repetition of the basics of the study and obtaining results or findings that are either identical or similar. Hence positivists emphasise replication as the fundamental test of knowledge because they believe that when identical research is carried out under the same conditions and limitations using clear facts, then the results obtained will be similar if ideas are carefully specified as well as facts and standards precisely measured and adhered to (Guo and Sheffield, 2008, Chen and Hirschheim, 2004). As a result, when IS researchers carry out similar empirical studies using known facts and follow a precise measurable standard and achieve similar results, other academics indicate increased confidence that the researchers have captured data accurately as well as applied the correct research method. Therefore using theories in the correct context contributes to an increase in scientific knowledge which can be generalised to the sample of population (Neuman, 2007).

### **3.1.1.1                      *Criticisms of Positivism***

The application of the positivist paradigm is most suited and associated with either laboratory or survey research (Guo and Sheffield, 2008), because it assumes the determination of cause and effect to be the highest goal of science and equates data integrity with the control afforded by laboratory experiment (Hirschman, 1986). Unlike in the current study where the process of identifying and adopting an IS/IT system is expensive and due to this financial constraint can only be performed once. The positivist paradigm remains the dominant approach in conducting research in IS field (Chen and Hirschheim, 2004, Orlikowski and Baroudi, 1991) with Chen and Hirschheim (2004) and Biedenbach and Muller (2011) arguing that the positivist paradigm overwhelmingly dominates the IS research community by more than 90%. Such imbalance in

paradigmatic and methodological research in the IS research community could have a negative impact (Orlikowski and Baroudi, 1991, Chen and Hirschheim, 2004) and these researchers further proposed the importance of employing other research methodologies to better investigate research questions of interest.

Therefore, there is an argument that the positivist paradigm does not provide different dimensions for a research investigation, since most studies can only confirm or reject existing hypothesis and theories and do not lend themselves to investigate new areas of knowledge discovery. There is also the argument that although the positivist paradigm focuses on data and business processes, it fails to equally focus on people and the more non-dominant aspects of an organisation (Vickers, 1999, Smith, 1999). This seemingly neglected aspect is indisputably vital in the current study and could contribute to successful IS/IT decision making and pre-adoption as a result of the contribution of these non-dominant human factors to the overall business processes re-engineering in the organisation. Although the positivist paradigm is popular in laboratory work and is based, for example, on survey data, it is less popular in case study research, which limits its application and adoption (Guo and Sheffield, 2008, Hirschman, 1986, Chen and Hirschheim, 2004). In the current study, adopting the positivist paradigm would be inappropriate in light of the research settings and aims, since human interactions and involvement with ERP systems and their functionality are of interest here.

### **3.1.2.0                      *Interpretivism***

Interpretive studies, as a research paradigm, attempt to understand phenomena through the meaning people involved assign to them. Interpretive approaches to research are associated with producing a subjective understanding (see table 3.1) of the context of the information system and of the process, whereby IS influences and is influenced by the context (Black, 2006). Table 3.1 indicates that the interpretive approach intends to uncover socially constructed meaning of reality as understood by an individual or group. Table 3.1 also illustrates the interpretive assumption, which is the existence of an inter-subjective world which science can represent with concepts and indicators such as the social construction of reality

The interpretive paradigm is summarised by Biedenbach and Muller (2011) as being subjective, using phenomenological social science approaches and often is based on qualitative data collection and analysis methods. It has also been argued, in favour of the current study, to provide the participant's understanding of a particular social settings (Guo and Sheffield, 2008). Generally, management studies often report 10% qualitative and 90% quantitative studies, however there is a steady increase in interpretive studies (Aguinis et al., 2009).

The interpretive ontology assumes a subjective reality as seen by individuals, because it is socially constructed and this leads to the assumption of multiple realities (Collis and Hussey, 2009, Biedenbach and Muller, 2011). Interpretivism stresses the necessity for the researcher to understand the difference between humans in their roles as social actors. Therefore, it is suitable to understand meanings and perceptions individuals attach to phenomena. Interpretivism has also been identified as being very suitable in addressing particular research questions (Biedenbach and Muller, 2011, Smyth and Morris, 2007). Interpretivism has emerged and is used in the field of IS and has become more widely accepted even in traditionally positivist-oriented journals such as *MIS Quarterly* (Chen and Hirschheim, 2004, Trauth and Jessup, 2000). With this growing popularity and acceptance, interpretivism should be welcomed and encouraged because it provides an essential dimension for research investigation which the positivist paradigm would not be able to accomplish (Chen and Hirschheim, 2004).

### **3.1.2.1                      *Criticisms of Interpretivism***

Interpretivism has been identified as being fairly useful in addressing exploratory and explanatory research questions, but has also been criticised for being poor at addressing generic research problems (Biedenbach and Muller, 2011). The term 'generic research problem' refers to a research problem which provides generalisation to the samples population. As a result, when the research question being investigated takes a more generic perspective, the use of interpretivism is discouraged. In the current study, the research question looks at how OIPT can be used as the theoretical lens when streamlining business process and adopting suitable IS/IT system, which is not particularly generic.



The interpretive approach has also been criticised as being time consuming and thus researchers are likely to choose a less time consuming approach in response to Chen and Hirschheim's (2004). In the current study, the consideration of taking longer time to apply an interpretive approach does not imply the quality of the research conducted is compromised. Rather, could imply that the time could be better spent achieving better results. Walsham (1995) also criticised the interpretive paradigm by stating that there is no homogenous school of thought with respect to knowledge claims. This implies that various researchers could apply various differing categorising schemes using different justifications and arriving at different outcomes. Given this potential bias, researchers using the interpretive paradigm can only claim that their findings serve as a reflection of IS research (Chen and Hirschheim, 2004) this is also applicable in the current study.

Denzin (1970) suggests using multiple unique methodologies in a triangulation to reach the same conclusion to enhance reliability, indicating that researchers are able to combine several methodologies, such as observation, interviews, meetings and documentary sources, in a single case study (Atkinson and Hammersley, 1994).

### **3.1.3.0                      *Critical Pluralist***

Critical pluralism focuses primarily on its explanatory power and on the dismissal of issues (see table 3.1), such as context and distribution of power (Faria and Wensley, 2002). Many critical studies conducted stress the need to understand and explain phenomena, that is to find the reasons for their existence, rather than to describe the existence and prescribe solutions for eliminating their symptoms (Adamides et al., 2012). Critical realist perspective is situated somewhere in the middle between positivism and interpretivism (Bhaskar, 1979). It admits the existence of a more complex, multi-level reality (ontology) as well as aiming at challenging the ontological assumptions and certainties of the positivist paradigm (Adamides et al., 2012). This challenge of ontological assumptions and certainties is via qualitative and multi-faceted, pluralistic research methodologies employing a retroductive mode of inference (Adamides et al., 2012). With the above, in the field of IS adoption and implementation research, Biedenbach and Muller (2011) summarised the critical study as being built on objective mechanisms, events and subjective experiences.

This perspective challenges the rationality behind information systems research by building an argument based on objective mechanisms, events and subjective experiences without putting into consideration the human and cultural aspects of information systems usage and adoption. Finally, the critical pluralist paradigm has been credited for providing participants with the understanding of particular social settings as required (Guo and Sheffield, 2008).

### **3.1.3.1                      *Criticisms of Critical Pluralist***

The critical pluralist is criticised as embracing the concept of adopting or using information systems without questioning the ethos of industrial society and this limits human choice (Baskerville and Wood-Harper, 1996). As a result, the use of this approach while investigating human related aspects or influence in information systems could provide unreliable results, due to the approach not considering the human and cultural aspects of information systems usage and adoption. Guo and Sheffield (2008) argues that among 120 empirical articles surveyed, only 1% actually applied critical pluralist stance. This argument was also supported by the findings presented by Chen and Hirschheim (2004), this may be linked to the above criticism.

### **3.1.4                      *Philosophical review***

To effectively manage change during system implementation and also learn from past projects, it is essential to review and apply to the research context the various philosophical positions. The researcher initially reviewed the theoretical assumptions of the two main research philosophies that have been used in conducting information systems research in the past. This review will support the understanding of these two philosophical approaches and clarify the choice of position for this study. In order to position this research in its epistemological, ontological and paradigmatic context, the philosophical stance and choice of research methodology will have to be explicitly discussed (Biedenbach and Muller, 2011).

Chua (1986) classifies research epistemologies as positivist, interpretive or critical. Malina et al. (2011) and Orlikowski and Baroudi (1991) argue that positivism searches for empirical truths and is not about confronting 'things themselves' because direct observation of a phenomenon is subjective and hence not reliable. When applied in this research context, it would ensure that

the selection of an appropriate ERP system for a HVAC service SME should be done using empirical evaluation after having reviewed all factors and constraints, such that the decision would be based on the available facts and not on “good feelings”.

Phenomenologically-based methodology does not create an immediate interpretation of phenomena at the level of concepts, theories or statements of fact. Concepts, for example, are not constructed through direct confrontation with the phenomena but by analyzing the data collected.

### ***3.2 Justification of research paradigm***

The decision to adopt the interpretive research approach is discussed and justified in this section. This research study applies an interpretive approach while looking at the influence of human factors when adopting and implementing SAP Business One ERP system in a hybrid service and manufacturing company. This is despite the fact that, historically, the interpretivist approach is deemed the second most popular research paradigm and positivist paradigm the most popular (Chen and Hirschheim, 2004, Guo and Sheffield, 2008). In relation to case studies in general, interpretivism paradigm emphasizes an often story-like presentation of a problem and an iterative process of constructing the case study (VanWynsberghe and Khan, 2008).

The approach adopted in the current research project is dependent on the research questions along with the aims and objectives of the study. Epistemologically, (see table 3.1) interpretivists researchers seek to uncover socially constructed meanings of reality, as understood by a group or an individual and would argue that methods proposed by natural sciences would fail to address particular social phenomena (Guo and Sheffield, 2008, Black, 2006). Whereas the positivist seeks to discover universal laws that can be used to predict human activity while the critical pluralist approach seeks to uncover ‘surface illusions’ to empower people so that they can change their world (Guo and Sheffield, 2008). In this study, ERP system adoption and the implementation of SAP Business One is considered a socially constructed reality; the interpretivist paradigm is therefore most relevant to aid the understanding of business process analysis during this process as a social phenomena. The study is not interested in identifying power neither is it interested in understanding the universal law surrounding utility. With the

increasing acceptance of the interpretivist approach by IS researchers, the interpretive perspective has been gaining more credibility and wider acceptance in IS research (Klein and Myers, 1999, Walsham, 1995). This increase in the acceptance of the interpretive research approach can be attributed to a general shift in IS research away from technology to managerial and organisational issues (Myers, 1997). Another reason for the increase in acceptance of the interpretive approach is the fact that it provides an understanding of the context of the information system and the process, whereby the information system influences and is influenced by the context (Black, 2006, Klein and Myers, 1999). This second attribute is applicable in this research. Researchers are therefore increasingly interested in the application of the interpretivist approach in qualitative IS research. This increasing interest can be attributed to the richness of the real-life setting such as case study as contrasted with the artificial context or laboratory based studies.

The current study is interested in uncovering the socially constructed meaning of reality from the perspective of the intended system users and stakeholders. The assumption in the current study is that the requirements expected from the IS system is subjective and can only be understood by involving the users and the construction of the user perception of social reality. As a result of the subjective nature of the study, the researcher saw the need for close observation over a longer period of time and in order to help facilitate change was actively involved in the study. The deeper involvement with the stakeholders increased the trustworthiness and authenticity as suggested by the interpretive perspective as well as a fit with social norms and values. As shown in table 3.1.1, the author's philosophical beliefs about this study are in line with the interpretive paradigm.

Since IS represents a dynamic social process in this research, such as vendor's knowledge of the business process changing with time, it cannot therefore be represented in a model that is understandable using positivist approach which has always been used to represent fixed and predictive relationships as well as generic research area (Guo and Sheffield, 2008). As the present study looks at the socio-technical complexity of ERP system pre-adoption and implementation, the positivist approach was regarded as inappropriate.

Hence, based on the knowledge that interpretive paradigm provides this research with the understanding of the social settings within the hybrid service and manufacturing SME, the interpretive paradigm is therefore a more suitable paradigm for the current study.

Table 3.1.1

| <b>Research Paradigm</b>       | <b>Current Study</b>   |
|--------------------------------|--|
| <i>Theoretical perspective</i> | The researcher focuses on human factors to understand people’s views of IS system.   |
| <i>Concerns</i>                | Interested in uncovering the socially constructed meanings of reality from the perspective of the intended system users and stakeholders.                |
| Assumptions                    | Assumes that the requirements from the IS system is subjective and can only be understood by involving the users and the construction of social reality. |
| Perspective of researcher      | Researcher becomes more involved with stakeholders and the subject to gain a better understanding of the subject and the stakeholder’s world.            |
| Goodness or quality Criteria   | Trustworthiness and authenticity: Fit with social norms and values.  |

**3.3 Research Methodology**

This section focuses on the research methodology chosen and used in this study. Action case methodology was used in the construction of this study. To fully justify the adoption of this methodology, some of the other relevant research methodologies will be briefly discussed.

The known research methodologies that have been used in information systems research are laboratory/experimental, investigative, historical, archival record analysis and case study (Chang et al., 2009). There is also action research and mixed methodology, which combine more than one methodology (Weerd-Nederhof, 2001). Section 2.1 while discussing information processing

suggested that theories can be used to shape a case study. Action research and case study will be discussed further in the following sections.

Table 3.2 Relevant situations for the different research strategies/methods

| Strategy                 | Form of research question            | Requires control over behavioural events? | Focuses on contemporary events? |
|--------------------------|--------------------------------------|---|---------------------------------|
| <b>Experiment</b>        | How, why                             | Yes                                       | Yes                             |
| <b>Survey</b>            | Who, what, where, how many, how much | No  | Yes                             |
| <b>Archival analysis</b> | Who, what, where, how many, how much | No  | Yes/No                          |
| <b>History</b>           | How, why                             | No  | No                              |
| <b>Case study</b>        | How, why                             | No  | Yes                             |

Note: The “what” questions, when asked as part of an exploratory study, pertain to all five methods.

Adopted from Yin (1989)

### ***3.3.1 Laboratory Experiment***

Here researchers manipulate variables, control the intervening variables and also, measure the effect of the independent variables on the dependent variables (Wongpinunwatana et al., 2000). Practical activities are designed to stimulate conceptual reasoning and critical thinking to prompt the application of science to resolving everyday situations (Prodan and Campean, 2005).

An argument presented against laboratory experimental methodology by Introna and Edgar (2000) indicates that laboratory experiments are simulated and could ignore key factors that would have been obvious in real life SME settings. It is also argued that in laboratory experiments, there appears to be more focus on satisfying the requirements and constraints of the research rather than focusing on the main objectives of the research (Introna and Whitley, 2000). Laboratory experiment is a laboratory based research methodology and as a result is not applicable in the current study because this research is field based.

### **3.3.2 Case Study**

Research by Zelkowitz and Wallace (1998) revealed that in a case study a project is monitored and its data collected over a period of time. In IS, the project is often a large one and would be undertaken whether data was to be collected or not (Zelkowitz and Wallace, 1998). The implication is that there would be relatively minimal additions to the expected costs to the project. Case studies have also established themselves in the field of information technology as an acceptable strategy of data collection, as it offers insight into a particular complex phenomenon which is only possible with this methodology (Pare, 2004). Although the researcher is involved as an observer he/she is restricted by not intervening in the research in any way (Oates, 2006, Goduscheit, 2014, Suprateek and Lee, 2003).

Data is often collected and used in building a baseline to represent the organisation's standard business processes from a class of projects for ERP system adoption and implementation (Pare, 2004, Zelkowitz and Wallace, 1998). In the current study, the researcher has an active involvement in the information systems process because of the influence they may have on the pre-adoption and implementation of the ERP systems.

Case study methodology has some advantages, but it has also been criticised for having some weaknesses. One of the weaknesses is that each development is relatively unique, so it is not always possible to compare one development profile with another. However the merit with this, according to Oates (2006), Eisenhardt (1989), Rowley (2002) and Eisenhardt and Graebner (2007), is that it is possible to generate a wider conclusion which is relevant beyond the case being studied – generalisation to theory and not to the sample of population is possible. For example, the findings from a service hybrid SME may also apply to the theory of hybrid service and manufacturing SMEs as well as the use of OIPT theory for this context. Oates (2006) and Herlocker *et al.* (2000) emphasised that clarity on the extent to which the case shares similarity with other cases in its class is important to be established. As a result, it is difficult to determine trends and statistical validity. For example, Zelkowitz and Wallace (1998) argued that there have been some efforts at collecting data from various information systems implementation projects but the projects have been quite diverse, and so the data could not be applied in other projects.

Finally, Chang *et al.* (2009) summarised that three advantages exist with using case study methodology within the information technology field:

- (1) The current situation can be understood in a natural and un-manipulated environment, and theories can be derived from actual observations.
- (2) It is easier to understand the essence and complexity of the process.
- (3) Facing rapid changes in terms of information management, it is easier to obtain new insights on the research topic using case study method.

### ***3.3.3 Action Research***

Action research as a methodology is also known as participative research. This methodology enables the researcher to be affected by and affect the research as well as the realization of the 'human creative potential' (Jenkins, 1985). A framework for approaching complex business problems collaboratively, supportively and with an open mind is provided by action research (Howell, 1994). Oates (2006), Stringer (2007) and Baskerville and Myers (2004) stated that action research concentrates on practical issues rather than abstract hypotheses, as the researcher is involved in a real world situation. This encourages the emergence of fresh questions about the problem being researched, and aims at providing practical outcomes as well as academic knowledge. Action research methodology has become popular amongst organisations, managers and their sponsors as it is identified within the Knowledge Transfer Partnership framework because the researcher's involvement is work-related, results-based and group-focused (Coghlan et al., 2014). The participation of the researcher in the case study organisation to effect changes should not be confused with consultancy because, as clearly pointed out by Oates (2006), consultancy differs from action research based on the following points:

- The researcher required more rigorous documentation than consultancy
- This research requires and applies theoretical justification whereas consultancy requires empirical justification
- Consultants are restrained to operate under tighter time and budget.



The main criticism of action research is the active and deliberate self-involvement of the researcher in the context being investigated (McKay and Marshall, 2001). Unlike other methods, such as methods of objectivist science, where the argument is that the researcher is seen as an impartial spectator in his or her research context (Chalmers, 1982). In action research the researcher is viewed as an important participant in the research process (Checkland, 1991). In action research, the researcher collaboratively works with other connected and/or affected actors to effect change in the problem context (Checkland, 1991, Hult and Lennung, 1980).

The existence of collaboration between the researcher and what may be described as the 'problem owner' is equally essential to the anticipated success of the action research process (McKay and Marshall, 2001). There is the existence of a mutual dependence between both researcher and problem owner as they are reliant on the other's skill, experiences, and competencies in order to ensure that the research process achieves its dual aim of practical problem solving and the generation of new knowledge and understanding (Hult and Lennung, 1980).

Action research requires several cycles (Baskerville, 1999, Myers and Nielsen, 1999) of action and evaluation of that action, however in the current research there is only one option to carry out this action. The ERP system evaluation and implementation is an expensive process and cannot be repeated within the constraints of a PhD process. Therefore, because there is only one opportunity to implement an ERP system in the case, action research would not be appropriate in this study, although in principle it is a good approach where the cycle can be carried out a number of times.

### ***3.3.4 Action Case***

Vidgen and Braa (1997) argued that action case draws from the strengths of both action research and case study as a hybrid method. They further argued that it will take from the tradition associated with action research a concern with building the future through purposeful change, as well as maintaining an interest on the historic conditions in which the research is set (Vidgen and Braa, 1997). The difference between action case and action research is that there

is only one cycle required in action case, whilst action research can go indefinitely or have at least two iterations.

In figure 3.1, action case is positioned in relation to other research methodology options. Field experiment is aligned with prediction, case study aligned with understanding and action research with change so as to identify the research method with the research framework. Hard case and quasi-experiments have a less pure basis with respect to the ideal types of research outcome (Vidgen and Braa, 1997). As a result of this outcome, are placed in the triangle such that hard case is represented as a mix of understanding and prediction and quasi-experiment as a mix of change and prediction. Alternatively, action case represents a mix of understanding and change.

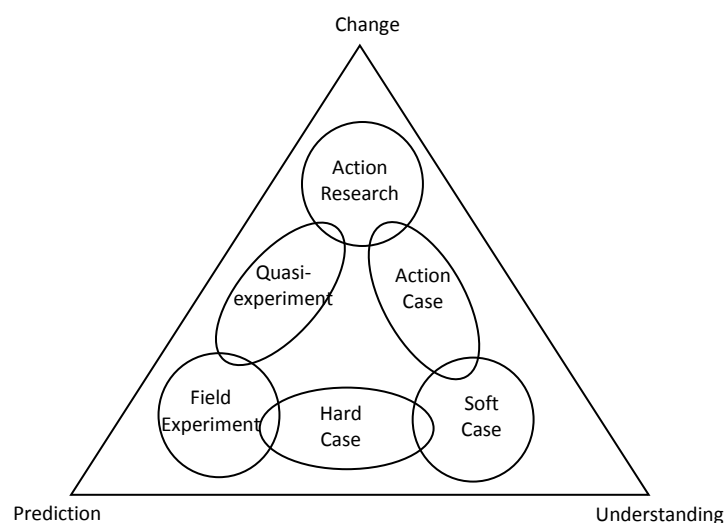


Fig. 3.1 Action Case method from Vidgen and Braa (1997)

Change is important in the current study and it can only happen once; hence, this research will be using action case methodology. The researcher is also taking an active part in the process hence the action can be both researched and implemented in practice.

As mentioned in section 3.2 above, interpretivism ontology assumes a subjective reality as seen by individuals, because it is socially constructed and as a result, leads to the assumption of multiple realities (Collis and Hussey, 2009, Biedenbach and Muller, 2011). Therefore, as

supported by Interpretivism, small teams were formed to ensure that clear understanding of humans in their role as social contributors were achieved and therefore understanding the meanings and perceptions which individuals attach to phenomena. The implementation of action case was through active participation of the researcher in pre-adoption decision making process of an ERP system. The researcher was conducting academic study as well as working in a team comprising of organisational staff and third party members. This allowed the researcher to advance theoretical understanding of the subject area and affect change in the action case organisation.

The process of data gathering was done by conducting interviews with key stakeholders and staff using the various systems at Alpha, the action case organisation. Close involvement was important in this research because the researcher's involvement has a strength of providing an in-depth access to people, issues and data as suggested by Walsham (2006). Interviews with staff were organized so that they did not cause any down time in the process. Interviews were then reproduced and validated by following the same process on the relevant system and given to staff to re-validate the documentation, following Miles and Huberman (1994). The data collected was used again to produce a VSM of the present and future processes state, identifying areas of waste within the present business processes used in modelling the adopted solution. Features required by the company's strategic plans, such as enabling electronic time sheets submission by engineers etc, were among features identified for the desired features list.

As discussed in chapter two, VSM is used in research to diagrammatically represent and analyse information obtained via semi-structured interviews and questionnaires to visualise and develop the current business processes called current state (Lasa et al., 2008b). Analysis of an SME's current state is achievable with the support of enthusiastic stakeholders, and this current state analysis is important for the identification of areas of waste and areas for improvement, which can then be used to develop the organisation towards target state (Hines et al., 1999). The target, future state business analysis can be instrumental in developing appropriate systems for hybrid service and manufacturing organisations. The development of an appropriate system is necessary where off-the-shelf ERP systems fail to adequately meet the business process needs of the organisation. This study will show how the information gathered as a result of developing

the VSM and output from the VSM was used as a guide for the customisation of SAP Business One in the absence of a suitable off the shelf solution.

### **3.3.4.1 *Single case justification***

As mentioned earlier in this chapter, this research adopts a single case study within an independent service and manufacturing SME based in the UK. This approach was deemed appropriate as a result of the research aims and due to the close interaction required between the researcher and the study. As the case study is a hybrid service and manufacturing SME, this form of business process is unique, and so a single case is the best approach. One argument against single case approach is that they cannot be used for generalisation (Themistocleous and Corbitt, 2006), however Oates (2006), Eisenhardt (1989), Rowley (2002) and Eisenhardt and Graebner (2007), argues that generalisation can also be made based on similarities between the organisations. The similarities between organisations include type of business and business locations, which are useful while generalising to theory of OIPT, VSM and hybrid service and manufacturing SMEs.

Gibb and Wilkins (1991) have argued that the multiple case neglects some of the classic strengths of case studies in three critical areas: the first, the in-depth study of a single case against the study of multiple cases; the second, telling of a good story against the creating of good construct; the third, deep versus surface descriptions. Gill (1995), in favour of this study, argued that this is enough reason to use single case approach in order to get detailed in-depth information for testing a theory or developing a new theory especially using action case.

Another argument against case study is that it takes a long time to be completed (Teegavarapu and Summers, 2008). This favours the choice of single case since the study requires extensive resources in order to gather the appropriate information required to evaluate the potential systems. As a result of the amount of resources required to effectively carry out the research being high, the option of having a similar type of organisation that is going through the process of adopting an ERP system becomes difficult. Choosing a single case wisely, as stated by Teegavarapu and Summers (2008), can have the same effect as Galileo's view of gravity which was based on a single case of a 'Pisa tower' experiment.

### ***3.3.5 Interpretive Action Case description – Alpha overview***

Alpha is an action case organisation that has been selected for the current study. As a result of past failures while adopting ERP systems, Alpha identified the need for an in-depth study in order to reduce the likelihood of failure while adopting another ERP system. Alpha approached the University for assistance, the University could not identify a readily available theory which could inform the process of an IS pre-adoption decision making for this organisation. This resulted in a development of a Knowledge Transfer Partnership (KTP) project proposal which was based on the academic and practical challenge presented by the situation at Alpha.

Upon approval of the project by the government body, the SME along with the University recruited the author of this research. To work and satisfy the needs of both the university and the organisation, the researcher was guided by the SME, the University and the government body. For the SME, the main deliverable is providing a solution to the defined scoped problem and to the University, the deliverable is a contribution to knowledge. The use of a KTP to identify an action case study provided the researcher with a unique opportunity to access rich in-depth data source over a period of two years. While working on the research project, the hybrid service and manufacturing SME uniqueness have been identified by the researcher as a particular area of focus and one of the causes for the past Alpha ERP adoption failures.

This was a research conducted as an **interpretive action case methodology** on a hybrid service and manufacturing SME organisation which was at the time selecting and implementing a service management solution to enhance their existing systems. The most important issues identified by the action case SME were the need to re-engineer business processes and service oriented functionalities such as: service job costing; field engineers' diary; manufacturing materials; onsite and offsite inventory management; equipment management; PDA functionality; timely job invoicing; scheduler; equipment tracking and real-time details of engineer's time sheet. This SME was evaluated by considering the inadequacy of their existing system against the functions listed above. The aim of this study was to look at the case of a hybrid service and manufacturing SME and Alpha presented a good opportunity for such study. Due to expansion, Alpha started off using systems such Opera and Telemagic, however, over time Alpha found that they out grew these first generation 'mini ERP' systems and they can no longer afford to manage the associated workarounds to allow them take on more businesses.

Hence the case SME identified the need to evaluate, adopt and implement a more suitable system, which adapts as the organisation grows and reduces the need for business process workarounds as well as offering the opportunity to fit the aim of this research.

Having identified the potential action case organisation, which for the purpose of this study is referred to as Alpha, there was a need to ensure that there was genuine lack of the functionalities mentioned above within their existing ERP systems.

With the current KTP context, the University of Salford identified that there was genuine lack of service functionalities at Alpha, a business case was submitted and sent to the Technology Strategy Board, who were also financiers of this project, for evaluation and approval. The project was approved by the National Strategy Board and, as a result, the author was employed in the capacity of a researcher for this project based on his interest in this research project and in accordance with the KTP structure. As part of the KTP structure, Alpha hosted the researcher at the company for a period of two years whilst the data was collected. The researcher was officially granted access to Alpha as a staff member within the IT department and also granted access to communicate to staff and customers while adopting and implementing the suitable ERP system.

Rahim and Baksh (2003) criticised case study research by referring to case study as not always being efficient because many visits could be required to develop a comprehensive view of operations and to understand the business processes. This limitation of case study methodology when combined by action case is mitigated by the researcher being an active participant and wholly involved in the whole organisational processes. The combination of case study and action case will also reduce the influence of human factors on the result of the research analysis and conclusion.

As stated by Oates (2006) and Cao and Wang (2013), this research took OIPT and used Alpha as the action case study to collect empirical evidence to advance the theory of OIPT as set out in the research objectives.

**Table 3.3 Characteristics of the Action Case**

| <b>Factor</b>  | <b>Attribute</b>    | <b>Action Case concern</b>  | <b>Example from Alpha</b>   |
|----------------|---------------------|---|---|
| Suitability    | Research Design     | Is action case appropriate to the research question being investigated?     | The action case methodology was appropriate to phase two (the analysis of hybrid ERP systems available for adoption and implementation) and phase three (value stream analysis and development of the future state system). |
|                | Research skills     | Does the researcher have the skills and experience to make an intervention? | The researcher had some years of experience in ERP systems customisation and implementation.  |
| Interpretation | Richness            | Is the scope of the research wide enough to provide understanding?          | The scope of the research was narrowed down to concentrate on a business process with service and manufacturing.  |
|                | Focus               | Is the research question sufficiently focused?                              | The focus of the research was narrowed to pre-adoption and implementation of an ERP system in the unique business process   |
| Intervention   | Scale               | Is the scale of the subject for research manageable?                        | The time-scale of phase three was constrained by the two year time frame of the project, hence was allocated only six months for completion. This also involves change in a small scale.                                    |
|                | Participation style | What level of participation can be expected from the organisation members?  | The intended users of the system were happy to be involved in the process of system adoption but wanted minimal disruption to their daily tasks.  |

|                |                 |   |  |
|----------------|-----------------|---|--|
|                | Critical impact | Is a critical approach required?  | The current situation was not perceived as requiring critical intervention but the scale of intervention from the research is expected to impact significantly in the re-engineered business process.                        |
| Practicability | Economics       | Is sufficient financial support and research time available?  | The researcher worked full time on this project and had funds available for travel, equipment and a set budget for the system development and implementation.  |
|                | Access          | Can access be negotiated with stakeholders (e.g. users, managers, developers, customers, business partners)?                | Due to the involvement of the Managing Director of Alpha, negotiation of access was always guaranteed as long as he is in agreement.   |
|                | Politics        | Does the research conflict with the organisations politics? Is there sufficient backing for the action and case components? | The researcher was not perceived as having any political motivation or involvement from a corporate perspective, the sponsors had a relationship with senior management and thus access was negotiated top-down.             |
|                | Control         | Can the research project be controlled?   | The research focus, scope, risk and scale contributed to a reduction of complexity in such a way that the research could be monitored against the research plan (using the research framework) and readjusting action taken. |

Adopted from (Vidgen and Braa, 1997)



### 3.3.6 Action Case protocol

When using action case as a research method, the development of a formal action case protocol provides the reliability and credibility required for the research (Tellis, 1997, Rahim and Baksh, 2003). The design of this case closely follows the Levy Single-Case Study Methodology, which is where the observer may have access to a phenomenon that was previously inaccessible (Tellis, 1997). This study was holistic because the same action case involved more than one unit of analysis, which are the service unit and manufacturing unit. Using the action case of Alpha, this research will attempt to validate the theory, given that the researcher is able to investigate a contemporary phenomenon within its real-life context (Rahim and Baksh, 2003). Action case research further allows the researcher to become an active participant within the research.

Table 3.2 below is adapted from Yin (2009) and is tailored to show the action case protocol and the relevant relation to this study.

Table 3.4: Action case protocol

|                     |            |   |
|---------------------|------------|---|
| Case study overview | Aim        | To contribute to knowledge and understanding of the impact business process analysis has on the pre-adoption and implementation of an Enterprise Resource Planning (ERP) system in a service hybrid HVAC SME.   |
|                     | Objectives | <ul style="list-style-type: none"> <li>- To contribute to the use of OIPT and tools available for researchers for evaluating ERP systems pre-adoption</li> <li>- To investigate the ERP pre-adoption decision-making process in hybrid service and manufacturing HVAC SME using Value Stream Mapping of the present and future states.</li> <li>- To contribute to the understanding of business process analysis and its influence on ERP systems pre-adoption decision making in the hybrid service and manufacturing industry.</li> <li>- To contribute to available knowledge in the use of action case methodology in information systems research.</li> </ul> |
|                     | Issues     | <ul style="list-style-type: none"> <li>- What effect does appropriate business process analysis have on the pre-adoption decision-making of an ERP system such as SAP Business One in a service hybrid HVAC SME?</li> <li>- Does organisational culture have any influence on the pre-adoption decision-making and implementation of an ERP system like SAP Business One?</li> </ul>  |

|                  |  |   |
|------------------|--|---|
| Field Procedure  | Case study   | A UK based service HVAC SME which also manufactures HVAC equipments which, is in the process of adopting and implementing an ERP system.  |
|                  | Source of information                                | <ul style="list-style-type: none"> <li>- Observation: The researcher was actively involved with various system owners and stakeholders to understand how they currently use the system and expectations.</li> <li>- Interviews: All users that affect and would be affected by the adopted system.</li> <li>- Meetings: With stakeholders such as Managing Director, managers, potential system resellers, user group members.</li> <li>- Documentation: The researcher used documentation from past systems projects, organisational reports and archival records of organisational strategy.</li> <li>- Customer Questionnaires: Customers were invited to provide information used during Value Stream Mapping of the business processes.</li> </ul> |
| Questions        | Main question categories (each having sub-questions) | <ul style="list-style-type: none"> <li>- Specialist hybrid service and manufacturing business process in an SME</li> <li>- IS business process analysis using Value Stream Mapping</li> <li>- Organisational Information Processing Theory (OIPT)</li> </ul>  |
|                  | Potential sources of information                     | <ul style="list-style-type: none"> <li>- Managing Director and managers of all departments</li> <li>- External IT support</li> <li>- ERP systems resellers and developers</li> <li>- Staff who know the current system and those that will use the new system</li> <li>- Technology strategy board and three staff from Salford University</li> </ul>   |
| Guide for report | Outline  | Logical structure   |
|                  | Narrative Format                                     | Findings and lessons learned clearly communicated   |
|                  | Bibliographical                                      | Sources of materials clearly represented both empirical and literature  |

Adapted from Yin (2009)

### **3.3.6.1 Action Case Description**

In this section the action case work was done following the iterative process as recommended by Sun et al. (2015) and represented using Bate's (2001) model as visualised in fig 3.2 below.

The practical implementation of this project was guided by the KTP management processes. This involved a weekly meeting with the operational team within the action case organisation. A monthly formal evaluation meeting was carried out with the senior management team. A quarterly formal meeting which were attended by a government official, senior management team and academic team was held for evaluation and monitoring of the overall project. The final project deliverables was also evaluated by the Technology Strategic Board (now Innovate UK) using a final project review which was also documented. Every meeting minute was documented and formed part of the research document data analysis.

The below diagram shows the stages as discussed in the literature review section 2.3.6 and combines with the action case stages and provides a high level of activities as applied in the current study.

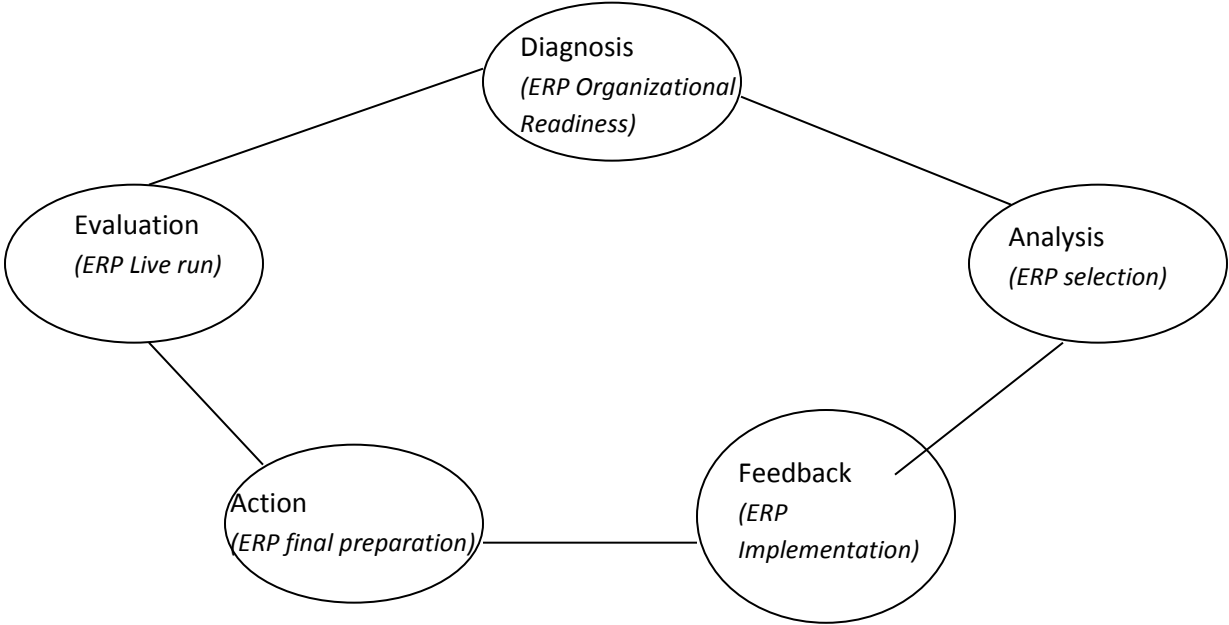


Fig 3.2: Change with action case approach adapted from Bate (2001) and Sun et al. (2015).

**Diagnosis/ERP Organisational readiness:** Following the recommendation of action case Bate (2001) and Sun et al. (2015), this study commenced firstly by observing in detail the action case to gain a better understanding of the structure and prioritise ERP features in consultation with the process owners. The observation involved site visit with engineer, observation with staff

while carrying out tasks, interview with stakeholders and studying archival documents. As mentioned earlier, a user could document steps followed to complete a task but practically follows another process. Therefore, carrying out these observations provides a firsthand knowledge of the processes rather than the perceived processes.

For example, the importance of mobile users is strategically identified as a priority therefore, the intended system is expected to improve these services and communication with the mobile engineers using equipments such as hand held devices. Strategic documents reviews, as well as interviews with senior management and other stakeholders allowed the study to gather this data. The list of these features can be found in table 4.12.

**Analysis/ERP Selection:** The next phase of the study was to produce a value stream map of the current state, as discussed in the section 2.2.2.1 of the literature review. This phase involved collecting data from the appropriate stakeholders and process owners which was used to carry out a detailed business process analysis. The data collected include ERP features staff use within the current system, ERP features lacking in the current system, how they use the current system to achieve a particular process, how long it took to complete a particular process and the associated dependencies. Following the protocol as advised by Patton (1999), to increase data trustworthiness as emphasised by interpretivist research (Rolfe, 2006), the researcher used covert and overt observation as discussed in section 3.3.7 to observe users carrying out tasks in their normal working condition, documented the process and also recorded the observation. After documenting the process and associated task, users were asked to check and confirm that information documented was trustworthy. This information was used to document each of the activities on the VSM, the associated time, the dependencies and also identify areas of improvement which will feed into the next phase.

For example, following the KTP weekly meetings, discussions and documentation of the first draft of the current state VSM was done, what notations to be used was established and how it should be presented (Jasti and Sharma, 2014, Ko et al., 2011, Patel et al., 2015). Monthly meetings were used for formal sign-off of the VSM stages, see diagram 4.14 for the output of this stage.

**Feedback/ERP Implementation:** Having completed the current state VSM and carried out a business process analysis, this stage involved using data from the business process analysis to

produce the future state value stream (Schuh et al., 2010). Following the notation as suggested by (Jasti and Sharma, 2014, Ko et al., 2011), this phase using data from the current state analysis' suggestion of areas of improvement and waste, draws up a better linkage of the processes by streamlining the processes and suggesting dependencies. One of the activities in this phase is the reduction or removal of activities that add no value to the process (Patel et al., 2015). This is based on extensive interviews and discussion of the future state model with the relevant stakeholders and the model becomes the visual synthesis of the interviews (Jasti and Sharma, 2014). The future state VSM is then used to map systems being analysed to ensure that the selected IS/IT system maps to the features and functionalities specified in the future state VSM. Each identified feature is setting out the key performance indicator (KPI) for the new system (Vinodh et al., 2015). These KPIs are then used for the evaluation of the adopted system implemented.

For example, the current state involved mobile engineers sending job sheets via post as represented in the current state VSM. The future state VSM proposes that the system allows the engineers send these documents electronically. The saving to the action case is on the time, cost and possible loss of documentation in the post, this is further discussed in chapter four section 4.2.4.3.

**Action/ERP final Preparation:** As presented in figure 3.2 above this stage involved the system development, implementation and system documentation (Molifi et al., 2015). This stage also observed the overall system performance and made recommendation for change where necessary. After the development of the appropriate system, the system was implemented, configured and feedback collected both formally and informally from the system users. The stage also involved the identification of training needs, training of the intended system users on new features and functionalities as well as evaluation of the users after training. Technical support was also provided, difficulties collected and logged, followed up the identified issues for resolution.

For example, the engineer calendar was identified as one of the required features, however the vendor had a misunderstanding of the user interface. This prompted a redesign of the engineer calendar following the required user interface. An example of such change request via email is shown in figure 3.2.1 below

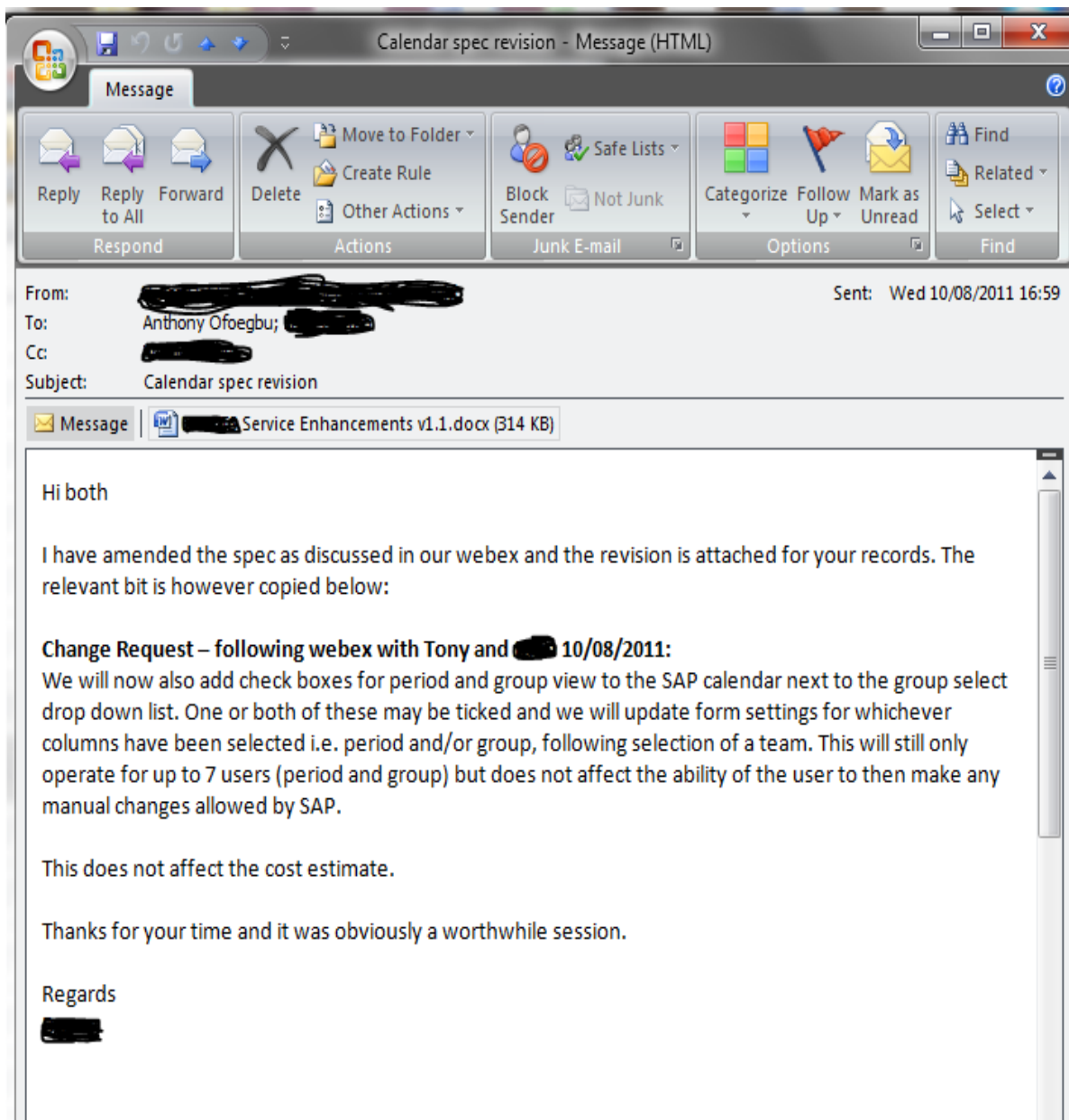


Figure 3.2.1 Calendar change request based on consultation with stakeholders

**Evaluation/ERP Live Run:** After the action, the researcher also observed the system performance. There were also project evaluation meetings as well as meetings with vendors and academic team. The researcher also observed the users' behaviour after the implementation of the system as well as any errors or difficulties identified. The identified

errors were logged and followed up for appropriate resolution. At this stage, the KPIs identified in the future state VSM were evaluated.

For example, one key performance indicator was that the action case organisation be able to invoice a service job the same day the job was serviced as against the current situation where it took over one week to invoice a service job after it was done. See section 4.1.2 that discusses the problem identified with the current state VSM invoicing delays.

In relation to the theory of OIPT2.0, in the stages above, information processing needs of the action case was established in detail using the data collection methods as discussed in section 3.3.7 below. Then the data collected was analysed in order to establish the information processing capabilities of each of the various units. The data gathered from the earlier phase provided this phase with understanding of the required processes as well as areas for improvement and was used to represent the information processing needs and information processing capabilities as the current state VSM. To obtain the optimal solution as suggested in OIPT2.0 see section 5.0.1, VSM was used to design the future state of the business process and represents the third phase above. Data from the first and second stage suggested the information requirements, based on data from observations, were necessary to accomplish the business needs. Data from the second phase clarified areas of improvement in a graphical representation which were all used to design a more streamlined future state VSM.

### ***3.3.7 Data collection and analysis***

Following the recommendations from Kilic et al. (2014), the study set out to identify the various stakeholders, various project owners and the overall project owner. These stakeholders were the main sources of data used in setting up the ERP pre-adoption decision-making processes, as well as the vendor evaluation processes. In this section, the sources of data and its analysis are described and justified. There is no restriction as to which data collection methodology that can be used while applying action case study (Oates, 2006, Stringer, 2007). All the data were collected from the single action case hybrid service and manufacturing SME and some of the relevant ERP resellers as identified by the KTP local management committee were invited to demonstrate their solutions.

**Interviews:** An interview is a special type of dialogue between individuals, where one individual leading the conversation is interested in finding out something from the other individual(s). An interview can also be carried out in groups. The term interview as referred to in this study is the conversation between two people (the researcher and one participant stakeholder).

The three types of interviews are structured, unstructured and semi-structured, and these are based on the degree of structure imposed by the researcher (Neergaard and Leitch, 2015). Only predetermined questions are asked in structured interviews whereas, unstructured interview allows the participant to present their own ideas with more control. Interviews were also conducted in person and over the phone to gather information from mobile engineers, as well as visiting some customer's site to enable the researcher, to create a rich picture of what is involved in the entire business process. Influenced by the exploratory nature of the current study, semi-structured interviews were selected as the most appropriate choice of interview method. These included some standard questions and themes which are of interest to the researcher, to explore any emergent issues or themes in details, further follow up questions were asked.

Although interviews could provide rich insight into themes and patterns, they are however criticised as presenting situations where participants tell the researcher what they think the researcher wants to hear (Miles et al., 2014). Another criticism of interview is that the researcher can potentially steer participants by emphasising certain themes or asking them leading questions. According to Miles et al. (2014), 'representation', 'availability' and 'weighting' influences the actual data collection and interpretation. Hence, the research is required to bear these three influential factors in mind when interpreting events, checking extreme cases and is required to be generally critical of the data collection process in order to manage these biases. The current study used interviews to document processes and had these data reviewed and agreed during meetings such as the monthly and quarterly meetings. In the course of the two years period of collecting data, a total of twenty three monthly meetings were held and a total of seven quarterly meetings were held. One of the interview techniques used in the current study is visual interview data where the researcher gathers data visually.

The process of data gathering was done by conducting interviews with key stakeholders and staff using the various systems at Alpha. A total of 15 initial interviews were conducted, this



involved 2 with service engineers, 1 with the production manager, 2 with account managers and 10 with ERP vendors. Each of these interviews were followed up by at least 3 more interviews to ensure that information represented was trustworthy as recommended by the interpretive study. Close involvement was important in this research because the researcher's involvement has a strength of providing an in-depth access to people, issues and data, as suggested by Walsham (2006). Interviews with staff were organized so they did not cause any down time in the process, then reproduced and validated by following the same process on the relevant system and given to staff to re-validate the documentation, following Miles and Huberman (1994). The data collected was used again to produce a VSM of the present and future state processes, identify areas of waste within the present business processes and also used in modelling the adopted solution. Features required by the company's strategic plans, such as enabling electronic time sheets submission by engineers, were among features identified for the desired features list.

**Observation:** Action case requires participant observation as suggested by Baskerville and Myers (2004) and this can be captured using different data sources. Generally, there are two types of observations: 'covert' and 'overt' (Wu et al., 2015). In covert observation, the observed are not aware that they are being observed while in overt, the observed is aware that they are being observed. The choice of covert or overt is based on the researcher's impression of the situation drawing on their senses such as seeing or hearing. Both covert and overt observations have been considered and used in the current study by the author. The covert observations have been documented via weekly meetings and where required, is escalated to the monthly meetings and if further required escalated to the quarterly meetings. These are documented and as a result are presented for discussion during the formal weekly, monthly or quarterly meetings as appropriate over the two years duration of the KTP. Covert observation included email communications with system users and other stakeholders where they report or identify potential issues and discuss informally about the system, an example is figure 3.2.2 which is an email extract.

Tony,

Please find below problem with the alternative description when doing quotations...it doesn't copy across automatically like it does in sales orders...

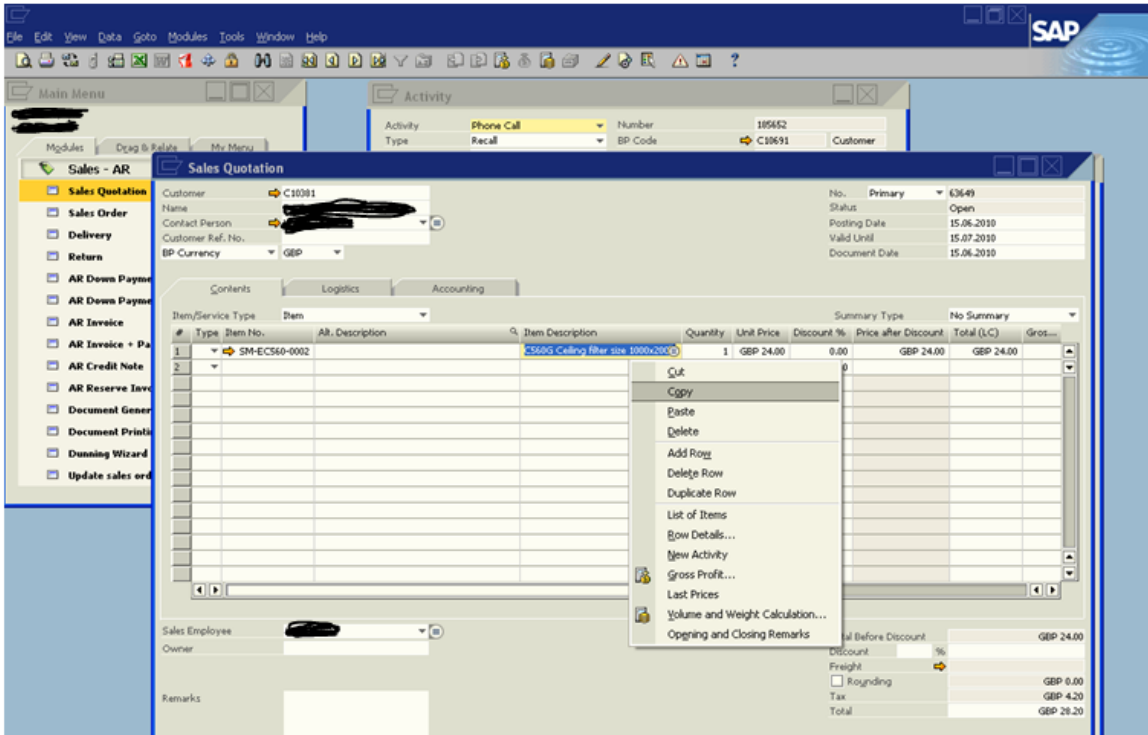


Figure 3.2.2 Email extract with issue reported by the user.

This data was gathered while the researcher was actively based in the organisation observing and interviewing staff at all levels. The observation of staff was very important in this research as Slack and Rowley (2000) pointed out, the researcher was able to clearly understand and document what the users actually do rather than what they assume they did. A total of eight overt observations were carried out which comprised of three with account managers, two with finance, one with the operations manager, one on a customer's site with an engineer and one with the production manager. The researcher first scheduled an appropriate time with the user, then sat with the user observing how they used the system to carry out their specific task. Following the recommendation of Mahoney and Vanderpoel (2015), while the user demonstrated what they did with the various systems, the researcher documented and codified the data into diagrams, to show what the user was doing and asked questions where necessary

to clarify why they performed certain tasks in specific ways. Considering that this was a live study, in order to ensure that the study did not negatively impact on the day to day business, disruption on users was kept to a minimum (Chetan et al., 2005). The reason for this was that what a user documents as what they did could differ from what they are actually doing (Miles et al., 2014), and this information will be helpful during information systems adoption. All these activities contributed to the understanding and representation of the current state of the business process and proposal of the future state using VSM as discussed in chapter two section 2.2.2.1.

Onsite and mobile engineers were also interviewed to define expectations, whilst also understanding limitations within the current business process and systems. Data from mobile service engineers was from a self reporting time and in order to verify the data, the researcher went on a site visit with an engineer where the timing was recorded using a stop watch to confirm the times provided by the engineers.

**Meeting:** Meetings were used to get the ERP vendor/supplier to demonstrate how their information system matches the system functionalities defined from information gathered from the users using interviews and observations. During these meetings with vendors, the researcher, along with at least two other managers from the action case organisation, who had extensive knowledge of the business, allocated a numeric weight to each of the functionalities, based on the way they were handled by the proposed system. At the end of each supplier meeting discussing a proposed ERP system, the average weight assigned to each of the functionalities is taken to minimise the effects of bias on the result. There were also structured meetings held weekly, monthly and quarterly to discuss each stage of the deliverable and the associated data. There were a total of seven quarterly meetings, twenty three monthly meetings and a weekly meeting held throughout the two years project duration.

**Document Analysis:** Another method used in collecting data for this research was document analysis. The researcher used extensive documentation from past system projects, organisational reports and archival records of organisational strategy in order to understand ERP systems evaluated in the past. Documentation including over 50 major company documents was also used to gain understanding of factors that affected previous implementations as well as features considered in the past.

Table 3.4.1 Customer questionnaire design

| Questions  | Why Question was asked   | Why Answer Types  | Intended Respondents |
|--|--|---|----------------------|
| How long have you been using our services?   | Understanding the range of customers who responded to the questionnaire                                      | Using range is most practical since customers might find it difficult to remember specific dates. This also targets different range of customers.   | Customers            |
| How often do you use our services?   | To test consistency of response from subject based on the first question                                     | Specific ranges provide the subject an alternate, reasonable and interpretable intention of the question  | Customer             |
| How would you rate your overall level of satisfaction with us  | To determine the subject's level of comprehension of the services provided                                   | Ranges provide the subject an alternate, reasonable and interpretable intention of the question   | Customer             |
| How do you rate us on the following attributes   | To determine the subject's level of confidence with services provided  | Ranges provide the subject an alternate, reasonable and interpretable intention of the question   | Customer             |
| How do you rate the importance of the following attributes to you, using 5 as being the highest and 1 the least important to you | To determine the subject's level of confidence with services provided and also support the previous question | The use of a scale allows the collection of reasonable data which can be analysed. This also gives an understanding of the customer's perception on the information processing capability of the action case. | Customer             |
| If you are using other companies that provide a similar service, how do we rate compared to them                                 | To provide a basis for comparison  | Ranges provide the subject an alternate, reasonable and interpretable intention of the question   | Customer             |
| How likely are you to continue using our services in the future  | To determine intention   | Ranges provide the subject an alternate, reasonable and interpretable intention of the question   | Customer             |

**Questionnaire:** Questionnaires were also used to gather information from customers to ensure the system not only meets the internal needs of the organisation, but also meets the external improvements required by the customers. A total of 300 questionnaires were sent to customers electronically, 162 of the email addresses were invalid hence a total of 138 valid questionnaires

were sent and delivered to the customer. A total of 72 valid responses were received for analysis from the customers. This represents a 52% response rate which when compared to the rate from Dormandy et al. (2008) is acceptable for this study. The questionnaire design, is presented in the table 3.4.1 above and the analysis discussed in section 3.3.7.1. The design of the question was based on information required from the customer in order to answer the three research questions. For more details on customer responses to the survey see appendix 1b.

From the customer satisfaction questions discussed in detail in the next chapter, the question, 'How do you rate us on the following attributes' feeds directly into VSM analysis of the current and future states. This question was aimed at understanding the areas that required improvement from the customer's perspective. Although a customer could rate the action case SME well below average on the attribute 'competitive price', it is important to understand why the customer provided this rating. The question 'If you are using other companies that provide a similar service, how do we rate compared to them' was used to get the why behind this question. That is, the response from the customer could be 'Not applicable' or 'much higher' which suggests that the service provided by the action case could be better when compared to other similar service providers. This could also suggest why although the customer indicated that pricing is not competitive they are however not willing to compromise the service received. Another attempt to understand why a customer rates a particular attribute in a particular way is using the question 'How do you rate the importance of the following attributes to you, using 5 as being the highest and 1 the least important to you'. The use of a 1 to 5 likert scale was based on the recommendation by Lambert et al. (2014), with 5 being the highest and 1 the least important to the respondent. The importance of this response is that, although to a customer the action case SME may not perform very well on a particular attribute, the customer may however indicate that the attribute is of little or no importance to them. If the customer indicates that a particular attribute is of high importance to them and the action case SME performs poorly on the same attribute, then there is a need to consider improving processes that contributes to the attribute.

To understand why a particular response pattern was received the question on how satisfied a customer is with Alpha's services was reviewed. From the above, about 75% indicated that they

are highly satisfied with services received from Alpha, indicating that they are generally satisfied. It is possible that the response on whether the customer has recommend Alpha could be linked to this response. That is, customers who suggested that they had recommended Alpha in the past could have done so because they also selected the option that they were satisfied with the service and those who indicated that they had not recommended Alpha in the past could have done so because they were dissatisfied with the services. This can be related back to the percentage of responses that indicate that they are dissatisfied tallying back to the percentage that indicated that they had never recommended Alpha in the past. Another attempt to understanding the why behind the responses is that 1.4% of the customers who responded indicated that they are somewhat dissatisfied and in a separate question 1.4% indicated that they were very unlikely to continue using Alpha's services in the future. From the data above, it can be suggested that when users suggest that they are dissatisfied, they proceed to also suggest that they are very unlikely to continue using Alpha's services. From the data, it can also be suggested that when customers indicate that they are satisfied, they are most likely to also suggest that they are most likely to continue using the services of Alpha.

### **Data Collection summary**

Observation and interview of strategic staff provided a wealth of knowledge which was used to design the customer satisfaction questionnaire. The customer satisfaction questionnaire answer options incorporated feedback from interviewed users of the system in the action case SME. In order to validate the views provided by the system users, the structuring of the customer questionnaire and response options on the questionnaire were designed to triangulate the data from interviews and observations, since data from the customers is independent of the action case study. Data triangulation is an accepted technique of increasing trustworthiness of the data (Lambert and Loiselle, 2008). For example, one of the questions presented to the service engineer is whether he thinks customers are generally happy with the service they receive. The response from the engineer is that 'customers is normally satisfied'. To strengthen this particular response from the engineer, one of the questions presented in the customer satisfaction questionnaire is 'How would you rate your overall level of satisfaction with us'. About 78% of the 72 responses expressed that they are highly satisfied, 18% indicated that they

are somewhat satisfied and about 1.4% indicated that they are dissatisfied. This strengthens the response from the service engineer who suggested that the customers are generally satisfied and this is because a total of 97.2% of the responses indicated that they are generally satisfied. The customer questionnaires were generally designed to provide possible responses so that the user selects the option that best fits his/her opinion.

The indication from the customer questionnaire that in general customers appear to be satisfied could be due to the self-selecting nature of the survey respondents since only those who are positively dissatisfied to Alpha wanted to share their views. On the other hand, if there are dissatisfied customers these could also be skewing the data since they might be more vocal in their feedback (Yaacob, 2014). To mitigate the self-selection raised above, the choice on who participates in the study from the customer base was based on the default contact person defined in the customer's account. This study also ensured that this default contact person represented those that inspected the service carried out and signed the service job off, hence are contacts with better understanding of the services provided by Alpha. Out of the 300 online questionnaires, more than half came back as failure delivery or an out of office prompt, which is where the contact person is away from the office. To ensure that this does not introduce any form of bias by providing responses from only one group of users being a hybrid service and manufacturing SME, the question 'How often do you use our services' was a check to ensure that both the service and the manufacturing areas being studied received substantial responses. Further discussion and analysis of the data is discussed in the next two sections below.

The action case user questionnaire was designed to allow the users enter their own views, although few questions suggested possible responses since the study was interested in only those responses. The reason for providing open questions in the action case staff questionnaire is to collect a wider range of opinions which was used to design the most suitable IS/IT solution. To ensure the credibility of the data from the customers, the contact person who supervises and approves the work done for each customer was chosen to receive and complete the questionnaires. To ensure that data from the engineers was credible, the engineers chosen to participate in the study were those identified as having the best knowledge of the service business process. Finally, to ensure the credibility of data from staff interviewed and observed,

the study involved the key person in all the departments as well as all account managers in the customer service department.

As mentioned earlier, using the data collected from observation and interviews of internal staff of the action case, responses from the customer questionnaire was used to strengthen responses from the engineers on customer satisfaction as provided from earlier data collection. Data from the service engineer's questionnaire provided information on the time scale associated with carrying out service jobs and to validate this data, the researcher carried out a site observation where he travelled to a customer's site with one of the engineers and timed the processes which was confirmed against data provided in the questionnaire. The validated data was used to prepare the current state value stream and also informed the improvements in the future state value stream.

Data was also collected from IS/IT resellers which was used to design the system evaluation grid presented in the next chapter. Given the inclusion of audio recording of the interviews with IS/IT resellers and as per ethical requirements, all participants provided a written informed consent. Maybe surprisingly, regardless of this study proposing an audio recording of the meeting and interview with IS/IT reseller, 100% of the potential reseller participants approached agreed to participate in the study. The prospect of selling their IS/IT solution to the action case is noted as a possible contributor to this high level of consent. Although the resellers were informed that their consent will not affect the decision of adopting their system, they willingly accepted to be part of the study.

### ***3.3.7.1 Data Analysis***

The previous section has so far outlined a detailed account of the data collection methods used. The section also outlined the individual data collection processes through observations, interviews, meetings, questionnaires and document analysis. This section focuses on the two types of data analysis as undertaken during this research as suggested by Palinkas (2014) and applicable in an action case research. The two data analysis approaches applied in the current study are qualitative and quantitative data analysis.



### 3.3.7.1.1 Qualitative Data Analysis

Miles and Huberman (1994) presented the definition of qualitative data analysis as comprising of three concurrent flows of activity, these three concurrent flows are data reduction, data display and conclusion drawing/verification. This definition of qualitative data analysis will be used in the current study. The three flows of qualitative data analysis presented in figure 3.3, is outlined briefly and subsequently a detail of how they were incorporated into the current study is provided.

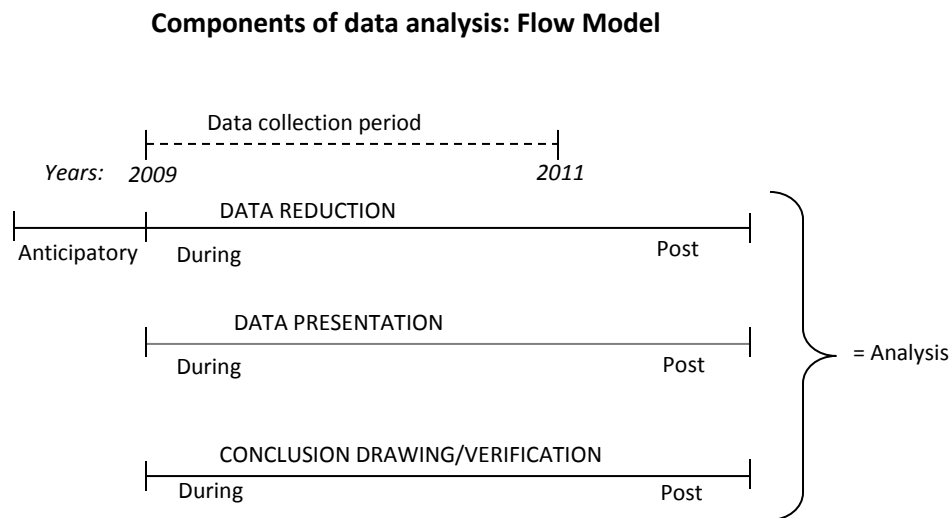


Figure 3.3: Components of Data Analysis: Flow Model as adapted from Miles and Huberman (1994)

The first flow is the data reduction which focuses on the process of selecting, focusing, simplifying, abstracting and transforming the data (Miles and Huberman, 1994, Miles et al., 2014) collected from the data collection. The organisation and reduction of data was performed using process known as coding as suggested by Stein et al. (2015) and Ary et al. (2002). The process of coding involved grouping data, selecting keywords and phrases that relate to the themes and objectives of the study as outlined in chapter one. The grouping of data according to Ary et al. (2002), provides a meaningful summary and reconstruction of the data collected.

The themes and keywords from the coding include themes in technology and process factors. Using the concept of action case, the researcher was able to view collected data in a manner that aided the understanding and reflection of the research questions, hence provides a lens to answering the research questions.

Data display as the second flow, is concerned with the presentation of the information to the audience in a logical and summarised format (Miles et al., 2014). Qualitative data can be displayed in a number of different formats and this includes tables, charts, diagrams and graphs. Generally, the display of coded texts in tables and diagrams, in the current study, simply represents all data in a form that is easier to understand.

The third flow is drawing conclusions and the verification which is interested in interpreting the data and answering the research questions. The interpretation can be in different forms such as identification of themes, patterns and explanations which are all induced from the data. Finally, the verification can be done in various ways in order to test how plausible the conclusion is. In the current action case study, the verification of the result was done through participant observations in practice and discussions.

According to Berg (2007), any data collected using interviews will have to be condensed and made comparable systematically before the data can be analyzed. To achieve this, an objective coding scheme is required to make the process more systematic. Content analysis, the process of condensing the data for systematic comparability, is represented in table 3.4.2. Berg (2007) suggests that an interpretive research approach aims at analyzing social phenomena through text as applied in the current study. The theoretical orientation adopted by the researcher, influences the interpretation of the text data. The condensing and sorting of the data is achieved through coding operations. Interpretive study focuses on uncovering patterns in a text whereas a phenomenological approach will focus on understanding the meaning behind the patterns. The current study follows the interpretive approach which seeks to uncover patterns from the data as represented in the third column of table 3.4.2.

Using content analysis, as defined by Holsti (1968), the study adopted a technique that systematically and objectively identifies special characteristics of a text visually to make inference. Prior to the analysis of data, the rules for data coding were formulated, which was to

focus on technology and process factor themes within the data. Following OIPT, the identification of the specific information processing needs is identified as being critical, therefore a lot of emphasis was placed to ensure information from users represented what they were trying to communicate. Data for the VSM were reduced immediately during the interviews and they were then followed up with drawings which were reviewed over a number of times until finally agreed with the stakeholders. During the interviews to develop Value Stream Mapping of both the current and future states, the first diagram was drawn as a sketch using VSM notation as discussed in chapter two. These sketches were then presented to the stakeholders at subsequent interviews for modifications leading to further corrections and interview until the sketches were agreed and then reproduced using Edraw software. The analysis of data was carried out in an iterative manner where the same representation was drawn from multiple stakeholders then summarized in one diagram. This is revised over several levels of meetings and different levels of document analysis to triangulate data. The criteria for selection of the individuals and the data sets were applied consistently (Berg, 2007) to ensure trustworthiness. Depending on the processes followed, content analysis can be both quantitative and qualitative, as applied in the study. According to Berg (2007), the approach of quantitative content analysis aims to count frequency of occurrence of a concept's appearance in a text. However qualitative analysis is interested in the literal words used in the text and the pattern of the word usage in order to uncover meanings. From Wilson (2011), a distinction is made between two kinds of content analysis, these are conceptual analysis and relational analysis. Wilson (2011) went on to suggest that conceptual analysis aims to either establish the existence or frequency of concepts or themes using patterns of words or phrases as they appear in the text. Relational content analysis however building upon conceptual analysis looks at the relationships between the concepts and themes.

Being an interpretive study that uses both qualitative and quantitative data, the current study followed the suggestion of Miles et al. (2014) to use numeric descriptive statistics from the customers to augment the qualitative data. Frequency represents the extent of the observation, Berg (2007) however cautions against the use of frequencies while making inferences about the nature of the data, rather suggests that frequencies of occurrence merely be used to strengthen and provide a more comprehensive analysis as applied in the current study.

The analysis of the qualitative data was carried out at multiple stages as suggested by Eisenhardt (1989) and Miles et al. (2014) and as mentioned above. This was done using the interpretive approach where comments extracted from the various data collection methods were then reduced as represented in a table as shown below. This example illustrates how the data analysis took place. The first column contains extracted data from the data sources and then grouped into themes. This is after reading each response closely and extracting information that is relevant to the systems under review, the business process or the way the task is performed. Secondly, each of the data is read a number of times in order to establish what the point is. In order to achieve this, while reading each data, the following questions were consistently asked to establish the information processing needs following the theory of OIPT:

- How does this affect the overall business process;
- What feature if incorporated into the new system will resolve this; and
- Why is this important.

Going through the data with these consistent questions in mind, the researcher was able to identify themes emerging from the data. These themes were represented based on the underlying issue or requirement identified from the extracted data. This is represented in the second column as the descriptive coding and is based on the functionality/business process aspect affected by the data. In some cases, a data is assigned multiple codes and this is because a single data can relate to multiple features or business processes. Finally, a theme or process feature implied by the data is represented in the third column, interpretive coding, in order to identify the requirements, coding frame, that are lacking in the current system. This is presented in table 3.4.2 below. From the coding, the evolving themes are the features that appear to cause the existing business process to be perceived as not being streamlined. For example the statement 'Allocating engineers to jobs is one of the main issues' appears to be an issue for both the back office staff and mobile engineers, the lack of GPS and real-time calendar functionality is identified as the cause.

Table 3.4.2 as adopted from Stein et al. (2015) and Miles et al. (2014)

| <b>Data</b>  | <b>Descriptive Coding</b>                                  | <b>Interpretive Coding</b>  |
|--|--|---|
| The dairy is a problem in the current systems because the diary is not user friendly and does not allow drag and drop function                           | - Dairy/Calendar functionality                             | - Calendar Scheduling<br>- GPS  |
| Allocating engineers to jobs is one of the main issues   | - Dairy/Calendar functionality                             | - Calendar Scheduling<br>- GPS  |
| Sometimes when there is cancellation, engineers don't get to know and might end up turning up at customer's site, only to be told they were not expected | - Engineer Communication<br>- Dairy/Calendar functionality | - Email functionality<br>- Reporting<br>- Service Call Management<br>- Calendar Scheduling<br>- GPS |
| If the job is cancelled and the engineer is not told, then the engineer would just turn up at the job  | - Engineer Communication                                   | - Email functionality<br>- Reporting<br>- Service Call  |
| Having to wait until I am online to check job information online   | - Engineer Communication                                   | - Email functionality<br>- Reporting<br>- Service Call  |
| The sending of job sheets should be done either by email or electronically   | - Engineer Communication<br>- Prompt Invoicing             | - Email functionality<br>- Reporting<br>- Service Call<br>- Job Costing                             |
| Sometimes there is miscommunication in terms of job information  | - Engineer Communication                                   | - Email functionality<br>- Reporting<br>- Service Call  |
| Waiting until Friday to send job and material information in a specific job  | - Prompt Invoicing<br>- Engineer Communication             | - Job Costing<br>- Email functionality<br>- Reporting<br>- Service call management                  |
| These jobs were done last week and they will be invoiced on Friday, the customer will receive the invoices on Monday the following week                  | - Prompt Invoicing   | - Job Costing   |
| Ordering the parts used for service is not very visible to the engineers   | - Stock Management   | - Equipment/Site Maint  |
| Field engineer utilization (travel time, time spent on job, allocation of jobs to engineers)   | - Engineer Time Management                                 | - Calendar Scheduling<br>- GPS<br>- Handheld  |
| Manual processing of twenty four (24) field engineers time sheets takes back office staff 20 hours per week  | - Timesheet processing delay                               | - Timesheet Entry<br>- Job Costing<br>- Reporting   |
| Pricing breakdown before servicing takes place   | - Efficient Service Module                                 | - Equipment/site maint<br>- ERP   |
| Better diagnostics   | - Efficient Service Module                                 | - Equipment/site maint<br>- ERP   |

The analysis of the data was further enhanced by representing the data from the interpreted coding in a weight related grid developed during the course of this research. The data was collected over a two-year period from January 2010 to February 2012. The design of the grid will be discussed in the next chapter see section 4.2.2.

As a consequence of the action case setting, the data analysis had to satisfy the academic rigour as well as the action case to ensure it is completed in a timely manner. The decision was taken to use visual analysis to gather the information processing needs of the action case instead of having this in a text format. As discussed in the literature review section, the visual representation of the data was done via Value Stream Mapping (VSM). The process of VSM diagrams was as follows: a current and future state VSM was produced. An initial sketch of the VSM diagram, see fig 3.4 was presented to stakeholders at the first quarterly meeting in the office on the 28<sup>th</sup> of January 2010. From this meeting and eleven other follow on meetings with users and management, changes were identified leading to the redraw of the VSM to incorporate these changes. This process was repeated twelve times until an agreed representation of the current state VSM was reproduced.

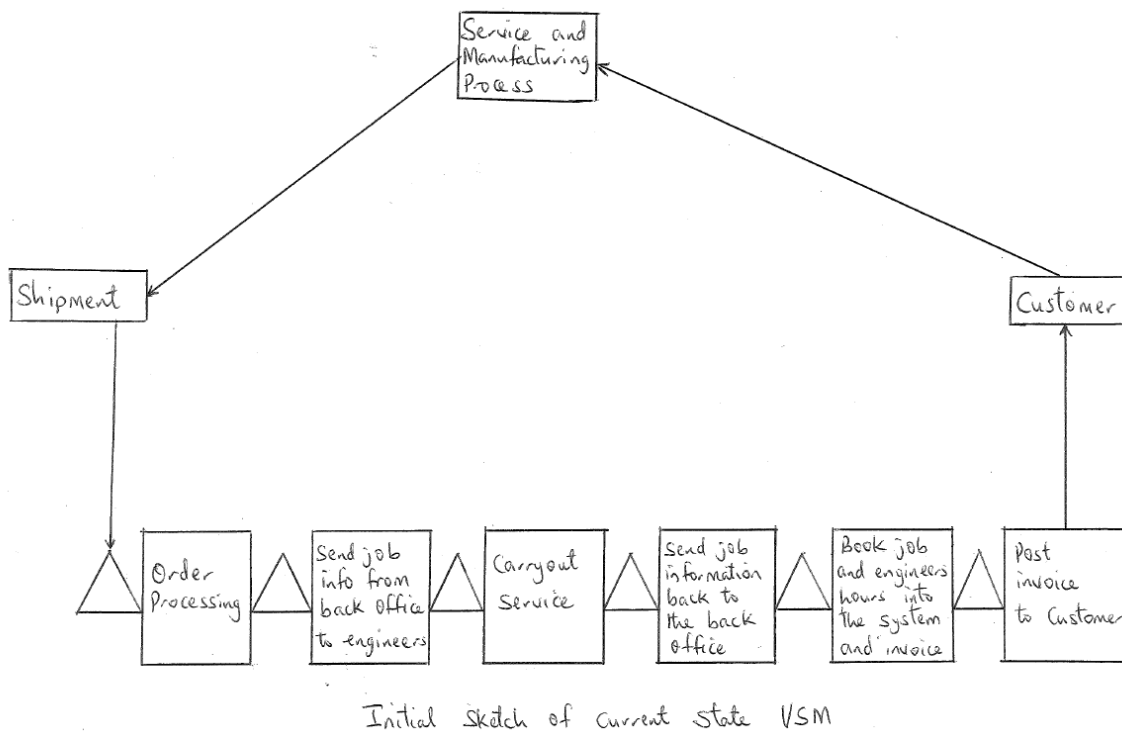


Fig 3.4, initial VSM sketch of the current state

After drafting this initial sketch following consultations during interviews and meetings, the sketch was presented to the engineers, onsite staff and management of the action case SME for further revisions and confirmation of the actual process. The data interpretation, reduction and visualisation happened during the interviews following the interview analysis and visual representation as suggested by Bishop (1989). For example, one of the revisions that was required was the need to separate the task 'Book Hours into system and invoice' into two tasks. The reason for separating this identified task is due to the task 'Book Hours into system and invoice' involving two separate processes 'Booking hours into the system' and 'Invoicing the customer'. This modification led to the redesign of the next sketch incorporating this change. Further modifications have been identified through stakeholder meeting which highlighted the modification of the arrow leading from 'service and manufacturing process' to the task 'shipment', to split into three as represented in the current VSM state. This three split represent the options of either purchasing service part from supplier, producing the service part or having the service part already in stock. The process of modifying the VSM based on sketches and meetings with stakeholders was an iterative process which continued until the final VSM version was developed and accepted by all stakeholders as accurate and shown in figure 4.14, the current state VSM. The notation of VSM helped the stakeholders to articulate the information processing needs and requirements as suggested by the theory of OIPT.

#### **3.3.7.1.2 Quantitative Analysis**

Some of the qualitative data collected can be quantified hence analysed quantitatively as suggested by Haq (2015). The closed ended question responses in the customer questionnaire contained information which was used for augmenting the open ended responses. Although the main focus is on the qualitative data set, understanding how long the customer has used the action case services and how frequently offers insight into the trustworthiness of the data provided by the customer. This data set increased trustworthiness of the qualitative data in order to establish themes on customer satisfaction and retention based on their information processing needs. In such a situation linking respondents' service retention characteristics with responses to their qualitative comments in the questionnaire is useful in order to interrogate the relationship between trends and experiences. The analysis below follows Forsati et al.

(2009) recommendation of assigning weight and calculating the mean based on the weighted total. The weighted mean  $w(t_k)$  according to Forsati et al. (2009) is calculated using the formula:

$$w(t_k) = \frac{\sum w(p_i)}{t_k}$$

Where  $w(p_i)$  is the weighted total for each row and  $t_k$  is the sum of valid responses.

The questions presented in the customer questionnaire and the analyses are as follows:

Question 1: ‘How long have you been using our services’

|                              | Responses | Assigned weight | Weighted Total $w(p_i)$ |
|------------------------------|-----------|-----------------|-------------------------|
| Less than 6 months           | 5         | 1               | 5                       |
| 6 Months to less than 1 year | 6         | 2               | 12                      |
| 1 Year to less than 3 years  | 12        | 3               | 36                      |
| 3 Years to less than 5 years | 14        | 4               | 48                      |
| 5 Years or more              | 33        | 5               | 165                     |
| Skipped Question             | 2         |                 |                         |

The mean response is therefore 274 divided by 70 valid responses, which is 3.9, indicating that on the average, data collected from customers indicate that the customers have been with the action case for more than 3 years but less than 5 years. Therefore they are able to comment on the offers from Alpha in detail but might not necessarily be able to compare the services offered by Alpha with that offered by another competitor. Within this timeframe, these customers would have experienced services based on two ERP systems since the current system was implemented three years before the survey was administered.

It is important to clarify the boundaries drawn around a case (Cousin, 2005), this allows other studies to identify the unit of analysis used in the current study to allow future comparisons. A hybrid service and manufacturing SME was the main focus of this study, the researcher had access to all staff of the organisation and whoever the vendor company deemed most knowledgeable to sell their products. The researcher was not able to physically communicate with the action case customers, however used online questionnaire created and distributed to customers via online ‘Survey Monkey.’ Hence using the adopted theory, evaluating the question



of how an organisation's information processing requirements and capabilities combine to affect the intention to adopt and implement an ERP system for all business processes from the point a prospect requests a service or product quote to the point of manufacturing, servicing, invoicing the customer and senior management reporting.

### ***3.3.8 Data sources***

Multiple sources of evidence were used in collecting data, not just to strengthen the quality of the research, but also because of the varied stakeholders, it was important to use suitable methods for each type of stakeholder. Each of these sources has associated strengths as well as weaknesses which have been discussed above. The primary sources of evidence for data collection were observations, interviews and meetings. Other sources of evidence for data collection were questionnaires and documentation, such as the organisation's documents.

Table 3.5: Comparison of data sources, adapted from (Oates, 2006)

| Data source          | Strengths  | Weaknesses  | Researcher's role and identity  | Use of source in the study                                     |
|----------------------|--|---|---|--|
| <i>Interview</i>     | <ul style="list-style-type: none"> <li>- Discovery: Allows interviewee to give information for in-depth investigation.</li> <li>- Insightful: Information on system and human perception of system.</li> <li>- Data collected can be verified as original.</li> <li>- Interviewees often enjoy discussing their ideas to non critical researchers.</li> </ul>                        | <ul style="list-style-type: none"> <li>- Can be biased based on subjective responses</li> <li>- Could focus on interviewee's perception of the system rather than what really is the case</li> <li>- Interviewee may give a false information</li> </ul>            | Professional, neutral and receptive   | Semi-structured interviews                                     |
| <i>Observation</i>   | <ul style="list-style-type: none"> <li>- Actual account of event</li> <li>- Ability to work with other observers and have <i>inter-observer reliability</i></li> <li>- Provides rich insights into social settings leading to holistic explanations of complex situations</li> <li>- Practitioner-researcher are able to carry out research while actively in normal job.</li> </ul> | <ul style="list-style-type: none"> <li>- Time consuming</li> <li>- Due single research, the validity could be questioned</li> <li>- It is difficult to generalise because findings may be unique to the particular situation</li> </ul>                             | Observe how the systems are used and then using practitioner-researcher observation, replicate the data | Systematic observation and practitioner-researcher observation |
| <i>Questionnaire</i> | <ul style="list-style-type: none"> <li>- More economical to generate more data</li> <li>- With closed questions, it is easy for respondents to complete and easy to analyse</li> <li>- Requires no special skills for the researcher.</li> </ul>   | <ul style="list-style-type: none"> <li>- Predefined answers can bias respondents towards researcher's views.</li> <li>- No opportunity to seek more information</li> <li>- Internet questionnaires are unsuitable for people with poor computer literacy</li> </ul> | Prepare the questions to ensure that respondents interpret questions exactly the same                   | Self-administered  |

Table 3.6: Contribution of data sources to VSM process

| <b>Phase</b>             | <b>Data Source</b>                  | <b>Purpose</b>  |
|--------------------------|-------------------------------------|---|
| <i>Current State VSM</i> | - Observation<br>- Interview (User) | - Understanding what each business process activity requires.<br>- Provided a clear understanding of how each activity fed into the overall ERP pre-adoption and why the activity is required.  |
|                          | - Questionnaire (Customer)          | - To provide understanding of what is priority to the customer in terms of value adding activities.   |
| <i>Future State VSM</i>  | - Interview (Vendor)                | - Understanding of features contained in the proposed ERP system<br>- Understanding of the limitations of the proposed ERP system<br>- Insightful discussion with the vendor on features and how the proposed ERP system would handle/deliver each of the features identified from the current state VSM. |
|                          | - Questionnaire (Customer)          | - Used to understand and develop the future state business process to ensure the adopted ERP system is capable of delivering value to customer  |

### ***3.4.1 OIPT and Interpretive contextualism***

Klein and Myers' (1999) classification suggests that interpretative study assumes that knowledge of reality is gained only through social construction such as consciousness, language, shared meanings, interviews, observations, meetings, trainings and documents. Considering this classification from Klein and Myers' (1999), the data sources are also supported by OIPT and will enhance the integrity of the research findings.

Interpretivism has been identified as a useful paradigm in addressing particular research questions (Biedenbach and Muller, 2011) which will compatibly allow the application of OIPT, as this theory allows the addressing of complex issues and questions in complex business environment (Premkumar et al., 2005). Interpretive studies also seek to understand phenomena through the meaning people involved assign to them by understanding the context of the information system and of the process whereby IS influences and is influenced by the context (Black, 2006); this logically follows the theoretical concept of OIPT Cegielski et. al. (2012). Finally, following the argument by Guo and Sheffield (2008) that interpretive study provided understanding of particular social settings, OIPT has been successfully used as the theoretical framework in further understanding and discussing particular social settings (Premkumar et al., 2005, Cegielski et al., 2012, Gattiker and Goodhue, 2005).

### ***3.4.2 Analysing empirical material***

To aid understanding and clarity for readers, it is important to expand on the interrelationship between data collection, data analysis and the researcher (Miles et al., 2014). The researcher had no pre-knowledge of the area being studied and its impact in the action case industry and as a result of the action case research method (Vidgen and Braa, 1997), had to immerse himself completely with the focus of being accepted by the system users prior to data collection. The analysis of the empirical data came after collecting data via various information sources and verifying the relevance of data to avoid wasting time on invalid or non-relevant data as has been discussed in section 3.3.7.1.1.

Considering that data collected was required in designing the current state of the organisation using VSM it was important to use appropriate flow process tool. Microsoft Vision was

considered inflexible, hence a product called 'Edraw' was used for data analysis to create a value stream process for the current state and onwards was also used in creating the future state. Although Edraw also required some special skills to use, it was however, easier to understand the application of the symbols and to develop the logical thinking required to reproduce a value stream diagram using this software tool. After creating the current state value diagram, the waste activities within the process was also calculated and analyzed.

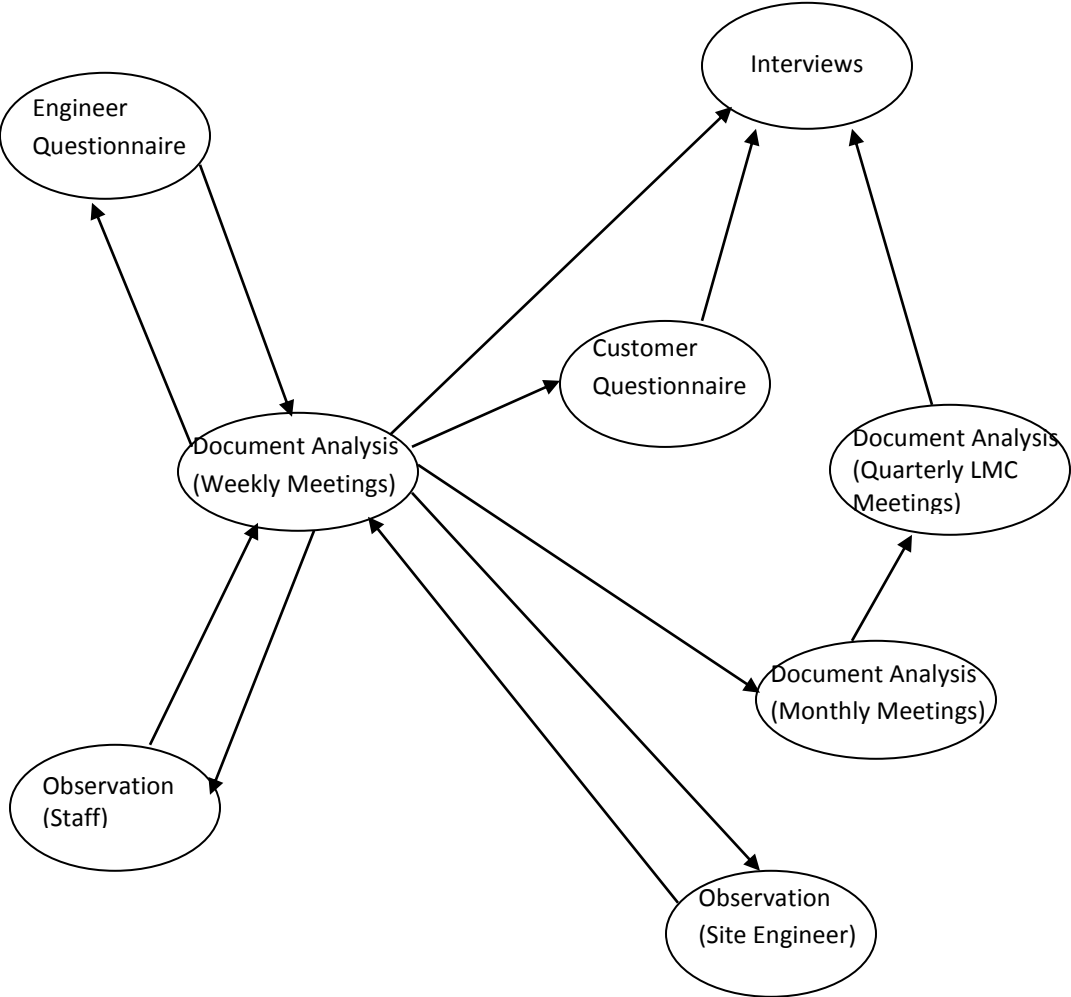
The questionnaires were drafted and reviewed several times based on the recommendation from Stevens et al. (1999), so that they were easily understandable to somebody who did not have the background knowledge of the subject that the researcher had. The engineer questionnaires were posted out to field engineers, who then completed and returned them to the researcher. Once completed and received, the questionnaires were screened by the researcher for suitability, to ensure that they met the needs of the research and answered the research questions. On completion, the engineers returned the questionnaires which were analysed using the same qualitative approaches as discussed in section 3.4.2.

The data collected by those reviewing the ERP system via interviews and meetings was first compared to ensure that there was uniformity in subjective representation of data from sources such as external suppliers. To ensure there was uniformity in the representation of the data from supplier meetings, a discussion was held where the reviewers clarified their understanding of how the proposed system intended to meet each of the functionalities and a justification of the weight assigned to the functionalities. These sets of data were then transferred into an Excel grid, where the weighted average of each response was taken as the overall response for the particular feature and for that supplier.

The transcribing of information, which was gathered from questionnaires, observations, meetings and interviews was done immediately. As mentioned earlier in this chapter, data collected from staff questionnaire and observation was used to reproduce the current state value stream of the action case as well as used in suggesting areas of the business process which could benefit from improvement. With the data analysis obtained from the current state value stream and the suggested areas of improvement, the future state value stream was designed which proposed the possible optimal performance of the business process. Data from interview and meetings with potential IS/IT vendors provided information used to analyse the future state

value stream features against the functionalities supported by the potential IS/IT system. The whole data was collected to enable the analysis and representation of the current and future states of the business process using Value Stream Mapping which generally suggests the optimal performance of the business process.

Fig 3.5 Link on Data connection



The figure 3.5 above shows the iterative connection between the data collection approaches used in the current study. Data from the weekly document analysis was used to design the engineer questionnaire and data from the engineer questionnaire was also discussed during the next weekly document analysis meeting. Data from interviews, site engineer observation and onsite staff observation was presented during the weekly meeting to ensure the appropriate data was collected while also planning on how the data feeds into the next data source. From

data collected and fed into the weekly document analysis meetings, the customer questionnaire was designed to ensure that it focuses on collecting the data relevant to the current study. To ensure that data collected during the weekly document analysis meetings were relevant to the current study, the monthly document analysis meetings provided an opportunity for the action case, the researcher and the academic team to review the summarized data and agree on its relevance. Further to the monthly meetings, the quarterly meeting took the monthly meeting data a step further by providing the opportunity for the action case SME, the researcher, the academic and the government representative to review and agree on data and action decision from monthly meetings. The interview stage of data collection also depended on data from the three document analysis meetings to provide adequate structure.

#### **3.4.2.1      *Data and Research Questions***

This section relates data and research questions to highlight the data collection activities that addressed specific research questions. This will justify why the data was collected.

The interview with the managing director was conducted to understand what the strategy of the organisation is which contributed to the design of the future state value stream. A basic understanding and clarification of the strategy of the action case informed what data was collected after this stage and also formed a focus of the deliverable IS/IT solution. This data contributed to answering the first research question by providing the required information used in the design of the two value stream processes. The data from service engineers was structured so that they provided clarity on areas of improvement in the current system and business process which was used to inform the design of the future state value stream. The design of the future state, which suggests the optimal performance in OIPT2.0, contributed to answering the second research question on how OIPT could benefit an ERP implementation. The data from customer questionnaire was structured to gain a better understanding of areas of improvement, from a customer's perspective, which contributed to answering the first research question regarding Value Stream Mapping. In order to streamline the business process, keeping a focus on the customer, there was a need to understand improvements that would add value to the customer. The response from these questions aided the understanding of these improvements as well as contributing to answering the third research question.

In order to contribute to answering the three research questions set out in chapter one, the following data types in table 3.7 contribute to the understanding of the main themes of this work.

Table 3.7

|                   |  |   |   |
|-------------------|--|---|---|
| Research Question | Research Question 1:<br>How does <b>business process analysis</b> using Value Stream Mapping impact the implementation and customisation of an ERP system in a hybrid service and manufacturing SME? | Research Question 2:<br>How can an SME benefit from the use of <b>OIPT in an ERP implementation</b> for an SME? | Research Question 3:<br>How does business process automation affect a <b>hybrid service and manufacturing SME</b> ? |
| Data Sources      | Observation<br>Interviews<br>Document Analysis   | Interviews<br>Customer Questionnaire<br>Document Analysis<br>Observation  | Interviews<br>Engineer Questionnaire<br>Document Analysis<br>Observation  |

### 3.4.3 Research Integrity

In Klein and Myers (1999), a set of principles were used for the evaluation of information systems interpretive field research. Also, from Klein and Myers (1999), the two sources of these principles are anthropological research practices and the underlying philosophy of hermeneutics and phenomenology. As illustrated in table 3.4, and further discussed in chapter four, these principles were drawn up to serve as guide for interpretive information systems researchers. Researchers should however be conscious of the warning, not to confuse process with outcome (Walsham, 2006, Klein and Myers, 1999). Hence, it is insufficient to say the principles have been applied; it is however more important to present the associated result of applying the principle in order to justify the application of the principle.

The first fundamental principle of hermeneutics is that of the hermeneutic circle, to which all interpretive work of hermeneutic nature forms the basis. This idea from Klein and Myers (1999), suggests that the understanding of a complex whole from the beginning comes about from the



understanding of the meanings of the associated parts and the interrelationships of these parts. As a result our understanding is an iterative process, whereby sufficient understanding of the parts that make up the whole and the interrelationship equally leads to sufficient understanding of the complex whole. This fundamental principle of the hermeneutic circle forms the basis of the remaining six principles (Klein and Myers, 1999). The researcher, in this study, uses this principle as a guide in order to decide what sort of information to source, from who and how to acquire this information. This also aids the understanding of the relevance of data collected and in general adds meaning and clarity to problem as a whole.

The principle of contextualization is the second principle of hermeneutics and consciously brings out the tension between the text and the present. In order to gain a more grounded understanding of the context being studied, it is important to understand the cultural, historical and social circumstances of the organisation being studied. This principle illustrates the role traditions and present organisational attributes play in contextualizing the subject being researched. As a result, the contextualization principle upholds the importance of placing the subject matter in the required social and historical context to direct the audience understanding of the emergence of the current study under investigation (Klein and Myers, 1999). As was uncovered in this research, an organisation's information systems implementation history influences future systems adoption and implementation which in itself becomes history and can also influence future adoption and implementation. The impact of this observation is that the knowledge of social and historical understanding of a context aids the understanding of the current context which in turn forms history to the future context.

Unlike the principle of contextualization, which places subject of research into its context, the third principle is that of the interaction between the researcher and the subjects. The emphasis in the third principle is on the researcher placing himself or herself and the subjects into historical perspective, in order to understand how activities in the past might affect the current subject. To put the principle of interaction between researcher and subjects into perspective there is need to understand that the researcher, as well as the participant, can also contribute as both the interpreter and the analyst during the research process. As a result there is the possibility that the preconception the researcher holds about the participants could affect the construction, direction and documentation of the research and associated materials. In this

sense, the researcher must be clear about this interaction and how it can influence the process of data collection.

The fourth principle is the principle of abstraction and generalization. This has a philosophical backing, which states that the validity of the inferences drawn from one or more cases does not necessarily depend on the representativeness of cases in statistical sense, but on the quality and cogency of the logical reasoning used in describing the results from the cases and drawing conclusions from the results.

#### ***3.4.4 Research limitation***

The methodological limitations that affected this research are discussed in this section. As mentioned earlier in this section, the finding in this study is limited to this action case in line with KTP studies. As this research was conducted to fulfil the requirements for a doctor of PhD degree, whilst also implementing the sponsored project, time was a big constraint. The constraint posed by time was obtaining data and ensuring the ERP system was up and running in the action case organisation within the two years defined by the sponsors as the duration of the KTP project. With the researcher being based in the organisation, there was the tendency of losing the required critical distance. To help mitigate this, the researcher recorded most of the interviews in order to reference back to quotes during the course of the research. Also, with the help of meetings with the academic supervisors and the KTP supervisor, the researcher maintained critical distance even while based in the action case organisation. Another limitation within this research is the researcher's involvement, which could also introduce a level of bias; but, as discussed the researcher endeavoured to overcome this by ensuring that he did not influence any of the data collected. One other limitation was prioritising whether to capture action or act, that is, whether to collect data or carry out the implementation as required by the SME. As a result, some of the data might not be up to the standard it would have been if the researcher was concentrating on just collecting data. Finally, it is important to mention that the selection of this case study was a unique opportunity as described by Oates (2006) and Benbasat et al. (1987) and was assumed that such opportunity to study an SME which is primarily service oriented with a manufacturing aspect might not present itself again.

### ***3.4.5 Ethical Consideration***

Ethical consideration was paramount to this study, to ensure that every required measure was put in place, in order to make sure that research adhered to the ethical standards stipulated by the University. In adherence with the University's ethical standards, ethical approval was obtained before commencing the data collection process. This research falls under the scrutiny of the Research Governance and Ethics Committee, and as a result required approval by this ethics committee of the University of Salford. The study obtained informed written consent from participants, as shown in the appendix, as well as assured participants that data confidentiality and anonymity, was strictly adhered to. To gain approval, a copy of the questionnaire, interview schedule and participants consent forms were sent to the Ethics Committee before collection of data.

Before any observation or interview, all participants were given the opportunity to opt out of the research, and they were also given an information letter stating what the data they provided would be used for and who would have access to these data. They were also informed of their right to opt out or participate in the research without any implication to their jobs at Alpha. Participants were then given informed consent forms to read and sign, which stated that they understood what data was required from them, what it would be used for and who would have access to it. The researcher also made time available to clarify any concerns that the participants may have had. Before any interview, observation and questionnaire filling, the participants read, agreed and signed the written informed consent form which recorded the participant's consent to be involved in the research and data collected used in the research.

To maintain anonymity for both the participant and the action case organisation, all information which might suggest the identity of the participant or the action case organisation was removed or replaced with pseudonyms. As stated earlier in this section, this study respected the confidentiality and anonymity of the participants as well as the action case organisation and all hard copies apart from consent forms have been anonymised.

### **3.5 Summary**

In this chapter, the research philosophy, approach and methods adopted to successfully carry out this research were presented in detail. A justification to apply the interpretive approach was also explained by demonstrating how the interpretive study best fits the research and how it presents a stronger analysis tool than the positivist and critical approaches.

Action case was chosen and justified for the current study since there is a unique opportunity to study the phenomena of hybrid service and manufacturing SME going through a process of ERP evaluation and implementation.

The data collection tools were also described and justified to make clear what the study is aiming to achieve.

The next chapter presents an analysis of the empirical findings.

## ***Chapter Four: Data Analysis and Findings***

### ***4.0 Introduction***

In the previous chapter, the choice of interpretivist research paradigm and action case was discussed and justified.

This chapter presents an in-depth analysis of the way in which this hybrid service and manufacturing organisation adopted and implemented an ERP system (SAP Business One).

To align the data analysis to follow the action case methodology, Vidgen and Braa (1997) demonstrated the adoption of a three phase approach for more meaningful discussion as follows:

1. Phase one: Study of the development organisation
2. Phase two: Analysis of specific information systems
3. Phase three: Application of the information system quality method

These three phases have been adapted and tailored to this research to aid the research structure. The three phases are modified for this research as follows:

- a. Phase one: Study of the development organisation (Alpha)
- b. Phase two: Analysis of available hybrid ERP systems and suppliers
- c. Phase three: Application of the re-engineered business process

The data analysis chapter is hence structured into these three phases as discussed after the introduction to the action case below.

#### ***4.0.1 Action Case description: Introduction to Alpha***

Established in the late 1980s, this service SME is based in the North West of England and is, for the purposes of this research, referred to under the pseudonym of Alpha. This SME was originally a manufacturing company, but has evolved to become one of the country's leading service and maintenance specialists, as well as manufacturing specialist of air filters for all

aspects of the heating, ventilating, air conditioning (HVAC) and spraybooth industries. In order to clearly emphasize why this organisation qualifies as a hybrid SME, it is necessary to explain why it is both a service and manufacturing SME. The services offered by this organisation are in heating, ventilation and air conditioning (HVAC) and spraybooth. As it is both a mechanical and electrical service management organisation, this SME also manufactures most of the components the engineers use in carrying out services on customer's site.

With a mechanical and electrical division, Alpha are also contracted to maintain commercial buildings on a contract or breakdown basis. The ability to respond quickly and professionally alongside having qualified experienced engineers located across the UK enables them to exceed customer's expectations. This specialist service SME provides nationwide rapid response cover, through their network of mobile engineers located in strategic locations across the UK.

Alpha has four operating divisions namely Mechanical and Engineering (M&E), Spraybooth, Filtration and Coatings divisions. The M&E division concentrates on commercial building maintenance such as boilers in schools, electrical and air ventilation services. The spraybooth division is geared towards servicing spraybooths for customers who have on-site spraybooths. This is the identified niche for this organisation, as it prides itself on having knowledgeable engineers in the field. Filtration division manufactures and supplies filters to Alpha's spraybooth division, it also sells filters to external companies such as users or other servicing companies. Finally, the newest division coating sells paints and coats to end users and companies. The company has a diverse customer base ranging from aircraft, car, train manufacturers, schools and councils across the UK.

#### ***4.1 Phase One: Study of the development organisation – Alpha***

The first phase of the research lasted for six months. At the beginning of the first stage, the research was deliberately not very structured as the main focus was to understand the business, its processes and the organisation in general with the aim of gaining clearer understanding of the needs for the adoption of a more efficient hybrid ERP system for Alpha. This was achieved by interviews, site visits, meetings, questionnaires, archival documents and demonstrations. The themes that emerged during the first phase are discussed below.

### 4.1.1 The case of Alpha

As found from data collected from interviews, meetings and observation, and presented in figure 4.1 below, the general overview of Alpha's business process starts with the customer placing an order over the phone with the customer service sales team. This order is then processed and sent through to the operation's department who decides what service requirements are to be passed to the production department and what should be purchased. These are then sent to the customer's site in time for the service engineers' arrival to carry out the job. On completion of the job, the customer receives a customer job sheet to confirm completion of the service, while the payroll department receives the engineer timesheet and job sheet, which is used in invoicing the customer and paying the engineers salary.

Figure 4.1 below shows a general overview of Alpha's business process:

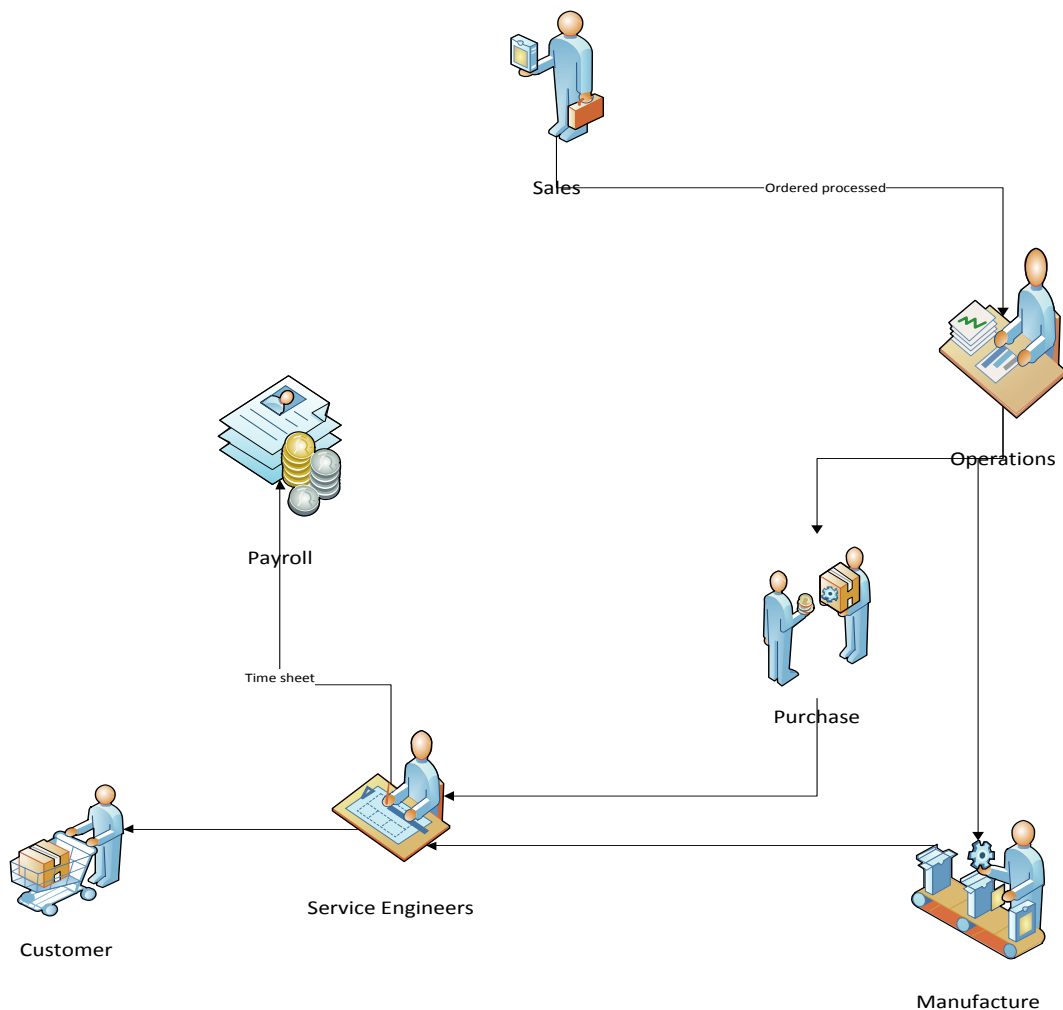


Fig. 4.1:

Due to expansion through growth and acquisitions, Alpha has seen an increase in the number of disparate information systems being used as part of its IT infrastructures. There were four disparate systems in use before the commencement of this project and they were SAP Business One, Telemagic, Resultware and Sage Payroll. SAP Business One was perceived as the general ERP system, which was used, but greatly under-used. Telemagic, Resultware and Sage were used to complement the inadequacies of SAP Business One.

Table 4.1 below shows how the systems in Alpha have evolved, whilst also showing what area of the business process each system supported. The use of Style systems was discontinued in 2000 when Alpha adopted Opera payroll which was used alongside Telemagic. As the company grew, the need for a service solution became clearer, which led to the implementation of Resultware in 2005. Pegasus Opera, a DOS system, was no longer supported by its developers from 2006; this meant that there was a need to source and implement another suitable service ERP system.

The action case SME currently uses SAP® Business One version 2007 as its main ERP system, in addition to three other partial ERP systems as a result of SAP's limitations, which are mainly the lack of efficient engineers' calendar and job costing functions. As stated earlier, the action case organisation operates neither a typical service oriented nor a typical manufacturing oriented business process. Therefore, Alpha requires an ERP solution that meets its unique and specific needs.

These challenges are unique within the hybrid service and manufacturing industry because the majority of companies that specialise in only manufacturing are able to account for the time and components consumed in a standardized manufacturing process (Helo et al., 2008): while companies that specialise in only service provision have no need to account for bill of materials used in building an item. As a result of the lack of production of an item, typical service companies do not require an ERP system that account for bill of materials. Other issues not documented by the existing literature, but identified and explored in this study as peculiar to the hybrid service and manufacturing business process will be discussed further in this chapter.

The company was unaware of the existence in the market of a possible ERP solution capable of carrying out all the functions of the disparate systems. It embarked on the process of identifying



and implementing a suitable ERP system in 2006, which led to the current use of SAP Business One. At that point the company felt that their major problem was solved by the implementation of a supposedly all-in-one ‘best of breed’ ERP system to take the burden of double entry of data into the other systems that were also in use. However, that system failed to resolve the service-related needs of Alpha due to its specific hybrid business processes.

| <b>Date of implementation</b> | <b>Application Name</b> | <b>Business Area</b> | <b>Usage Status</b>             |
|-------------------------------|-------------------------|----------------------|---------------------------------|
| August 1987                   | Style                   | Foundation Accounts  | Discontinued usage in 2000      |
| 2000                          | Opera                   | Accounts Payroll     | Discontinued usage in July 2006 |
| 1995                          | Telemagic               | CRM                  | In partial use                  |
| 2005                          | Resultware              | Service              | In partial use                  |
| August 2006                   | SAP Business one        | ERP                  | In partial use                  |
| August 2006                   | Sage                    | Payroll              | In partial use                  |

Table 4.1: Alpha’s IT System History

***4.1.2 The need of an efficient ERP system in this hybrid service and manufacturing Organisation***

Through interviewing various staff of the organisation, comments made by the interviewees indicated that, like manufacturing, this service hybrid HVAC SME also required a robust suitable ERP system to manage all aspects of its business processes. This is indicated in statements from relevant categories of stakeholders as shown below:

### ***Managing director:***

In 2010, the managing director of the action case organisation was interviewed and was asked the question 'Why is there a need to re-engineer business processes and adopt a new ERP system'. His response was represented in two categories:

***Efficiency*** – *'Currently back office and field engineering operations are the two largest cost centres. They account for 75 percent of total business costs and therefore represent major opportunities for strategic cost savings. Specifically, manual processing of twenty four (24) field engineers' time sheets takes back office staff twenty (20) hours per week; field engineer utilization (travel time, time spent on job, allocation of jobs to engineers etc) is suboptimal therefore the costs of jobs are often underestimated resulting in loss of income. (The scale of these losses is currently unknown as the existing systems produce insufficient data).'*

***Strategic business development:*** *'The analysis and re-engineering of relevant processes will enable a streamlining of many current procedures, freeing up the managing director's time to pursue new business development opportunities. The present situation is inhibiting the company's growth as the existing management infrastructure could not support any strategic expansion of the business through acquisition'.*

(2010, Code: A)

On a separate interview, the managing director also stated that '*streamlining Alpha's business processes*' was among the reasons to re-engineer the business processes.

This data was collected via documented evidence from an interview with the managing director of the action case SME and the purpose of collecting this data and how it relates back to the research questions is as discussed in section 3.4.2.1. From the above quote we can see that for the director, the adoption and implementation of a robust ERP system such as SAP Business One to the business processes is strategic for Alpha to remain both profitable and in meeting future strategic expansions. The director saw this as an opportunity to improve the company's efficiency as well as improve the services being offered to the customers, which could also improve customer satisfaction. The customer service staff also identified the need for an

improved system by stating that it took a relatively long time for a customer to be invoiced after a job is completed. This was agreed by the following comment from an interview with a senior member of the customer service team: *'These jobs were done last week and they will be invoiced on Friday, the customers will receive the invoices on Monday the following week'* (Interview 03).

They also saw the need for an improved and flexible engineer diary or calendar which would allow the staff to drag and relate jobs based on engineers *'the diary is a problem in the current systems because the diary is not user friendly and does not allow drag and drop function'*(interview 03). This could also be improved with the adoption of a more efficient service oriented ERP system.

This finding resulted in further research on the service management components of SAP Business One with the introduction of customisation to bridge the existing gap. The requirement gathering and customisation scoping done by the researcher, ensured that the actual development of the customisation was done by the SAP Business One vendor. This SAP Business One vendor is also known as the reseller.

In relation to the literature, in order to achieve a successful business process analysis, some researchers focused on business process analysis from the perspective of customer value (Porter, 1985, Hvam and Have, 1998). Others, such as Tsaih and Lin (2006), argued that basing the focus of business process analysis on both customer value and the business strategy provides a better approach. Both are achievable when business process analysis is conducted using Value Stream Mapping (VSM). This supports the flow of information systems adoption and implementation as contributing to the SME's efficiency and strategy as contained in the conceptual framework.

The literature supports my findings that the adoption of a robust service oriented ERP system would assist the strategic positioning of Alpha. Drew (2011) identified that although information technology plays a great role in strategic development, other factors such as globalization of markets and accelerating pace of innovation are also strategic for the future direction of an SME. Jagoda (2012), while agreeing with the Alpha director's view, listed above, identified information technology as a strong factor which has changed the competitive landscape upon

which SMEs operate. In a bid for SMEs to remain strategically competitive, Beal (2000) linked the importance of aligning business environment to competitive strategy, in order to survive the effects of changes. Since business processes elaborate how work is carried out within an organisation, such as the hybrid service and manufacturing SME, organisations are constantly attempting to improve business processes in an attempt to increase organisational performance and efficiencies (Gulledge and Deller, 2009), as illustrated in the conceptual framework – see figure 1.3, conceptual model figure.

Data collected from engineers, which was obtained by interviews and shadowing some of the engineers while out on customers' sites, was used in VSM to quantify the time it took them at various stages of the business process. The engineers identified the need to be able to view job histories on a per job basis. The engineers wanted to see information such as who carried out the last job, what faults were identified and what was done to resolve the issue, as well as what parts were used in resolving the issue. For a non-service organisation this might not be a problem worth investing time and resources to resolve. The reason being that in a non-service organisation, such as manufacturing, the focus is on the item being made. However, with the logistics involved in the engineers driving long distances to the customer's site, being prepared will definitely increase efficiency of the engineer and reduce cost associated with each job.

An engineer's diary or calendar is also vital for the daily, weekly and monthly planning of each of the engineers' jobs, and although the customer service staffs highlighted how they want to view the diary, the engineers themselves want to view jobs associated with a specific engineer within specific region. This is confirmed in the following comments '*allocating engineers to jobs is one of the main issues*' (interview 04) and '*If the job is cancelled and the engineer is not told, then the engineer would just turn up at the job*' (interview 01). There is also the need for the engineers to have a real-time visibility of bought in goods, going from supplier to customer's location, since they do not want to be at a site without the necessary goods and thus not being able to undertake their work. This is confirmed from the response from an engineer when asked what issues they faced and one of the issues was '*ordering the parts used for the service is not very visible to the engineers*' (interview 01).

Another question that was asked in the engineer questionnaire was 'What are the issues with sending and receiving job information while outside Alpha offices?' (Appendix 1b: Employee

Questionnaire). The purpose of collecting this data from the engineers is as discussed in section 3.4.2.1. Some of the responses were as follows:

*'Having to wait until I am online to check job information online'.*

(04/02/2010 Code: B)

*'Waiting until Friday to send job and material information used in a specific job'.*

(04/02/2010 Code: B)

*'Having to post job sheets, customer satisfaction notes and time sheets on Friday and sometimes waiting until Wednesday the next week for them to be confirmed received at Alpha'.*

(04/02/2010 Code: B)

*'Ordering the parts used for the service is not very visible to the engineers' (interview 01).*

*'Allocating engineers to a job is one of the main issues' (interview 01).*

*'The sending of job sheets should be done either by email or electronically.'*

The above quotes highlight the frustration that the engineers feel toward the current processes. They are not happy about the need to wait until Friday for a weekly job report, as well as waiting for a confirmation of a safe receipt until Wednesday in the following week. For a job done on a Monday, it takes over a week for the job to be reported and logged into the current system. The impact of this is that the customer can only be invoiced nearly two weeks after the work was undertaken, hence increasing the time it takes to get paid by the customer thereby causing inefficiency by reducing cash flow.

From a process re-engineering point of view, sending job sheets and time sheets via email is a clear area for improvement and will be further discussed during the analysis and discussion of the current and future states of the business processes using VSM.

Communication between onsite and offsite staff is also very important for a service organisation that has all of its engineers working offsite. The reason for this is that for the engineers to function correctly there must be clear and effective communication between the customer service team, who are the first point of contact for the customers, and the engineers who get to

actually go to the customer's site and carry out the service. With the current system, this is not the case based on two of the following comments:

*'Sometimes there is miscommunication in terms of job information'*

(04/02/2010 Code: B)

*'Sometimes when there is cancellation, engineers don't get to know and might end up turning up at customer's site, only to be told they were not expected'.*

(04/02/2010 Code: B)

From the management, onsite and offsite staff, there is a need to adopt and implement a better ERP system to meet the inefficiencies identified above. As discussed by DeLone and McLean (2004) there is also the need to ensure that the customer feels the benefit of the improvements that Alpha makes as well as ensure that these improvements add cost benefit to Alpha's customers.

### ***Customers:***

To understand how the customers currently feel about Alpha's services, an online questionnaire was sent to about 300 customers, 162 of these were not delivered or received by the customer, and 72 responses were returned, this represents a 52% response rate. One of the questions asked was *'If you have any suggestions regarding how we could improve the services we provide to you, please enter them in the box below.'*

The purpose for collecting data from the customer and how this data contributes to answering the research questions is as discussed in section 3.4.2.1.

Some of the responses received from customers were:

*'Pricing breakdown before servicing takes place. Please can you contact us on this subject'?*

*'Better diagnostics' (Appendix 1b: Customer Questionnaire)*

This indicates that from the customers' perspective, there is the need for this hybrid service and manufacturing SME to improve its service delivery using an appropriate system to ensure pricing breakdown is efficiently managed. A way of achieving this is through the implementation of an appropriate ERP system. One of the customers who filled the questionnaire identified that using the current system, Alpha fails to effectively diagnose reported service issues with customer's HVAC and spraybooths. With an effective ERP system, it can be inferred that Alpha will be strategically placed to diagnose and carry out service maintenance and repairs for their customers. This will make them more proactive and profitable, which will increase customer satisfaction.

Other questions presented to the customers via the online questionnaire are presented in graphical way for better understanding. The structure of this survey is in the form of gaining more understanding of what needed changing from the customers' perspective.

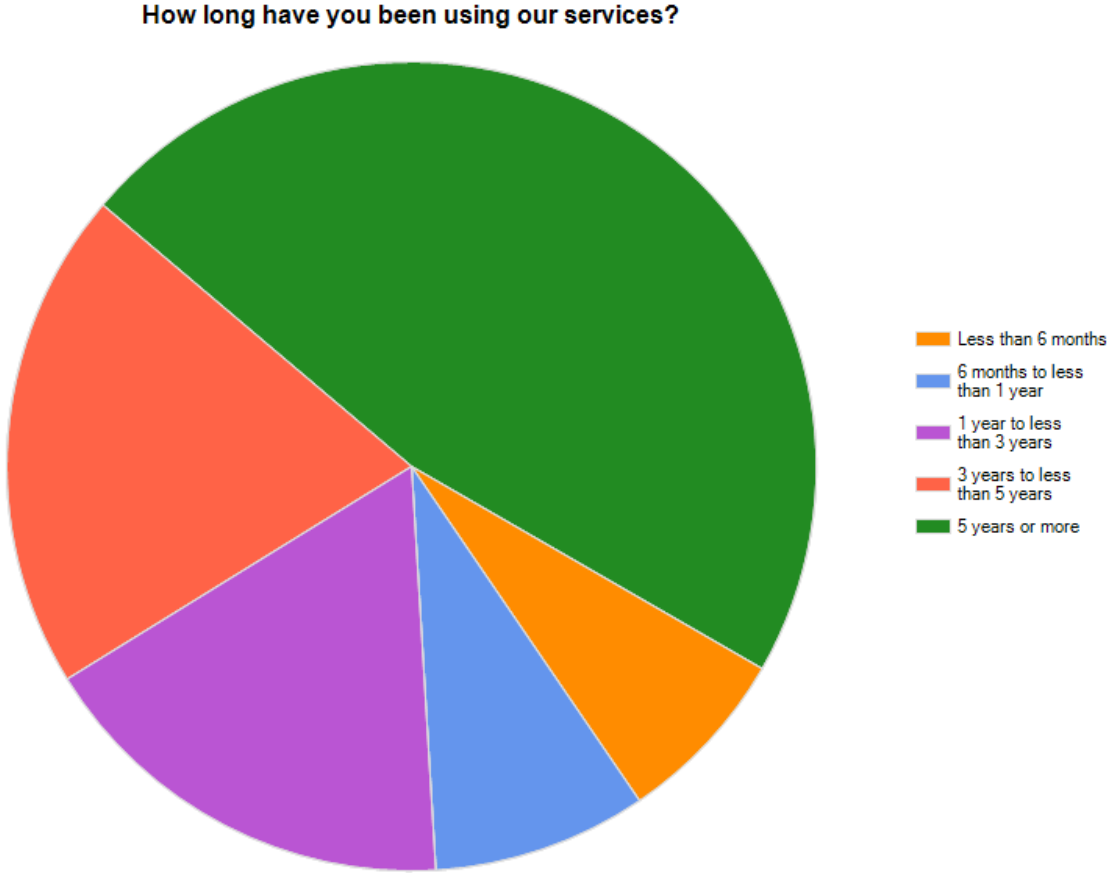


Fig. 4.2 (Question: How long have you been using our services?)

This question was asked to establish the percentage of customers who responded to the online questionnaire that are new customers. To recommend an IS system capable of supporting the SME strategically, it is identified that respondents should contain both new and old customers. The current study also used this question to ensure balanced responses so that responses are not tilted towards the views of new customers or that of old customers.

From the graph above it can be seen that almost 50% of the respondents have been with Alpha for 5 years or more and more than 70% of the remaining half have been with the company for one year or more but less than five years. It can therefore be deduced that, overall, customers are satisfied with the services offered by Alpha and there might be no urgent need for the company to improve its operations, since repeat business is good. More than 85% of those who responded have been with Alpha for at least one year and as a result information provided by them will give more insight towards how these groups of customers perceive Alpha.

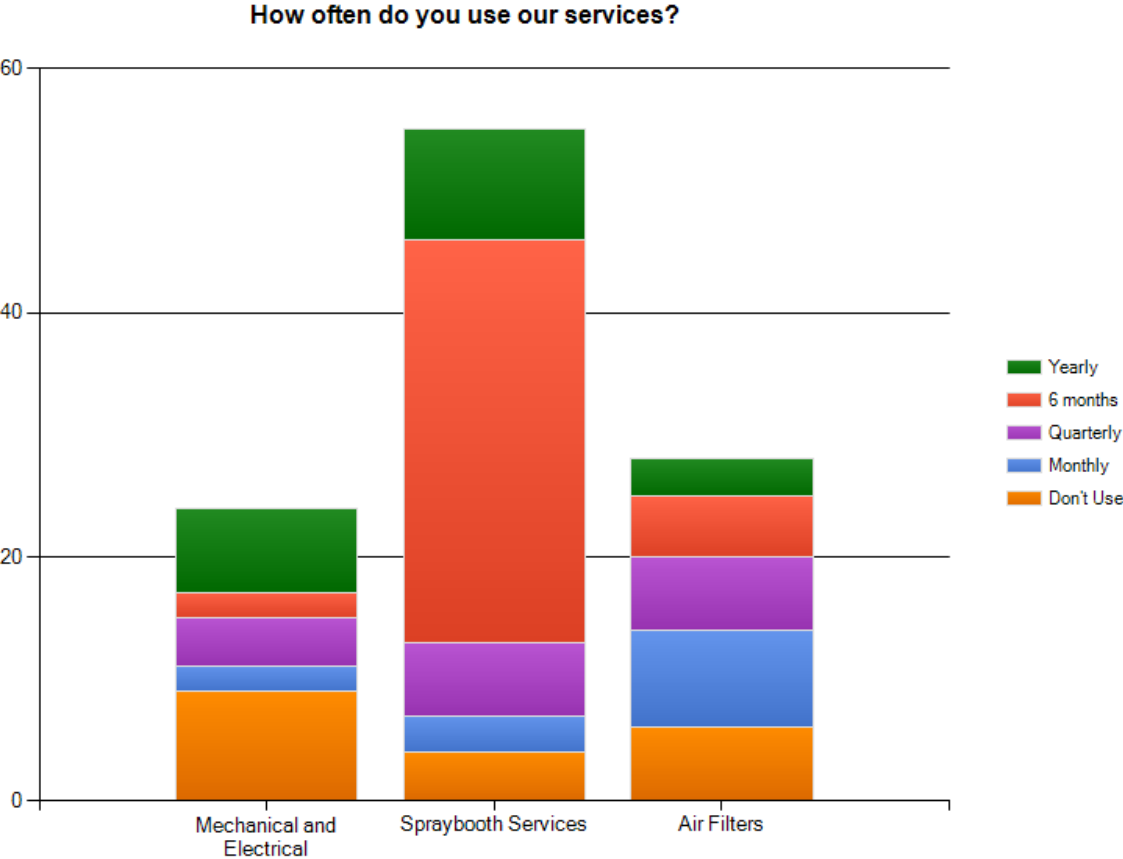


Fig. 4.3 (Question: How often do you use our services?)



This question was also asked to ensure responses were balanced. It can be seen that in the three graphs, a percent of the responses indicate that they do not use that particular part of the business. This does not however imply that they do not use the three services rather a customer who does not use the mechanical and electrical service could be using spraybooth or air filter service or both. Hence, in order to ensure that respondents were customers who used the services of the case organisation, the question was asked to know how often the customers used the organisation’s services. From the responses, more than 80% of the responses currently use the services of the three service departments and less than 20% do not use the services anymore or might have never used the services.

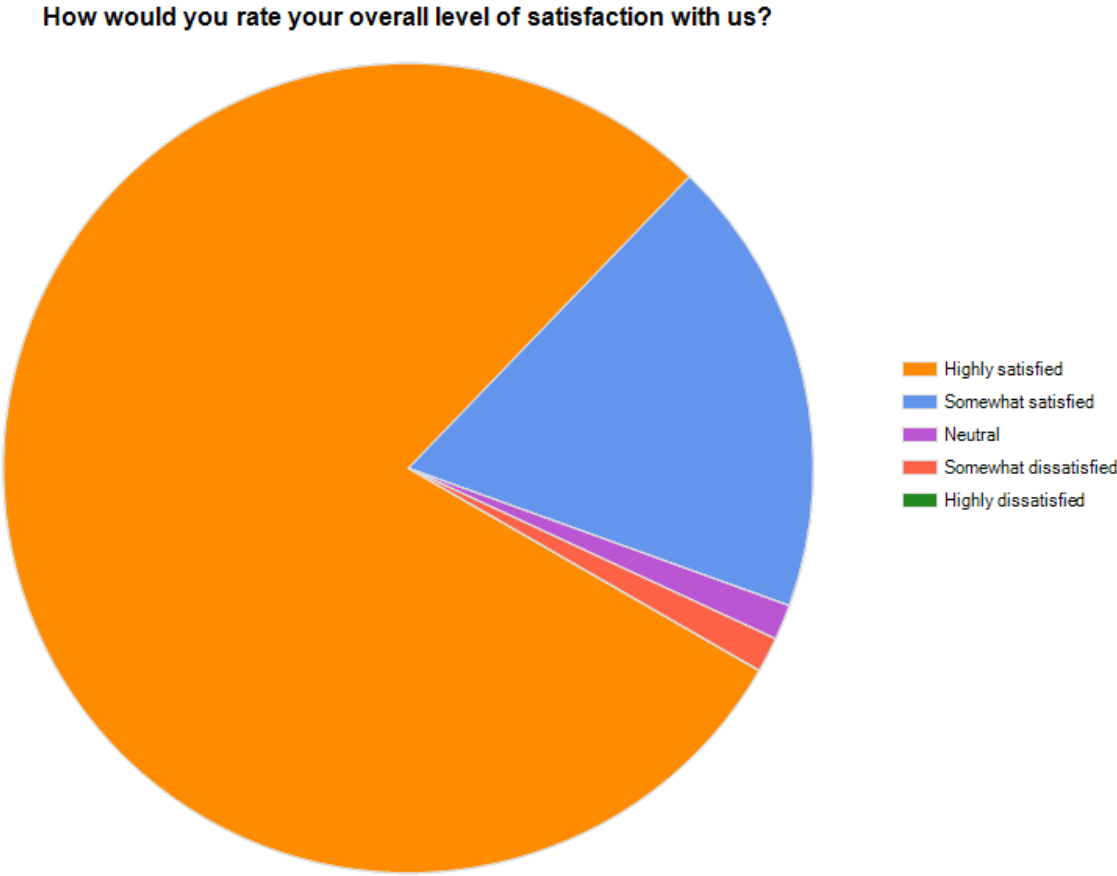


Fig. 4.4 (Question: how would you rate your overall level of satisfaction with us?)

The question asked was “How would you rate your overall level of satisfaction with us?” and the result again showed that about 75% of the respondents were highly satisfied with the level of service they received from Alpha. This implies that about 25% of the respondents are not highly satisfied, hence there is room for improvement.

With 75% of respondents being satisfied with the level of service provided, it can also be interpreted that there is less requirements for improvement to be made in the customer’s service experience. The challenge for the company is however to improve efficiencies and reduce costs while maintaining current levels of service and thereby increasing profit. This research seeks to achieve this improvement by adopting a suitable ERP module capable of managing and maintaining the current service functions. It could also be interpreted that some people are difficult to please and might have ticked the somewhat satisfied box instead. Those who have actively stated that they are highly dissatisfied have no presence at all and there are only about 2% of valid respondents who are only somewhat dissatisfied. So, overall it is a positive customer base, which will be used to answer further questions. This could also be due to the self-selecting nature of the survey respondents since only those who are positively dissatisfied to Alpha wanted to share their views as has been explained in detail in section 3.3.7.

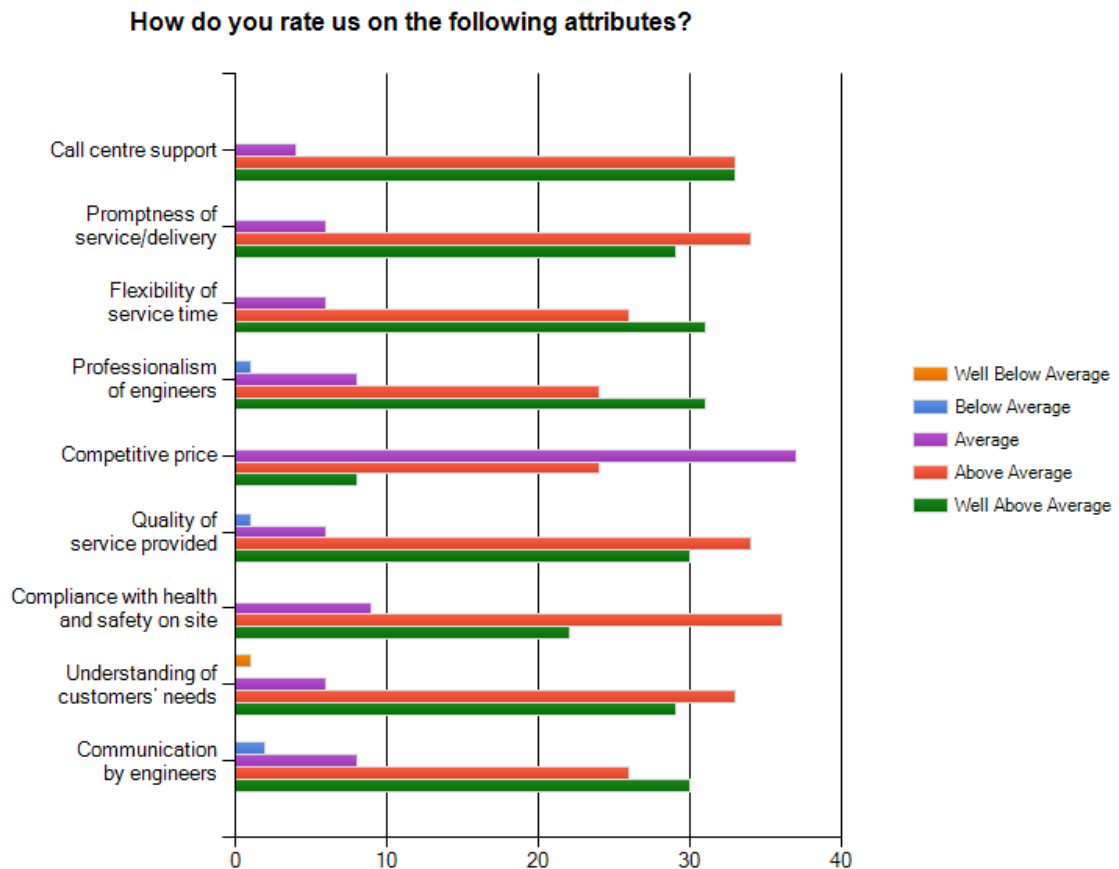


Fig. 4.5 (Question: How do you rate us on the following attributes?)

Although about 75% of the respondents indicated that they were highly satisfied with the level of service that they received, the question on how the customers rated the action case organisation on the attributes shown in the figure above, suggests some areas for improvement. In order to ensure that the action case SME maintains its current service experience while also improving efficiencies and reducing operating cost, it is necessary to improve certain areas of the business processes. Communication by engineers and pricing from the graph indicate these are the two areas that require the most attention. This is because although ‘competitive price’ has a high rate of average opinions, it also has the lowest confident response of ‘well above average’ when compared to other responses. Also ‘communication by engineers’ has the highest responses with ‘below average.’ Though all the other areas suggest that there could be room for improvement in order to achieve a higher and more consistent response with ‘well above average’, this can only be achieved by streamlining the back office and implementing suitable service ERP solution.

How do you rate the importance of the following attributes to you, using 5 as being the highest and 1 the least important to you?

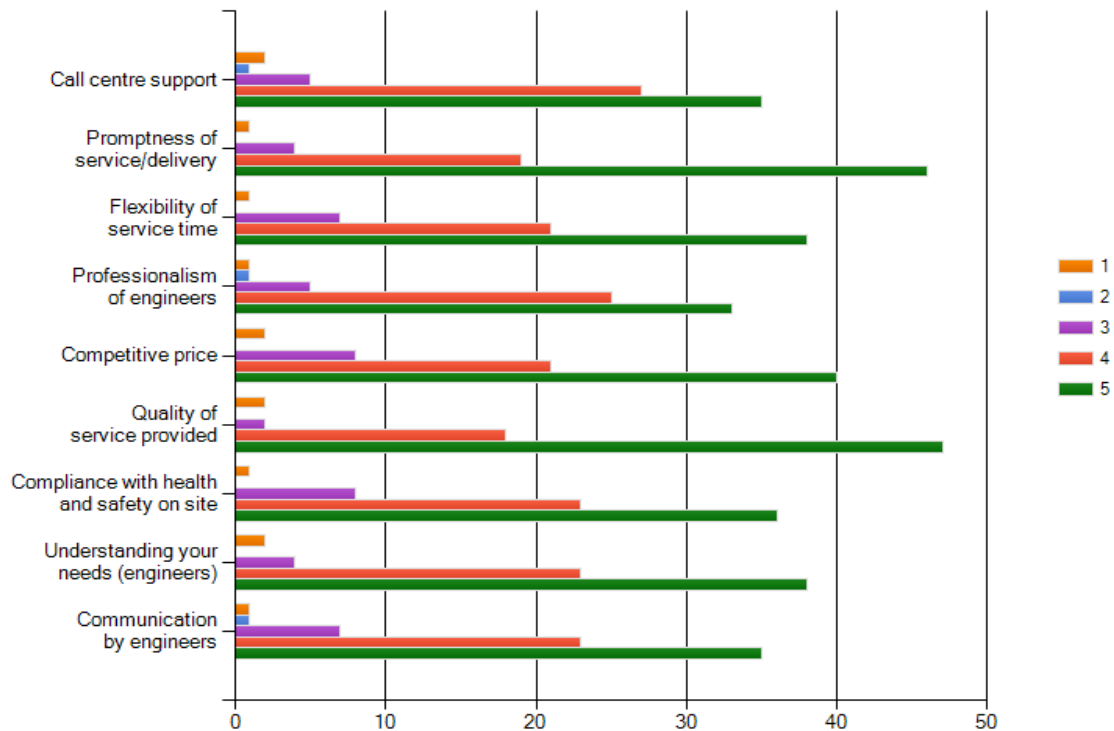


Fig. 4.6 (Question: How do you rate the importance of the following attributes to you, using 5 as being the highest and 1 the least important to you?)

With the understanding of how the customers rate the organisation on the attributes, it is also important to understand the importance the customer attaches to each of these attributes. The reason for this is that to a customer, the organisation may not be performing well on a particular attribute which the customer attaches no importance to. With such an attribute, an improvement in the attribute may be of no significance to the customer. However, when the organisation performs well on an attribute which the customer attaches great importance to, the customer recognises this and relates the performance to value added to the service. Hence, with the importance customers attach to attributes, the whole design is based on **value** and what the customer perceives as value to themselves or their business. This is then related back to the methods adapted in this research, which is based on value adding to the customer using VSM. This method reduces or removes areas of waste and concentrates on customer-oriented value adding activities.

**If you are using other companies that provide a similar service, how do we rate compared to them?**

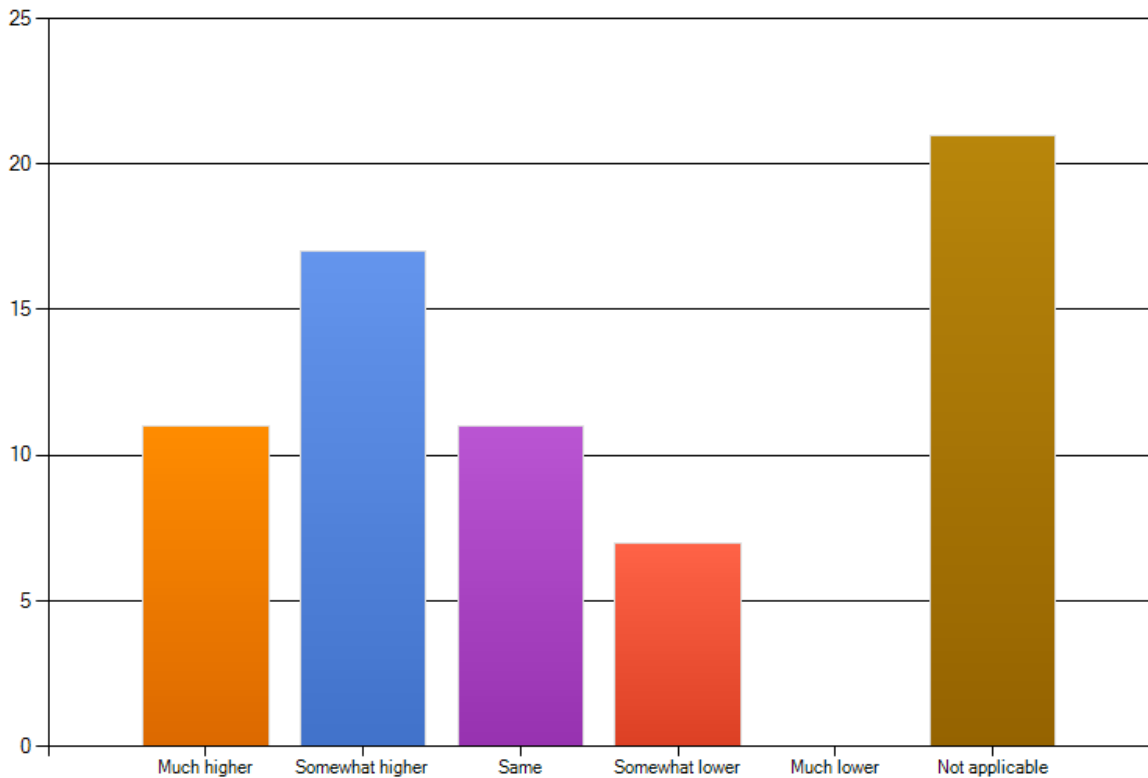


Fig. 4.7 (Question: If you are using other companies that provide a similar service, how do we rate compared to them?)

Understanding a competitor’s place in the market is very important to businesses, particularly when it comes to understanding how customers perceive each of the businesses. In the case of the responses, it is interesting to see that more than 70% of the respondents who use Alpha’s competitors are not confident that Alpha rates much higher than its competitors, which indicates a further need for improving the service delivery process.

### How likely are you to continue using our services in the future?

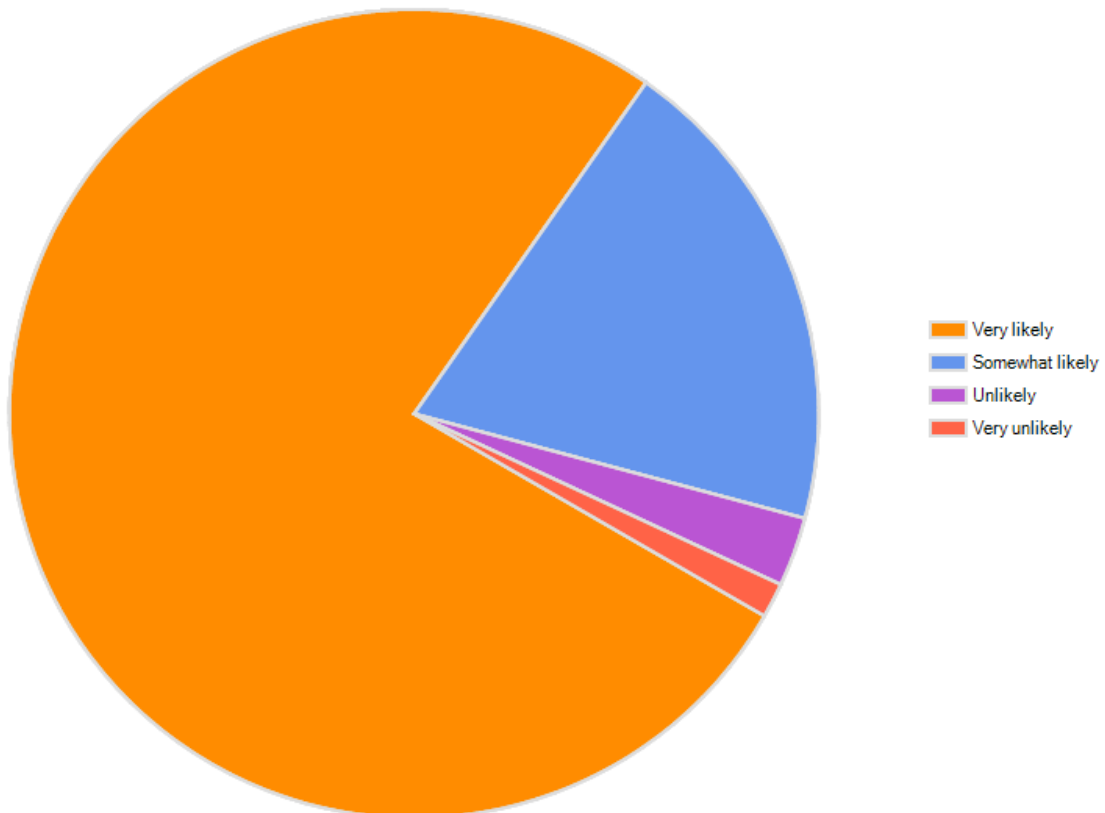


Fig. 4.8 (Question: How likely are you to continue using our services in the future?)

Although some of the responses to this question indicated the need for improvements in the service process, it is shown that more than 75% of the respondents intend to continue using the services of Alpha. About 5% of the respondents are 'unlikely' or 'very unlikely' to continue using Alpha. Although this could be interpreted as being a small proportion of the respondents, but it is also important to understand what causes this trend to avoid it affecting more customers. In order to achieve this, business process analysis using VSM is essential in this action case research.

This section provides data from the director, staff and customers, which have been used to gain a better understanding of the views of these stakeholders. This section brings out the strategic position of the action case organisation, the perception of the customers based on the services carried out by the action case organisation and staff views of the business process.

For clearer understanding, the information obtained from the above data collection methods used in this study were represented in a diagrammatic form for clarity, while developing the value stream maps of the current and future states.

However, in order to adequately prepare an accurate current and future state value stream of the action case, a representation of the entire service business process will be presented and discussed in the next section.

#### **4.1.2.1      *Alpha service business process overview***

Having a list of prospective customers, the customer service team create a Business Partner (BP) record when they receive a confirmation that an individual wants to place an order, thereby converting the prospective customer from an enquiry (lead) into a customer. Following the sale, the customer service team create an activity to update what they have done against the BP record, as well as when the next contact is due. If there is need to add another BP record then the process is repeated. These activities serve as a reminder to customer service to contact customers in the future to enquire whether the customer requires service to be carried out on their equipment. It also forms the basis upon which customer service decides which customer to contact and the purpose of the calls. When the customer service team check the list of activities to follow-up on, they phone up the customer to enquire if the customer requires a service or maintenance on their building or facilities. If the customer does not require either a service or maintenance, the customer service staffs create a follow-up activity and if the customer requires a sales quotation in order to make a decision whether or not to request a service, the customer service team creates a sales quotation and links this to the follow-up activity. It is also important to note that the quotes at the beginning of the research were sent out manually in the post. The activities marked in blue are those carried out in SAP Business One as shown in figure 4.9a.

If the customer requires a service, then the customer service team proceeds to check the diary in a different system called Resultware and agrees a service date with the customer. They then go back into SAP Business One to create a service call and an activity to track what has been discussed with the customer. They also create an activity in Resultware in order to organise the service engineers' diary. After updating the service call, a sales order is then created by copying

the sales quotation in SAP Business One. In order to keep Resultware up to date, the customer service team update the activity to include the sales order number and service call details. This is marked as the green activity in the diagram below, figure 4.9a.

Then a third system is updated to keep track of the customer's equipments. This gives Alpha a detailed history of the equipments on the customer's site, what services were carried out on each of the equipments, what service parts were replaced and who serviced the equipment. This also gives Alpha a knowledge base of similar equipments which is transferred to similar issues on other customers' sites. This is marked as the orange activities in figure 4.9a.

The sales orders are sent to the engineers by standard post or email. If a filter is required, then a copy of the sales order containing the filter details is sent to the manufacturing department, which makes the filter and gets it sent directly to the customer's site before the scheduled date of service. If a material that needs to be purchased from another supplier is also required for the service, then the purchase department purchases the item and gets the item delivered either directly to the customer's site or to the engineer. On the service day, the engineer carries out the service and explains to the customer what has been done. The customer checks the work and signs the service confirmation document to confirm that the work has been carried out correctly.

The confirmation of service (CS Note) is sent by the engineers on Fridays, and as a result, there is a delay on invoicing services carried out earlier in the week. Upon receiving the CS Note, the office staffs match the CS note with the job sheet, which is used to invoice the customer, as well as confirm the hours payable to the engineers weekly.

From the analysis the following issues were identified:

1. There is a possibility that time sheets might be missing or delayed, which means that office staffs have to chase up missing time sheets.
2. Most processes are still manual.
3. Communications with engineers are done manually by post or email.
4. There is no clarity regarding the full account of the 40 hours which each engineer is contracted to be paid each week.



5. There is no clarity whether Alpha fully invoices all 40 hours posted in the system against each engineer.
6. The issue of who extends the orders and who confirms what is invoiced is also raised, because there is no audit trail due to the use of disparate systems.

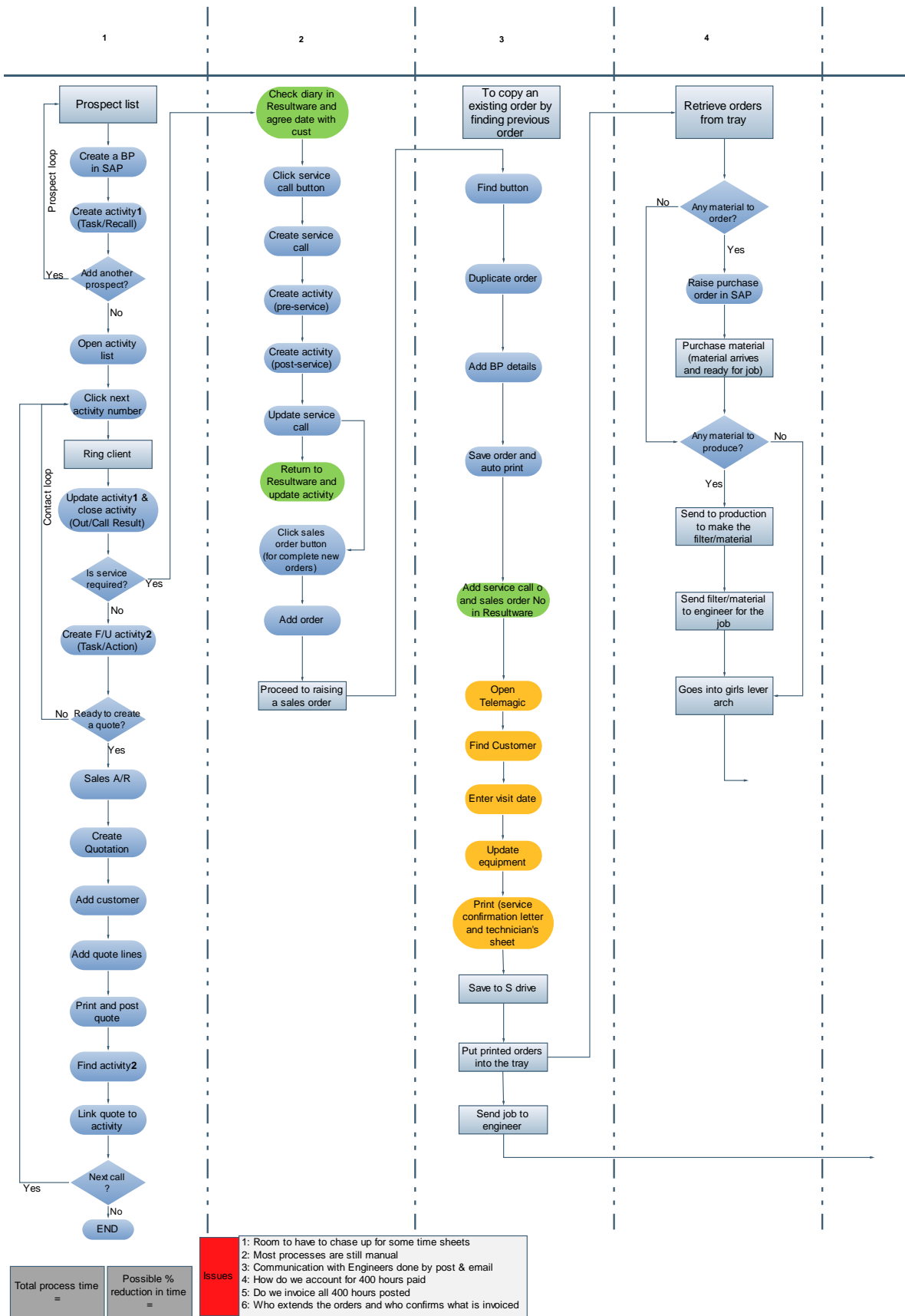


Fig. 4.9a Unique flow process of the hybrid service and manufacturing SME

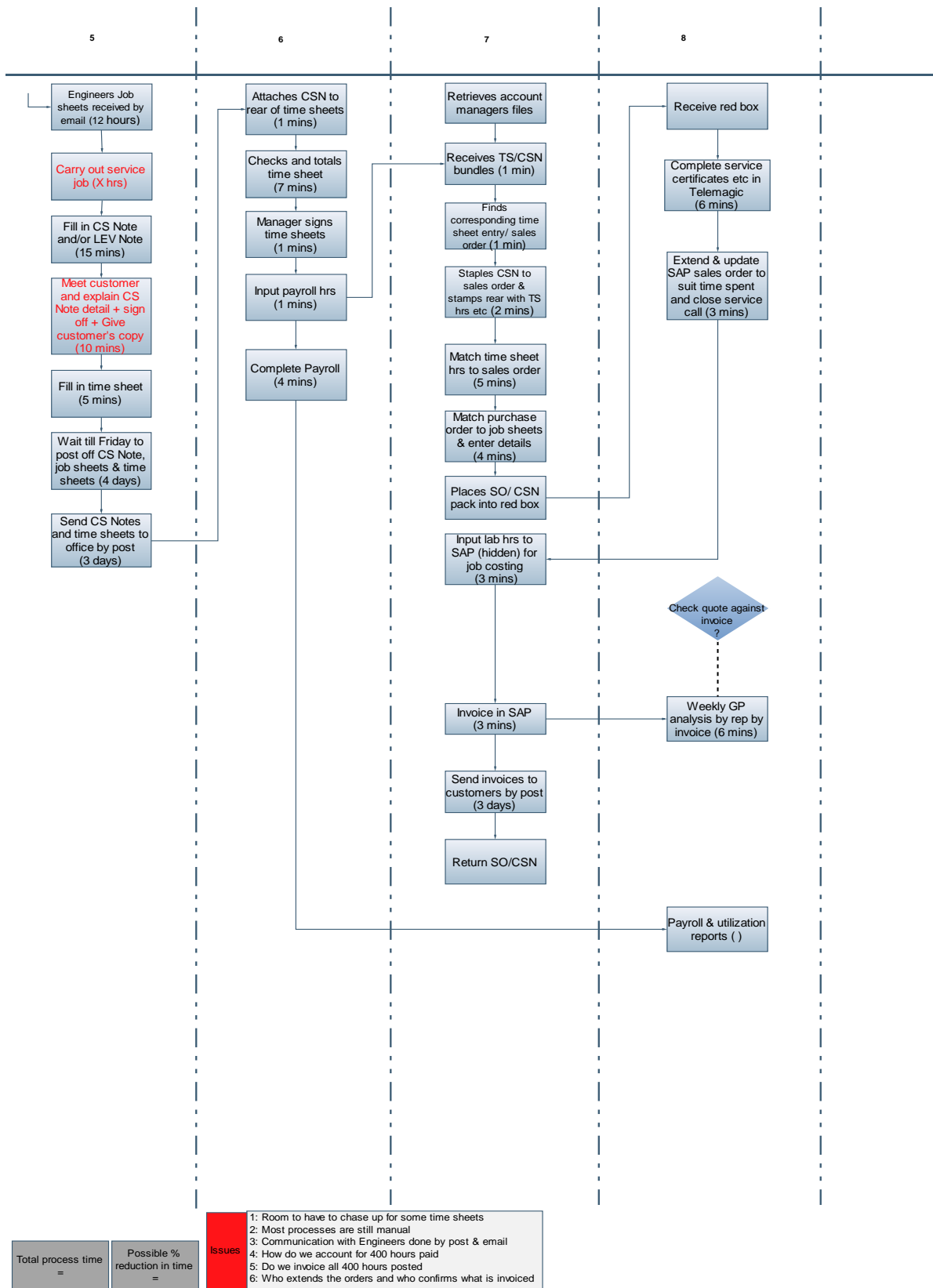


Fig. 4.9b Unique flow process of the hybrid service and manufacturing SME

From the VSM and data collected, the following areas have been identified to be peculiar to the hybrid HVAC service and manufacturing business process and have not been covered by previous researchers.

- Account for parts used for particular jobs and by specific engineers.
- Travel hours to and from the customer's site.
- Diagnostic time (time taken for the engineer to carry out the job).
- Equipment types and the corresponding consumables located on customer's site.
- How to reduce the time taken before customers are invoiced.
- How to improve the efficiency of data communication between field engineers and back office.

As mentioned earlier, one of the issues faced by hybrid service and manufacturing organisations is the lack of a comprehensive system that is capable of tracking the types and models of equipment on a customer's site. Also the parts and consumables used during each service for specific customer equipments should be documented within the system as a knowledge base for future works. The availability of a knowledge base is essential for both future services as well as training of staff. To the customer, the value adding time is that time spent by the engineer diagnosing or servicing their equipment. However, to the hybrid service and manufacturing organisation, it is equally important to capture the time spent by the engineer traveling to and from the customer's site, since the engineers are paid for this time.

One other issue identified through this research is the inability of disparate systems, which send documents electronically to customers without using add-ons. As a result, the business has to wait for days in order to send an invoice to customers for services already carried out, which reduces the cash flow of the hybrid organisation. This also extends to communication with the engineers, because sending documents via post can cause substantial delays to urgent services.

### ***4.1.3 Risk assessment of adoption and implementation of ineffective service ERP system***

In chapter three (section 3.3.5 table 3.3, characteristics of action case method), the research focus, risk, scope and scale contributes to the reduction of the complexity so that the research could be monitored against the research plan. Due to the complexity of this service and manufacturing hybrid SME, identification of risk in this ERP pre-adoption and implementation was identified as being very important, time-consuming, complicated and also contributed to the reduction of the research complexity. In order to frame the study and generate meaningful and significant outcomes, the researcher particularly looked at ERP pre-adoption and implementation risks in four main categories:

1. **Operational risk:** Operational staffs are the daily users of the adopted and implemented ERP system. Operational risks refer to risks that may occur within operations while operational staff performs daily business activities without the adoption and implementation of a suitable hybrid service and manufacturing ERP system.
2. **Organisation-wide risk:** When adopting and implementing ERP systems in the pre-adoption and pre-implementation stages, organisations could encounter a set of risk events in relation to various internal (e.g. system users and in-house IT experts) and external factors (e.g. system vendor and system consultants). Such risks could have an impact on the entire company and are therefore referred to as organisation-wide risks.
3. **Analytical risk:** Front-line managers use ERP systems to generate plans and make forecasts for strategic decision making (e.g. sales forecast, production plan, etc.). Analytical risks refer to risks that could occur due to managers not having adequate ERP system required to carry out analytical tasks.
4. **Technical risk:** A set of system and technical factors could result in risk events that can hinder the successful adoption and implementation of the appropriate service ERP system. This may result in the system not meeting its intended functions and performance requirements when implemented. These risk events are referred to as technical risks.

To aid clarity, the risk assessment was represented in fig. 4.10 below using 'Factor', 'Event', 'Outcome', 'Reaction', 'Effect Set' and 'Utility Loss.' The data represented in Fig. 4.10 was based on extensive interviews with the managing director. Fig. 4.10 also draws on data collected through interviews with staff and questionnaires, in order to ascertain the impact of activities on the business. In the figure below, 'Factor' represents the overall action that is being assessed for risk of either carrying out the action or not. In the illustration below, it is the risk of not adopting and implementing appropriate service management system, thereby resulting in inefficiencies within the service related functions, for the four categories of risk discussed above.

The 'Events' were then identified as a result of discussions with the relevant stakeholders, including staff and customers, within the action case organisation to determine what activities within the business processes were currently affected as a result of the lack of appropriate service ERP system. With the events identified, the 'Outcome' of these events was then highlighted to assist in the understanding and evaluation of these events. This is because an event without a tangible associated impact on any of the four categories of risk would not be covered for the scope of this research.

The 'Reaction' is used to identify how each outcome is being currently mitigated. This gives the organisation a clearer understanding of what is being used as a 'work around' system or even the inefficiencies associated with the existing system(s).

The 'Effect Set' then illustrates how this is costing the organisation in the form of resources, time loss etc and can also be discussed in relation to the four categories of risks mentioned earlier.

Finally, the 'Utility Loss' illustrates the overall impact of all the above on the business and proposes a solution, which is a recommendation for decision making.

## Risk assessment of ineffective service management module

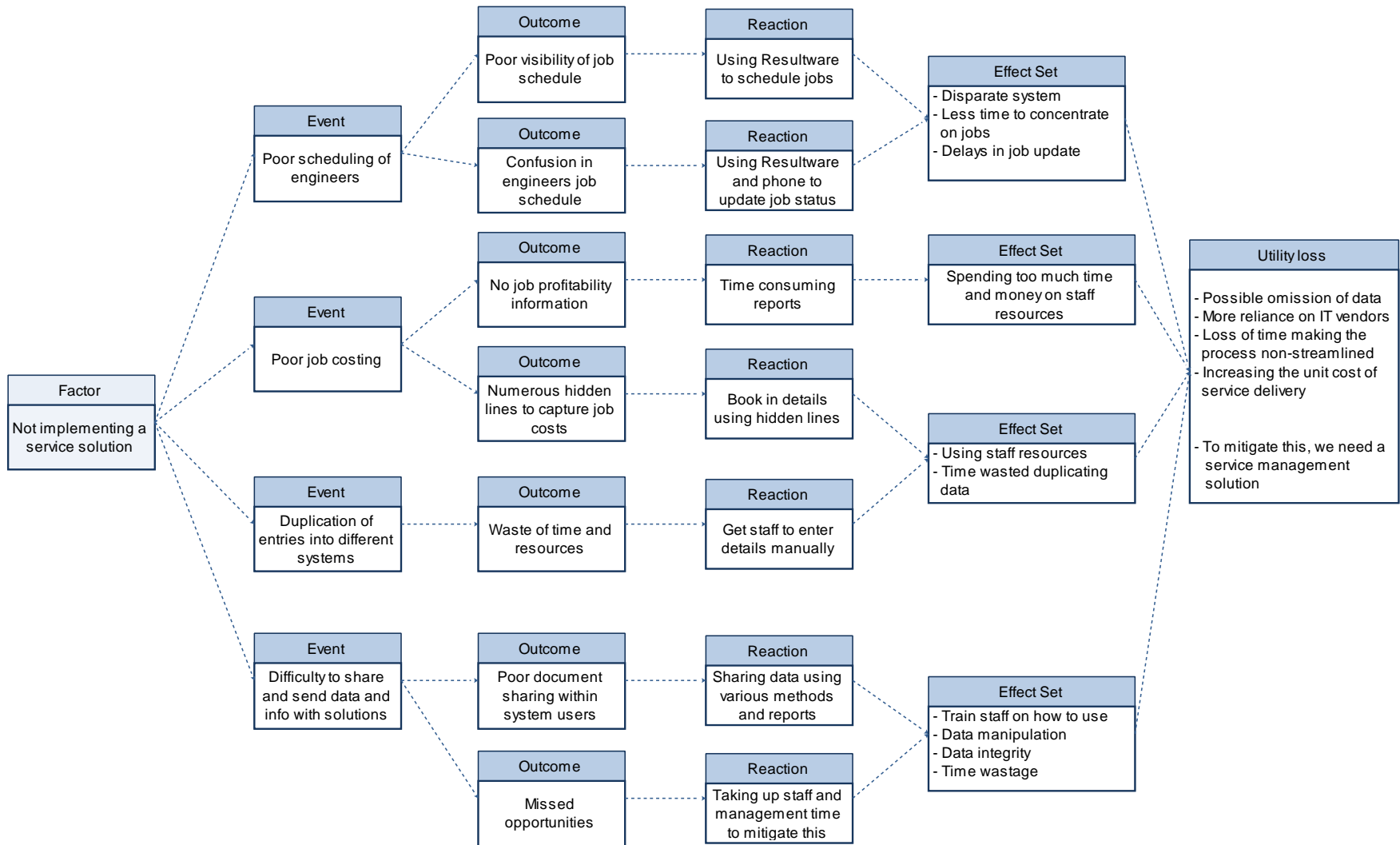


Fig. 4.10 Risk assesment of Alpha adopting an ineffctive service ERP system

#### ***4.1.4 Reflection on Phase One***

According to Vezzosi (2006), reflection is the last stage of the iterative approach of action case research. In this first stage, data was collected via interviews, observations such as site visits, meetings, archival documents and documentations as discussed in section 3.3.7. By interviewing engineers face-to-face, the researcher noticed from the recorded interview (interview 02) that the engineer was not very open to responding freely which could be attributed to fear of information provided being used against them. Although the researcher provided written assurance, in the consent/withdrawal forms, this could have been improved by using alternative method to complement the consent/withdrawal form such as creating focus groups while interviewing (Halkier, 2010) so that each interview comprises of two or three engineers. It is argued that focus group provides a feeling of security to the participants (Bowen and Tillman, 2015). In a focus group, the engineers might be more confident that information provided would not be directly linked to them but to the group. Also if the researcher had spent as much time with the engineers as he spent with the back office staff, the engineers might be more comfortable in providing responses as experienced with the back office staff. The interview with back office staff was more open with users coming forward with feedback and opinions about the information processing needs and requirements. It can also be suggested that the engineers do not see information needs and requirements as the focal point of their day to day job whereas the back office staff understand that information processing needs and requirements are critical to them achieving their tasks.

This stage benefited from the weekly, monthly and quarterly meeting structure as provided by the KTP. While the theoretic underpinning and the refinement of OIPT use as well as VSM have been identified at the end of this phase, the data collection and observation have been rigorously conducted and verified. The researcher by reading research books such as Oates (2006) and articles as well as attending research focused seminars, was able to improve on research skills which are reflected in the next two phases.

The analysis in this first phase contributed to the understanding and answering of the second research question, on the benefit of information requirement and information capabilities when implementing an IS system. Information from staff and customers were analysed and provided



insight into the information requirements and information capabilities from the various perspectives, which was further used to accomplish the second phase analysis. This phase identified a gap in applying OIPT in its original form as although it presented insight into information processing needs and information processing capabilities, it however failed to suggest means of arriving at the optimal solution of a business process for the action case organisation. A need for a further theory that provides a detailed solution for business process analysis using information processing needs and information processing requirements is identified. This stage identified that there is a benefit associated with the researcher being involved in the data collection which implied that the current system design in phase two benefited from a more trustworthy data which is a consequence of a covert and overt observation.

In this phase, if the researcher had more time and resources, perhaps he would have done more onsite visits to have more in-depth timing records to compare against. Also with more time, the study would have benefited from a more in dept analysis using a qualitative analysis tool such NVivo. However, with the time restriction the study found that reducing data visually provided a valuable compromise between the detail of data being captured and the capturing of the focal point of the study such as the information processing needs of the individuals of the organisation.

#### ***4.2 Phase two: Analysis of available hybrid ERP systems and suppliers***

The second phase of this interpretive action case focused on the research of available ERP systems and the understanding of how they aim to support service and manufacturing business processes: this phase had a timeframe of twelve months. This phase made use of information gathered from the first phase and constantly gave the stakeholders the assurance that they were involved in the pre-adoption decision-making and implementation of the final solution. In this second phase, VSM was also used to design the specification for the future state, which was used to re-engineer the business processes and also develop the ideal hybrid solution. Hence information gathered from this phase was used to scope the documentation for the development of the future system. The themes identified from this phase are further discussed below.

### ***4.2.1 Overall ERP system selection process***

To ensure that each ERP system and associated vendor is evaluated using the same standard, a flow chart is developed using information gathered from the initial stakeholders. The main information which sat at the top level of the flow process is the identification of the problem being solved with the adoption and implementation of an ERP system. The steps taken to invite vendors start first with showing interest in their solution and inviting them in to demonstrate how their solution matches with what the organisation requires. This is mostly in the form of a fact-finding meeting for the vendor to understand what features the organisation requires, as well as the organisation making its service processes clearer to the vendor, in order for the vendor to fully justify how these processes could be met with the intended system. Figure 4.11 below shows a detailed flow chart which is used as the guide during the ERP functionality and vendor evaluation.

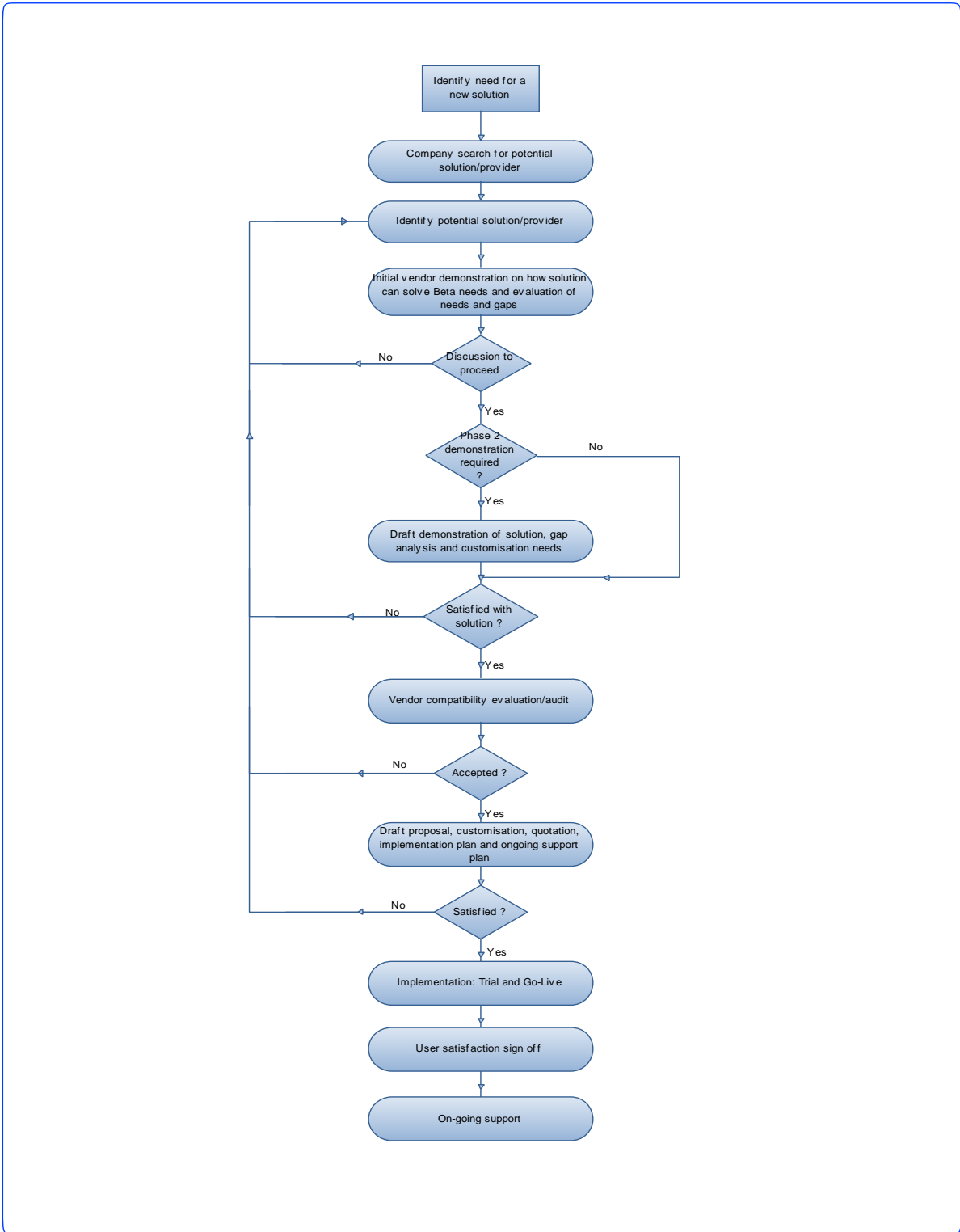


Fig. 4.11 ERP Product selection flowchart

The flow diagram above highlights the various steps taken to review each potential vendor as well as the options identified as potential solutions. The process started when the organisation identified a problem within the business process, which could be solved using specific enterprise resource planning (ERP) systems. The researcher then proceeded to explore available ERP solutions and vendors, with the objective of inviting suitable solutions and vendors for a demonstration on how the solution intends to meet the organisation's features/functionality and help to make the business process leaner. Further on, the solutions are critically evaluated to ascertain those solutions that will provide a possible match to the features without creating further problems in the business process.

To get the functionalities completely mapped out, the table in fig 4.12 was used to map organisational business process needs to features contained and demonstrated in each solution. The product evaluation will be discussed in more detail later in this chapter. After initial product and vendor review which, in most cases were carried out on the product website, a decision was made as to whether to proceed with the product or not, based on the product functionality and vendor assessment. If the information on the product and vendor website indicates the need to invite the vendor in for an interview to demonstrate the system, then the vendor is invited to demonstrate the system. If the information suggests that the company does not want to invite the vendor in, then the product is dropped. The vendor is interviewed during the demonstration and, although it might not be possible to make a decision on a vendor or solution during one demonstration, the process can be carried out until all relevant information required for the decision making phase are obtained. This could include the vendor taking requests on requirements that were not clearly demonstrated, which is then passed on to the vendor's development team to clarify how the solution handled such requirement. As a result, a further demonstration was held to clarify how the solution met the requirements. A major issue to clarify while at this stage is the level of customisation required to get the solution to adequately fit into the business processes of the action case SME.

When a decision is made on shortlisted solutions and vendors, only then will there be need for drafting a scoping for the company. It is highly important to understand the cost associated with the solution and what extra customisations could cost the organisation. For example, if there is need to customise the calendar in SAP Business One, then it would be necessary to consider the

associated cost, time and implication on various modules in SAP Business One, which inter-relates with the calendar. Having extensively reviewed each of the solutions against the requirements, as discussed below, and products and vendors shortlisted, an extensive review was carried out with representative of all stakeholders of the project (excluding vendors) to identify the most suitable, cost effective and reliable solution and vendor. The emphasis on vendors is because, although the solution has been purchased, the organisation requires a reliable vendor to carry on with after sales support. Identifying the final solution then leads to signing off and then into the solution implementation and after sales support.

These steps can be increased or reduced depending on the clarity of features demonstrated during various stages and can also change from vendor to vendor, because some vendors could want to have fewer visits to the customer's site than others.

A summary on the step discussed above is given below:

1. Agree and add weight for each criteria in the feature/service evaluation grid (fig. 4.12)
2. Breakdown the applications into groups:
  - SAP Business One Addon.
  - Applications that integrates seamlessly with SAP Business One.
  - Third Party software.
3. Identify the top three within each section.
4. Identify the top three service solutions and install demos.
5. Get target users to evaluate demos of installed service demos.
6. Further evaluation of demos.
7. Follow up references, including site visits, as recommended by resellers.
8. Study potential contract and make changes where appropriate.
9. Install pilot application.
10. Final decision by management (based on information on outcome of evaluations done above).
11. Produce training materials and train staff.
12. Final deployment and ongoing support.

In order to maintain a levelled and structured approach in terms of selecting suppliers, a set of guidelines were followed with structured questions used, to gain a better understanding of the resellers and the level of their understanding of the product and subsequent support available.

This structure is as given below:

- Developing a thorough understanding of the suppliers/vendors — who they are and what the organisation would be purchasing from each of them — which would allow Alpha to negotiate better contracts, streamline the supply chain and minimize risk. These objectives are met by having a meeting where the researcher and the organisation explained who they were, what problem existed and the vendor demonstrated how their solution could be used in solving the identified problems.
- Measuring IT service delivery levels to ensure that scarce IT resources are deployed as effectively as possible to support business strategies.
- Evaluating financial performance, regulatory compliance and exposure to financial risk to create future value for the organisation as well as ensure the supplier will continually be available to support the IS system. This mitigates the situation which the organisation currently found themselves in, which was as a result of one of their current reseller seizing to operate as a business.
- Understanding how the reseller plans to roll out training, both pre-implementation and post-implementation, in order to align with the organisation's strategic system needs and objectives. (This includes training for the company specific contact for the solution).
- Identify changes in processes, which needed to be made for successful implementation and usage of the potential solution to better align to usage, monitoring, control and improvement actions.
- Making decisions based on facts.

#### ***4.2.2 ERP service management functionality evaluation and vendor mapping process***

The following model has been developed to address the issues discussed earlier, in order to successfully map business processes within a service operations, its service functionalities and most suitable vendor. First, an information gathering process was carried out, as mentioned earlier, in order to understand what functionalities were needed and then prioritize these functionalities in terms of their importance towards achieving business objectives and organisational strategic goals.

This section uses data from the staff questionnaires, interviews and observations to get the most accurate information from both the SME staff and its customers on functionalities as stated earlier to meet business process needs. This was followed by interviews and demonstrations from vendors on how their service management solution matches the functionalities required to mitigate service operations processes. This data is contained in appendix 1c, recorded supplier interviews. IT and business managers have also argued that ERP suites tend to have only one 'best in class' application, for example Peoplesoft has a good human resources module and Oracle is useful for financials (Light et al., 2001). However, service operations require the combination of some of these 'best in class' functionalities, as learned from practice, in order to work effectively. Interviews and demonstrations by vendors were used to bridge this gap of information between the service process feature requirements and service process features supported by the solution.

| Vendor                              | Solution   | Licence Purchase Cost | Service Management | Job Costing | Calendar Scheduling | Service call Mngt | Time sheet entry | Equip link Vs Site maint. | GPS | ERP | Vendor Knowledge evaluation | Integrates with SAP | Email Functionality | Human Computer Interface | Indv. Acct Activity | Reporting | Hand held | Customer Login | Total weighted Average |
|-------------------------------------|------------|-----------------------|--------------------|-------------|---------------------|-------------------|------------------|---------------------------|-----|-----|-----------------------------|---------------------|---------------------|--------------------------|---------------------|-----------|-----------|----------------|------------------------|
|                                     |            | 10                    |                    | 10          | 10                  | 10                | 10               | 10                        | 10  | 10  | 10                          | 9                   | 8                   | 8                        | 8                   | 8         | 5         | 2              |                        |
| <b>SAP business one add-ons</b>     |            |                       |                    |             |                     |                   |                  |                           |     |     |                             |                     |                     |                          |                     |           |           |                |                        |
| A                                   | A Solution | £36380 for 30 Eng     | 25%                | 0           | 0                   | 0                 | 0                | 0                         | 0   | 0   | 0                           | 10                  | 0                   | 0                        | 0                   | 10        | 10        | 0              | 220                    |
| B                                   | B Solution | £290 & £180 per User  | 40%                | 10          | 0                   | 0                 | 10               | 0                         | 0   | 0   | 0                           | 10                  | 0                   | 0                        | 0                   | 10        | 10        | 10             | 440                    |
| C                                   | C Solution | Not specified         | 70%                | 10          | 3                   | 10                | 10               | 8                         | 10  | 10  | 7                           | 10                  |                     | 10                       | 10                  | 10        | 10        | 0              | 1060                   |
| D                                   | D Solution | Not specified         | 85%                | 10          | 10                  | 10                | 10               | 10                        | 10  | 10  | 10                          | 10                  |                     | 10                       | 10                  | 10        | 10        | 0              | 1180                   |
| <b>Third Party Service Software</b> |            |                       |                    |             |                     |                   |                  |                           |     |     |                             |                     |                     |                          |                     |           |           |                |                        |
| E                                   | E Solution | £70000 + 18%pa        | 70%                | 0           | 10                  | 10                | 5                | 0                         | 10  | 5   | 0                           | 3                   | 10                  | 2                        | 0                   | 10        | 10        | 10             | 673                    |
| F                                   | F Solution | Not specified         | 75%                | 10          | 10                  | 0                 | 10               | 0                         | 10  | 0   | 0                           | 0                   | 10                  | 0                        | 10                  | 10        | 10        | 10             | 710                    |
| G                                   | G Solution | Not specified         | 50%                | 10          | 10                  | 0                 | 0                | 10                        | 10  | 0   | 0                           | 0                   | 0                   | 0                        | 0                   | 0         | 10        | 10             | 470                    |
| H                                   | H Solution | Not specified         | 20%                | 0           | 0                   | 10                | 0                | 0                         | 0   | 0   | 0                           | 0                   | 0                   | 0                        | 0                   | 10        | 0         | 10             | 200                    |
| I                                   | I Solution | Not specified         | 30%                | 5           | 5                   | 5                 | 10               | 10                        | 10  | 0   | 5                           | 5                   | 10                  | 10                       | 10                  | 10        | 10        | 0              | 915                    |
| J                                   | J Solution | Not specified         | 15%                | 0           | 0                   | 10                | 0                | 0                         | 0   | 0   | 0                           | 0                   | 0                   | 0                        | 0                   | 0         | 0         | 10             | 120                    |

Fig. 4.12 Feature/service evaluation grid



The first column named 'Vendor' contains the names of the service solution resellers or suppliers and is represented by letters A to J. The second column contains the names of the service solutions being offered by the resellers. The third column is the cost of the solution as specified by the resellers during the product demonstration. The column with the title 'Service Management' is the extent to which the solution meets the service management functionality being sought after by this service hybrid organisation; this is as expressed by the organisation during the vendor demonstration of the solution. The rest of the columns represent various functionalities being sought after and the extent to which each solution meets the requirement is being graded on a scale of 0 to 10, where 0 indicates that the solution does not meet the function and 10 indicates that the solution met the complete functionality required for that particular need. In the last column, the average for each of the solutions is presented. The second row represents the weight that the organisation has given to each of the functionalities, based on the criticality of their current business process and the future strategic growth of the organisation.

In this model, the attributes evaluated are: Job costing; scheduler; service call management; time sheet entry; equipment or site management; global positioning system (GPS); enterprise resource planning (ERP); vendor knowledge; integration with other systems; email functionality; human computer interface; customisable account activity; reporting and customer log-in. These attributes are based on an SME service industry needs from a system, and the functionalities also have varied levels of importance attached to them by each department. That is because although the field engineers may describe the need for a better system to handle the knowledgebase of customer equipments as well as timesheet entry, the customer service team will describe the calendar scheduler as the most important while the finance manager would describe job costing as the most crucial. It is important to step backwards and understand how all the functionalities' collective roles drive the organisation forward, strategically.

In the second row, each attribute had a weight assigned to it and this was based on the importance of the attribute to the company's service process as indicated by Alpha's management team. The decision of the weighting was based on the immediate and future needs of Alpha. That is, where the immediate requirements are weighted on a scale between 10 and 7 and requirements that feed into the future strategy of Alpha are weighted between 6 and

1. The range is from one, indicating low importance, and ten, indicating the highest importance. Each vendor demonstrated how their solution met the attributes and based on that, the functionalities were graded between one and ten. The weight assigned to each feature and the assigned attribute weight/grade from each vendor's demonstration was used to analyse each feature under the vendor's solution which was further used to arrive at the total for the vendor. The total weight considers both the required attributes and the solution's functionalities, matching required attributes to solution functionalities. The total weighted average for each row is therefore calculated by multiplying the assigned weight of each attribute by the score awarded to the solution based on how it met the attribute, this is then summed for each row. For example, in solution A, the attribute 'Integrates with SAP' has a weight of 9 and the solution was awarded a maximum point of 10 implying it fulfils this attribute completely, hence the total is 90. The next attribute fulfilled by the same solution is 'Reporting' which is weighted 8 and the solution awarded 10, totalling 80 for the attribute. The third attribute is 'Handheld' weighted 5 and solution A was awarded a 10 point to total 50 for the attribute. Therefore, the total weight assigned to solution A based on meeting the three attributes is the sum of each total, which is 220 obtained by summing 90, 80 and 50. This helped the business manager (Managing Director) to make an informed decision, whilst choosing the best fit IS solution.

The solutions are also grouped into two distinct groups, which are add-ons and third party solutions. The groups were chosen because they were the possible solutions the company can have considering legacy solutions currently in use. The add-on group is identified based on the primary solution in use during the time of implementing the service solution. An add-on is a solution or application installed alongside a primary solution, to enhance the functionality of a primary solution such as SAP Business One. In most cases, these add-ons are developed by various software companies, other than the developers of the main or primary solution, but have the same user interface. Unlike the add-ons, third party solutions do not necessarily have the same look and feel of the main or primary solution. Another issue with add-ons, also known as third party solutions, is in integration with the existing primary solution, and that is because in most cases both solutions could run on different databases/platforms. This therefore makes integration and data transfer difficult and not seamless. Third party solutions also have some positivity which is that the solution is most appropriate in a specific feature but when an

organisation wants a combination of features, then third party solutions might not necessary be the best solution.

### ***4.2.3 Vendor evaluation and selection***

In as much as it is important to select the most appropriate service management solution, there is also the need to evaluate and select the most suitable vendor or reseller to support the service solution. To fully understand how the vendor organisation is structured and how they intend to support the adopted service solution, the vendors were interviewed and during these interviews, the vendors were asked how their system performed against the following features: job costing; engineer calendar scheduling; engineers' hour's entry and communication with payroll system; time sheet entry; and management reporting. The vendors were also asked how their applications supported and provided handhelds (PDA) and GPS functionalities (if provided in their solution). These questions were aimed at gaining more understanding around the extent to which the solution provided the features being sought, as well as giving Alpha a view of how knowledgeable the vendor was in the specialist features being sought by in the appropriate solution. Further on in the interview, each vendor was asked more questions on the integration of the solution with SAP Business One, such as how the system integrates with SAP Business One. The vendors were also asked how data and information were updated between SAP Business One and the solution to ensure data and platform compatibility such as uploading data using the traditional data transfer workbench (DTW) available in SAP Business One.

The vendors were also asked how their applications confirm that hours paid to engineers matches the hours indicated in the service documentation and invoiced to customers. If the solutions will generate its own marketing documents such as sales orders, invoices, service confirmation and credit notes, then an understanding is also sought from the vendor on whether their application has the functionality to customise invoices and official marketing documents. In order to understand how existing customers view these vendors, a reference check question was also included to understand how the vendors support their existing customers in terms of service level agreement, response time and product knowledge. To ensure the vendor is trading well enough to support the rapid growth and acquisition of Alpha, each vendor was also asked to provide the number of active customers that they currently have

using the service application, how long these customers have been with them and how many support or development staff they have available to support customers. Finally, the vendors were asked to specify and clarify the cost of the service solution, licences and the associated annual cost to Alpha based on specific number of users. In hindsight, one limitation to the questions asked to the reseller or vendor is the clarification of the flexibility of modifying the software and how readily that can be done when required. To give the vendor the opportunity to contribute on the grid ratings for the overall level of service management functionality met by their solution, the vendor was asked to give in their view the percentage to which their solution met the service management functionality.

#### ***4.2.4 Value Stream Mapping (VSM)***

Value Stream Mapping is a tool created using a predefined set of icons. Although time consuming, there are benefits associated to drawing value stream maps manually using paper and pencil before replicating this onto a computer aided tool. With manual representation of VSM, we are able to see what is actually happening on the shopfloor using a value stream of either manufacturing or service processes. Also the flexibility of being able to quickly draw and redraw a value stream map provides the opportunity to conduct the 'plan, do, check, act' cycle which increases the understanding of the overall process flow of value or lack of value in the process. The first step in creating a VSM is to choose the desired product family which is the target for analysis and improvement. To add value, process improvement should be considered from the customer's view point and the reason for this is that customers are only concerned with services they require and receive and not what is associated with the service. As a result in this study, the service delivery process is the target process for improvement. This choice was based on the requirement that the service process is the exact process which requires re-engineering and it would be too complex to map the whole company process flow.

VSM was done using a tool called Edraw, with various process symbols of VSM to enable the visualization of the flow of service, material and information as the service made its way down the service process. Mapping was carried out with a view of the lean manufacturing principles, as discussed by Seth and Gupta (2005). These principles are: define value from customer's perspective; identify the value stream; eliminate process associated wastes; make the work

flow; do not push the work but pull it; aim for perfection. The major steps associated to mapping using VSM are as follows:

- Value stream process symbols are used to represent customer, supplier and service control.
- All important data related to current state of the shop floor of both service and manufacturing such as lead time, process time and number of hours worked are shown by data boxes below the VSM symbols.
- The daily requirements of the service by customers along with the number of engineers are presented and discussed.
- Movement of products and services is indicated with arrows including, shipment of service products required to carry out the service when an engineer visits the site.
- Major areas of improvement are identified from the current state and proposed as areas for improvement.
- Where necessary, modifications are proposed in the current state and, using lean tools, these identified gaps are bridged so as to prepare for the mapping of the future state.
- Finally, the future state map is produced alongside is the highlighting of achieved improvements.

In order to fully understand the development of the current state and then a further understanding of the proposed future state, there is a need to give a graphical overview of Alpha's operation from the point of a customer placing a request for service to the point of invoicing the customer for the work done. Firstly, a potential customer phones the office, wishing to place an order. The customer places a request for a service, and an order confirmation for the service is generated. Then, because service orders are linked to customers using purchase orders (PO), there is a check to make sure that a PO was received from the customer when they placed the service request. If a PO was received, then it is included in the service order and, if not, the service order proceeds without one, but uses the name of the person who requested the service. The customer service operator confirms the date of the job, along with how long it will take to complete and the materials that the engineers will need to do

the work are also explained to the customer. Then, using a different system, which manages the engineer's diary, the customer service operator checks the engineers' availability. If there is no engineer available on the date that the customer wants to have the work done, then the customer service operator will arrange another date with the customer. Simultaneously, a check is made on an excel file to ensure that all the materials required by the engineer to carry out the service are in stock. If any material is not in stock, then a request to purchase the required materials is passed on to the department that handles procurements. This department then orders the material and gets it delivered at the customer's site before the start of the work.

# Alpha Service Order Process

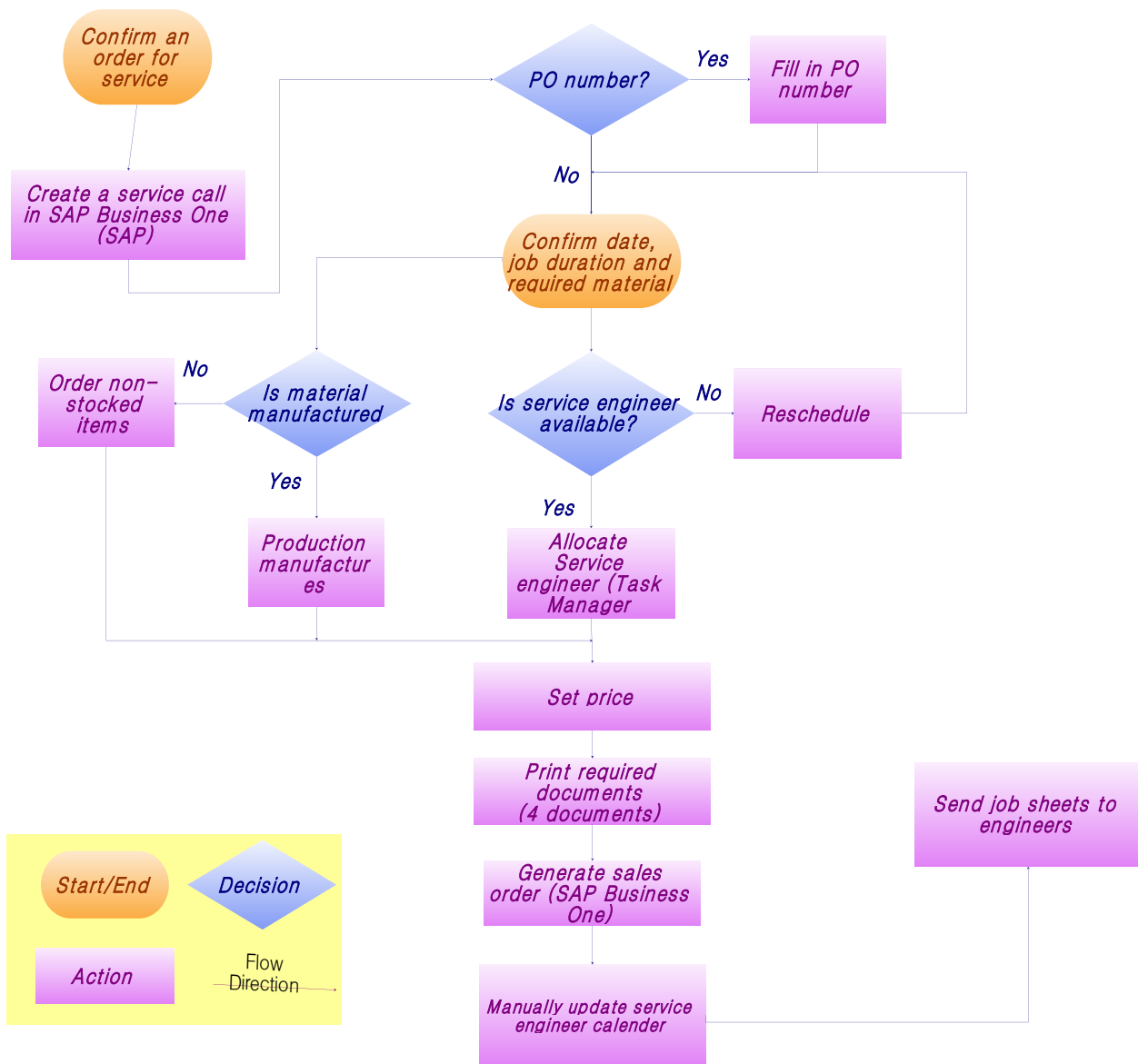


Fig. 4.13 Overview of Alpha's service process

## 4.2.4.1 Current state

The next step is to illustrate the VSM, for which an understanding of the business process is a pre-requisite. Drawing VSM involves two steps: the first step is to draw up the current state map, while the second step is to draw up the future state map. In drawing the current state map, a snapshot of how things are being done now in the service process is being presented. This is done while following the actual pathways from the current service process. Representing

the service flow map on the current state should always start with the process most linked to the customers, which in this case is actual delivery of the service at the customer's site, and then should work towards the upstream process. All the critical information, such as the cycle time and lead time, are documented at each process. In the case of a manufacturing process, the inventory level on the map should correspond to that at the time of the actual mapping and not the average, because VSM represents actual information and not historical or assumptive figures provided by the organisation.

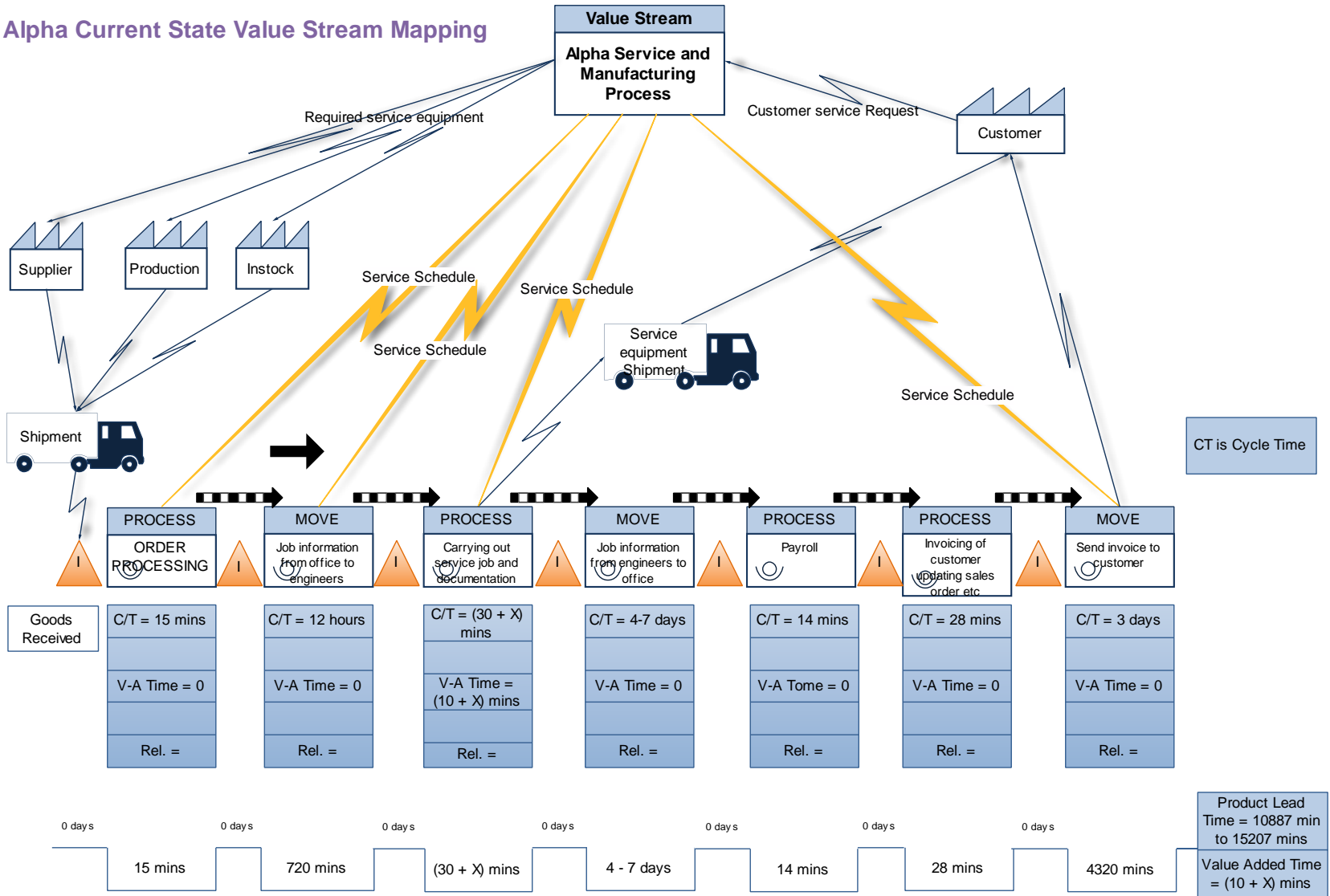
The other aspect of mapping the current state is the representation of the information flow, indicating how much each process contributes towards adding value to the final service; this is also from the customer's perspective. The information flow is drawn in the upper part of the map and is drawn from right to left, connecting material and service flow process previously drawn. A time line is drawn below the process boxes after the completion of the map. This time line shows the production lead-time, which is the time taken on the shop floor for a particular product from the time it arrives to the time it reaches completion. A second time, known as the value-added time, is also indicated and represents the sum of the processing times for process in relation to the main product or service of value to the customer.

As a result, the current state VSM of the action case organisation for the service delivered to the customer was developed and shown in figure 4.14.



Fig. 4.14 Alpha's Current State

Alpha Current State Value Stream Mapping



#### **4.2.4.2 Evaluation of current state map**

From figure 4.14, it can be deduced that the value added time for the cell is just (10 + X)mins, that is for a typical 1 hour service for a customer the value added time (VA) is 70mins, while the lead time is between 10887 to 15207 minutes. The process ratio is therefore found to be between 0.0046 and 0.0064, which implies that the current service process involves so many non value adding (NVA) activities. The takt time is the elapsed time between units of production, when production rate is synchronised to customer demand, and is calculated using the formula: takt time = (production time available per period) / (customer demand per period). To compute the takt time, the current demand is about 20 service calls per day and the mobile engineers work for a single shift of 8 hours, which excludes a 1 hour lunch break. The available time is therefore calculated as:

$$\begin{aligned}\text{Production time available} &= 8\text{hrs} \times 60\text{mins} \times 60\text{sec per day} \\ &= 28,800\text{sec}\end{aligned}$$

$$\text{Customer demand} = 20 \text{ service calls per day}$$

$$\begin{aligned}\text{Takt time} &= 28800/20 \\ &= 1440 \text{ sec or } 24\text{mins}\end{aligned}$$

Hence, the takt time for the current service process is computed to be 1440 seconds or 24 minutes. From fig 4.14 above, it can be deduced that the stages, such as order processing and payroll, have cycle times (CT) less than the takt time, whereas the time taken for the remaining stages are greater than the takt time. This is the main reason why it takes a very long time for customers to pay for services carried out by the service engineers. Data used in this section discussed in section 3.3.7, was from a self reporting time from the engineers which was verified by the researcher on a site visit with the engineer using a stop watch to record the timing it took to complete each process activities.

#### **4.2.4.3 Value Stream Mapping (VSM) of future state**

In the future state it is expected that the service demand per day would increase to about 30 services as compared to the current demand of 20 services per day. If that happens, then the

difference between the cycle times of the various processing service stages and the takt time is very high. According to the future service demand, the takt time is calculated as  $8 \times 60 \times 60/30 = 960$  seconds or 16 minutes, in which case the current system would not support the demands placed on it.

Therefore, to ensure that Alpha is in a strategic position to take on new business and open to expansion, the following elements were introduced into the future state design of the ideal service solution:

- Automation of the process of sending job information (job sheets) from the back office to the field service engineers.
- Automation of the process of sending job sheets from the field service engineers to the back office using compatible systems and eliminating the current process, of sending via post.
- Automate the process of sending invoices to customers by introducing an appropriate system which allows the generation of the invoices and consequently emailing this invoice copies to the customers.

Figure 4.15 shows the future state representation of the proposed system, which also visualizes how this organisation will be performing after eliminating the wastes and possible non value adding activities by applying the lean elements, as mentioned above. It can also be found that the processing time can be reduced through process improvement and automation using an appropriate service ERP system. Based on the future state estimates, it is predicted that the process ratio can be increased to 0.5109 from about 0.0046 for a typical 1 hour service.

VSM is criticized as having the following shortcomings:

- VSM, as a tool, is static in nature and has the ability to only capture a snapshot view of the service process on any particular day. For example, on a given day the service process might run smoothly without any delays, whereas on other days there might be delays due to postal delivery, weather condition, late delivery of required service equipments and other factors. As a result, VSM tend to vary depending on these associated factors. To mitigate this, the current study took various snapshots and used

the average data to ensure that data used in developing the current state is not a single snapshot but an average of multiple snapshots of actual data.

- The given future state map in figure 4.15 is based on the assumption that all issues identified in various areas will be resolved completely.
- Manual drawing of VSM, displaying them and making changes to the VSM is a taxing process and does take a lot of time. However, the tool used in this study, Edraw, is very flexible and reduces the burden associated with drawing VSM.

The merits of VSM make it indispensable for analyzing wastes and improvements within a business process. The strengths of VSM are in its ability to aid the user:

- Visualize and clearly understand the entire business flow process.
- Identify areas of waste in the value stream.
- Identify and establish the link between the flow of information, the flow of material and the flow of service.
- Gain an understanding of how the organisation will be in the future, that is if all improvement activities are implemented correctly and if the identified wastes were reduced or eliminated. This can then be used to design the appropriate IS or ERP system required to achieve this future state.

# Alpha Future State Value Stream Mapping

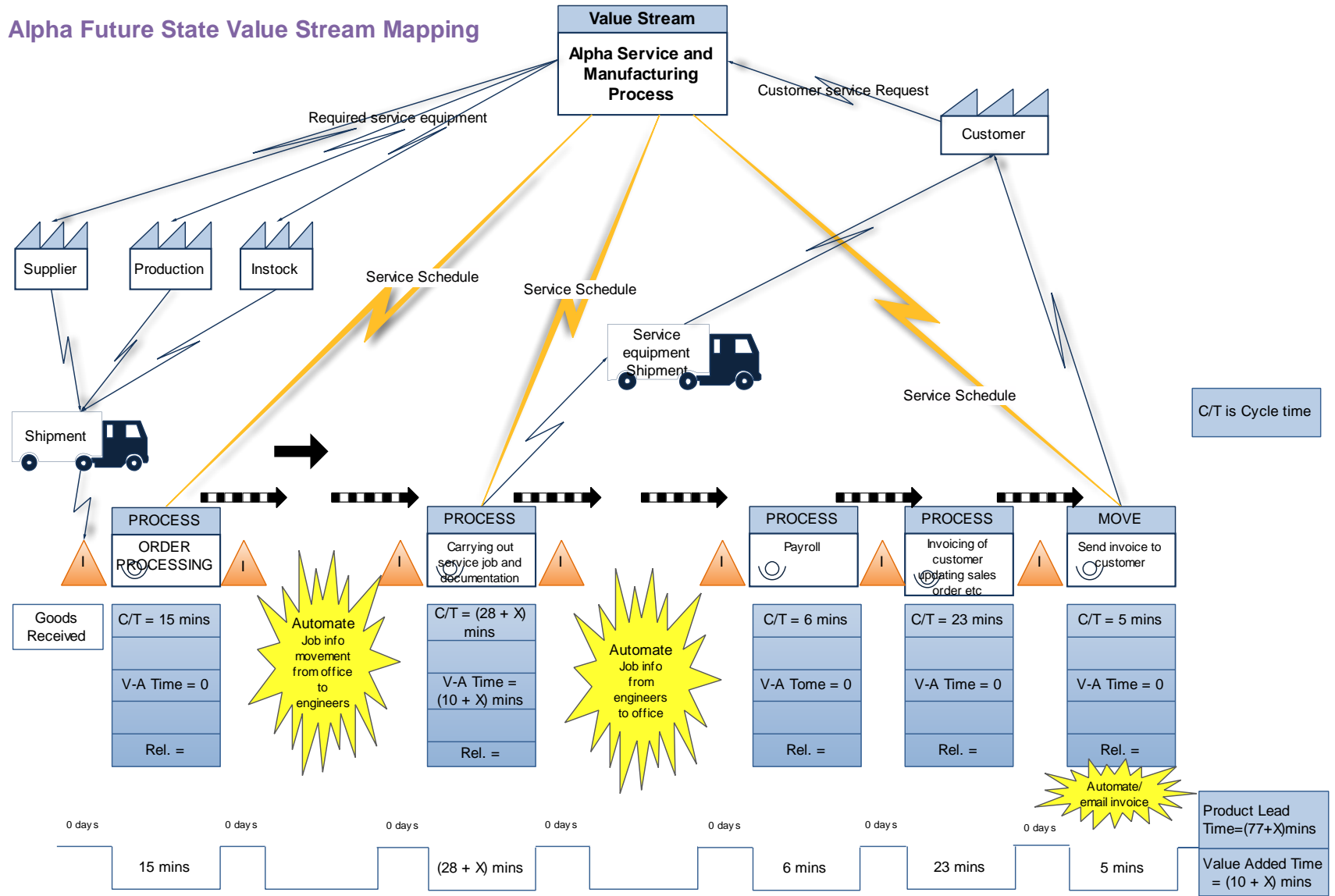


Fig. 4.15: Alpha's future state VSM

#### **4.2.4.4      *Cost impact of waste on business using VSM data***

From the above value stream diagrams, the success of any planned changes to the overall business process can be estimated. The analysis of the data from the Value Stream diagram not only attempts to quantify the impact of changes, but also quantifies the cost of current wastes in the business process. Without providing the quantitative aspects of the Value Stream, it becomes difficult to attach a financial value to the proposed changes, hence the analysis using the following value systems.

**Time:**

| Activity  | Time taken to complete job | Cost to the company  |
|---|----------------------------|--|
| Confirm order, raise sales order and send job details to engineers    | 15 mins                    | £1.81  |
| Engineers receiving job sheets  | 12 hours = 720 mins        | ❖ Possible delay in carrying out job<br>❖ Possibility of missing some jobs   |
| <b>Carry out service for customer</b>                                 | X mins                     | £(X * 12.24)   |
| Fill CS note and/or LEV note  | 15 mins                    | £3.06  |
| <b>Meet customer and explain details of job done and sign job off</b> | 10 mins                    | £2.45  |
| Fill in time sheet  | 5 mins                     | £1.22  |
| Post CS note, job sheet and time sheet                                | Avg. 5 days = 7200 mins    | ❖ Delay in invoicing customer<br>❖ Possibility of missing CSN<br>❖ Delay in running payroll<br>❖ Postal cost (£0.50) |
| Attach CSN to rear of time sheet                                      | 1 mins                     | £0.14  |
| Check and total time sheet  | 7 mins                     | £0.99  |
| Send time sheet to manager to sign                                    | 1 min                      | £0.14  |
| Input payroll hours   | 1 min                      | £0.14  |
| Complete payroll  | 4 mins                     | £0.57  |
| Receive TS/CS note  | 1 min                      | £0.12  |
| Finds corresponding time sheet entry/ sales order                     | 1 min                      | £0.12  |
| Staples CSN to sales order & stamps rear with TS hrs                  | 2 mins                     | £0.24  |
| Match time sheet hrs to sales order                                   | 5 mins                     | £0.60  |
| Match purchase order to job sheets and enter details                  | 4 mins                     | £0.48  |
| Input lab hours to SAP (hidden) for job costing                       | 3 mins                     | £0.36  |
| Invoice in SAP  | 3 mins                     | £0.36  |
| Send invoices to customers by post                                    | 3 days = 4320 mins         | ❖ Delay in customer making payment<br>❖ Postal cost (£0.50)  |
| Complete service certificates etc                                     | 6 mins                     | £0.72  |
| Extend and update SAP sales order to suit time spent                  | 3 mins                     | £0.36  |
| <b>Total</b>  | (12327 + X) mins           | £(14.86 + (X * 12.24))   |

**Table 4.2**

### **Current System Analysis:**

Total time taken on a single order is calculated to be =  $(12327 + X)$  mins

Total cost of executing a single order/job is calculated as being =  $\text{£} (14.86 + (X * 12.24) + w)$

Total value added time is calculated to be =  $(10 + X)$  mins

Total value added cost is  $\text{£} (2.45 + (X * 12.24))$

Time spent on non value adding activity is therefore = **12317 mins**

Cost on non value adding activity is hence = **£12.41 + w**

Percentage value added time is approximately = **1%** (with the assumption that service job X = 2hours)

Where w is the variable cost impact on delay:

- in invoicing customers and
- in customers making payment

### **4.2.5 Reflection on Phase Two**

The use of VSM to design the specifications of the future state was informed as a result of the current study seeking to bridge the gap between information requirements and information capabilities of an organisation as suggested by OIPT. Based on the finding from phase one, the study identified a gap in the original form of OIPT and as a result a need to customise OIPT in order for the methodology to be usefully applied in the current study. The involvement of the researcher could have introduced a level of bias in the pre-adoption decision-making of the IS/IT selection, however with the overall decision resting with the managing director, this bias from the researcher is reduced or eliminated entirely. Also the structure of the KTP study allowed a multiple loop of decision making to reduce bias. The second phase contributed to answering the first and third research questions. That is by providing information of areas of the business that could benefit from process improvement and automation which in turn aids in understanding the effect of business process automation on an SME. Value Stream Mapping from literature has been applied in various business areas but not in the service business process, the findings from phase one presented the opportunity for this second phase to successfully apply VSM in the service business process. The successful application of VSM to design the future state, which



also benefited from the researcher's involvement, informed the third phase by providing the required information for developing a more suitable bolt-on system for the chosen ERP system. Just like the first phase, with more time on this stage, the volume and detail of data captured and analysed could be increased to provide an even more thick description of the current study.

### ***4.3 Phase three: Application of the re-engineered business process***

The re-engineered hybrid business process developed at the end of phase two was tested and developed through action case research method. Developing the suitable system became necessary because after careful and thorough review, there was no perfect hybrid system available in the market that satisfied the requirements for this service and manufacturing business process. The researcher met with Alpha's technical team and the technical team of the selected vendor and discussed the development of the service solution, which was to be bolted upon SAP Business One as an add-on. The development of the add-on was identified as a project and it was necessary to use appropriate project management methodology to handle this. The result of this phase was the development of a solution that automated the gap in the SAP Business One system. The researcher, who was a member of the development team, adopted agile methodology, using scrum, to ensure that the project went to plan and met the required project aims and objectives. The third phase lasted six months; this involved the development of the solution, testing and implementation and had a level of intervention introduced by the researcher as the scrum master.

#### ***4.3.1 Project scoping***

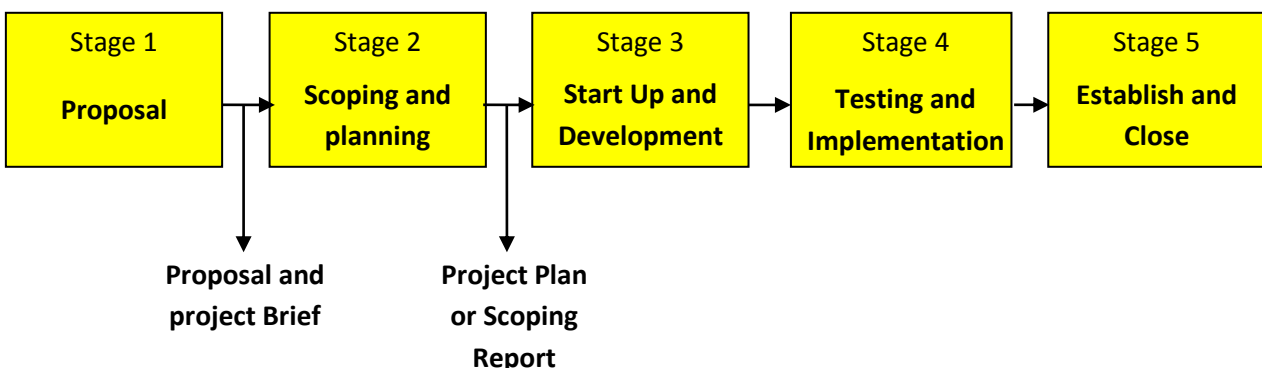
The scope aims to establish the exact detail of the deliverables. Clear establishment of the project scope as well as the completeness of the client's expectations is a critical factor in software project success. Many researchers have indicated the issues that result from improper identification of project scope. An example of this is Loulakis (1987), who encouraged designers to be aware of what portions of the software development are most crucial to timely completion of the project and their priorities. Ndekugri & Turner (1994), who were more critical, doubted whether a single point of responsibility always works to the advantage of the

client. They indicated that a software development output benefited from a good project management methodology adopted during development and also from the clarity and concise nature of the project scope. If the software application requirements are not defined very explicitly at the start of the project, Chritamara, Ogunlana and Bach (2001) argued that it may result in the development of a non-usable application and delays in developing the application to the user specifications as well as changes in client's requirements during design and development (Chritamara et al., 2001).

The scoping is a brief analysis and study to establish what the solution being developed will involve, what the risks and possible difficulties are and how the implementation should be organised. This should produce a project plan containing:

- A clear and concise description of what is to be delivered and when.
- Proposed general approach to the project.
- A project timeline showing a feasible schedule of key activities and milestones.
- Clarification of proposed responsibilities.
- Key resources needed.
- Identification of likely risks to the project.

***Fig 4.16 Project Scoping and planning:***



### ***4.3.2 SAP Business One Analysed***

The design of SAP Business One incorporated the concept that partners or vendors can create extensions, called add-ons, to plug into SAP Business One. In the diagram below, the circular segments indicate the various layers within SAP Business One. The inner circle segment indicates the core functionalities provided and included in the core SAP Business One when purchased. The middle circular section represents the functionalities that comes with standard SAP Business One, but is not bolted onto the core SAP Business One. Add-ons are integrated into SAP Business One, but because they are not in the core system, there is some delay in data communication, which results in these parts of the system being relatively slower than the core SAP Business One functions. The outer circle indicates the functionalities that are provided by partners or vendors to complement the limitations within SAP Business One. SAP definitely had a reason for separating the functionalities into core and extensions and this was to avoid severe upgrade issues when migration to later versions was required.

Every application developed by partners and vendors, which includes SAP parts that are not directly related to Business One core development, is compelled to use the SAP Business One software development kit (SDK). The SDK has limited and well defined access to the SAP Business One functions and this is separated into three parts which are:

- The user interface tool kit executing on the client.
- The data interface tool kit executing on the server.
- The integration tool kit (now superseded by Business One Integration).

While core developers are given some autonomy to enhance their code without too many restrictions on hidden requirements on compatibility, this strategy has immense limitations. It has been found to be slow when integrating, and as a result, any application built on this platform equally takes that attribute of being severely slow. SAP's philosophy of tightly guarding the source code of the core system presents a fundamental limitation in relation to extending Business One. With most similar applications moving towards the Service Oriented Architecture (SOA), because this platform presents a more robust integrating interface than SAP's SDK, there

is a need for SAP to embrace the SOA platform. The development of this add-on was done using the SDK.

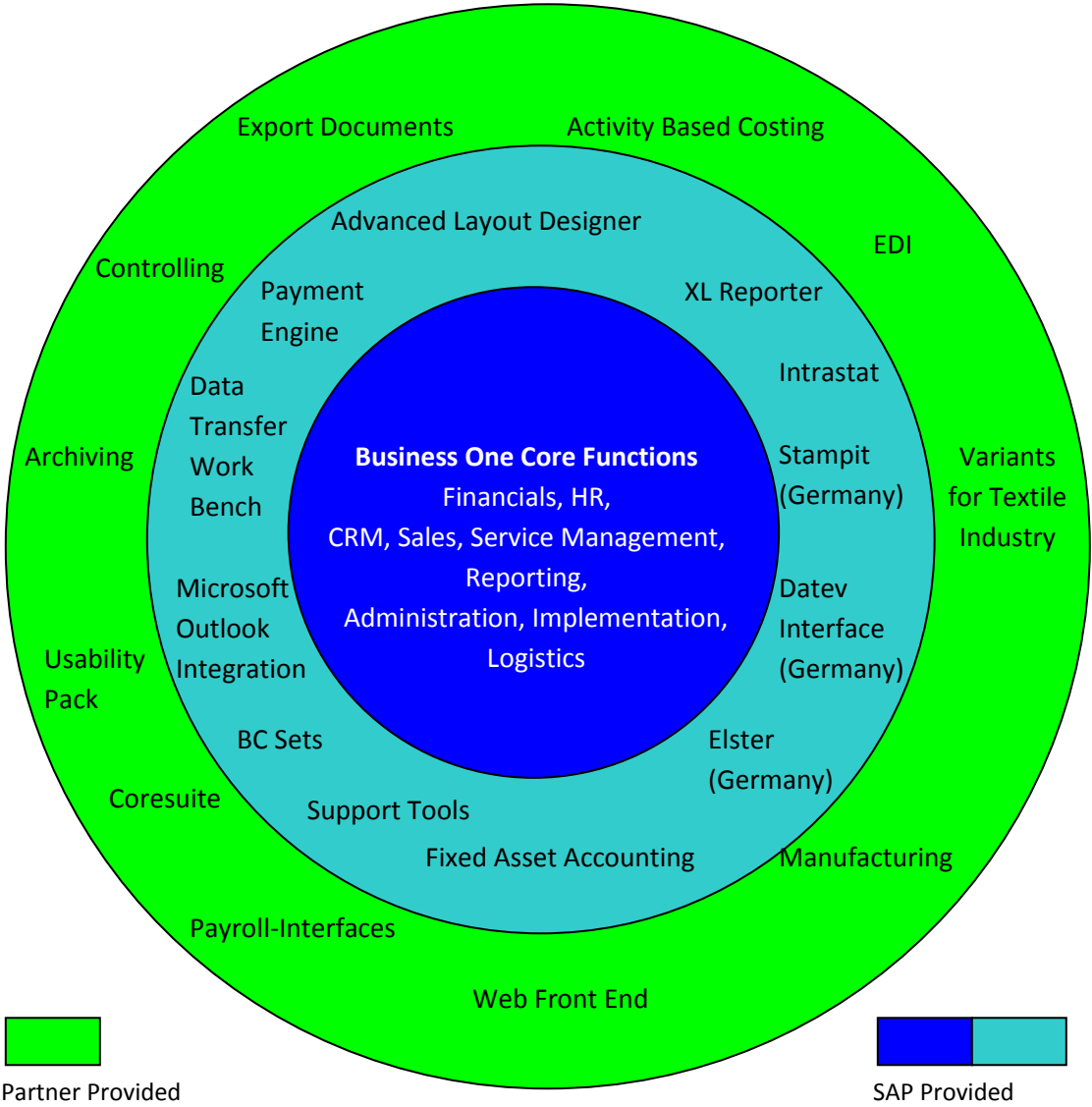


Fig 4.17 Core functions, SAP supplied extensions and some known partner add-ons: taken from Gumbel (2006).

The process of developing, implementing and integrating the service software with SAP Business One was done using the plan and test scripts in appendix three.

### ***4.3.3 Reflection on Phase Three***

The development and the implementation of the desired solution was achieved at this pre-adoption decision making study. The MD and staff of Alpha were happy with the way the developed solution handled the features identified. The future state VSM solution has been implemented as suggested and agreed and signed off during a quarterly KTP meeting with the government representative. This phase contributes to answering the third question, how business process automation affects SMEs. In the action case, from the management feedback, business process analysis increased management's confidence and reliance on the system. This is evident as a result of management reducing their reliance on applications such as 'Microsoft Excel', indicating trust in the system handling extra functionalities which could not have been handled by the system in the past. The impact of business process automation was also evident in the overall business by ceasing to use disparate systems and performing all business process activities in the newly adopted robust system. As a result, the adoption of the IS system using information from phases one and two, ensured that an IS system capable of accommodating the identified business needs of the SME was adopted and implemented. Having learnt from the first phase, the importance of management buy-in, this phase involved the management team throughout the development phase and also relied on the users for testing and process sign-off. Since the focus of the current study is on pre-adoption decision making of an IS/IT system, the aim of the study was fulfilled. However, a further follow up could have been conducted to make a more trustworthy assessment on whether the decision to adopt the specific system was suitable for the organisational information processing requirements and capability of the action case. The customer satisfaction questionnaire could have been re-administered to the customers after the implementation of the future state system to measure how the future state system impacted on satisfaction.

### ***4.4 Benefits expected from the implementation of a most suitable service management solution***

With the service-oriented architecture (SOA) which SAP has adopted, enterprise services can now leverage SAP solutions in conjunction with partner solutions and other bespoke solutions

(SAP, 2010), which provides a more seamless integration as a landscape to build new, flexible and more service-specific innovative solutions. Although this is a great effort from SAP, it highlights the acknowledgement of a gap in service-process inefficiency in SAP Business One and its ability to accomplish service specific operations. SMEs benefit from adopting an appropriate service management technology in terms of improving the organisational strategy, profitability and machine utilisation, which have all been mentioned in previous studies (Fulton and Hon, 2010). However, there are other more service management specific benefits that an SME can get when appropriate service process automation is achieved. This is a gap in the existing literature, which has been identified in this work through extensive work within an SME and other service-related organisations, which have been involved in various meetings.

*Engineers' efficiency:* Managers in organisations have confirmed that CRM and ERP solutions were made with features more ideal for manufacturing and retail operations (Bealby, 2010), making ERP systems less efficient in meeting service management operations. SAP R/3 has been recognized as an efficient ERP solution as used by the UK Royal Mail Group Property Holdings (Roberts and Daker, 2004). Martin and Cheung (2000) described SAP as a solution with extensive functionalities, which covers the full range of business requirements. However SAP Business One Version 2007, which is a version of SAP suitable for SMEs, fails to make provision for more than seven engineers in its diary, which is predominately used in service operations. This limits service management users from managing more than seven engineers in its diary using SAP Business One, which is one of the reasons for implementing a solution that effectively allows a service organisation to manage more than seven engineers if they have the need to.

*Measuring customer satisfaction:* In service delivery, it is important to get a response from customers on the performance of engineers or staff while on customer's site as well as finding out how satisfied customers are with the services delivered. Using a service management solution which incorporates the use of a personal digital assistant (PDA) and handheld devices, offsite staff can collect information from customers, which are then relayed in real-time to the office. The data collected can include customer satisfaction level on individual jobs, which serves a good purpose when audits are being conducted.

*Increase cash flow:* With the implementation of an efficient service solution, the time between job completions, invoicing the customer and receipt of payment from customer can be greatly

reduced. Delays in invoicing customers only cause a delay in the customer making a payment, which in the long run reduces cash flow. However, if the completion of a job on customer's site is updated real-time using a service solution, then the back office can effectively invoice the customer immediately. Updating a job in real-time has been very effective in reducing back office paperwork and the number of man hours spent in processing these documents.

*Better stock management:* With the difficulty of managing stock on site, it could be more difficult managing off-site stocks, such as those contained in either vans or other off-site warehouse locations. With the use of an efficient service management solution, stocks contained in vans and other warehouse locations can be adequately managed and replaced when necessary. To the engineer, this provides them with more time to concentrate on providing good personalised service to the customers.

*Fewer customisations:* Most IT vendors propose or offer solutions that would require a substantial amount of customisation to meet an organisation's goal. Whilst this can be useful, it exposes the organisation to being liable to pay for customisations, increases the possibility of glitches within the system and potentially makes the final solution more complicated to either understand or use. Therefore selecting a solution that is the best fit and having the required functionalities reduces the need for customisation, which could also reduce the need to further complicate the solution. SAP Business One using the SDK allows customisation, in order for organisations with more specialist business processes, can be tailored to fit well with the ERP system.

*Integration:* Organisations having separate IT systems always face the risk of these systems not interacting with each other, in terms of data and information transfer. Some systems claim to integrate with other solutions; however, for communication of data and information within these different solutions data might need to be converted in another specific format for communication or the process of the communication could be time consuming. Integration of add-ons to the main ERP system is therefore important because a best fit solution for the organisation will better aid the SME achieve its business goals and processes.

## **4.5 Summary**

This chapter documents the three stages implemented in this interpretive action case. The first stage outlines the company position prior to the system implementation. Here the views of the company director, staff and customers are used to give context to the forthcoming ERP decision. The second stage involves the use of ERP options evaluation. The main tensions that a hybrid service and manufacturing SME faces when using SAP Business One version 2007 system were also highlighted and discussed.

Due to SAP Business One's manufacturing focused background, there are several limitations of basic service management functionality, as discussed in this chapter. This chapter introduced tools that can make the process of identifying ideal solutions more intuitive. However, when evaluating service management specific systems aimed at the SME market, the researcher was also surprised to find that not many of these offer a comprehensive solution, as most of the solution vendors suggest.

Finally, this chapter uses VSM for business process analysis and modelling to improve the state of the current operations using a core SAP Business One solution with extensive add-ons. The next chapter discusses the action case in light of the three themes used in this work following the hermeneutic cycle of dialogic reasoning.



## ***Chapter Five: Discussion***

### ***5.0 Introduction***

The previous chapter analysed the results of the action case primary data collection, which contributes to existing knowledge of business process analysis in a hybrid service and manufacturing SME.

This chapter discusses the findings based on the data analysis (chapter 4) and theories identified in the existing literature review (Chapter 2). The chapter also introduces OIPT2.0 and a diagrammatic representation, fig. 5.1, showing the customisation made to OIPT in order to make it suitable for an IS/IT pre-adoption decision making process. Areas which share similarity with the literature are highlighted, so are the differences. The figure below (fig 5.0, conceptual framework), highlights the problem areas focused upon in this chapter and reminds us of the inter-relationship between the three themes – A) the specialist hybrid service and manufacturing industry, B) business process analysis using VSM and C) Organisational Information Processing Theory (OIPT) – studied in this work.

From the literature in section 2.3.4, it can be suggested that the increasing reliance of this service management SME on information technology indicates that the SME's consideration to operate in a competitive market necessitates the increasing reliance on information systems (Grant et al., 2014, Bayrak, 2013). As found in the action case SME, the features required from the information system as discussed in this chapter include efficient job sheet handling, automated processing of invoices and marketing documents to customers, mobile devices and efficient engineer calendars (Tarantilis et al., 2008).

This study sought to answer three research questions, which also constitute to the structure of this chapter. The first section of this chapter will discuss VSM and its impact on business process analysis while implementing and customising an ERP system in a hybrid service and manufacturing SME. The second section discusses how SMEs benefit from the use of OIPT in an ERP implementation for an SME. The third and final section will discuss how business process automation affects a hybrid service and manufacturing SME.

### Conceptual framework: Chapter 5

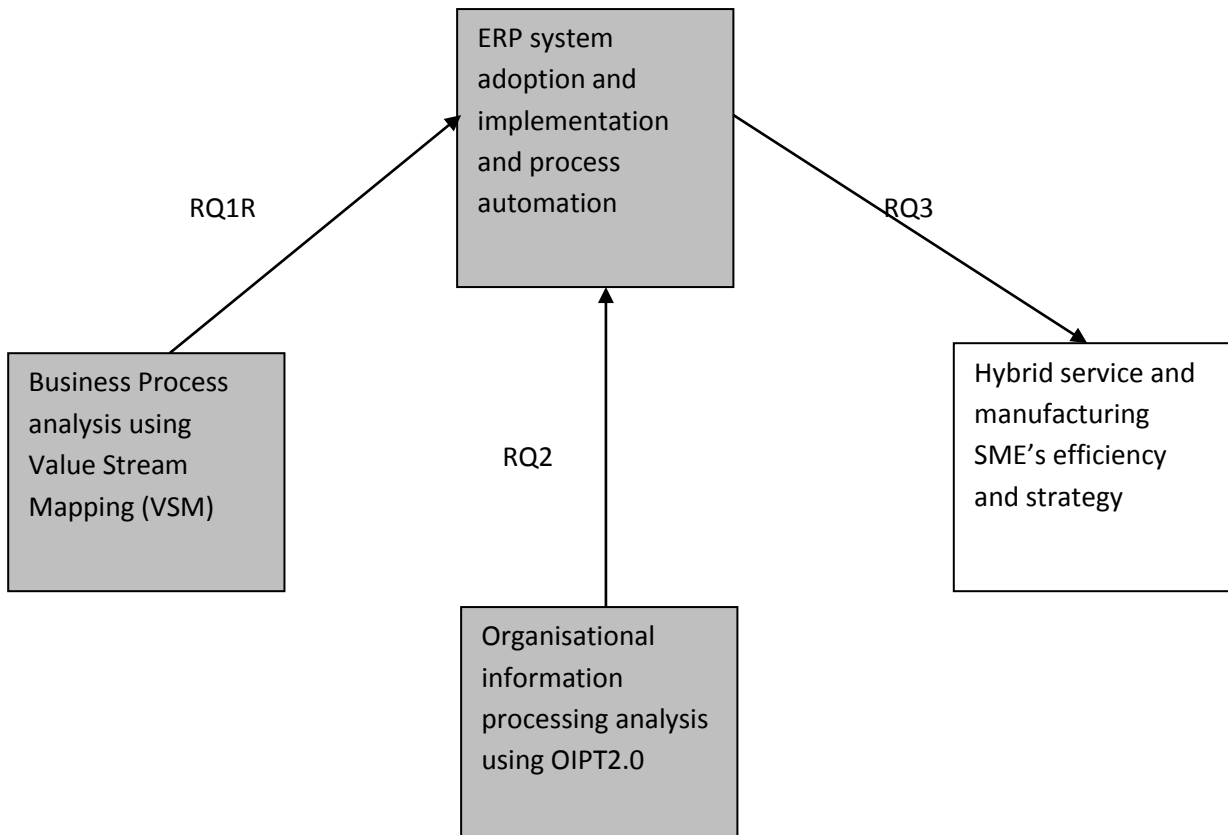


Fig. 5.0 Conceptual framework indicating relationship between VSM, Business process analysis and organisational efficiency

In the conceptual framework above, the current study using the future state Value Stream Map, documented a flow design of the most suitable add-on that when bolted unto the current system provides the required features. This was used to develop the add-on which the current study successfully tested and implemented before the end of the project's two year period. Due to time constraint, the current study was not able to formally test the degree of efficiency introduced as a result of the business process re-engineering and IS/IT adoption. The study was however able to identify improvement in efficiencies as a result of automating the manual process of posting job related documents and the increase in visibility of customer equipment

service history which aids planning and carrying out of future jobs on same or similar equipments.

These are the main insights generated from this study and these will be discussed in detail:

- A model for evaluation and pre-adoption decision-making of an ERP system is proposed to aid the identification and implementation of the most appropriate ERP system for the hybrid service and manufacturing SME.
- Business process analysis using VSM is applicable in identifying areas of waste and can be applied in a hybrid service and manufacturing SME to aid the adoption of an ERP system that meets the future state strategy.
- The rich insight into the uniqueness of a hybrid service and manufacturing SME.

Finally, the design of this research will be evaluated following Klein and Myers (1999) principles for the interpretive research evaluation guidelines, the limitations of the research will also be considered

### ***5.0.1 Adaption of Organisational Information Processing Theory (OIPT2.0)***

While adopting OIPT based on the second strategy as referred to in chapter two section 2.3.1.1 to redesign an organisation's business processes and implement an integrated information system (IS), the current study suggests that there is a need to adapt OIPT, as suggested in section 2.1.2.1, to include how to obtain the optimal fit between the information needs and information capability.

The need to adapt OIPT is as a result of the theory being focused at a post-adoption of IS/IT system (Gattiker and Goodhue, 2005), whereas the focus in the current study is on pre-adoption of an IS/IT system. According to Karahanna, Straub and Chervary (1999), post-adoption is based on beliefs of usefulness and perceptions of enhancements whereas, pre-adoption is based on perceptions of usefulness, result demonstrability, visualisation and trialability.

Although OIPT does not categorically define the scope of managerial input, it however provides the opportunity of adopting one of its dimensions to understand how leadership input at pre-adoption decision making and implementation may contribute to the success of the ERP system

within an organisation. Early theorist of OIPT such as Galbraith (1973) focused on uncertainty, using OIPT as a lens, at the company level. Tushman and Nadler (1978), while enhancing the theory, moved the focus on OIPT to an organisational sub-unit level. These theorist have focused the development of OIPT on the post-adoption and post-implementation of IS/IT systems (Gattiker and Goodhue, 2005). The post-adoption and post-implementation perspective of OIPT focuses on uncertainties and buffers in business process, such as in the current study where buffers were created in the activity of sending time sheet in the post. That is, instead of 2 days an extra 2 days buffer was allowed. In order to move the focus of OIPT to pre-adoption decision making and pre-implementation of an IS/IT system, there is a need to customise OIPT. Despite the potential utility of Galbraith's organisational information processing theory for exploring IS/IT performance relationship, no empirical studies based on this theory has been reported to date (Fairbank et al., 2006).

Galbriath's information processing theory suggests a linear relationship between information processing variables and performance. Fairbank (2006) suggests that certain design choices may be more or less effective depending on the strategy of the organisation. In order to effectively align information processing needs and capability to meet the strategic design choice, a perspective that recognises the effect of each of the variables in an IS/IT pre-adoption process is required.

OIPT2.0 provides this strategic perspective by not only accepting that there should be a fit between information processing needs and capability but suggests VSM as the tool which collects information from both variables and then provides that required fit for optimal performance. To obtain this fit, information processing needs and information processing capability of the organisation is fed into VSM to produce the current state map. Using information from the current state map, a more streamlined process state map called the future state map is then produced which provides a fit between the information needs and information capability for optimal performance.

Optimal performance is built based on the customer expectation obtained through the customer survey and based on the requirements of the organisation and the staff capabilities on both IT and business processes. Using VSM of the current state which was developed using the information requirements from sources such as the customer survey and information capability

from interviews from prospective IS/IT users, VSM of the future state is developed which is the fit for optimal performance of the business process.

The diagram below is the adapted framework of OIPT2.0 as suggested by the current study. The original OIPT framework is shown on page 29 Fig 2.1 and the new addition to the original OIPT framework as suggested in the current study is shown in red text in fig 5.1 below.

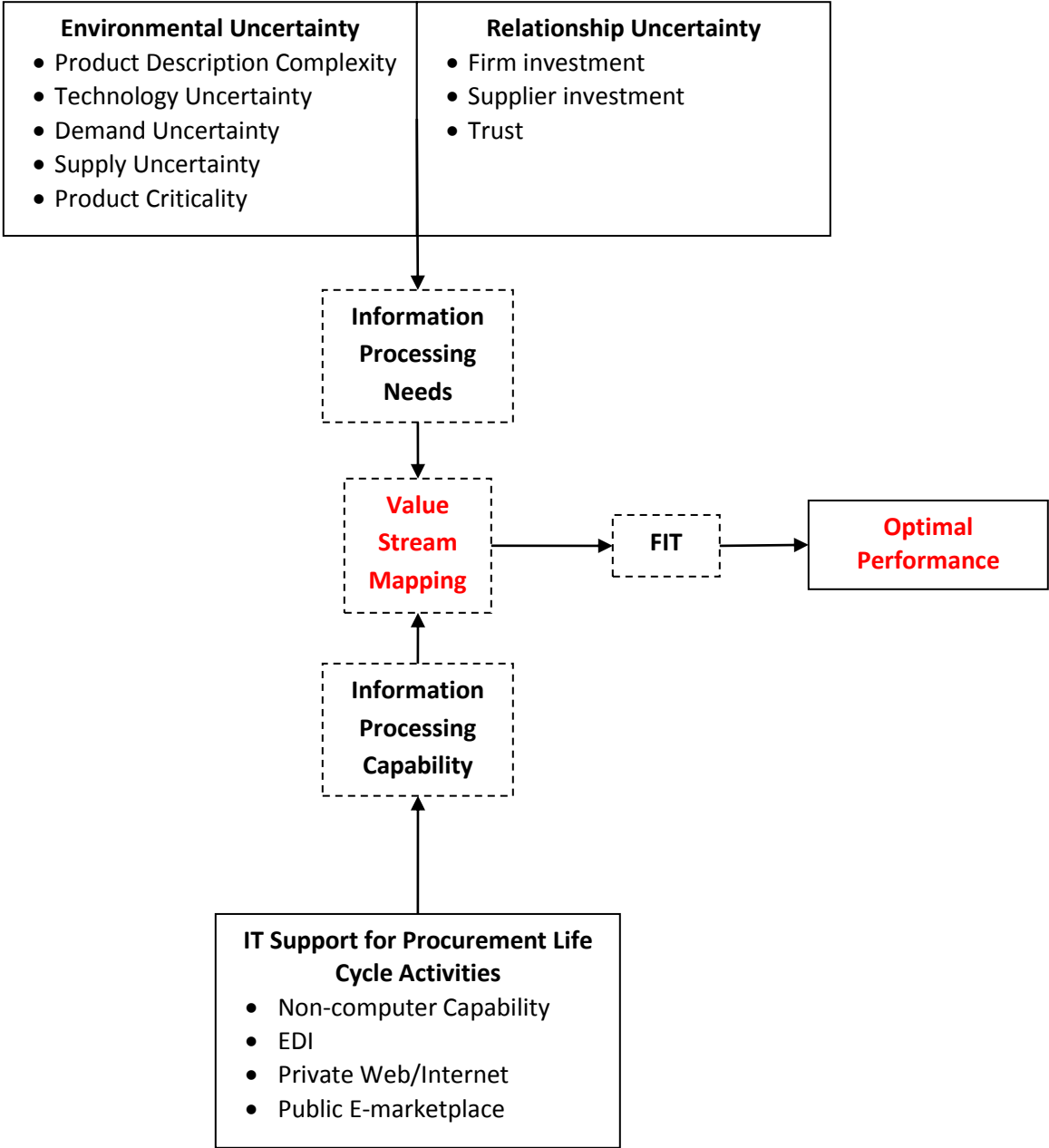


Figure 5.1 OIPT2.0 Framework

The diagram above illustrates that in order to obtain the fit between information processing needs and information processing capability, OIPT2.0 suggests that a tool is required to collect and analyse information processing needs and information processing capability. This tool which OIPT2.0 suggests as VSM, then feeds information into the 'fit' phase which then leads to the provision of the optimal performance. Therefore, OIPT2.0 identifies four important concepts: information processing needs, information processing capability, **the use of VSM**, and the fit between information needs and capability to obtain **optimal performance**.

## ***5.1 How does business process analysis using Value Stream Mapping impact the implementation and customisation of an ERP system in a hybrid service and manufacturing SME?***

### ***5.1.0 Business Process Analysis and Process Improvement***

Process improvement is a benefit derived when an organisation adopts a suitable ERP system (Beheshti, 2006). Business process analysis carried out during the pre-adoption decision-making of an ERP system in the current study provides the hybrid service and manufacturing SME with a better understanding of its current processes, giving clear indication of areas for improvement. In this action case study, process users were able to demonstrate their processes and were asked questions regarding why specific tasks were carried out the way they were carried out thereby, creating the platform for discussion towards process changes and streamlining the back office operations.

#### ***5.1.1.1 VSM is helpful for hybrid service and manufacturing SMEs***

As identified in the literature review chapter, in the studied example a company having richer experience in process management and business process redesign (BPR) is more likely to succeed with ERP as a result of the extensive thought given to the processes and involvement of users and owners of the ERP system during the pre-adoption decision-making and implementation (Garcia, 2002, Lasa et al., 2008a). ERP systems are based on a value chain view of the business where functional departments coordinate their work, focus on value-adding activities and eliminate redundancy (Beheshti, 2006). This study supports the findings from the

literature, because it found that value stream of the current and future states can be used to evaluate the value chain of a hybrid service and manufacturing SME business, in order to focus on value-adding activities and eliminate redundancies within the current service process. This finding was in relation to Beheshti's (2006) view from the perspective of VSM, by mapping the activities that make up the current state of the value stream in the service section and using the current state to create a more streamlined state of the business process called the future state, as shown in section 4.2.4.

The study found that VSM can be used to view value chain, as represented in figures 4.15 and 4.16, where the various activities carried out in the service process are identified alongside the associated time dependencies. This study agrees with the existing literature (Garcia, 2002, Lasa et al., 2008a), which argues that VSM is useful in re-engineering the business process of an organisation thereby making the processes leaner. Although literature which analyses the application of VSM is more focused on manufacturing, this study provides an original contribution of the application of VSM in a hybrid service and manufacturing SME. The value stream of the current and future states are also used to evaluate the value chain of the business, in order to focus on value-adding activities and eliminate redundancies.

The current study also found that ERP failure could be attributed to SMEs attempting to change the business processes contained in an ERP system after they have adopted the ERP system, rather than adopting an ERP system whose business process could be mapped to the SME's business processes. The problem of assumed processes which all ERP packages have pre-defined in them is well documented (Light et al., 2001). The current study identified evidence to support these views in a hybrid service and manufacturing SME – as discussed in chapter four, Data Analysis, section 4.1.2.1. The examples of failure are evident: A) in additional time needed to process information; B) the increased reliance on the customisation vendors provide when it comes to updating systems to the next version; C) most processes are still manual; and D) Lack of clarity and audit trail.

Although there are many other methods of analysing business processes as discussed in the previous chapters, see section 2.2.2.1 (VSM and other methods for systems redesign), VSM was used to demonstrate successful business process re-engineering. The business process re-

engineering carried out in this study was termed successful because it removed areas of waste and made the process leaner and as indicated by the MD who was happy with the IS solution because he felt it increased the SME's efficiency. Moreover, the future state mapping have been implemented as designed and agreed by the stakeholders such as service engineers, back office staff and senior management team. This increase in efficiency is as a result of automating the process of sending job sheets and invoices out via post which used to take days, to sending them electronically within seconds. For example, before the automation, it took over a week for engineers to post their job information, then the office receives the job sheet and invoice the customers. However, with the automation, job sheet information is received as soon as they are signed off by the customer allowing the immediate invoicing of the job. This in return will improve the cash flow of the organisation. Another example is that before the implementation of the future state the researcher received on the average, 5 support calls from users daily. However, after implementing the future state, there were 2 calls on the average daily as a result of referring to one system rather than 3 disparate systems. It also allowed the SME to hold accurate information of customer equipments providing details such equipment model, substitute equipments used in the past and general service history. It is possible to have exactly same model of equipment at two separate customer sites, but the filters and other service parts might have been changed over time. To the engineer, it is important to know to what extent the spraybooth on the customer's site has been customised before arriving at the customer's site. This becomes an issue if for example spraybooth A uses a specific type of filter but over time the original filter on that specific customer equipment might have been changed to resolve an issue. If the engineer replaces the filter back to the original, then there is the possibility that the customer starts experiencing the issue that might have been resolved in the past. This is where information availability and processing have been improved. Furthermore, the elimination of disparate systems and the use of one robust ERP system was also a key success indicator set out from the beginning and achieving this implies that the project was a success. The use of one central ERP system eliminated the duplication of data across various disparate systems in order to keep them synchronised with one another. For example, at the commencement of the study, when a new customer was created, this was replicated across all the disparate systems manually, this was also the case when there was need to update information such as the spraybooth equipments on the customer's site. With one central ERP system, this duplication of



information is eliminated and reduces potential manual errors. The project was also able to successfully deliver training to staff on how to use the adopted IS/IT system. Using the new calendar, onsite staff are able to quickly access the engineers' diary to suggest to customers most suitable time to carry out their jobs. The developed calendar is more user friendly, allowing the staff to easily move jobs across engineers and also move engineers across jobs. The new calendar also gives the user visibility on engineers that have serviced specific customer equipment, their comments and how they resolved issues thereby providing a knowledge base on each customer's equipment. The application of VSM to document the current state of the business process highlighted areas of waste and improvement within the current processes. This prompted further analysis with the process owners to identify and agree on possible areas of the business processes that would benefit from improvement using process automation. Further on, the improvement was used to design the future state of the business processes.

One of the common criticisms of VSM as identified in the literature according to Lamming (1996), is its lack of flexibility in terms of 'space to experiment' and 'time to think'. Smart et al. (2003) further argued that from a system reliability perspective, high levels of leanness could isolate system redundancy levels or organisational provision made to accommodate unforeseen circumstances (organisational slack), which are all required in order to effectively deal with contextual uncertainty and non-routine behaviours. Lawson (2001), supporting this argument, also proposed that organisational slack is necessary to ensure that system interdependencies are supported; when they are ignored, this exposes the entire system to becoming vulnerable. An example of such scenario was presented by Lawson (2001) where in 1998 General Motors' workforce went on strike resulting to the entire North-American operations being shut down. Due to the lack of parts from the striking plant, 29 assembly plants which were not out on strike had no material to build cars; as a result of this, the organisation lost production of 576,000 vehicles, which was estimated at \$2.2 billion in lost sales (Blumenstein, 1998).

In the case of the current study removing wastes using system automation, in an attempt of making the business process leaner, does not expose the organisation to any risk. Rather the use of automated systems removes unwanted redundancies and ensures that organisational slacks incorporated into the system design are strictly complied with by users. In the current hybrid service and manufacturing SME, VSM application isolates the criticism of lack of flexibility

because the eliminated manual activities were proposed for automation in the ERP system adopted. Unlike the example of General Motors and other manufacturing organisations, where there are great dependencies on some departments, the hybrid service and manufacturing SME, although with great dependency on the manufacturing section, can also completely function without the manufacturing department; this is because they can also purchase all the required materials externally. As defined in the first two chapters, the main strength and focus of the hybrid service and manufacturing SME is service with manufacturing as complementary. Therefore if, for example, the manufacturing department decides to go on strike, the services department can carry on functioning simply by purchasing the service materials from external suppliers.

As discussed in the literature review section, using process mapping to create flow chart of types of activities in the current study would provide information that is too generic and unsuited to modelling a complex business process (Kateel et al., 1996) as is the case of the action case SME. VSM from the literature was criticised by Chitturi *et al.* (2007) as being difficult to handle different family types and suggested that to get VSM to handle different family types, information gathering must be tailored to suit the business process and industry. As a result, this study used a top to bottom approach of information gathering to ensure that there is clear understanding of the goal which was then used to gather information relevant to the top level goal. VSM has also been criticised by Chitturi *et al.* (2007) as involving assumptions made during the design of the future state VSM which could lead to unachievable goals, however, by reducing assumptions to the minimal and making the necessary assumptions as realistic as possible the current study was able to avoid this potential shortfall.

Another popular critique, which is argued against VSM, is the human factor. According to Williams, Haslam, Williams, Adcoft and Johal (1992), lean process can be perceived as being de-humanising and exploitative on the shop floor workers. This was further criticised as handing management greater power and control which is made acceptable by being termed 'management through customer responsiveness' (Green, 1999). In the current study, for example, a board was displayed in the main office which listed the daily and weekly performances of each of the customer service staff. From the management and field engineers' perspective, they are able to walk in and at a glance see how each of the customer service

agents is performing. But from the customer service perspective this pressurises them because although they are expected to be involved in the process documentation, they are also expected to meet set targets for the day and week. Also, in the current study, the involvement of management through greater power over the system was not evident as a result of the system redesign being based on structured process of data gathering and analysis. In process analysis for the purpose of ERP adoption and implementation, using an agreed structured process like the ERP evaluation grid in fig 4.12 ensures that an ERP is selected based on its merits on meeting the business processes. This study therefore partially agrees with the human factor because the action case organisation uses the board to display information which is dehumanising however uses the ERP evaluation grid to ensure that management influence does not influence the decision of ERP adopted. Finally, concerns have been raised with lean's involvement of shop floor workers while carrying out business process improvement activities (Gibbons et al., 2012). Rinehart, Huxley and Robertson (1997) argued that this was a concern, and highlighted that while carrying out their study on General Motors-Suzuki's joint venture, that shop floor workers were encouraged to participate in developing improvements. As a result of that, workers were expected to design the very system they would have to use. In the current study although users, such as field engineers and back office staff, were involved in the understanding of areas of waste and streamlining the business process, the design of the system was not done by them but by the system design team.

One of the core principles informing the lean theoretical framework is the elimination of non-value adding activities in product based process driven value streams (Womack and Jones, 1996a, Womack and Jones, 1996b). VSM tools have been developed (Womack and Jones, 1996a, Hines and Rich, 1997, Rother and Shook, 1999, Hines et al., 2000, Jones and Womack, 2003) as static analysis tools for identifying and quantifying the seven wastes of lean as defined by Ohno (1998).

The literature also identified the benefit of VSM which centrally focuses on how essential VSM is while analysing how various activities impact on the overall business process (Hines et al., 1999, Lasa et al., 2008a) (Shararah, 2013). According to Womack and Jones (1996b, 1996a), elimination of non-value adding activities, known as wastes, in product-based process driven value stream forms one of the core principles informing the lean theoretical framework. This

core principle of waste elimination using VSM formed the main argument to its application in the hybrid service and manufacturing SME in the current study.

#### **5.1.1.2 Customer centrality in BPR**

Many SMEs carry out ERP implementation without critically evaluating their business processes (Snider et al., 2009, Kale et al., 2010). As a result, they migrate into new ERP systems carrying along activities and practices which when removed could make their business processes leaner and more profitable. **The current study demonstrated that for this hybrid service and manufacturing SME, the process of business process analysis becomes even more important as a result of having both service and manufacturing business process.** This SME in the past implemented three different ERP systems without carrying out thorough business process analysis. The current study found that carrying out thorough business process analysis allowed and informed the process of identifying the most suitable IS/IT system. This analysis evaluated the full service process using VSM, and then identified the areas of the current processes that fail to add value to the customer. The areas that fail to add value to the customer were either removed, if possible, or minimised. The customer value centrality benefit was discussed by Gummesson (2008), who suggests that the benefit from a product development point of view is the design of a product or solution with the customer as the focus of development. As a result, the product meets the expectations of the customer as opposed by the development of a product which the customer should find a way to use. Gummesson (2008) argued that it could be difficult to actually develop products which completely meet the customers expectation. Another view from a service point is given by Kasabov and Warlow (2010), who suggest that in place of a customer centric approach, the organisation should adopt a customer compliance approach. Although customer compliance approach can be feasibly applied from a service provision point of view, however from a system adoption perspective, a customer centric approach is more feasible. In the current study, Gummesson's (2008) argument partly applies because the emphasis is on system development which, although requiring a customer centric approach, it also requires great focus on how the adopted system meets the entire business processes.

The drawbacks of only using a customers' value determinants is the development of a product which meets the customer demand; this does not consider other determinants such as business processes and process owner perspectives. From the perspective of this study, customer value determinant alone is not suited for a system adoption or development perspective because it fails to incorporate a holistic approach to system analysis and design. If the study was based on the development of a product then focusing on customer value would achieve the desired result. However, if the purpose requires a more holistic approach then customer centric approach alone would not be enough, therefore requiring the researcher to explore other options, such as business process analysis.

### ***5.1.1.3 Role of customer satisfaction in VSM***

Many VSM exercises are done entirely using information gathered from an internal perspective (Jasti and Sharma, 2014, Singh and Singh, 2013). **However, in the current study an external view of VSM was taken in addition to the views inside the company.** For example, customers were asked to rate the importance of a service and its perceived quality. This links the internal and external perspectives in BPR and puts the customer at the centre of the process improvement. The strength with this view is that although the view puts the customer at the centre of the process improvement, it does not neglect other views such as systems users and shareholder perspectives

From the customer satisfaction survey, it was found that the definition of value from the point of view of the customer was closely linked to the quality of service they receive. With this in mind, the development of the future state was made without compromising on the quality of service received by the customer.

### ***5.1.2 Business Process Analysis and Value Stream Mapping***

This section aims to support work already done by researchers on the importance of business process analysis by highlighting the importance of not overlooking business process analysis when adapting an IS solution such as an ERP system. The current study used data from a hybrid service and manufacturing SME in order to support its argument in contrast to a more popular

approach of using data from larger organisations such as multi-national businesses where similar studies seem to have taken place.

Business process improvement (BPI) is an ongoing issue for companies and methodologies, techniques, and tools have been developed for use while re-engineering business processes in an organisation. Zellner (2011) evaluated selected process improvement approaches in a structured overview in order to identify their potential to methodically support the act of improving business processes.

| Author(s)   | Approach  | Mandatory elements of a method |            |      |         |                   |
|---|---|--------------------------------|------------|------|---------|-------------------|
|   |   | Activities                     | Techniques | Role | Results | Information Model |
| Harrington (1991) and Harrington (1995)   | BPI   | ●                              | ⊖          | ⊖    | ○       | ○                 |
| Pande, Neumann and Cavanagh et al (2000), Breyfogle (2003) and Harry and Schroeder (2006) | Six Sigma   | ●                              | ●          | ⊖    | ⊖       | ○                 |
| Dalmaris, Tsui, Hall and Smith (2007)   | Framework for the improvement of knowledge-intensive business processes | ●                              | ○          | ○    | ○       | ○                 |
| Rohleder and Silver (1997)  | A tutorial on BPI   | ⊖                              | ●          | ○    | ○       | ○                 |
| Coskun, Basligil and Baracli (2008)   | WABPI methodology   | ○                              | ○          | ○    | ○       | ○                 |
| Lee and Chuah (2001)  | A SUPER methodology for BPI   | ●                              | ●          | ⊖    | ○       | ○                 |
| McAdam (1996)   | An integrated business improvement methodology                          | ●                              | ●          | ⊖    | ○       | ○                 |
| Siha and Saad (2008)  | SAM framework for BPI   | ○                              | ⊖          | ○    | ○       | ○                 |
| Khan, Bali and Wickramasinghe (2007)  | BPI framework   | ○                              | ○          | ⊖    | ○       | ○                 |
| Adesola and Baines (2005)   | MIPI methodology  | ●                              | ●          | ○    | ○       | ○                 |
| Povey (1998)  | Best practice BPI methodology   | ●                              | ●          | ⊖    | ○       | ○                 |
| Varghese (2004)   | Strategy for launching meaningful BPI                                   | ●                              | ●          | ○    | ○       | ○                 |
| Seethamraju and Marjanovic (2009)   | Process knowledge in business process improvement methodology           | ●                              | ○          | ○    | ○       | ○                 |
| McAdam and McIntyre (1997)  | BPI methodology with focus on learning organisation concepts            | ○                              | ○          | ○    | ○       | ○                 |
| Paper (1998)  | Holistic framework for BPI adopted at caterpillar Inc.                  | ●                              | ⊖          | ⊖    | ○       | ○                 |
| Bisson and Folk (2000)  | Case study for BPI  | ●                              | ○          | ○    | ○       | ○                 |

**Notes:** ●, fully accomplished or mentioned; ⊖, partly accomplished or implicitly mentioned; ○, not accomplished or not mentioned

Table 5.1 adopted from Zellner (2011)

Zellner (2011) conducted a structured evaluation of BPI approaches and showed that none of the above listed approaches deliver a complete method according to the mandatory elements of a method (MEM), which involves a clear definition of activities, techniques, assigned role, expected results and an information model. MEM is a mode of analysis which aids the quick identification of how methodologically supported or not an approach is (Zellner, 2011). The more an MEM approach can be aligned, the better the methodological procedure is in supporting the improvement of business processes. MEM is therefore a criterion for measuring the quality of the chosen approaches with regards to their ability to completely support the act of process improvement. In order to achieve this, it is vital to have a clear understanding of the allocation of 'role' and detailed knowledge of how to perform the improvement processes of activities so as to gain process improvement using 'techniques'. There should also be a clear definition of the expected 'results' both as input and output activities (Zellner, 2011). The benefit of MEM is the identification of business process improvement approach which is structured and detailed. The drawback of using the MEM when identifying a suitable approach is the time taken during the evaluation of the various approaches. This means that none of the identified 16 BPI approaches adequately support the practitioner through all stages in the business process improvement activity, which supports earlier studies by Adesola and Baines (2005). Considering that none of the approaches mentioned in table 5.1 were developed according to the MEM, the associated shortcomings leave room for further improvement of a more suitable approach, which would include an information model.

The drawback of MEM, as identified above, is that it takes a considerably long time to perform the task of analysing BPI approaches using MEM. This study supports this view that the time taken trying to establish how an approach meets the MEM is relatively time consuming. The study, however, suggests that this analysis to identify the most appropriate approach is crucial if the appropriate BPI approach is to be chosen.

#### **5.1.2.1      *VSM is suitable for hybrid organisation***

Biege, Lay and Bushchak (2012) argued that VSM is perceived as being suitable when applied in support of process re-engineering in manufacturing but they do not agree that VSM provides



the same level of success when applied in service driven business. **The current study suggests that VSM could be successfully applied in a service organisation whose primary business processes is service provision with manufacturing as the secondary business process.**

Biege et al. (2012) concentrated on manufacturing companies that are in transition from being primary producers of capital goods to becoming service providers. It can therefore be argued that their area of concentration could account for their conclusion. Unlike this study which concentrated on applying VSM on an existing service business process with smaller element of manufacturing. VSM's suitability in hybrid service and manufacturing SME is as a result of its ability to allow the user analyse processes from the perspective of value to process within both the service processes and the manufacturing processes. VSM also allows the mapping of current state of both the service and of the manufacturing processes thereby informing the design of the future state VSM, which has been applied in the current study.

#### **5.1.2.2 VSM is vague, imprecise and uncertain**

Another criticism against VSM is from Vimal and Vinodh (2013), who argued that lean manufacturing methodologies such as VSM are perceived as vague, imprecise and uncertain while scoring features identified.

The use of VSM while carrying out BPI includes an information model in the form of the Functionality Evaluation Model presented in chapter four section (4.2.2). This also meant that following the same process the same outcome is assured and can be accomplished by the BPI practitioner, as demonstrated in the data analysis chapter. Using information from VSM analysis of the current and future process states, the information model served as the blueprint, whilst the future state of the VSM gave more information on how the results of the suggested activities during the improvement would impact current activities within the organisation. Although Six Sigma could give an implicit explanation of the result achieved, it does not provide information regarding why an activity has to be performed, or what the expected result should be, unlike the approach applied in this study. The approach used in this study ensured that the researcher was available in order to coordinate all activities, in the form of a role model, while identifying process improvements without the researcher influencing the results.

The approach of conducting BPI using VSM and the model presented in this study has a defined set of activities. The approach also presents a technique which is applied by one who assumes the role of a facilitator with the aim of achieving desired results. The Functionality Evaluation Model presented in chapter four – section 4.2.2 is also presented as the Information model.

A method of conducting business process improvement must consist of the following five elements (Winter and Schelp, 2006, Zellner, 2011):

1. Procedure model (Activities): order of activities to be fulfilled when employing the method.
2. Techniques: ways of generating the results; also supports an activity.
3. Role: someone that carries out activities in order to follow the method and is responsible for the activities.
4. Results: an artefact (e.g. a document, etc.) created by an activity.
5. Information model: consists of the above described elements as well as their relationships. Information models are also used to represent the results.

In the current research, this is how the above five elements were achieved:

1. Procedure model (Activities): The method used in this study provides those involved in the business process improvement project with an understanding of tasks which have to be performed such as the gathering of information required to reproduce a VSM of the current state which is used to develop a VSM of the future state. The development of the VSM, of both current and future states, is also activities which all combine to achieve the goal of BPI.
2. Techniques: This method indicates to the user what results need to be fed into the next stage in order to achieve the desired results from the next stage, as is achieved using a technique. In this study, the product selection flowchart in fig. 4.11 shows the various decision making stages and what feeds into each of these stages. Using flowcharts, it is clear what information is required at various decision making stages.
3. Role: While carrying out business process improvement, it is not only important to be aware of what needs to be done and in what order, but equally important is a clarification of who is responsible for each activities: in this study, the researcher took responsibility of

- all the activities. The researcher acted as the role model, helping to identify the process owners and guaranteeing a smooth process of the improvement act.
4. Results: The results from surveys, customer questionnaires, user interviews and prospective systems interview are all results used in developing the next level activity of VSM analysis of both the current and the future states.
  5. Information Model: To ensure that the method is reproducible for any following project of improving business process and adopting suitable ERP system, the model in figure 4.12 acts as the information model to ensure the adopted system follows a structured approach.

### **5.1.2.3 Comparison with the SAP Business One's implementation model**

As shown in section 4.9 of this study, the major discrepancy between the implementation strategy used in this study and that proposed by SAP, is the absence of business process analysis and improvement in SAP's implementation model. As a result of the absence of business process improvement as a strategy of removing wastes in the current process before implementing the system, SAP's approach lacks the five steps as stated by Winter and Schelp (2006) and Zellner (2011). They stated that a method of conducting business process improvement must consist of the five elements mentioned above (Winter and Schelp, 2006, Zellner, 2011).

This study shows that using business process analysis, a better understanding of the current processes is achieved. When a clear understanding is achieved, then a clearer definition of expectations, in terms of features from the potential ERP system, is also achieved. SAP's implementation strategy, although used by some implementations, does not emphasise in-depth business process analysis as being important during the pre-adoption decision-making and implementation of an ERP system. There is no clear emphasis on business process analysis unlike the approach in this study, which has made strong emphasis on business process analysis of both the current and future states.

SAP's implementation model is currently one of the most popular as a result of SAP being widely accepted as a major ERP system for SME usage. Unlike the SAP's implementation model, this

approach would require further testing and publicity. SAP's implementation model however does not cover the following areas which have been found very helpful in this study.

1. **Activities:** The method used in this study provides those involved in the business process improvement project with an understanding of tasks which have to be performed, such as the gathering of information required to reproduce a VSM of the current state which is used to develop a VSM of the future state. SAP's implementation approach gives an overview of activities however it does not breakdown these activities into smaller more understandable activities as does this approach.
2. **Results:** The implementation approach used in this study used results from surveys, customer questionnaires, user interviews and prospective systems interview in developing the next level activity of VSM analysis of both the current and the future states. SAP's implementation approach specifies the expected result as the implementation of an ERP system or an add-on, but it does not specify what the expected result of the scoping phase is, for example. The approach in this study clearly identified activities and the expected results from each activity, such as the business process analysis, where the expected results were the current and future states of the business process.
3. **Techniques:** This method indicates to the user what results need to be fed into the next stage in order to achieve the desired results from the next stage, as is achieved using a technique. The implementation approach used in this study used OIPT as a theory in order to understand the complex whole of the ERP implementation. Breaking the complex whole into smaller more understandable units is also a strength of this approach which if incorporated into SAP's approach will make it more structured and useful.
4. **Role:** While carrying out business process improvement, the approach used in this study was not aware of what needed to be done and in what order, but equally the approach, unlike the SAP's implementation model, clarified roles and responsibilities for each of

the activities. As mentioned earlier, SAP's implementation model is quite high-levelled by just specifying the ERP implementer as the only defined role. It does not specify roles, such as who takes responsibility of each of the test phases and who takes responsibility of the business process analysis, considering that the knowledge of the business process is greatly within the SME and its staff. The researcher in this approach took the high level responsibility of all the activities, but also based on the activities, identified role models in the form of process owners.

5. Information Model: To ensure that the method is reproducible for any following project of improving business process and adopting suitable ERP system, the model in figure 4.12 acts as the information model to ensure the adopted system follows a structured approach. Although the implementation approach suggested by SAP could be argued by SAP as being structured, Zellner (2011) argued that an implementation approach should have an information model in order to be classified as a structured approach. SAP's approach does not provide an information model for anyone using their approach and as a result contributes to its down side.

#### **5.1.2.4 RQ1 summary**

**Research Question 1:** How does business process analysis using Value Stream Mapping impact the implementation and customisation of an ERP system in a hybrid service and manufacturing SME?

**Finding:** Whilst technological innovations, such as the cost-effectiveness of an ERP system, drive opportunities for strategic change, there is an expectation that new systems would be 'better' than the older legacy options. However, the reality is that some good features do not feed into the latest versions of some ERP systems, so a long-term view of the product's development has to be taken into account when selecting the most relevant option. These experiences have definitely shaped the management team at Alpha. Though they are more knowledgeable, about their requirements, they have become more risk averse and there is an apprehension of failing again, so this has possibly hindered or lengthened the selection of IT solutions processes. The

more rigour the management expects in evaluating the options, the more time is required and consequently higher costs are incurred. Using VSM, the study found that it is easier to identify the importance of each activity and how activities link to one another in order to achieve the desired business process need. This information is then used to identify activities that add value to the customer and suggests activities that require re-engineering in order to minimise or completely remove waste and increase efficiency of the entire process. Peppard and Ward (1999) offer some platitudes regarding inadequate structures and processes which can severely impinge on the success of IT in an organisation. A rigorous business process mapping exercise has been conducted to ensure that the best possible match is selected. Additionally, Alpha is concerned with a full project life-cycle, not just with the implementation phase. As noted by many researchers such as Yu (2005), success in the post-implementation phase of a system is accepted as a crucial indicator of a successful system implementation overall. Velcu (2007) further supports this by saying that the journey of system implementation does not end with the 'switch on' of the desired system. Thus, the current project is scheduled to go on for several months beyond the 'switch on' date, during which time the project team will oversee the new system being used. Inevitably, this extended period of implementation is also costly but to ensure positive results these costs are justified by long-term gains and a positive return on investment. Finally, the evaluation and adoption of the ERP system is based on the re-engineered business process; that is, the future state of the business process. The proposed ERP evaluation tool presented in figure 4.12 not only evaluates the solution but extends to the evaluation of the ERP supplier.

## ***5.2 How can an SME benefit from the use of OIPT in an ERP implementation for an SME?***

### ***5.2.1 SME's and Organisational Information Processing Theory (OIPT)***

OIPT emphasises that resolving uncertainty is the central task in organisational design (Gattiker and Goodhue, 2004). This is not only in organisational design but can be extended to process redesign and ERP adoption and implementation. The theory conceptualizes uncertainty as the inability to identify boundaries and interdependencies of tasks and departments while mapping

out processes during ERP systems evaluation. Although the amount and type of uncertainties vary from one organisation to the other, the hybrid service and manufacturing SME due to its complexities shares boundaries of uncertainties with both typical service and manufacturing business strategies. In order to adopt and implement the correct ERP solution for such complex business strategies, the associated uncertainties between various units of the SME must be clearly stated and appropriately linked within the business strategy of the ERP system. Although it is difficult to completely identify uncertainties while adopting an ERP system, Gattiker and Goodhue (2004) suggested that these uncertainties could have an impact on performance. This study took this further and found that with past ERP systems, emphasis was not made on uncertainties associated with the sub-units. The SME laid more emphasis on the cost of the ERP system rather than on its suitability. The result of this is the adoption of ERP systems which met only one unit of the business strategy hence, the hybrid service and manufacturing SME's current usage of three disparate ERP systems. Information processing theorists have suggested that one source of uncertainty is interdependence within units and departments and that greater interdependence among these units would lead to greater benefits from the adopted ERP system (Gattiker and Goodhue, 2004). This study agrees that greater interdependence between units would eliminate the need for data duplication and redundancy. A further finding is that process ownership is another factor that could lead to greater benefits from the ERP system. During process analysis and ERP systems evaluation, each identified uncertainty should be allocated an owner who is responsible with ensuring that the uncertainty is adequately eliminated in the adopted ERP system.

### **5.2.2            *Interdependence and OIPT***

Just like multinational organisations, SMEs require from an ERP system the ability to enter data once and, thereafter, to be able to access this data from any required department linked in the ERP system. OIPT proposes that the benefit of a standardised information system such as an ERP system is positively influenced by the level to which sub units are interdependent to each other (Gattiker and Goodhue, 2004). Interdependence within ERP system is the extent to which various modules, departments and sub-units in the system rely on data and information from

other units in order to complete their tasks. During the selection and adoption of an ERP system, this study argues that managing this interdependence is crucial if the proposed benefits from the adopted ERP system are to be maximised. This study used process flow diagrams and VSM to establish the interdependence between the sub-units of the action case hybrid service and manufacturing SME. For example, from the process flow diagram in fig 4.9, this study identified that there is dependence between the procurement or manufacturing of the service items (filters) and the service being carried out. If the required service items failed to arrive at the customer's site before the service is due to be carried out then the service must be either rescheduled or cancelled. The consequence of this on the hybrid service and manufacturing SME is the loss of time, money and potentially losing the business being offered to the customer entirely. ERP systems when adopted and implemented based on their ability to handle these interdependencies are capable of facilitating the flow of these interdependencies across the sub-units.

### **5.2.3 *SME's Information requirement during ERP implementation***

Just like multinational organisations, SMEs require the ability to enter data once and have the data accessible in various forms. A concern identified from the action case is the current process of entering data into multiple systems before they can be used as meaningful information. Researchers like Yusuf, Gunasekaran and Abthorpe (2004), looked at information requirement after the ERP system has been implemented. This study suggests that a better understanding of the SMEs information requirements during ERP adoption aids a better decision of selecting an appropriate ERP system. Yusuf et al. (2004) identified that ERP systems use technologies to integrate the flow of required information from the internal business functions and information from suppliers and customers. From their perspective, this information is used to capture valuable management data and further translated into management information requirements. The opinion of this study is that if the wrong ERP is adopted, it would be difficult to integrate information from internal business functions, customers and suppliers. This is evident from table 4.1 (Alpha's IT System History) where systems like Style and Opera were implemented but these systems failed to integrate business, supplier and customer information requirements.



Further systems such as Telemagic, ResultWare, SAP Business One and Sage were also adopted, but each of these ERP systems failed to integrate the hybrid service and manufacturing SME's information requirements for internal business functions, customers and suppliers.

Conducting interviews with key back office staff and mobile engineers, customers' questionnaires and interviewing suppliers provided clarification of the level of information required by the internal business functions, suppliers and customers. Then in order to discontinue the use of several disparate ERP systems, the study scoped the development of an add-on which bolts on to SAP Business One. With this add-on, the organisation is able to integrate core internal business functions and also integrate the information requirements from the customer and suppliers. This also ensures that data is entered once and then will be accessible from every module within the ERP systems and this data, once modified or stored, automatically triggers the updating of all related information in the ERP system. The robust ERP system is then able to support virtually all areas of the hybrid service and manufacturing SME, across business units and departmental functions.

#### **5.2.4 *SME's information processing during ERP implementation***

The findings from past implementations of ERP systems in this hybrid service and manufacturing SME indicated that business complexity was not used as the basis for the past ERP adoptions, but rather the fear of the organisation growing as a result of acquisition of other companies. In other words, SMEs where the basis of ERP adoption is to accommodate business growth, appear not to pay too much emphasis on incorporating information processing and business complexities while adopting an ERP system. The decision process regarding the adoption of an ERP system within such hybrid service and manufacturing SME is more affected by the director(s) decision rather than emphasis on the business information processing factor. This, according to Yusuf, Gunasekaran and Abthorpe (2004), Davenport (1998) and Mandal and Gunasekaran (2002), is contrary to what is experienced during ERP systems adoption in large companies, where the larger companies are reported to pay more attention to the management of process integration and data inconsistency. This ensures that redundant data are eliminated and not migrated into the new system.

The analysis carried out in this study also paid attention not only to the form of information required to effectively meet business complexities, but also considered how this information was to be processed in the adopted system. From interviews, this study identified that although two members of staff could be tasked with achieving the same goals, they seem to achieve these goals in slightly different ways. Due to the complexity of the hybrid service and manufacturing SME, the ERP system adopted is expected to be robust enough to meet the different information processing requirements.

### **5.2.5            *Management trust in hybrid service and manufacturing SME***

The approach adopted was useful in providing the research with the understanding of key players, variables and systems within this hybrid service and manufacturing industry, which was required to inform the process of business process analysis of the current state and thereby proposing the future state. This contributed to increasing management and user trust associated with the adopted system as well as clearly identifying and acknowledging the subjects of this study. The study found that as a result of the action case being an SME, the management of the organisation were very influential in the decision of systems being adopted and this was evident in the management style. The study also found that due to the influence of the management on the choice of system adopted, a proper analysis of possible ERP system was compromised in order to please the management. The current study was able to demonstrate this by minimising the influence of management and based the decision on which system to adopt solemnly on the structured analysis of potential systems and resellers. Although the final decision on which ERP system was adopted was made by the management, they however made their decision based on results presented to them by the researcher based on structured evaluation.

### **5.2.6            *RQ2 summary***

**Research Question 2:**            How can an SME benefit from the use of OIPT in an ERP implementation for an SME:

**Finding:** Using OIPT, the process of gathering information using the adopted methods was more focused strictly on information required to meet the current and future business processes. As a

result, the understanding of information processing requirements and information processing capabilities of an organisation ensured that clear mapping of the current and future processes were achieved. This information was then fed into the process of VSM. The understanding and application of OIPT in the context of a hybrid service and manufacturing SME ensured that the right questions were asked in order to gather accurate and relevant information on the current processes; this enabled clear understanding of what the anticipated ERP system should be capable of handling.

### **5.3        *How does business process automation affect a hybrid service and manufacturing SME?***

#### **5.3.0        *Hybrid service and manufacturing SME***

Although ERP systems are designed so that they can be customised, they fail to fit properly into a hybrid service and manufacturing SME's business process strategies. This is as a result of these ERP systems not containing the basic functions capable of handling a combination of a typical service and manufacturing process. These ERP systems are designed to accommodate customisations in order to fit into some manufacturing business processes. The study found that there was no ERP system available off-the-shelf that could fully meet the functions of an SME whose business process contains both typical servicing and manufacturing business processes, and none especially for an SME whose business strategy has more focus on service with manufacturing as a supplement of the service strategy.

#### **5.3.1    *ERP Systems and hybrid service and manufacturing functionality***

Although a manufacturing and service business processes have been defined in the literature review, this section further presents a theory of both manufacturing and service business processes from past studies. This section proposes a graphical theory of the hybrid service and manufacturing business process.

**Comparison of manufacturing and service theoretic business process model:** From the diagram below fig. 5.2, the main areas are input subsystem, management and control subsystems, manufacturing process subsystems, support and information processing subsystem and output subsystem. These various subsystems also share significant links, for example the manufacturing process subsystem cannot function without raw material information from the input subsystem. Although the dependence on raw material is unique to the manufacturing business process, the service business process on the other hand, as shown in fig. 5.3, does not produce any physical item and as a result does not share same dependence on raw materials. In the manufacturing diagram, the approval request represents the request to the management from the manufacturing process for guidance on issues relating to manufacturing. This is also notably not represented in the service model because in the case of the TV channels service provision this is not the output, but a TV channel which is defined and would not require any management approval request for the customer to select or use the service. Both manufacturing and service diagrams indicate the need for an information management system processing of requests which can be an ERP system or other information processing systems. There is also a significant involvement of the management dealing with suppliers in the manufacturing process because there is no output without the raw materials for the manufacturing of the output.

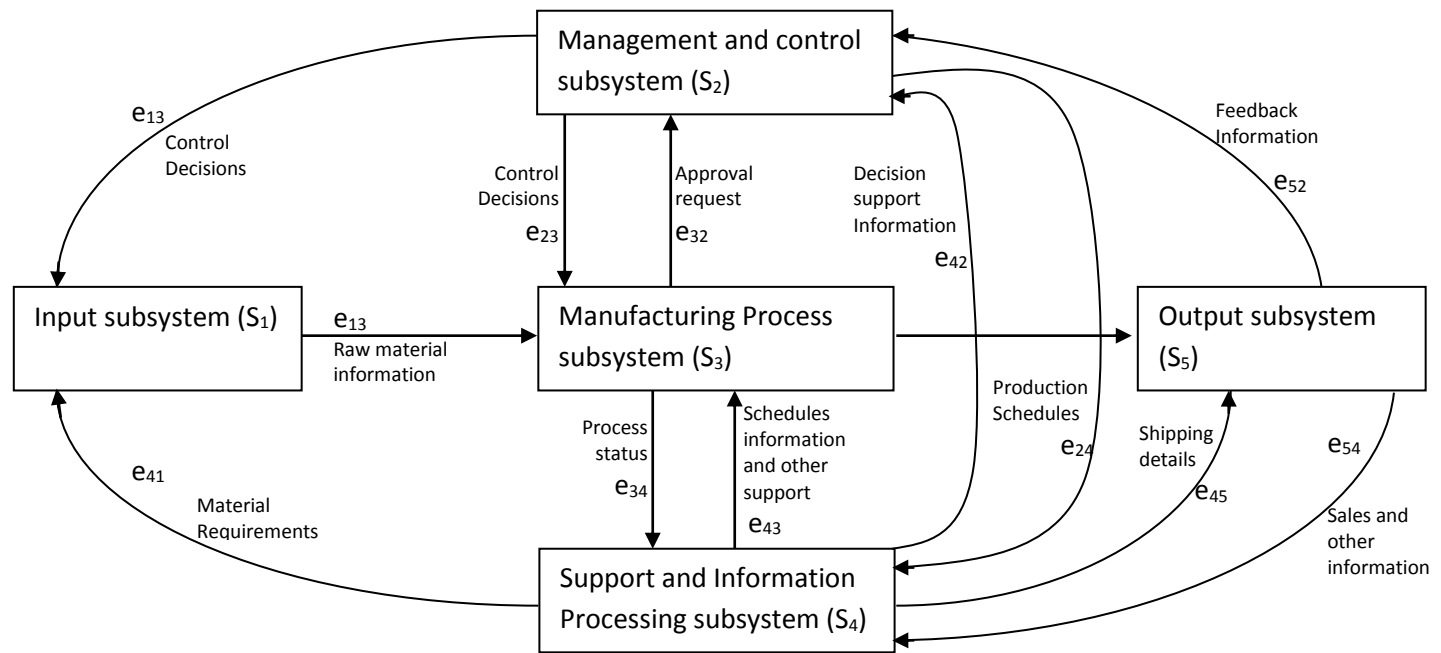


Fig 5.2 Theoretic model of the manufacturing business process from (Singh and Singru, 2013)

**Manufacturing model:** *the theory of manufacturing can be said to take only one external input, which is raw materials, this input is fed into the manufacturing subsystem. The manufacturing subsystem shares a two way information transfer between the management and ERP system in order to produce the required output.*

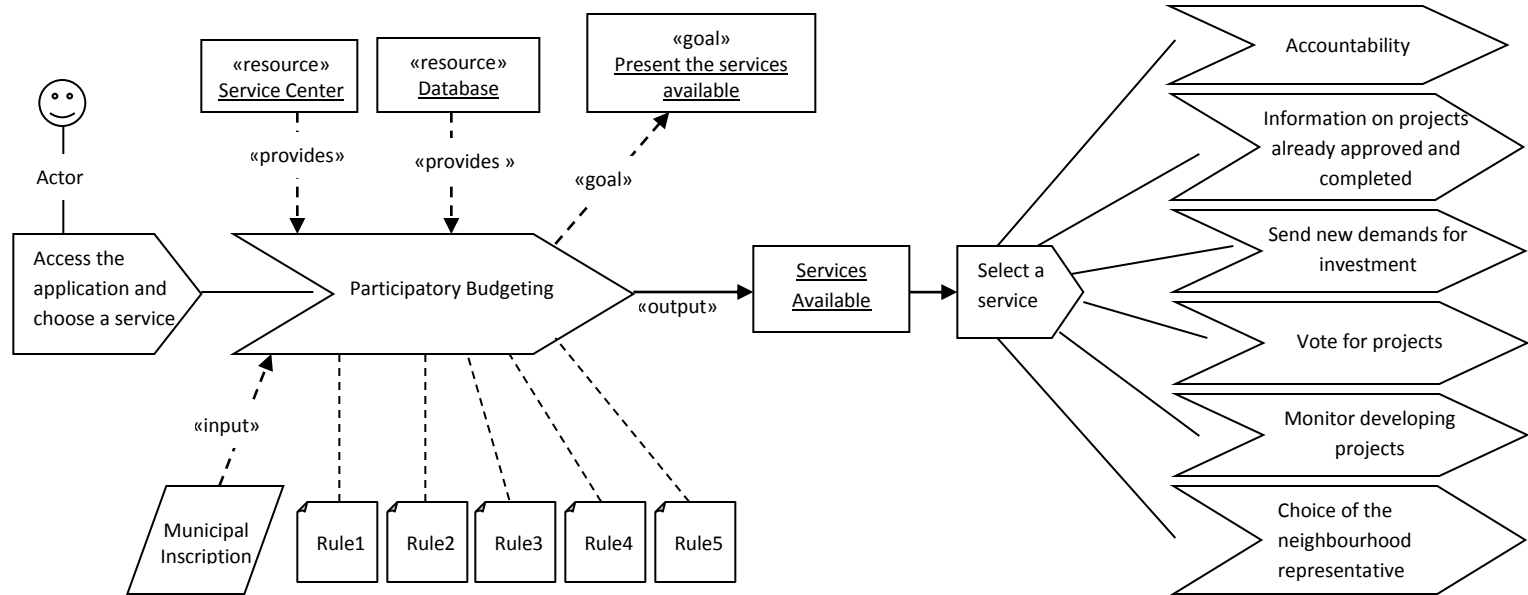


Fig 5.3 Theoretic model of the service business process from (Santos et al., 2013)

**Service model:** *the theory of service can be said to take more than one external input such as input from the person carrying out the service and materials required to carry out the service, which are fed into the service subsystem. The service subsystem shares a two way information transfer between the management and ERP system in order to effectively carryout the required service.*

From the diagram in fig. 5.4, the main areas of the hybrid service and manufacturing business process are input subsystem, management and control subsystems, manufacturing process subsystems, service subsystem, support and information processing subsystem and output subsystem. Although the manufacturing and service subsystems as shown in figures 5.2 and 5.3 could be independent, the hybrid service and manufacturing business process links both the manufacturing and service subsystems together with the service subsystem dependent on the manufacturing subsystem. The input subsystem feeds raw material into the manufacturing subsystem and the manufacturing subsystem feeds into the service subsystem. The dependence on raw material is unique to the manufacturing business process and the service business process has an output of services rendered to the customers. The hybrid service and manufacturing business process, however, has two main outputs which are the manufactured item, which is then fed into the service subsystem in order to effectively carry out the service. In the hybrid service and manufacturing process diagram, the approval request represents the request to the management from both the service and manufacturing subsystems for guidance on issues relating to both servicing and manufacturing. The hybrid service and manufacturing process indicates the need for an information management system feeding into both the manufacturing and service subsystems for requests which can be an ERP system or other information processing systems. There is also a significant involvement of the management dealing with suppliers in the hybrid service and manufacturing process subsystems because there is no output without the raw materials for the manufacturing and no service output without the manufactured items.



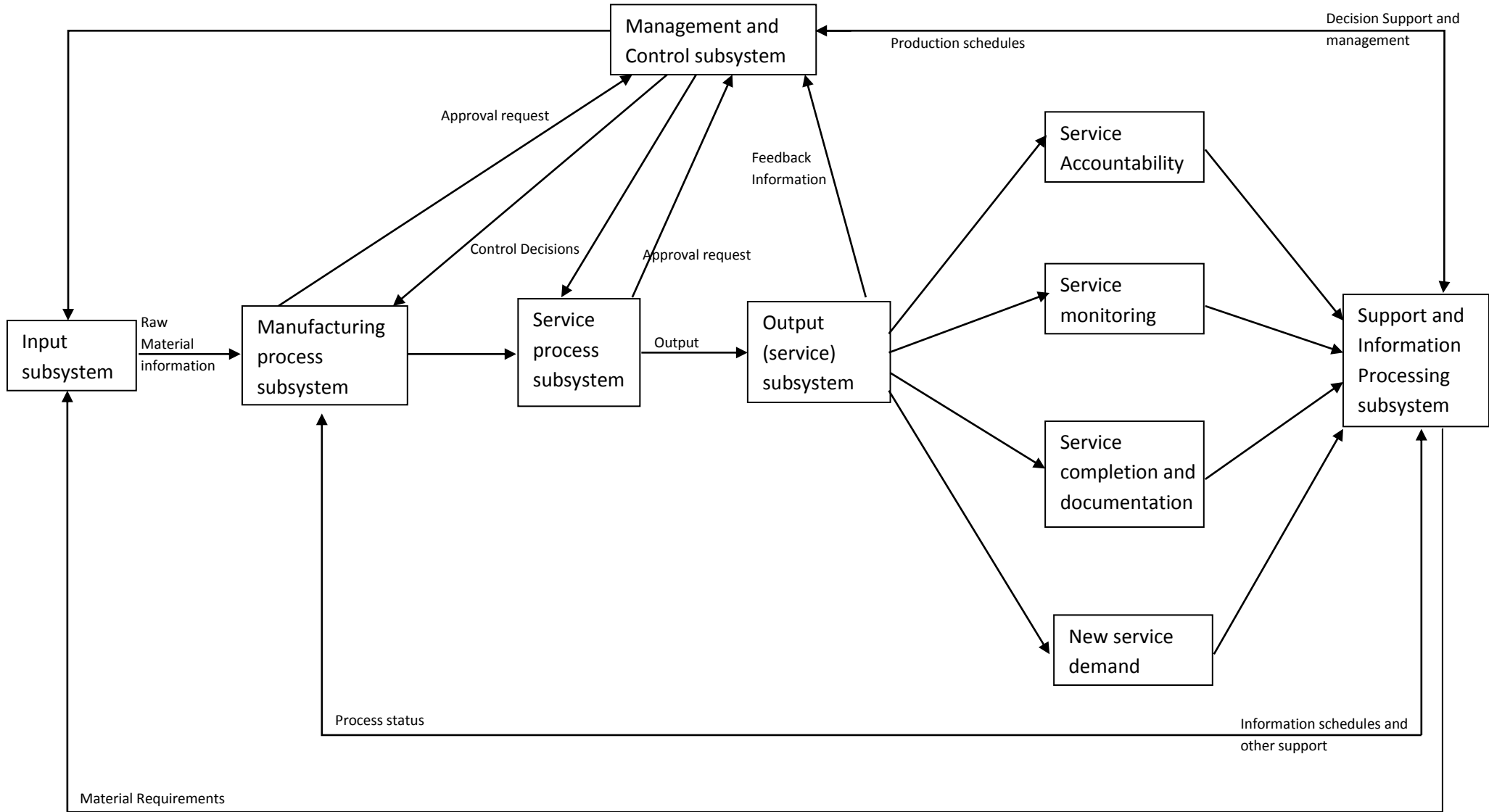


Fig 5.4 Theoretic model of the hybrid service business process

**Hybrid service and manufacturing model:** *this study proposes that the theory of hybrid service and manufacturing model can first, be said to take only one external input, raw materials, which is fed into the manufacturing subsystem to produce an output. Then the service subsystem further takes more than one external input, the effort from the engineer, while carrying out the service and output from the manufacturing subsystem. The service subsystem then shares a two-way information transfer between the management and ERP system in order to effectively carry out the required service for the customer.*

Having mentioned that service-oriented architecture (SOA) has been adopted by SAP, the expectation was that enterprise services could benefit from SAP solutions in conjunction with partner solutions and other bespoke solutions (SAP, 2010). This study also evaluated other full ERP systems available for hybrid service and manufacturing SMEs, such as Microsoft Dynamics Navision. The literature review identified that there is a gap in service-process inefficiency in ERP systems available for hybrid service and manufacturing SMEs adoption. Hybrid service and manufacturing organisations, whose main business strategy is manufacturing with service being secondary, could use most of the available ERP systems. However hybrid service and manufacturing SMEs, whose main business strategy is service with manufacturing as secondary, find that the available ERP systems cannot support their core service business strategies. Manufacturing SMEs benefit from adopting an appropriate ERP solution by improving the organisational strategy, profitability and machine utilisation (Fulton and Hon, 2010). However, the action case hybrid service and manufacturing SME, having a more service oriented business strategy, is left out on these benefits as a result of the inability of the available ERP systems meeting the service specific needs. The service specific needs found in this study were discussed in the previous chapters and summarised below:

**Engineers' efficiency:** This study confirms that ERP solutions are designed to have features that are more ideal for manufacturing and retail operations as identified by Bealby (2010); as a result hybrid service and manufacturing SMEs find these ERP systems incomplete with regards to their service business strategy. Most manufacturing business strategies concentrate on the production of a tangible output using defined raw materials and do not involve an engineer carrying out a task for the customer as part of the output. ERP systems, as mentioned earlier in

this study, are developed primarily to accommodate the production of an output using inputs and also running material resource planning (MRP). This is, therefore, the reason for this study's conclusion that the basic business strategy focused on during the design of most off-the-shelf ERP systems is the manufacturing strategy.

***Measuring customer satisfaction:*** The available ERP systems fail to provide hybrid SMEs with real time information from engineers and staff when they carry out services and repairs on customer's site. This study, from the questionnaire and interview feedback, identified that this has been perceived as a major inefficiency in the ERP systems available for such hybrid service and manufacturing SMEs to implement. From the customer satisfaction survey in appendix 1b, 'Professionalism of engineers'; 'Quality of service provided'; 'Understanding of customers' needs' and 'Communication by engineers' were the areas customers rated the action case organisation as being 'well below average' and 'below average'. These are all areas related to customer's satisfaction and with an appropriate ERP system, a hybrid service and manufacturing SME can effectively measure its customers' satisfaction. Although a manufacturing business strategy does not carry out services on a customer's site, they can however also benefit from knowing how satisfied customers are with their products. It can further be argued that the knowledge of how satisfied customers are with products is not extremely strategic for only a manufacturing SME but is also extremely strategic for a hybrid service and manufacturing SME.

***Increase cash flow:*** The time between service completions, invoicing of the customer and receipt of payment from the customer is an area most service SMEs struggle to reduce due to lack of suitable ERP systems available to SME that can accommodate this issue. In manufacturing business strategy, this is not evident due to the absence of any service element for the customer. In the example of the action case study, it is found that some documentation indicating a particular service is complete took up to seven days to get to the office. As a result, this reduces the action case's cash flow. The use of a mobile device which the engineer uses to record data, and the information fed directly into the ERP system in the back office, will greatly impact on the time wasted for the information to be received via post.

**Better stock management: Operations Management:** Hybrid service and manufacturing SMEs, who not only have stocks in the office warehouses but also hold stocks in the engineer's vans, need visibility on the stocks on the engineers van, when they are used, the job they were used on and if replacement of the stock is required. Most ERP systems provide the visibility of handling non-mobile warehouses, however for such hybrid service and manufacturing SME, there is need to manage mobile warehouses located in each engineer's van. With such visibility, engineers have identified that it would be easier with the knowledge of stock on each engineer's van and the stock in the warehouses, they could easily swap stock around if properly managed by the ERP system.

**Fewer customisations: Systems Architecture:** Most IT vendors propose or offer solutions that would require a substantial amount of customisation to meet an organisation's goal. Whilst this can be useful, it is expensive, it could present the SME with potential issues and it can make the overall ERP system more complicated and difficult to manage. As a result, the study found that adopting an ERP system which fits more closely to the service and manufacturing hybrid SME's business processes will reduce the risk of such need for customisation. The adoption of an ERP solution with a platform accessible via SDK, for example, provides the flexibility for minimal customisation and data transfer required for the ERP solution to fit properly into the SME's business processes. Customisation of ERP systems is therefore available for both manufacturing and service business strategies. However, because the business model used in designing the architecture of these ERP systems is that of manufacturing, they are almost perfectly suited for organisations operating on manufacturing business strategy, hence requiring little or no customisations. This is unlike in the service business strategy where customisations are essential in order to get these ERP systems originally designed using the manufacturing model to also accommodate the service business model.

**Integration and Systems architecture:** Hybrid service and manufacturing SME, such as the action case, have disparate IT systems as a result of using different ERP systems to meet the service functionality, while also using another ERP system to meet the manufacturing functionality. This results into issues such as the disparate ERP systems not interacting with each other thereby causing the duplication of data entry to maintain accurate data in both systems.

### ***5.3.2 ERP Adoption model in hybrid service and manufacturing SME***

With the uniqueness of this hybrid service and manufacturing SME and the design of ERP systems, using core manufacturing business processes, the use of a model which allows detailed systematic evaluation of ERP and IS systems becomes more necessary. As a result of the need for a detailed systematic approach in mapping required features against features on potential ERP systems before implementation, the model in Figure 4.12 is proposed. The use of this model in figure 4.12, feature/service evaluation grid, was useful in the pre-adoption decision-making and implementation of an ERP solution with service elements for the hybrid service and manufacturing SME. The model presents the organisation and those involved in the ERP selection a better understanding of the features, identified during interviews. These are the features required to meet both the service and manufacturing functionalities. Not only does this aid the conceptualisation and prioritisation of the features required to meet the current business processes and future business needs, it also allows the evaluation of add-ons which can be plugged into the existing ERP system to meet other process requirements.

The study found that the last two ERP systems adopted by the action case organisation were adopted without using any model in analysing the business processes before the implementation. There was also no evidence of a structured approach to identifying the suitability of the ERP systems implemented in the past in this hybrid service and manufacturing SME. Although these last two ERP systems contain standard features like most available ERP systems, they do not support the service business strategy of hybrid service and manufacturing SMEs. This is because these ERP systems are designed with manufacturing core functions and for hybrid service and manufacturing SMEs who take on manufacturing in order to become more strategic; the off-the-shelf ERP systems fail to meet the more complicated business processes of hybrid service and manufacturing SME.

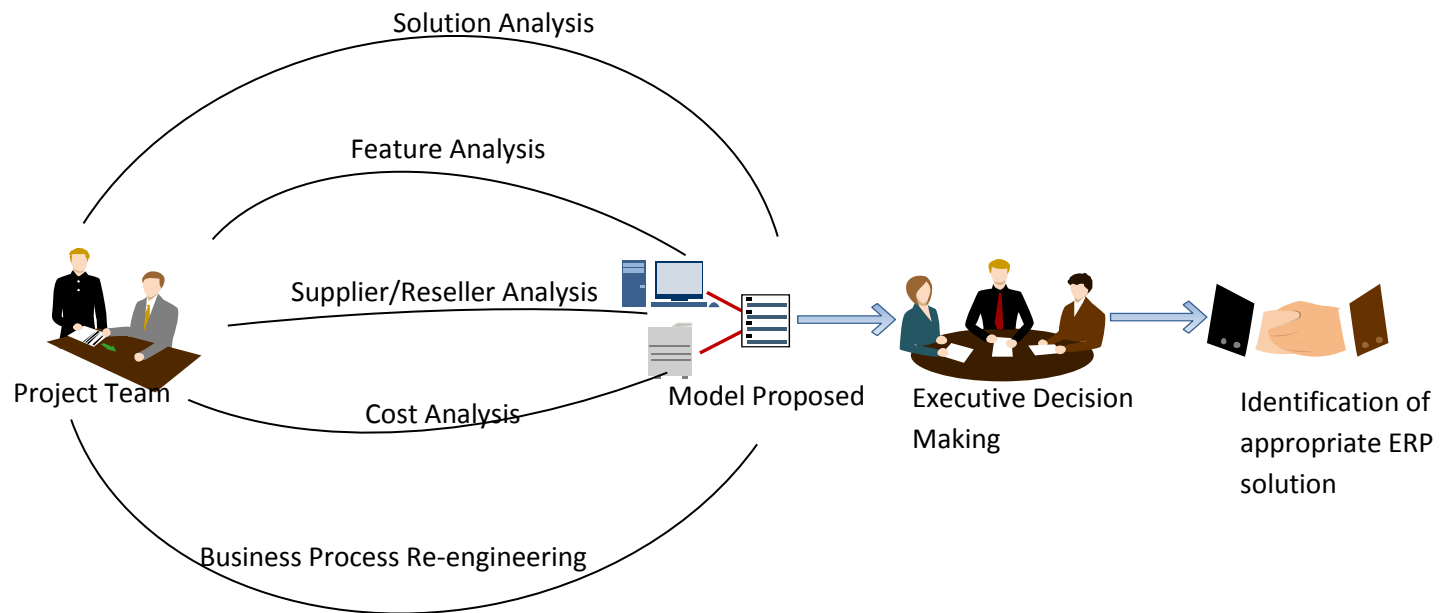
For an SME which runs a complete manufacturing process, it is relatively easy to adopt an ERP system without going through a rigorous evaluation to map the business processes against ERP features. This is because the ERP systems which already have manufacturing business processes will require little or no customisation in order to fit into another manufacturing business process. However, for an SME whose main business process strategy is service combined with

manufacturing, the adoption of an ERP system which suits the hybrid business process becomes more difficult. Hence the ERP adoption concept below is useful in ensuring that the important generic factors are adequately evaluated and agreed by strategic stakeholders. Firstly the project team gathered and reviewed information from surveys, questionnaires, interviews and historic data which the researcher fed into the ERP evaluation model proposed in fig 4.12. Information gathered and fed into the model were those on the required solution and features required for the ERP to effectively fit into the business processes of the action case SME.

The study supports the need to adequately manage change resulting from process reengineering during system implementation, in order to ensure that there is adequate involvement of the workforce during system implementation. To achieve this, the ERP system adoption and implementation process was discussed with the workforce, as well as keeping them informed of the benefits available to them and to the business, while also highlighting potential risks of changes on how activities would be performed.

Information on the solution developers and the reseller's stability as an organisation is also gathered in order to ensure that with the SME's growth, the system remains future proof. Proposed areas of improvement on the business processes based on current and future state analysis using VSM is also fed into the model. The model is then used to obtain more intelligent information on each of the proposed ERP systems, and then used in making an informed decision on the most suitable ERP system(s). The identified system(s) is then proposed to the executive board, which makes a final decision based on the information presented to them using the evaluation model. The overall ERP adoption and implementation concept as discussed above is represented in figure 5.5 below.

**Fig. 5.5 ERP system adoption concept**



In the current research, figure 5.5 above is an overview of the various stages of analysis and decisions towards the identification and selection of the appropriate hybrid service and manufacturing ERP system suitable for such an SME. The initiation of the process began with the constitution of the project team made up of the researcher who from Zellner (2011), in table 5.1, is the 'Role Model'. Also among the members of the project team are the Operations Manager of Alpha and three academic staff of the University of Salford. The project team carried out five main types of analysis which were used to develop the model proposed in this study, which was also sent to the executive board for further analysis and approval. The first of the five stages of analyses as shown in fig. 5.5 is the solution analysis, which is the analysis of all available solutions at the point of evaluating potential solutions. The second analysis is the feature analysis, which evaluates how each of the features required by the action case organisation is met by the potential solution. The third analysis is the analysis of the reseller in order to identify the fit between the action case organisation and the solution reseller. The fourth analysis is the cost analysis which reviewed the cost impact of business process activities. Finally, the fifth is the business process re-engineering which evaluates all the activities, cost analysis and potential features that could improve the current business process, and then proposes achievable changes capable of improving the current business processes.

### ***5.3.3 Non-hybrid SME ERP Adoption model***

From a manufacturing organisation's point of view, Law and Ngai (2007) used a similar approach to that used in this study by first gathering data via interviews with the users to document the requirements expected from the prospective system. They then used the data collected to test the hypothesis and the extent to which users wanted specific features. Their study focused on the features with little emphasis on how to match these features against prospective ERP systems. They also tested a hypothesis on senior management support on an ERP implementation, which in a hybrid service and manufacturing SME would be important to show how senior management contribute to the choice of adopted ERP system. A more detailed ERP adoption model is given by Powell, Alfnes, Strandhagen and Dreyer (2013) where they proposed seven steps which are:



1. Establish strategic vision
2. Identify and establish teams
3. Identify products
4. Identify processes
5. Review factory layout
6. Select appropriate strategy
7. Continuously improve

This approach identified the need for the establishment of a strategic vision which can be achieved by the adoption and implementation of an appropriate ERP system. This is the same concept applied in this study, which also emphasised the importance of establishing the strategic need for an ERP adoption. In this stage they also recommended a cost benefit analysis, which the approach recommended in this study also recommends. The next phase is to establish teams who become strategic during the identification and implementation of the appropriate ERP system. Powellet al. (2013) also emphasised that teams are essential if a successful ERP adoption and implementation was to be achieved. The next phase, as suggested by Powell et. al. (2013), is defining the products that can be used and defining the processes that the SME requires. The approach recommended in this study extends this further by defining the processes currently used by the SME, streamlining the processes and using the streamlined business process to map against potential ERP systems. The advantage of this is that a more strategic ERP system capable of supporting future strategic growth of the SME is adopted and implemented. The next phase is reviewing factory settings, which further reviews the uniqueness of the organisation and is most suitably applied in a manufacturing organisation. The phase of selecting an appropriate strategy is important but in this approach from Powell, Alfnes, Strandhagen and Dreyer (2013), there is no mention of how the strategy was created. In the current study, the use of VSM of the future state creates a strategy of meeting both the current and future business process demands. Continuous improvement is always the last phase of IS implementation which also involves user support and customisation of the ERP system to effectively fit the business process of the SME.

### **5.3.4 RQ3 summary**

**Research Question 3:** How does business process automation affect a hybrid service and manufacturing SME?

**Finding:** The current systems at Alpha Ltd require labour-intensive work in order to maintain this high quality of service; there are high expectations across the company for the add-on to the existing SAP Business One system. System outages have a much bigger impact on SMEs compared to large enterprises; some statistics suggest that seven out of ten SMEs can go out of business after a major data loss event (Bilan, 2010). Hence the service quality that SMEs offer has to be high to keep them in business (Martin et al., 2008), which in-turn relies on the resilience of the IT infrastructure installed and maintained by the SAP partners. This study found that business process automation provided the capacity that such a hybrid organisation requires in order to manage its unique business processes. Unlike in manufacturing business process where raw materials are mainly sourced externally or in service where the equipment required to carry out service is sourced externally, in the hybrid business process the service business process depends on the manufacturing section for raw materials. That is, in the hybrid business process, to carry out a service, the engineer might require service parts such as an air filter which is manufactured by the manufacturing section of the business. For example, without the input air filter, the service section will not be able to carry out the required service, there is therefore a dependency of the service business on the manufacturing sector. As a result, business process automation in the hybrid business would have greater impact as a result of the hybrid business having two defined and different business strategies where one strategy (service) significantly depends on the other (manufacturing). For example, an improvement in the manufacturing sector, such as reducing the time and resources required to produce an air filter, will impact positively on the service sector by reducing the waiting time for this filter which improves the information processing capability of the organisation. This improvement in time in turn will improve the overall time from the customer placing the service request to the actual carrying out of the service. The current action case study highlights the complexity of an extensive review, which was carried out with representatives of all stakeholders of the project to identify the most suitable, cost effective and reliable technological solution and vendor. The significance of the vendor was found to be crucial. Despite the 'off-the shelf' nature of the

majority of software products, a reliable vendor offering after sales support is a must for any business. It transpired from the vendor interviews that there is a feeling amongst SAP Business One resellers that any company that supports this entry level SAP product needs at least 30 customers in order to justify investment in a new member of support staff. This disadvantages any small reseller who might not have these numbers; if they have low profit margins, they might struggle to construct a viable business model on this product alone. With the automation of processes, errors are removed from the processing of information ensuring that the processing of information can be repeated in the exact same way. This gives hybrid organisations greater reliance on the data from the system and more capacity for growth. Therefore the introduction of an effective ERP system capable of managing the unique business processes offers the service SME the opportunity to maintain good service quality and also keep the service SME in business.

#### ***5.4 Limitations and Strengths of the Research***

This research was challenging due to the constraints placed on the researcher, based on the selection of the action case and time available to gather data. Yin (2009) noted that every research study has restrictions that limits it and these restrictions are placed by the researcher and context of the research. As far as possible, the researcher attempted to overcome the limitations to ensure that the study was conducted thoroughly. One of the limitations of this research is that the finding in the current study is limited to the action case and this is in line with the KTP study. The research investigated OIPT and identified the lack of usage, and as a result of this lack of usage, the researcher developed an interest in studying OIPT and its application in this unique KTP setting. A consequence of this limitation, KTP Setting, is regarding the choice of sample selection, which allowed the selection of only a single action case. Another action case could not be included in the current study because of the KTP setting and the uniqueness of the service hybrid business process, which makes it relatively difficult to identify similar organisation willing to either carry out a business process re-engineering or an ERP implementation. It is important to mention that the selection of this action case was a unique opportunity as described by Oates (2006) and Benbasat et al. (1987) and was assumed that such opportunity might not present itself again. Some aspects of this research, such as specialist

issues within hybrid service and manufacturing SME, cannot be widely generalised to all SMEs. However, the main results can be considered by other SMEs while planning to adapt an ERP system. In line with interpretivist line of argument, the current study is generalising the findings to theory and not sample of population. Therefore generalisation to the theories of OIPT, value stream mapping and hybrid service and manufacturing SME are proposed. The current study suggests the clarification of the hybrid service and manufacturing business process as one which **takes firstly only one external input, raw materials which is fed into the manufacturing subsystem to produce an output. Then the service subsystem further takes more than one external input, the effort from the engineer while carrying out the service, and output from the manufacturing subsystem. The service subsystem then shares a two way information transfer between the management and ERP system in order to effectively carryout the required service for the customer.**

Another limitation encountered was the available time for obtaining data and ensuring the ERP system was up and running in the action case company. Due to the nature of the funding allocated to the project, the KTP research duration implied the researcher had two years to gather data, identify and implement the most appropriate ERP system. As result of the time constraint, the researcher was faced with the challenge of prioritising whether to capture data for the purpose of this research or to perform action which will directly impact positively on the action case. The decision on what to prioritise was greatly dependent on the related action and the data being collected. Regular meetings between the researcher, the academic staff and the KTP supervisors ensured that a balance was maintained and that the researcher maintained a critical distance required for the current study.

In terms of strengths, multiple methods were used in collecting data. The face-to-face interviews with users and potential suppliers helped in drawing a clear picture of the action case's current business processes and the understanding of the business process contained in each potential system. The interviews, generally, provided an in-depth rich information used in structuring the entire study, with the researcher being as passive as possible during interviews and job shadowing.

## **5.5 Reflection on Methodology**

The researcher used action case in which a single case was used based on the uniqueness of the business process of the SME investigated. This also allowed the involvement of the researcher to gather data without influencing the outcome of the study. The choice of interpretive approach was based on its suitability for understanding phenomena through the meaning people involved assign to them. In the study, interpretivism was used to understand the context of the ERP system pre-adoption decision-making as the IS system, whereby IS influences and is influenced by the context being studied. Other important criteria in the selection of the research approach were the research questions, aims and objectives set out in chapter one. Research methods based on the interpretive paradigm was found to be suitable for understanding and capturing the rich experience of a practitioner and also analysing non-generic research questions. The study focused on qualitative data and, where necessary, converted the qualitative data using a weighing method. This approach helped to achieve the research results as well as provided data used in the analysis. A lot of internal and external factors from various sections of the organisation (ERP users, customers, field engineers and ERP systems suppliers) provided an in-depth understanding of the subject.

## **5.6 Reflections on the research from the interpretive perspective**

This section describes the evaluation of the current study from the perspective of the seven principles for a high quality interpretive field study, as proposed by Klein and Myers (1999). Using the seven principles, the researcher is able to reflect, evaluate and ensure the credibility and reliability of the outcomes. This section first considers all the seven principles and further evaluated the three research questions from the perspective of the relevant aspects of the seven principles. The application of the seven principles are all from the perspective of the researcher as encouraged by Klein and Myers (1999).

### **5.6.1 The principle of the hermeneutic circle**

The hermeneutic circle is a key principle of interpretive research and holds that all human understanding is achieved by iterating between considering the interdependent meaning of

parts and the whole that they form and this is fundamental to all other principles (Klein and Myers, 1999). According to Lee (1994), hermeneutics is the study of interpretation, especially the process of fully understanding a text as a whole. In order to fully understand the social aspects of life and the complex whole, the hermeneutic circle is used to guide and enhance the understanding of the meaning and interrelation of various parts, which combine to make up the perception or understanding of the complex whole. As a result of the hermeneutic circle's view of understanding the parts that make up the whole, this work adopted the methodology of identifying and understanding the parts of the process of ERP system adoption for a hybrid service and manufacturing SME, which is then used to guide a better understanding of the process in whole via a continuous improvement process. This process of iteration was important in gaining an understanding of the users' perception of and expectations from the potential ERP system. This process of iteration also establishes how these two factors influence the process and choice of ERP system adoption and was evident in this analysis stage.

The adoption of the suitable service and manufacturing ERP system for this hybrid SME was achieved as a result of reviews of the whole process. A similar view was taken by Lee (1994), who noted a continuous process of iteration between the parts and the whole which they form part of. It is important to get information about the users' expectations of the system, but this is only useful if it leads to the identification of the required service solution. Being aware of this fact made the researcher keen to constantly refer back to the individual perceptions that had been gathered, about the required service solution. The process of identifying and eliminating areas of waste within the existing business process was taken as a whole. The information from questionnaires was used to design a value stream process of the current and future states. Finally, the future state value stream process was used in the development of the adopted system. The suitable service and manufacturing ERP system, which is the whole, was constantly revisited while analysing information from the intended users. This was also the case while developing the VSM as well as while reviewing prospective solutions and vendors. As a result, this study followed the fundamental principle of the hermeneutic circle by using information from the parts to understand and inform the whole, as well as using information from the whole to fully understand the parts.

***Applying the hermeneutic circle to the research question: How does business process analysis using Value Stream Mapping impact the implementation and customisation of an ERP system in a hybrid service and manufacturing SME?***

As stated in the principle of the hermeneutic circle, the understanding of the whole which is the identification and adoption of an appropriate ERP system to meet the needs of the hybrid service and manufacturing SME was guided and understood by breaking the components.

In the current study, the context is provided by the literature discussion on BPI, Information Model and Hybrid service and manufacturing SMEs. The specifics are given through the special action case of Alpha which went through the process of BPI using VSM.

One of the components was the construction of VSM in order to understand the areas of the business process that required improvement. In order to use the data from VSM to meaningfully identify the most appropriate solution which would meet the business processes with minimal customisation, another part based on the hermeneutic circle was created which is the information model used to understand the features provided by each potential solution.

***Applying the hermeneutic circle to the research question: How does business process automation affect a hybrid service and manufacturing SME?***

The idea of a hermeneutic circle refers to the dialectic between the understanding of the hybrid service and manufacturing SME as the whole and the interpretation of its parts. The understanding of these parts, which are service SME and manufacturing SME, is essential in order to fully interpret the whole. It is a circular relationship in which interpretation from the typical service and manufacturing strategies in an SME were used to further interpret the uniqueness of the hybrid service and manufacturing SME. The understanding of the hybrid service and manufacturing SME was also used to give more interpretation of the parts being studied. Using the hermeneutic strategy, this study first identified the clear and obvious meanings, which are typical service and manufacturing strategies, and then used this understanding to make sense of the more obscure and confusing hybrid service and manufacturing strategy. Thus keeping an open mind, hermeneutics circle manifests a circular pattern where the progress of an investigation returns the researcher to the starting point, and the new beginning results to a new course of progress (Dilthey, 1990). The interpretation of

parts hence yields a conception of the whole however that conception brings a whole new meaning to the parts, and may result to re-conception of the whole as a result of re-interpretation of the parts.

***Applying the hermeneutic circle to the research question: How can an SME benefit from the use of OIPT in an ERP implementation for an SME?***

The hermeneutic circle and its dialectic between the understanding of the hybrid service and manufacturing SME as the whole and the interpretation of its parts which are service SME and manufacturing SME in order to fully interpret the whole can benefit from using OIPT to understand the whole. The information needed to gain a better understanding of the business process can be broken down into information processing requirements and information processing capability. The understanding of each of the units feeds into the understanding of the system requirements, which further translates to understanding of the fit between the information processing requirements, information processing capability and the ERP system functionalities. This is a circular relationship in which interpretation using OIPT informs the understanding of the choice of ERP system being adopted. Using the hermeneutic strategy, this study first used interviews, questionnaires, observations, documentation and meetings, gathered data based on the information needs and information processing capability of the various units. Using this information, the study was able to appropriately link relationship of information gathered against the features of the ERP being adopted.

***5.6.2 Principle of contextualization***

This principle of contextualisation requires critical reflection of the social and historical background of the research setting, so that the intended audience can see how the current situation under investigation emerged (Klein and Myers, 1999). To fully understand and follow how the current situation being investigated emerged, the principle of contextualisation required that the subject matter be set in its social and historical context. This study has used the interpretive research approach, which supports the argument that organisations are not static and the relationships between people, organisations and technology are dynamic and constantly changing. As a result, interpretivists believe that an organisation historically avoids



making the same mistake twice (Klein and Myers, 1999) especially regarding ERP system implementations. The hybrid service and manufacturing ERP system has been the focal point of this study and can be referred to as the phenomenon which requires contextual understanding. The understanding of the context will aid the understanding of how this organisation outgrew its existing ERP system and why the existing ERP system became inefficient due to strategic expansions, such as new business acquisitions.

As a result of understanding the context being studied, the researcher collected data on the history of the organisation, especially in connection to past systems implementation, as shown in chapter four table 4.1. This historic data collection was to aid the understanding of the socio-technological context. Interestingly, OIPT also supports the addressing of complex issues and questions in complex business environments (Premkumar et al., 2005), this complex business environment is the context. As a result of the above, the use OIPT did not constitute any form of limitation to this research and the theory and research approach adopted.

***Applying the principle of contextualization to the research question: How does business process analysis using Value Stream Mapping impact the implementation and customisation of an ERP system in a hybrid service and manufacturing SME?***

The principle of contextualisation requires critical reflection of the social and **historical background of the research setting**, so that the intended audience can see how the current situation under investigation emerged (Klein and Myers, 1999). To fully understand and follow how the current situation being investigated in this study emerged, this principle was used to ensure that the problem being investigated in this hybrid service and manufacturing SME, as the subject matter, was set in its social and historical context. This can be inferred from feedback from customer and engineer questionnaire such as;

*‘Having to post job sheets, customer satisfaction notes and time sheets on Friday and sometimes waiting until Wednesday the next week for them to be confirmed received at Alpha’ (Appendix 1a: Employee Questionnaire Code B 04/02/2010)*

*‘Pricing breakdown before servicing takes place. Please can you contact us on this subject’*

*‘Better diagnostics’ (Appendix 1b: Customer Questionnaire)*

It can be inferred that the process of sending job sheets via post was acceptable in the past. The same can be said about the customer whom at the point of being a customer of the organisation would have been informed of the process and might have also accepted that as the process. This confirms the argument from the literature that organisations are not static and the relationships between people, organisations and technology are dynamic and constantly changing. Although both staff and customers at some point accepted the current process, but as the business changes and the social context of each business changes, organisations become dynamic, therefore requiring changes in processes. The literature also argued that interpretivists believe that organisations avoid making historic mistakes (Klein and Myers, 1999); this study confirms Klein and Myers' argument because the action case's acceptance of a more structured approach to adopting an ERP system which fulfils all its business process needs confirms that SMEs such as the action case, avoid repeating historic mistakes associated to information systems adoption. In the action case SME, due to expansion through growth and acquisitions, Alpha has seen an increase in the number of disparate information systems being used as part of its IT infrastructures. There were four disparate systems which were implemented with the view of a full ERP system and were in use before the commencement of this project. These systems were SAP Business One, Telemagic, Resultware and Sage Payroll. SAP Business One was perceived as the general ERP system, which was used, but greatly under-used. Telemagic, Resultware and Sage were used to complement the inadequacies of SAP Business One.

***Applying the principle of contextualization to the research question: How does business process automation affect a hybrid service and manufacturing SME?***

Contextualization of research made it possible to confront previous challenges as it facilitated the comparison of constructs of the study of the adoption of appropriate service oriented ERP system in the hybrid service and manufacturing SME to those of previous implementations in the action case SME. Contextualization also helped this study to specify the point of view focused, which is the identification and implementation of an ERP system which supports the present business process. The ERP system should also be capable of supporting the re-

engineered business process following a streamlining of the current process using VSM. With conceptualization, the researcher in this study was able to understand how historical events such as the previous implementations of Opera, Telemagic and Resultware systems were done and why they were termed as a failure by the action case organisation. The researcher was also able to compare the steps followed during the adoption and implementation of the previous systems in order to gain an understanding of how some steps might have influenced the choice of previous systems. A contextualization of the employee roles and involvement was also carried out to understand positive and negative roles and involvement. This study identified that with the contextualization of roles and involvement during previous ERP adoption and implementation, using the right role for a particular task with defined constraints, a more reliable result is obtained. The contextualization of the action case organisation provided the study with a better understanding of how the organisation has evolved from a service organisation to a hybrid service and manufacturing organisation and how it has grown by acquisition. Finally, contextualization of the above provided this study with a new perspective by which the researcher was able to explain similarities and differences between the findings and that which exists in literature (Vishwanath and HakemZadeh, 2012).

***Applying the principle of contextualization to the research question: How can an SME benefit from the use of OIPT in an ERP implementation for an SME?***

Contextualization of the research made it possible to overcome previous challenges as it facilitated the comparison of constructs of the study during the adoption of appropriate service oriented ERP system in the hybrid service and manufacturing SME to those of previous implementations in the action case SME. OIPT was used to establish the directors as the main sources of information requirements and capability in past ERP system implementations. Using contextualization, the study was able to agree with Yusuf, Gunasekaran and Abthorpe (2004), who argued that SMEs' would benefit more from adopted ERP systems if they paid more attention to the management of process integration and data inconsistency during ERP systems adoption like is the current situation in large organisations.

### ***5.6.3 Principle of interaction between researcher and subjects***

This principle of interaction between researcher and subjects considers the ‘critical reflection on how the research materials were socially constructed through the interaction between the researcher and participants’ (Klein and Myers, 1999). This principle considers how the understanding of the social construct, the whole being studied, improves as the researcher becomes self-conscious and starts asking questions about their previous assumptions. The principle supports the reflection of the researcher and participant’s role in moving the research towards the desired goal. This study, which has used the interpretivist approach, falls in-line with Klein and Myers’ (1999) argument of the recognition by interpretive researchers. Klein and Myers (1999) argued that participants, just like the researcher, can be seen as interpreters and analysts. As a result, the perspective of the whole process is that which is shared between the researcher and the participants.

The researcher was aware of the influence of participants such as the Director, whose opinion, although very valuable, should not influence the critical approach of the research. Care was also taken to avoid vendors influencing the decision on selecting appropriate solutions. This was by ensuring that the same criteria were used in measuring the suitability of each solution, as shown in fig. 4.2. Furthermore, management buy-in was of great importance while collecting data from staff. Management buy-in is important because in most cases these staff would have to be slower with their duties to ensure the researcher was carried along during the VSM process and interviews. In relating the principle of contextualisation here, the experience of this organisation in the past was that ERP implementations always failed, thereby making the participants less keen to participate. However, the knowledge that management fully backed this implementation motivated staff into doing their best and participating fully, which helped the researcher carry out this work. The finding of this research is therefore the interpretation and perspective of the researcher and the participants involved in this study.

#### ***Applying the principle of interaction between researcher and subjects to the research***

##### ***question: How does business process automation affect a hybrid service and manufacturing SME?***

The principle of interaction between researcher and subjects considers how the understanding of the social construct, the whole being studied, improves as the researcher becomes self-

conscious and starts asking questions about their previous assumptions. In this section, the subject is the hybrid service and manufacturing SME and the principle supports the reflection of the researcher and participant's role in moving the research towards the desired goal. Klein and Myers (1999) argued that participants like the researcher in the current study can be seen as interpreters and analysts. As a result, the perspective of the whole process is that which is shared between the researcher and the participants. Having chosen a qualitative approach to investigate the subject, meetings with stakeholders, questionnaires, document analysis and in-depth interviews were selected as the data collection instruments. Observations allowed interactions between the subjects and ensured that initial ideas from the subjects' point of view can be obtained. In-depth interviews provided the researcher in the current study with the opportunity to capture detailed information about the hybrid service and manufacturing SME. Insightful ideas provided by archival documents in the hybrid service and manufacturing SME was followed up by the researcher and this method is suitable for understanding inherent human feelings as supported by the Organisational Information Processing Theory OIPT.

#### ***5.6.4 Principle of abstraction and generalisation***

The principle of abstraction and generalisation 'requires relating the idiographic details revealed by the data interpretation through the application of principles one and two to theoretical, general concepts that describe the nature of human understanding and social action' (Klein and Myers, 1999).

The main strength of OIPT is in its ability to closely relate technology and organisational needs, this forms the main reason for applying the OIPT to this study. According to Monteiro and Hanseth (1996), this principle focuses on general theoretical (OIPT) relations between technological and organisational issues. With Guo and Sheffield's (2008) argument, that an interpretive study provides an understanding of particular social settings, OIPT has been successfully applied as the theoretical framework used in further understanding and discussions of particular social settings (Premkumar et al., 2005, Cegielski et al., 2012, Gattiker and Goodhue, 2005).

One fundamental acknowledgement in the interpretivist approach is its perception that the researcher is not completely detached from the phenomenon being studied, as mentioned earlier.

***Applying the principle of abstraction and generalisation to the research question: How does business process automation affect a hybrid service and manufacturing SME?***

The main strength of OIPT is in its ability to closely relate technology and organisational needs, this forms the main reason for applying the OIPT to this study. This section aimed to understand the uniqueness of the hybrid service and manufacturing SME and the relationship with typical manufacturing and service business processes. As a result of this, the current study presented ERP features which are specifically unique for such hybrid service and manufacturing SME business process. In order to achieve this, bearing in mind this principle, a clear definition of a typical manufacturing business process as well as a typical service business process was given in order to aid the reader understand clearly what makes this hybrid service and manufacturing SME unique.

***5.6.5 Principle of dialogical reasoning***

This fifth principle of dialogical reasoning, according to Klein and Myers (1999), ‘requires sensitivity to possible contradictions between the theoretical preconceptions guiding the research design and actual findings (‘the story which the data tells’) with subsequent cycles of revision.’ The most important aspect of this principle is that the researcher makes the fundamental philosophical assumptions within the research as clear as possible to both the reader and the researcher. With the philosophical assumptions made clear, it is possible to identify data and its relevance to the study, thereby collecting and analysing only data relevant to the study.

The researcher has always had the intention of studying the impact of effective business process analysis on the adoption and implementation of appropriate service ERP system and this led to his involvement in this live project. Furthermore, the research questions were constructed in light of historical failures with ERP adoption in this hybrid organisation and the existing

literature about the impact of business analysis on ERP adoption. With many researchers focusing on the evaluation of successes or failures of ERP system implementation as well as ERP implementation in manufacturing, this work took a more unique focus on hybrid service/manufacturing HVAC organisation. The reason for this, as stated in chapter one, is that the business processes in this hybrid organisation is very unique unlike in manufacturing. The hybrid service and manufacturing SME business processes are not just primarily focused on converting raw materials to finished products, but also involves human resources in the form of a service.

As discussed in chapter three, OIPT was used to guide the process of data analysis in order to gain better understanding of the data gathered. The researcher appreciates that this research could have been conducted without the guidance of a theory, but acknowledges that the use of a theory has been of great advantage in understanding and examining the validity of data in connection to the study.

***Applying the principle of dialogical reasoning to the research question: How does business process analysis using Value stream Mapping impact the implementation and customisation of an ERP system in a hybrid service and manufacturing SME?***

The principle of dialogical reasoning was also applied in this section in order to clearly define the fundamental philosophical assumptions and generalisation which guided the findings. The generalisation is that this study based its findings within the scope of an organisation which started off originally as a service SME but expanded to manufacturing parts used in carrying out its services (hybrid service and manufacturing SME). Unlike most studies that focus on evaluating success and failures of ERP implementations in manufacturing, this study contributes to aiding successful implementations in a hybrid service and manufacturing SME.

Based on the understanding of the documented past failures with ERP adoption and implementations cited in the literature, some organisations would argue that there is no added value to carrying out business process analysis using VSM, they would assume that a non structured process of ERP adoption would work for them. However, approaching the adoption of ERP systems in a non structured way in research would lead to a cycle of incomplete systems

requiring add-ons to enhance its performance. OIPT, as stated in chapter three, identifies three important concepts which are: information processing needs; information processing capability; and the fit between the two to obtain an optimal performance (Premkumar et al., 2005). Organisations continuously identify the need for quality information in order to cope with business uncertainties and improve their ability to make informed business decisions. In the action case, the organisation identified a lack of timely management information which translates to information processing needs. Organisations generally adapt two strategies to cope with uncertainty and increased information needs: firstly, they develop buffers to reduce the effect of uncertainty on their business; and secondly, they implement structural mechanisms and information processing capability to enhance the flow of information and thereby reduce or even eliminate uncertainties. A common example of the first strategy in the current study is the building-in of a time buffer into the typical time required for a service engineer to carry out a job on a customer's site in order to reduce the effect of uncertainty in quality of services delivered. Cooper and Wolfe (2005a) argued, which is also confirmed in the current study, that ERP adoption activities differ with the extent of uncertainty as discussed in chapter three. It is identified that the more information processing needs identified by SME, the more information processing capabilities required for effective performance of the processes. The current research was informed by this theory while redesigning the service SME's business processes and implementing an integrated information system in order to improve information flow and staff efficiency. As seen in the survey, some of the engineers and customers indicated a need for an improved information system. This confirms from the literature the need to maintain a balance in the ERP system adopted in order not to get stuck between business strategy and organisational configuration as indicated by Gebauer et al. (2010).

***Applying the principle of dialogical reasoning to the research question: How does business process automation affect a hybrid service and manufacturing SME?***

The research made clear the fundamental assumption that hybrid service and manufacturing SME business process is different from typical service and typical manufacturing business process. Having made clear the assumption, the method of data collection was tailored to accommodate the gathering of data relevant to demonstrating the uniqueness of the hybrid



service and manufacturing SME. The researcher has always had the intention of studying the impact of effective business process analysis on the adoption and implementation of appropriate service ERP system and this led to his involvement in the current study in an action case organisation. The research questions were constructed in light of historical failures with ERP adoption in the action case hybrid organisation and the existing literature about the impact of business analysis on ERP adoption. The current study focuses on hybrid service and manufacturing SME and ERP implementation in the action case organisation and this is due to the lack of research in this area, as mentioned in the literature review. The reason for this, as stated in chapter one and also demonstrated in this study, is that the business processes in the hybrid organisation is unique unlike the business process in typical manufacturing or service organisation. As discussed in chapter three, OIPT was used to guide the process of data analysis in order to gain better understanding of the data gathered. The researcher appreciates that this research could have been conducted without the guidance of a theory, but acknowledges that the use of a theory has been of great advantage in understanding and examining the validity of data in connection to the study.

#### ***5.6.6 The Principle of multiple interpretations***

Klein and Myers' (1999) principle of multiple interpretations requires 'sensitivity to possible differences in interpretations among the participants as are typically expressed in multiple narratives or stories of the same sequence of events under study'. This principle requires the researcher to review the impacts that the social context has on the actions being studied by engaging and documenting multiple view points, as well as the reasons for those views. This was evident in this study as a result of the differing viewpoints collected from the stakeholders, who view ERP system requirements from the perspective of their job roles and what they perceive the ERP system should do for them. In the stakeholder's views, there is a conflict of perception in power and understanding of the existing business processes and values. The researcher had to confront and manage this conflict of perception, in order to ensure the most suitable ERP system is adopted and implemented. Such conflict does not exist in every organisation, but it is typical of ERP requirement gathering. This conflict is typical of ERP requirement gathering due to various role dependency and expectation of various departments from the ERP system being

adopted and implemented. Therefore the identification and management of these conflicts and multiple interpretations will lead to effective systems requirements gathering and therefore leading to the adoption and implementation of the most efficient service ERP system.

***Applying the principle of multiple interpretations to the research question: How does business process automation affect a hybrid service and manufacturing SME?***

Klein and Myers' (1999) principle of multiple interpretations requires 'sensitivity to possible differences in interpretations among the participants as are typically expressed in multiple narratives or stories of the same sequence of events under study'. Multiple interpretations are considered in this section from the perspective of the hybrid service and manufacturing SME. From the perspective of one of the account managers, standard SAP Business One does not give the user visibility on stocks on an engineers' van and it also fails to provide the needed editable template for document generation and printing. She also felt that there is need to improve the flexibility of the diary contained in SAP Business One while also reducing the duplication of information on the disparate systems (Appendix 1a). It was also interesting to read from her interview that from her perspective, customers are happy (Appendix 1a). Another interpretation is that of the customers who were asked how likely they were to continue using the action case's services, 76.4 percent indicated that they were very likely to continue using the services. However 22.2 percent of the customers who responded were not sure they would use Alpha's services, 1.4 percent was certain they would not use these services any more. Although the percentage of customers certain to use the services was high at 76.4 percent, it is also interesting to note that more than 23 percent of customers who responded might never use Alpha's services (Appendix 1b). This indicates that as opposed to the perspective of the account manager, it cannot be generalised that all customers were happy with the level of service delivered to them. For an organisation that intends to remain strategic, the 23 percent unsatisfied customers should present a real concern, as the retention of customers is equally as important as the building of a strong reputation to draw more new customers.

### ***5.6.7 The Principle of suspicion***

This final principle, according to Klein and Myers (1999), is the principle of suspicion, which requires ‘sensitivity to possible “biases” and systematic “distortions” in the narratives collected from the participants’. This principle encourages the researcher’s awareness of any possible bias, which could be either consciously or unconsciously introduced by the participants. The researcher was aware of this whilst collecting data from participants, especially whilst interviewing the Directors, who ultimately could influence the choice of what system is adopted and implemented. This awareness was maintained throughout the stages of this research, which included the choice of user participation, vendor participation, data collection and data analysis.

## ***5.7 Chapter summary***

This discussion chapter has focused on the three research questions asked in the current study. The individual questions were responded to and discussed in relation to the literature, highlighting original contributions and supporting existing knowledge.

The hybrid service and manufacturing SME is differentiated from typical manufacturing and service business processes. The section also emphasised the features sought after by hybrid service and manufacturing SMEs which standard off-the-shelve ERP systems fail to accommodate.

The interpretive research evaluation is conducted using the Klein and Myers (1999) framework. This research self-evaluation allows the reader to follow the logical processes used to arrive at the conclusion made in the next chapter.

## ***Chapter Six: Conclusion***

### ***6.0 Introduction***

The previous chapter discussed the similarities and differences between the empirical findings of this work and the findings from the literature. In this chapter, the contributions made by this study will be discussed using the guidelines for interpretive research contributions as mentioned in chapter three. The research questions will first be reviewed as indicated in the first chapter of this work; how they have been addressed in this study will also be detailed. An overview of the thesis is also provided in this chapter and this is followed by the interpretation of the research findings. Finally, the chapter suggests areas for further study.

### ***6.1 Achieving the Aim and Objectives of the Study***

The aim of this research is to contribute to knowledge and understanding of the impact of business process analysis on the pre-adoption decision-making and implementation of an Enterprise Resource Planning (ERP) system in a hybrid service and manufacturing HVAC SME. In order to contribute to existing literature in the subject area, the research aim has been achieved by addressing the research objectives as follows:

The first objective was *to investigate the ERP pre-adoption decision-making process in a hybrid service and manufacturing SME using Value Stream Mapping*. The purpose was to apply VSM in the analysis of a business process of a non typical manufacturing process. Existing literature has contributed to the understanding and application of VSM in manufacturing. As a result of the numerous studies on VSM application in manufacturing, there are more guides on the application of VSM which is more tailored to the manufacturing business process strategy. This study focused on contributing to knowledge on how the process of effective VSM analysis can contribute to a more efficient analysis of a **hybrid service and manufacturing** SME's business processes. Using VSM analysis of the current and future states of the hybrid service and manufacturing business process, as presented in sections 4.2.4.1 and 4.2.4.3 of the data analysis chapter, a structured approach was taken to the identification and adoption of the most

suitable ERP system to meet the functionalities identified in the future state VSM. Using OIPT as the preferred theory, the data analysis chapter was able to identify the information processing requirements and the information processing capability of the SME, however was unable to use the theory to identify the optimal performance. This study hence suggested embedding VSM as a means of identifying the optimal performance between information processing needs and information processing capabilities of an organisation. This study also demonstrated that the majority of the literature where VSM was applied was based on manufacturing business processes with little emphasis on service business processes. The study from the data analysis chapter successfully applied VSM to analyse a hybrid service and manufacturing SME's business processes.

One of the contributions resulting from this objective is the rich insight generated by the interpretive research method that allows the researcher to track the process of ERP system adoption in a hybrid service and manufacturing SME. This study highlights some of the unique features that a hybrid service and manufacturing SMEs needs and how these are challenged by the inadequate technological offerings.

The second objective was *to contribute to the tools available for researchers while evaluating ERP systems*. Data was collected from archival documents, interviews, questionnaires, observations and meetings which were used to develop the feature/service evaluation grid presented in fig 4.12 of the data analysis chapter suggesting how features identified from various sources can be presented in the grid and used as a benchmark while evaluating the suitability of identified IS/IT systems. Information on features identified as necessary in order to meet the future objectives of the organisation were identified and then assigned a weighted score based on information gathered. Potential ERP systems and SAP Business One add-ons were then evaluated via product demonstrations and a weighted score assigned to each of the potential solutions based on what extent it satisfied each feature. The grid was populated with all the information gathered and the solution with the largest total weighted average was identified as the most suitable solution. One of the contributions made here is that the suppliers themselves were identified as one of the criteria for analysis instead of focusing on the software features on their own. A methodical approach developed in this study could also be used as a template for future hybrid service and manufacturing SMEs.

The third objective was *to contribute to the understanding of business process analysis and its influence on ERP systems pre-adoption decision-making in the hybrid service and manufacturing industry*. This study reviewed the literature available and suggests that there is a gap on service management, which also includes hybrid service and manufacturing business strategy when compared to the well established literature on manufacturing. For successful implementation of most suitable ERP system in a hybrid service and manufacturing SME, proper business process analysis must be conducted and must also engage all stakeholders and not just the senior management, as discussed in chapter four. Following insights from the literature on business process analysis in SMEs, the current study identified similarities such as the need for involving management in order to get their buy-in into the ERP adoption process. Additionally, the findings from the literature have been based on ERP adoption and implementation in a manufacturing business strategy which was mainly studied in large organisations. However, the current study in a hybrid service and manufacturing SME, although agreeing with the existing literature, also suggests that if the ERP system directly or indirectly affects a department/group of stakeholders then the department or stakeholders should be engaged while selecting and implementing the appropriate ERP system. In the hybrid service and manufacturing business strategy customers have direct communication with the hybrid service and manufacturing SME as a consequence of the services being performed on the customer's site by the SME's service engineers. The current study argues that in the current situation, adopting and implementing the ERP solution, which meets the business needs, requires conducting business process analysis using methods such VSM and also using the information gathered from the analysis to form the basis of selecting a suitable ERP solution.

The fourth objective was *to contribute to knowledge about the use of action case as a methodology*. The study critically reviewed the relevant literature on action case methodology. This objective was achieved, as detailed in chapters two and three. The organisational information processing theory (OIPT) was used to provide a theoretical lens to gain better understanding of action case generated data. The literature review (chapter two) also covered the use of action case in project management in order to add a structural approach to project management. The themes from the literature, and in particular **specialist hybrid service and**

**manufacturing and business process analysis**, informed the development of the primary data collection approaches, as well as knowledge of the ERP systems pre-adoption decision-making in the hybrid service and manufacturing SME. Using action case, the current research made a major contribution to future studies by providing a meaningful definition of the hybrid service and manufacturing business process. This can be further developed by future studies. From the literature review in chapter 2, action case according to Vidgen and Braa (1997) represents a mix of interpretation/understanding and intervention/change, the current study reflected on the potential for research to change the case SME and used the understanding gained from the findings to propose the definition of the hybrid service and manufacturing business process. This contributes to the knowledge of how the elements of action research and that of case study was applied in the information systems study to generate a definition by using knowledge from practice to inform the suggestion of a definition. With the researcher's involvement as the action, the study was able to use a case, as suggested by action case, to propose the definition of the hybrid service and manufacturing business process.

## **6.2 *Answers to Research Questions***

The first question was, *how does business process analysis using Value Stream Mapping impact the implementation and customisation of an ERP system in a hybrid service and manufacturing SME?* The literature review (chapter two) identified the need to establish the basis upon which business process analysis should be focused and also evaluated two methods of conducting a structured business process analysis. Subsequently, the study conducted the process of business process analysis and re-engineering using VSM within the exploratory action case hybrid service and manufacturing SME. The outcome of the empirical investigation revealed that VSM can be effectively applied in a hybrid service and manufacturing SME and provides clearer understanding of the current and future business process requirements. The study found that conducting Value Stream Mapping aided the identification of areas of improvement within the business process thereby ensuring that the process of business process analysis focuses on eliminating areas of waste and enhancing process activities that focuses on the customer. The identification of the areas of improvement was conducted firstly, by understanding what

activities were currently carried out and how long each of these activities took to complete. Then the need for the activities were ascertained by talking to service engineers, process owners and the customer in order to establish what activities added value to the service provided. This is then represented as the current state using VSM which identifies the activities alongside the associated time, value and dependencies of each process activity. Finally, using VSM of the future state the study was able to replicate the business process flow reducing or eliminating the non-value adding activities.

The second question presented was, *how can an SME benefit from the use of OIPT in an ERP implementation for an SME?* The factors identified from the literature review (chapter two), chapters three and four indicate that past system implementations in the action case hybrid service and manufacturing SME could be attributed to the lack of knowledge on its information requirements and capabilities while adopting a new system. The current study using OIPT established the information requirements and capabilities of the action case SME and subsequently used this in the adoption and implementation of a suitable system. Therefore, the SME benefits from using OIPT to understand the information requirements of its processes and the information capability of both the human and non-human factors. The combination of this information requirements and information capability ensures that a fit is obtained as the optimal solution which is then used to adopt and implement the most suitable ERP system.

The third question presented was, *how does business process automation affect a hybrid service and manufacturing SME?* Again, from data analysis (chapter four) the impact of automating activities was established in the future state (fig 4.15) of the action case SME. The time saved was also quantified and the impact on the SME is in the time that it will save and the capacity to become leaner and more efficient. Also the hybrid service and manufacturing SME would also benefit from less reliance on external factor as identified in chapter four. The study therefore shows that automating parts of the business process increases efficiency such as the automation of engineer's job sheet which eliminated the time wasted when job sheets were sent in the post. The automation of the engineer's calendar also implied that users and mobile engineers were able to efficiently manage and allocate engineers to jobs. Removing disparate systems increased the efficiency of staff by ensuring that once data is entered it is available



from every single module within the central ERP system. Automation of the business processes ensures that the entire business process is efficient and such automation is used to adopt the IS/IT solution which best suits the optimal business process.

### **6.3 Contributions to knowledge**

Using the guidelines for interpretative research contributions to knowledge mentioned in chapter three, this section will now highlight the new contributions that have been identified in this work. These contributions will then be discussed in light of who will be able to benefit from these, as well as how these contributions should be used by future researchers.

Business process analysis, an important element of academic research in process improvement and ERP associated studies, has attracted researchers' attention in recent years and is relatively understood within ERP adoption researches in manufacturing journals. However, within a service SME, business process analysis is less well understood, and in particular, the case of hybrid service and manufacturing SMEs has not been researched at all.

The literature review revealed that no research on business process analysis has been conducted within a hybrid service and manufacturing SME while adopting and implementing an ERP system. Despite this, the service management SME, which includes the hybrid service and manufacturing SME, is becoming a lot more important for the economic contribution of a country, as mentioned in chapters one and two of this study. This research is among the first to attempt to explore the impact of business process analysis during the pre-adoption decision-making and implementation of an ERP system in a hybrid service and manufacturing SME. This study has explored and provided background insight into how a hybrid service and manufacturing SME can apply business process analysis during an ERP pre-adoption decision-making and implementation. The current exploratory action case provides the following contributions to knowledge:

#### **6.3.1 Scoping**

Future scholarly publications in the hybrid service and manufacturing SME can benefit from scoping by being able to understand what the specialist need is for the individual hybrid service

and manufacturing SME. This will demonstrate how a potential system could best meet these needs which are stated in the scoping document.

The literature review identified that the difficulties encountered from the perspective of operations and maintenance can be mitigated if better scoping was done during the identification of the implemented ERP solution. From the literature review, it can be argued that the lack of proper scoping could also contribute to the reasons why organisations viewed the experience of implementing appropriate ERP systems in the past a failure. While the impact of proper scoping was identified within this project, previous studies also strengthened that there is a link between the lack of scoping or improper scoping and failure in operations as a result of implemented ERP system. Researchers have identified this as a problem; however, the question is how can it be overcome?

This research suggested a means of overcoming this by involving external stakeholders such as customers and their views on the current service performance, as well as the potential users of the actual system during the process of scoping. This is in order to access their needs and technical knowledge, which is then used in analysing features, such as human computer interface (HCI). This strategy proved to be a good way of getting input from the users and also getting the staff committed to being involved in the IS product selection process (see section 4.1.2.1 in chapter four). Some organisations carry out a general scoping process, however this process has to be undertaken by individuals with three levels of knowledge: A) IT, B) business process and C) organisation's objectives.

In the discussion chapter of the current study, the scoping was achieved by first appointing an individual who has no influence on the current business process but with substantial knowledge of IT. Then the organisation's objectives based on the future state of the business process were then clearly stated with extensive involvement of the appointed person. This ensured that during the process, the appointed person gained further understanding of the organisation's objectives and business processes. Therefore, to be effective, project scoping depends on system knowledge and in-house expertise or expertise within the project team.

### ***Why is this contribution necessary?***

As mentioned in chapter one, Enterprise Resource Planning (ERP) systems implementation has been argued as being mostly partially integrated with the organisation's business processes. Partial implementation of ERP systems may be interpreted by some users as failure of the overall ERP implementation; however, with appropriate scoping before implementation, an ERP system will be adopted based on its best fit with the SME's business processes. With a best fit ERP system, the hybrid service and manufacturing SME could benefit from an improved service provision and a better contribution to the economy.

With the process of implementations in larger organisations conducting an extensive scoping due to the amount of investment, the literature argued that SMEs are lagging behind. Conducting extensive scoping while adopting and implementing an ERP system in a hybrid service and manufacturing SME will contribute to literature. The contribution to literature is that conducting extensive scoping greatly aids the identification, adoption and implementation of an ERP system which most fits the business process and also suggests areas of the business process and system that needs changing in order to achieve a successful ERP implementation.

Research conducted by Haug and Pedersen (2010) and Saini et. al (2013) could potentially benefit from this study by citing this work as a contribution to the application of business process analysis in an SME. Business process analysis, ERP adoption and implementation and the hybrid service and manufacturing SME are the three areas that will potentially benefit from this study. In relating this back to the research question, this contribution assisted in adopting a system which automates the hybrid service and manufacturing business process as a result, contributed to answering the third research question. This contributes to answering the research question: 'How does business process automation affect a hybrid service and manufacturing SME?' This third research question is interested in showing the impact of automating business processes in a hybrid service and manufacturing business strategy. In order to effectively automate an SME's business process, the study suggests that an IS/IT system is required to achieve the optimal business processes. Further on, to ensure that the optimal business process is achieved as well as automating the required business processes, the study suggests that a thorough scoping is required to understand the requirements and capabilities of the SME. As a result, the study suggests that a more thorough scoping impacts positively on the

ability of the SME to identify areas of the business processes that could benefit from automation as well as provide detailed information required to adopt the most suitable IS/IT system capable of supporting the required automation.

The current study concentrated on SMEs whose primary business process is service and manufacturing secondary (hybrid service and manufacturing SME). Future studies could conduct similar process of adopting and implementing an ERP system in an SME whose primary business process is manufacturing and service as secondary (hybrid manufacturing SME) using the suggestions in this study in order to draw a wider conclusion to whether or not the method suggested in this study can be suitably applicable to all hybrid SMEs.

### ***6.3.2 ERP system adoption and organisational performance and efficiency***

The adoption of an ERP in a hybrid service and manufacturing SME influences the organisational culture. The perception of post-ERP customisation is not based on organisational priorities, but on the department's priority as shown in the current state VSM in chapter four. Each department sees the ERP system as a means of improving its own processes, but these departments fail to look at process improvement from an organisational point of view. Improvement from an organisational point of view would equally reflect on improvement of the departmental processes. **The risk posed by process improvement focusing on departmental goal rather than organisational goal is that as each department strives to improve its own processes, without understanding how the requested changes impact on other departments, they fail to fully interconnect with each other. This tension is exacerbated in hybrid service and manufacturing SME.**

#### ***Why is this contribution necessary?***

Using literature, chapter one argued that the implementation of ERP systems is complex and requires a more systematic approach in order to ensure ERP systems are robust enough to support organisations' dynamic business goals. Literature was identified (Ajit et al., 2014, Wood and Caldas, 2001) in support of this view and further suggested that there is a need for more studies into the impact of ERP implementations on an SME's performance and efficiency, with the aim of supporting the growth in SME businesses, as mentioned earlier in section 1.2. Some

literature, while contributing to this area, investigated the role that business process analysis could play in Information Security (IS).

The contribution from the current study is from an ERP adoption and implementation perspective, with a focus on how the organisation changed either positively or negatively as a result of the adoption of an IS/IT system such as an ERP system. Having automated the process of sending and receiving job sheets from field engineers, the organisation was provided with the opportunity to increase its cash flow as a result of being able to invoice customers sooner. From table 4.2, sending invoices to customers on the average took the business about 3days and posting job sheets and time sheets took on the average 5days which is a total of 8days added to the customer's normal payment term. However, with the automation of these two processes, the business can invoice the customer instantly thereby improving its cash flow. There is also the risk of documents missing in the post, but with the automation of the process of receiving job sheets and time sheets and the sending of invoices to customers electronically, this risk is completely avoided. The current study therefore offers rich insight and understanding of the impact of an ERP adoption on process efficiency and contributes to answering the research question 'How does business process automation affect a hybrid service and manufacturing SME?' To use the contributions made in this study, future researchers could carry out similar studies in a different organisation to determine if the result from this study is specific to the action case or whether the contribution can be generalised.

### ***6.3.3 Business Process Analysis using VSM***

This study has made a significant contribution to the work already done in information systems research within the context of business process analysis (Ofoegbu et al., 2011, Griffiths et al., 2013). **It also provides rich insight into the action case study of how business process analysis can be conducted using VSM in a hybrid service and manufacturing SME.** In particular, this contribution is towards a hybrid service and manufacturing SME whose primary business strategy is service with manufacturing as a complementary activity.

The application of VSM in the hybrid service and manufacturing SME is based on the context of the SME, which has not been previously discussed. The finding of this study also contributes to the body of knowledge in the area of the application of VSM while conducting a business

process analysis in a hybrid service and manufacturing SME. The research identifies the need for establishing the SME's information requirements and capabilities, and subsequently feeding the outcome into VSM analysis.

**The theoretical contribution is that Organisational Information Processing theory (OIPT), can be used while conducting business process analysis using VSM in a hybrid service and manufacturing SME.** Although it is currently widely used in manufacturing business process analysis, **this study highlighted that service based business processes, such as the hybrid service and manufacturing SME, can also benefit from structured process re-engineering using VSM and OIPT.**

### ***Why is this contribution necessary?***

Chapters one and two, using the existing literature, highlighted the need for further studies to be carried out into the use of techniques, such as business process analysis, while adopting an IS system. This study while making contribution to business process analysis used VSM to carry out business process analysis. As stated in section 1.5.5 of chapter one, the study set out to investigate business process analysis in the hybrid service and manufacturing SME which was accomplished. Business process analysis has been conducted in the past in business areas such as manufacturing and supply chain; there is, however, no evidence of business process analysis in the hybrid service and manufacturing SME. While it will be very useful for other studies to use the contribution made in this study in relation to business process analysis, it is important to note that these contributions are from a hybrid service and manufacturing SME's perspective. Finally, this contribution to knowledge also contributes to answering the first research question: 'How does business process analysis using Value Stream Mapping impact the implementation and customisation of an ERP system in a hybrid service and manufacturing SME?'

### ***6.3.4 Theoretical contribution to OIPT***

OIPT as the research framework for diagnosing the gap between the IT and business systems was applied in an SME context. **The framework provided the current study clear understanding of the information processing requirements and information processing capabilities which was useful in steering the dialogic reasoning process of this research.**

Moreover, the application extends this concept further by suggesting that although OIPT provides a theoretical platform to study the information processing requirements and information processing capabilities of an SME, it however, fails to provide more information on how to obtain the optimal fit. This study agrees with the concept of OIPT to use information processing requirements and information processing capability of an organisation to find the optimal fit in performance, but also suggests that it is equally important to provide a platform within the theory in order to find the optimal fit. As a result, suggests OIPT2.0 as an enhanced version of OIPT which provides the platform to obtain the optimal fit.

### *Why is this contribution necessary?*

The literature review chapter presented studies that argued that there is a need to implement an integrated IS capable of improving the flow of information and reducing uncertainty within various parts of an organisation. Further literature was presented in the literature review (chapter two), which argued that ERP adoption activities vary with the extent of uncertainty; therefore the greater the uncertainty, the more information processing required. This contribution is therefore necessary since it uses OIPT to understand the information processing requirements and information processing capabilities while adopting an ERP system. The current study provides a modification of OIPT as OIPT2.0 which suggests the use of Value Stream Mapping as the tool to find the optimal fit using the main concepts of OIPT which are information processing requirements and information processing capabilities. The need for the enhancement of OIPT is discussed in section 2.1.2.1 (Limitation of Organisational Information Processing Theory). The second research question is: 'How can an SME benefit from the use of OIPT in an ERP implementation'. To answer this question, the current study used OIPT2.0 to understand information processing requirements and information processing capabilities and then using Value Stream Mapping to suggest change as the optimal fit between the two.

### *6.3.5 ERP Systems Evaluation vs ERP Vendor Evaluation*

Previous studies have identified many possible reasons as to why an ERP adoption and implementation was termed a failure. Among these reasons, there has not been any mention of vendor analysis as a possible reason to why an ERP system could have failed. **The finding in this**

**study suggests that the evaluation of vendors can be as important as the evaluation of potential ERP system itself.** This is because although an adopted ERP system could be matched to the organisation's business processes, without adequate knowledge of the business from the ERP vendor, there will always be obstacles while attempting to match the SME's business processes to that of the ERP system. The current study, using action case methodology, identified that the involvement of the researcher attempted to bridge the gap between the vendors' lack of knowledge about the organisation's business processes and the SME's lack of technical knowledge of the proposed ERP system. **As stated in table 3.4 in chapter three, the use of action case also permitted the clear documentation of the lessons learnt when vendor analysis is considered as an important factor when adopting and implementing an ERP system.**

### ***Why is this contribution necessary?***

Studies have suggested various reasons that can be attributed to why an ERP is termed a failure. Chapter one, from literature review, identified that some of the attributes are the lack of: mapping functionalities to business process; project team/management support; user training; dealing with organisational diversity; planning/budgeting/development and; adequate testing. Other literature, in chapters one and two, whilst providing detailed lists of why an ERP implementation could be termed a failure, did not mention the ERP vendor as a possible reason. The study contributes to this list by adding that a thorough evaluation of the ERP vendor to ascertain the vendor's knowledge of the proposed ERP system, the vendor's knowledge of the SME's business processes, the compatibility of the SME and the vendor and the level of support the vendor provides is required.

### ***6.3.6 Definition of hybrid service and manufacturing business model***

Although business model has received more interest from researchers, there has been no agreed definition of the term business model for any of the industries. The lack of generalised definition can be attributed to the fact that the definition provided by authors do not overlap. In chapter five, using the existing literature, it was argued that the definition of manufacturing business model takes one external input, which is raw materials and feeds this into the



manufacturing subsystem. The manufacturing subsystem shares a two way information transfer between the management and ERP system in order to produce the required output. Using the existing literature, chapter five gave that the service definition as taking more than one external input such as input from the person carrying out service, and materials required to carrying out the service which are fed into the service subsystem. ***From a hybrid service and manufacturing business model point of view, this study proposes that the hybrid service and manufacturing model can be said to take first only one external input, raw materials, which is fed into the manufacturing subsystem to produce an output. Then the service subsystem further takes more than one external input, the effort from the staff, such as an electrician, while carrying out the service and output from the manufacturing subsystem. The service subsystem then shares a two-way information transfer between the management and ERP system in order to effectively carryout the required service for the customer.***

### ***Why is this contribution necessary?***

Contribution to the definition of business process has been made in the areas of typical manufacturing as well as typical service sectors. However, the hybrid service and manufacturing business process has received little or no contribution to the definition of its business process. The understanding of the hybrid service and manufacturing business model provided the current study the required knowledge into the business model being mapped during the process of carrying out a business process analysis. The definition gave a clear understanding of the input and output factors within the business model being studied. Without the clear definition of the model, it is possible to directly link inputs and outputs to that of either a standard manufacturing or standard service without fully understanding the dependencies and interrelation between the input and output factors within the hybrid business model. The understanding of these input and output factors within the hybrid service and manufacturing business model will aid future researchers while investing similar business sector. The contribution of a definition of the hybrid service and manufacturing SME's business model provided the current study an understanding of the model being mapped and will provide the same for future researchers who can use the definition to gain understanding of similar business models prior to embarking on their research. This clear definition of the hybrid service and

manufacturing business model can also be used by researchers to distinguish this business model from standalone manufacturing and standalone service business models.

#### **6.4 Contribution to Practice**

The understanding of the influence of business process analysis on the choice and experience of ERP adoption can help SMEs to develop a better approach towards adopting an appropriate ERP system. Investigation of the impact of business process analysis will aid SMEs, such as the hybrid service and manufacturing SME, to identify weaknesses in potential ERP solutions, as well as identify areas of waste in the current business process. In addition, feature evaluation model presented in this study can be used by any SME currently evaluating for appropriate ERP and have multiple choices of ERPs to evaluate.

According to the findings in this study, the action case SME's previous ERP implementation was affected by the lack of structured business process analysis and the influence of management in the choice of adopted ERP system. This implies that although these ERP systems were implemented, they ended up failing to meet the business process needs. The study also contributed to how the understanding of the business processes by the ERP users influence the choice of adopted ERP system. The following recommendations address all the practical factors identified in the current action case study.

##### **6.4.1 Business Process Analysis**

Some SMEs believe that conducting business process analysis while adopting and implementing an ERP is only useful in large implementations for multinationals. It is important to encourage SMEs, and especially hybrid SMEs, to carry out business process analysis; this is because of the complexity of possessing both service and manufacturing business processes. The benefit of conducting business process analysis before selecting an ERP system is a better understanding of the current processes as well as a clear definition of future requirements based on the strategy of the SME. It was identified from the literature that a thorough business process analysis is an important factor to successfully adopting an ERP system capable of accommodating identified current and future business process needs. Considering that larger organisations currently benefit greatly from conducting a thorough business process analysis

before adopting and implementing an ERP system emphasises the need to ensure that ERP investment is strategic and not just necessary. **Therefore, SMEs such as the hybrid service and manufacturing SME should view an ERP pre-adoption decision-making and implementation as a strategic opportunity development rather than a necessity that is conducted at operational level. This could be achieved by conducting a thorough business process analysis, which clearly defines the required processes expected from the potential ERP system.**

#### ***6.4.2 Value Stream Mapping in service business strategy***

This research revealed that one of the reasons for not conducting business process analysis in organisations with service strategy is the lack of defined tools to support the analysis. Although developed and widely applied in manufacturing, VSM can also be applied in a service business strategy in order to identify and remove areas of waste. The outcome from this research indicates that VSM can be used in a hybrid service and manufacturing business to effectively identify areas of waste and also automate manual processes.

Using VSM, waste within the business process of the action case SME is highlighted and opportunities for improvement identified as suggested in the literature review chapter. **Another major finding in this study is that, if value is not being added to the service process, it is cost that is being added instead. Using VSM, activities and actions that do not add value to the service process are easily identified and by developing the future state of business process, a more suitable ERP system can be selected based on the realistic future business model. The current action case study offers practical insights into how VSM was used to effectively eliminate or minimise waste where possible.**

#### ***6.4.3 Specialist issues within the case study***

It is recognised in the existing literature that the majority of studies in ERP implementation and business analysis are in the area of manufacturing. This reveals the lack of in-depth focus on the service SME and as a result there are previous studies that have not highlighted the issues faced by such hybrid service and manufacturing SMEs. Researchers who focused on manufacturing have identified and highlighted the importance of understanding the issues manufacturing processes face. This study provides similar insight from a service business point of view. The

availability of such specialist issues will aid similar organisations who aim to streamline their business processes or adopt a new ERP system. This study identified the following specialist issues in the hybrid service and manufacturing SME:

**1. Presence of manual processes due to complex business processes.**

Using an ERP system designed based on the standard manufacturing business model, manufacturing businesses are able to automate most of their business processes. This is also the case in the standalone service operations where automation can be achieved to a great extent using ERP systems designed based on the service business model. However, this study identified the lack of suitable ERP systems designed based on the hybrid service and manufacturing business model. As a result, a hybrid service and manufacturing business model is forced to either adopt an ERP designed based on the manufacturing business model and then manually customise the service functions or adopt a service based ERP and manually apply the manufacturing functions.

**2. Lack of audit trail as a result of disparate systems being used for various activities.**

With the peculiarity identified in point one above, the hybrid service and manufacturing business is more inclined to adopt a disparate system to either meet the required service or manufacturing functions depending on the functions lacking in the standard ERP system. As a result, the hybrid service and manufacturing SME could lose the audit trail between what production orders relate to a particular service, as an example.

**3. Duplication of tasks in an attempt to keep disparate systems synchronised.**

This follows from point one and two above as a result of entering duplicate data in order to keep two or more non-related systems up to date based on the required data.

**4. Difficulties with IS implementation as a result of complexities in the business processes.**

Most ERP resellers/implementers over time have gained an in-depth knowledge on the implementation of either a manufacturing or service business model into the ERP system and this is due to these two business models being the most common. This study, from

resellers' interview, gathered that resellers struggled to understand the dependencies of some of the service activities on the manufacturing process and vice versa.

#### ***6.4.4 User involvement during ERP adoption and implementation***

This research identified that one of the factors affecting the classification of an adopted ERP system in such hybrid service and manufacturing SME is the level involvement of users and management. Previous implementation within the action case organisation had excessive input from the top management, and as a result the selection of an appropriate system rather than being structured and systematic was rather based on the top management personal feeling of a system. This can be a general issue for SMEs where all decisions tend to be made by the owner manager, an individual who might not be best placed to make this decision in the most objective manner. Additionally, outcomes from this research indicated that involving all groups of stakeholders such as prospective users and customers provides the necessary buy-in required. It also accords the stakeholders the opportunity to identify areas of improvement from the competent point of view. In general, without appropriate buy-in from the prospective users and other stakeholders, the adoption and implementation of an ERP system will not succeed; only specific process owners can give a holistic overview of the process or activity in question and are required to be fully involved while carrying out a review towards an ERP adoption. It is therefore recommended that in order to ensure successful post ERP implementation experience, stakeholder buy-in is essential.

Furthermore, the results obtained while using the scientific model introduced in this study to map Information System features to organisation's business process, result were weighted making the process of selecting the most suitable IT solution a more systematic approach. The main objectives for using such a process for identifying appropriate solution are:

- To select the most suitable solution which allows a service organisation to continue with its business activities with little or no changes to its business processes as a result of fitting with the business process contained in the ERP solution.
- Increase management and staff buy-in to the selection process by involving them in the whole decision process, thereby increasing confidence in the system selected.

- Reducing operating costs by automating manual activities, where possible, and increasing efficiency.

Finally, the SME management should also respect the result from a structured ERP selection process rather than adopt an ERP system based on personal feelings.

#### **6.4.5 SAP Business One and Add-ons**

SAP Business One is still the market leading solution in the UK for SMEs who are looking for service management options. However, to make it fit to strategic business needs, a number of additional add-ons are required. This is a good illustration of how an SME must invest considerable time and other resources costing approximately twice the initial headline figure of SAP Business One, and also includes the time of senior staff who could be growing the business; resulting in a loss of opportunity costs. Moreover, the study highlights that the 550+ add-ons are not necessarily features, as advertised in SAP sales literature, but rather a burden for an SME. The action case study highlights that major resources are needed to plug the gap between the business and SAP service management functionality. A recommendation to SAP is to extend its features of the SAP Business One core application to include a better offering for service management, closing the 10 common SAP gaps to a typical service management SME as identified in this study; these are:

- job costing
- calendar scheduling
- service call management
- time sheet entry
- equipment link/site maintenance
- ERP functionality
- GPS
- e-mail functionality
- online customer login
- integration with hand held devices.

## **6.5 *Suggestions for future work***

This thesis provided a number of insights by focusing on the pre-adoption decision-making and implementation of an ERP system in a hybrid service and manufacturing SME. The study explored several issues that required investigation and analysis in order to further contribute to knowledge within the hybrid service and manufacturing business process. This section suggests and justifies the need for further research into the identified issues.

A logical addition to this study would be to test the accuracy of the research outcomes. Further research is required in a similar hybrid service and manufacturing SME, whose primary business strategy is service and manufacturing as the secondary business strategy, to investigate the step associated with adopting a similar ERP system. An evaluation of the proposed recommendations could add value into the understanding of why ERP systems fail after adoption in SMEs.

Within the framework of the current study, it was not possible to thoroughly examine the influence of organisational culture on the pre-adoption decision-making and implementation of an ERP system in the hybrid SME. Thus, a similar study might be useful to identify the role played by an organisation's culture, such the leadership style and how that can influence the process of evaluating, selecting and implementing an ERP system. Such a study can also highlight the impact of an adopted ERP system on existing organisational culture.

Due to time restrictions, the study was not able to follow up further on the impact of the adopted ERP system and customisations on the existing organisational efficiency. The study however was able to show the efficiency derived when the process of document posting to and fro between the field engineers and the site based staff, this is shown in chapter four, table 4.2. From a post project interview with the Managing Director, he indicated that efficiency was improved as a result of the current study and that the time taken to invoice customers after jobs are completed was reduced. This therefore increases the cash flow of the SME. It could be useful to carry out a thorough study in order to identify whether the adoption of a suitable ERP system using the method used in this study causes any changes to the efficiency of the SME. This would aid in strengthening the validity of the suggested method in the current study.

## **6.6 *Researcher's Reflection on the Research Process***

This section aims to reflect on the researcher's personal experience as a researcher over the course of this study. Reflection is necessary in an attempt to identify strengths and weaknesses, what went well and what could have been improved. Using a monthly action plan and planned achievable, progress is constantly monitored, and achievements evaluated constantly. The knowledge acquired over the course of this study now enables the researcher to reflect and critically evaluate his strengths and areas for improvement. The last six years represent a foundation in his personal development in terms of conducting research. The researcher's knowledge and skill has been enhanced due to this research process. The main area of knowledge is business process analysis and ERP pre-adoption decision-making and implementation. There is also an enhancement in the researcher's capability in terms of research strategies and research methods.

## **6.7 *Concluding Remarks***

Mapping the current state of a business process is useful but not enough to make a decision on the most appropriate ERP solution. This study documents the main tensions that an SME faces when using a SAP Business One version 2007 system. Despite the success of the SAP R/3 for multi-nationals in service management, an SME has to examine the features very carefully before committing to the SAP Business One system and consider the way its limitations are to be addressed. Due to SAP Business One's manufacturing focused background, there are several limitations of basic service management functionality as discussed above.

This research supports previous studies that criticise off-the-shelf ERP systems since they encapsulate processes of those systems that were current at the time the software was initially developed. Manufacturing focused processes will stifle any radical innovation in terms of service management and systems logic designs. However, when evaluating service management systems aimed only at SMEs, this study surprisingly found that not many of these ERP systems offer a comprehensive solution. For any company optimising its service management business processes one other option remains, that is to develop a custom-made system, but that is often beyond the average SME's budget. Therefore, software vendors need to take account of the



latest advances in service management solutions to meet the increasing expectations of improved service management for SMEs.

Furthermore, the adoption and implementation of an ERP system in a hybrid service and manufacturing SME is an iterative process, particularly during the design stage, with the same steps repeated several times using business process analysis tools such as Value Stream Mapping, until the optimal solution is found. Using VSM, ERP systems pre-adoption decision-making and implementation requires SMEs to assess and evaluate their internal processes in order to identify areas for improvement so as to increase business efficiency and profitability.

With the rich insight generated by illustrating the processes discussed in this study, a theoretical decision making tool is provided for a service management focused organisation and should serve as a method to enable them in practice, to identify and implement the most suitable IT solution for their needs using available resources. Finally, it is important to mention that having identified processes as being extremely important, it is equally important to have someone with knowledge of both IT and the organisation's business processes to manage and be responsible for the process of system adoption and implementation. Whilst these tools provide some prescriptive options for any SME willing to go through a service management systems selection, pre-adoption decision-making and implementation, the organisational context and the scale of the organisation's needs are to be considered. For larger organisations, a substantial framework such as that offered by COBIT® or ITIL are more appropriate, although these were felt to be too cumbersome for the action case organisation.

A part of this thesis has also focused on VSM and how it has been used in the action case organisation to streamline the back office. Lasa *et al.* (2008a) and many others identified some limitations with using VSM for BPI. These limitations are the time and resources required to carry out VSM, as well as the need for someone with adequate VSM application skills to apply VSM. These limitations were not mentioned in the theory of VSM, however the study has incorporated these limitations in order to make VSM successful while conducting BPI.

Another gap in knowledge which is addressed in this thesis is that VSM has been predominantly successfully applied in supply chain and production line (Lasa et al., 2008a, Hines and Rich, 1997, Vinodh et al., 2013, Singh and Singh, 2013) with little or no application in service process.

This study showed how VSM has been applied in a new SME setting, this adds to the literature which shows that past application of VSM has been primarily in manufacturing SMEs. This study presents a different perspective of VSM application in the action case study, which is a hybrid service and manufacturing SME. This perspective argues that although VSM was developed and primarily applied in manufacturing and supply chain by researchers, the application of VSM in this hybrid service and manufacturing SME indicates that VSM can be successfully applied in the hybrid service and manufacturing SME.

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## *Appendices*

## ***Appendix 1a:***

Code – A

Martin Lewis: KTP Project Plan

Year 2010

Code – B

John Gray: Employee Questionnaire

Date: 04/02/2010

Code – C

Greg Scot: Employee Questionnaire

Date: 09/02/2010

Code – D

Angela Lewis: Employee Questionnaire

Date: 24/02/2010

# 1a: Employee questionnaire

## Interview Guide

Brief introduction of what we are trying to do.

Date: 04/02/2010

Location/ Division: Spray Booth

Name:

Job title: Senior Service Engineer

How long have you been on this job: 9 years

Process(es) involved

| What processes are involved in your task?              | How long does each process take?                                       | Is job done manually or automated? | If automated, what application is it done in? (see list below) |
|--|--|------------------------------------|--|
| Receiving job sheets via email from the office         | 12 Hours   | Email                              |  |
| Carrying out job                                       | X Hours (dependent on per job requirement)                             |                                    |  |
| Fill in CS Note and or LEV Note                        | 15 mins  | Manual                             |  |
| Explain details on CS Note to customer and sign it off | 10 mins  | Manual                             |  |
| Fill in time sheet                                     | 5 mins   | Manual                             |  |
| Post CS Notes, job sheets and time sheets on Friday    | (4 + 3) days i.e 4 days when job is done on a Monday and posted on Sat | Manual                             |  |



- How long have you used this system?

I have used this system for years carrying out my job in Beta

- How did you go about learning to use this system?

...mentor... for... first few days.....

- Have you worked in any other organisation before? **Yes**

- If Yes, have you used any other system to perform similar task?

**No**

- If Yes, what is the name of the system?

- How does this system compare with your present system

- What features in the present system do you prefer to the former?

..Customer... speed... of... parts... ordering.....

- What features on former system do you prefer to the present?

..Customer... retains... paper... copy... and... heavy.....

..Site.....

→ Refer to what is on the present system he hopes to see on the new system.

- Can you think of any other issues or ways in which service related processes could be improved?

Ability to view job history on per job basis such as who did the last job, what faults were identified and solutions applied and what parts were replaced.

Booking engineers to regions

Bought in goods going from supplier to customer's location

Using hand held devices and ability to readjust what materials were used on specific jobs

Adding a warehouse allocated to each engineer to know what stock they have in their van

.....  
.....  
.....

- What are the issues with sending and receiving job information while outside Beta?

Having to wait until I am online to check job information online

Waiting till Friday to send job and material information used in a specific job

Having to post job sheets, CS Notes and time sheets on Friday and sometimes waiting until Wednesday next week for them to be confirmed received

.....  
.....  
.....

- How can engineers' timesheets be improved?

Having the time sheets automated

.....

- Do you think customers are satisfied with the job you do for them?

With my visit on Thursday 4<sup>th</sup> February 2010, the customer was quite impressed as details of the job were explained to him.

.....  
.....

- Do you think customers are happy with the format and way invoices are communicated to them if not why?

Yes / No (delete as appropriate)

.....  
.....

- Do you think invoices are sent to customers right on time?

.....  
.....

- What regards to customers, what do you think we can improve?

.....  
.....  
.....  
.....

What present areas are customers happy with?

.....  
.....  
.....  
.....

- Any other issue not stated but needed to be addressed?

Sometimes when there is a cancellation, engineers don't get to know and might end up turning up at customer's site only to be told they were not expected

.....  
.....

- Thank you for your time.

Name:

Sign: 

GROUP

**Interview Guide**

Brief introduction of what we are trying to do.

Date 9-2-10 Location: SPray Booth

Name .....

Job title: S/EHow long have you been on this job: 6 Years

Process(es) involved

| What processes are involved in your task? | How long does each process take? | Is job done manually or automated? | If automated, what application is it done in? (see list below) |
|---|----------------------------------|------------------------------------|--|
| By Email                                  | 12 Hours                         | By Email                           |  |
| Camping out Job                           | Every Job Different              |                                    |  |
| Fill in CS Note or LeU notes              | 20 mins                          | manually                           |  |
| Explain any problems to customer          | 5 mins                           | manual                             |  |
| Fill in Time Sheets                       | 5 mins                           | manual                             |  |
| Post CS notes Job sheets and Time sheets  | (4+3) Days                       | manual                             |  |

- How long have you used this system?  
..... 6 Years .....
  
- How did you go about learning to use this system?  
..... John Gray .....
  
- Have you worked in any other organisation before? Yes /  No (delete as appropriate)
  - If yes, have you used any other system to perform similar task?  
Yes / No (delete as appropriate)
  - If yes, what is the name of the system?  
.....
  
- How does this system compare with your present system
  - What features in the present system do you prefer to the former?  
.....  
.....
  - What features on former system do you prefer to the present?  
.....  
.....
  
- Can you think of any other issues or ways in which service related processes could be improved?  
..... Foster Turn around .....
  
- .....
  
- .....
  
- .....

- What are the issues with sending and receiving job information while outside Beta?

.....  
.....  
.....  
.....

- How can engineers' timesheets be improved?

*Doing them by computer*  
.....  
.....

- As a customer, do you think you get the best service within allocated time?

*customer is normally satisfied*  
.....  
.....  
.....

- Are you happy with the format and way invoices are communicated to you if not why?

Yes /  No (delete as appropriate)

.....  
.....

- Are invoices sent to you right on time?

.....  
.....

- > What areas do you think can be improved?

ordering Parts  
Getting the information while I am onsite, having to call  
and the staff to speak with might be on downtime  
Possibly sending job information immediately

What present areas are you happy with?

.....  
.....  
.....  
.....

- > Any other issue not stated but needed to be addressed?

Sometimes there is miscommunication in terms  
of job information.  
⇒ When a job is done and the engineers have to order a part  
while on site, if information is sent straight to the office, time  
will be lost sometimes as long as 10 days.

- > Thank you for your time.

Scott.



**Interview Guide**

Brief introduction of what we are trying to do.

Date 24/02/2010 Location: .....

Name .....

Job title: Account Manager

Process(es) involved

| What processes are involved in your task? | How long does each process take? | Is job done manually or automated? | If automated, what application is it done in? (see list below) |
|---|----------------------------------|------------------------------------|--|
| Service Calls                             |                                  |                                    | SAP  |
| SOP (Sales order Processing)              |                                  |                                    | SAP  |
| Purchase order Processing                 |                                  |                                    | SAP  |
| Stock Management                          |                                  |                                    | SAP & Excel  |
|   |                                  |                                    |  |
|   |                                  |                                    |  |

Applications currently used:

- SAP As above.
- Telemagic For Inland documents & equipments we have.
- Resultware Diary & Cash prospective customers need transferring to SAP
- Sage Payroll .....

- > What processes can you not accomplish with the present system?
  - + Stocks are contained in an Excel document (spare parts)
  - + Stocks on engineers van is not visible
  - \* Reports (create a report that is a template which users can edit)
  
- > Which processes or sub-processes does this process depend on?
  - Receiving the red box
  - Raising a Sales Order
  
- > Why does the process depend on each of the identified above?
  - 
  - 
  - 
  -
  
- > Which processes or sub-processes depends on this process?
  - Lab hour booking
  - Engineers
  - Suppliers
  
- > How long have you used this system?
  - 3 yrs

- How did you go about learning to use this system?  
*Ochiuba presentation in bits, support email & In house presentation was more useful.*
- Have you worked in any other organisation before? Yes / No (delete as appropriate)
- If Yes, have you used any other system to perform similar task?  
 Yes / No (delete as appropriate)
  - If Yes, what is the name of the system?  
 .....
- How does this system compare with your present system
- What features in the present system do you prefer to the former?  
 .....
  - What features on former system do you prefer to the present?  
*This is has been better than the older systems.*  
 .....
- Can you think of any other issues or ways in which service related processes could be improved?
- \* *A general diary (without being separate)*
  - \* *Having the equipment updated on inputs in SAP*
  - \* *Being able to complete the service call info done in telematic done in SAP*
  - \* *stock information entered in SAP*
  - \* *templates prepared & contained in SAP*
- What are the issues with sending and receiving job information while outside Beta?  
*Hand helds will be great*

- How can engineers' timesheets be improved?

Palm held / hand held devices

- From a customer's perspective, do you think they get the best service within allocated time?

Customers are happy

- What do you think about the format and way invoices are communicated to customers?

If we can get to emailing invoices

\* Considered setting up an invoice that picks contact detail info and sends as an email.

- Are invoices sent to customers on time?

Yes

- What areas do you think can be improved?

.....  
What present areas of the systems being used are you happy with?

Quote easily converted to sales order in SAP  
Service call ~~for~~ package is quite good.  
Diary in Resultware is good because it is more usable

➤ Any other issue not stated but needed to be addressed?

.....  
.....  
.....  
.....

➤ Thank you for your time.

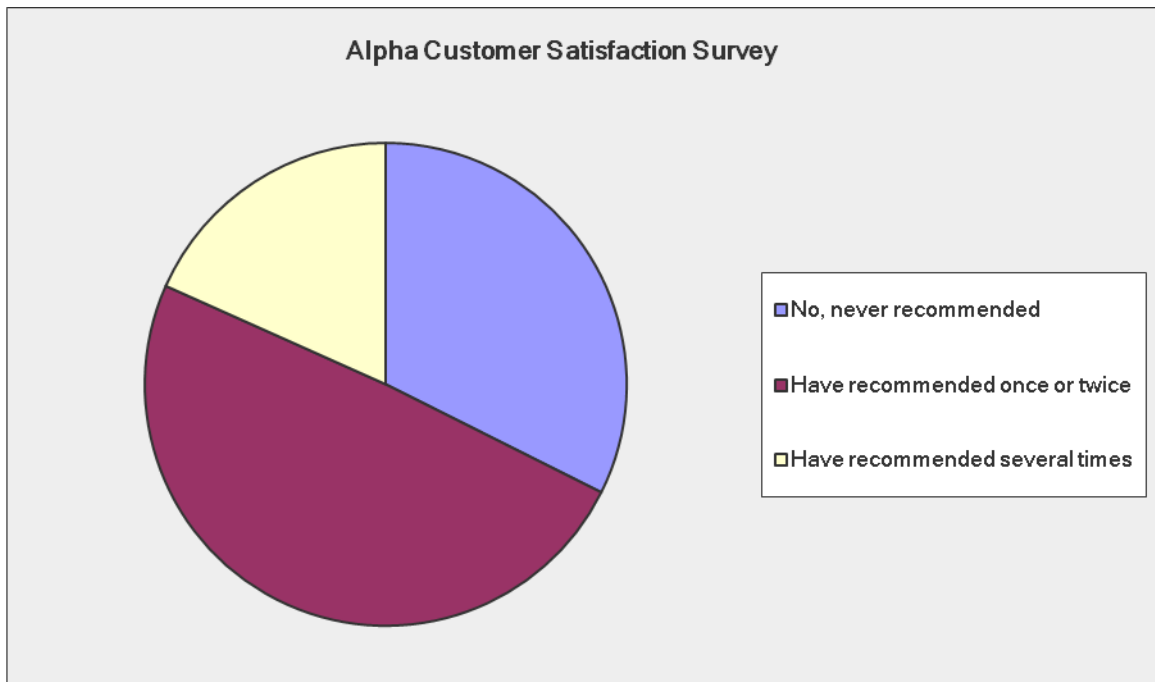
Sign: 

**1b: Customer questionnaire**

Question One: Have you ever recommended us to others?

**Alpha Customer Satisfaction Survey**

| Have you ever recommended us to others? |                  |                |
|---|------------------|----------------|
| Answer Options                          | Response Percent | Response Count |
| No, never recommended                   | 32.4%            | 23             |
| Have recommended once or twice          | 49.3%            | 35             |
| Have recommended several times          | 18.3%            | 13             |
| <i>answered question</i>                |                  | <b>71</b>      |
| <i>skipped question</i>                 |                  | <b>1</b>       |

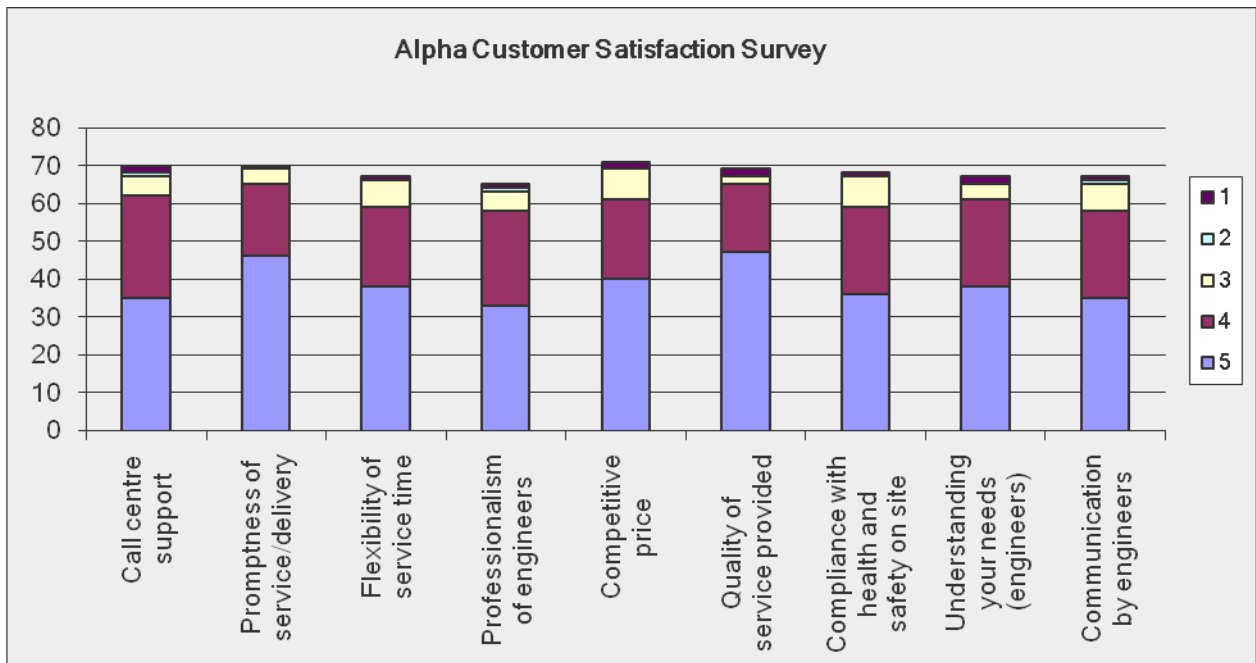


Question Two: How do you rate the importance of the following attributes to you, using 5 as being the highest and 1 the least important to you?

### Alpha Customer Satisfaction Survey

How do you rate the importance of the following attributes to you, using 5 as being the highest and 1 the least important to you?

| Answer Options                            | 1 | 2 | 3 | 4  | 5  | Response Count |
|---|---|---|---|----|----|----------------|
| Call centre support                       | 2 | 1 | 5 | 27 | 35 | 70             |
| Promptness of service/delivery            | 1 | 0 | 4 | 19 | 46 | 70             |
| Flexibility of service time               | 1 | 0 | 7 | 21 | 38 | 67             |
| Professionalism of engineers              | 1 | 1 | 5 | 25 | 33 | 65             |
| Competitive price                         | 2 | 0 | 8 | 21 | 40 | 71             |
| Quality of service provided               | 2 | 0 | 2 | 18 | 47 | 69             |
| Compliance with health and safety on site | 1 | 0 | 8 | 23 | 36 | 68             |
| Understanding your needs (engineers)      | 2 | 0 | 4 | 23 | 38 | 67             |
| Communication by engineers                | 1 | 1 | 7 | 23 | 35 | 67             |
| <i>answered question</i>                  |   |   |   |    |    | <b>72</b>      |
| <i>skipped question</i>                   |   |   |   |    |    | <b>0</b>       |



Question Three: How do you rate us on the following attributes?

### Alpha Customer Satisfaction Survey

| How do you rate us on the following attributes? |                    |               |         |               |                    |                |
|---|--------------------|---------------|---------|---------------|--------------------|----------------|
| Answer Options                                  | Well Below Average | Below Average | Average | Above Average | Well Above Average | Response Count |
| Call centre support                             | 0                  | 0             | 4       | 33            | 33                 | 70             |
| Promptness of service/delivery                  | 0                  | 0             | 6       | 34            | 29                 | 69             |
| Flexibility of service time                     | 0                  | 0             | 6       | 26            | 31                 | 63             |
| Professionalism of engineers                    | 0                  | 1             | 8       | 24            | 31                 | 64             |
| Competitive price                               | 0                  | 0             | 37      | 24            | 8                  | 69             |
| Quality of service provided                     | 0                  | 1             | 6       | 34            | 30                 | 71             |
| Compliance with health and safety on site       | 0                  | 0             | 9       | 36            | 22                 | 67             |
| Understanding of customers' needs               | 1                  | 0             | 6       | 33            | 29                 | 69             |
| Communication by engineers                      | 0                  | 2             | 8       | 26            | 30                 | 66             |
| <i>answered question</i>                        |                    |               |         |               |                    | <b>72</b>      |
| <i>skipped question</i>                         |                    |               |         |               |                    | <b>0</b>       |

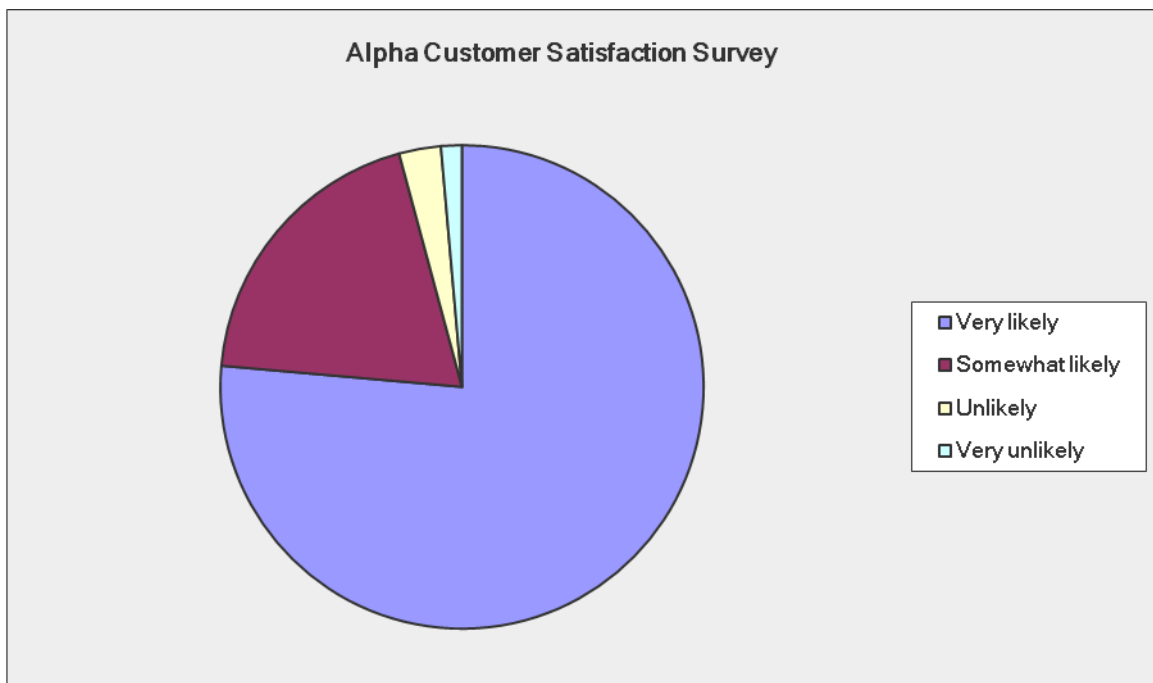




Question Four: How likely are you to continue using our services in the future?

### Alpha Customer Satisfaction Survey

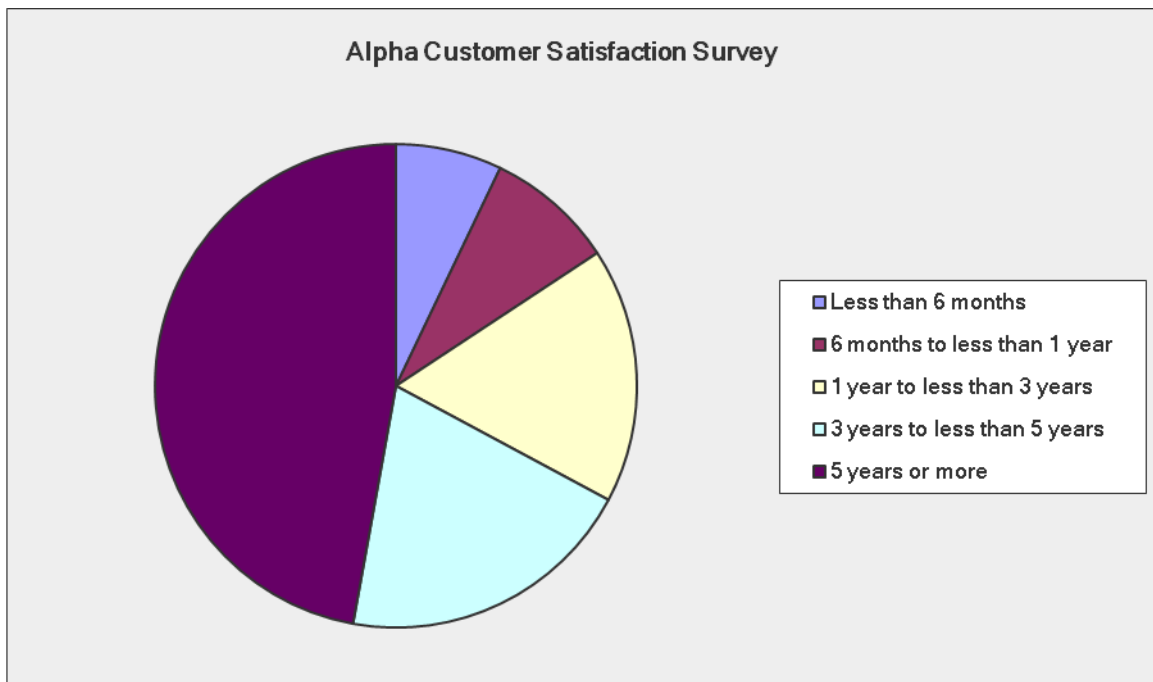
| How likely are you to continue using our services in the future? |                  |                |
|--|------------------|----------------|
| Answer Options   | Response Percent | Response Count |
| Very likely  | 76.4%            | 55             |
| Somewhat likely  | 19.4%            | 14             |
| Unlikely   | 2.8%             | 2              |
| Very unlikely  | 1.4%             | 1              |
| <i>answered question</i>   |                  | <b>72</b>      |
| <i>skipped question</i>  |                  | <b>0</b>       |



Question Five: How long have you been using our services?

### Alpha Customer Satisfaction Survey

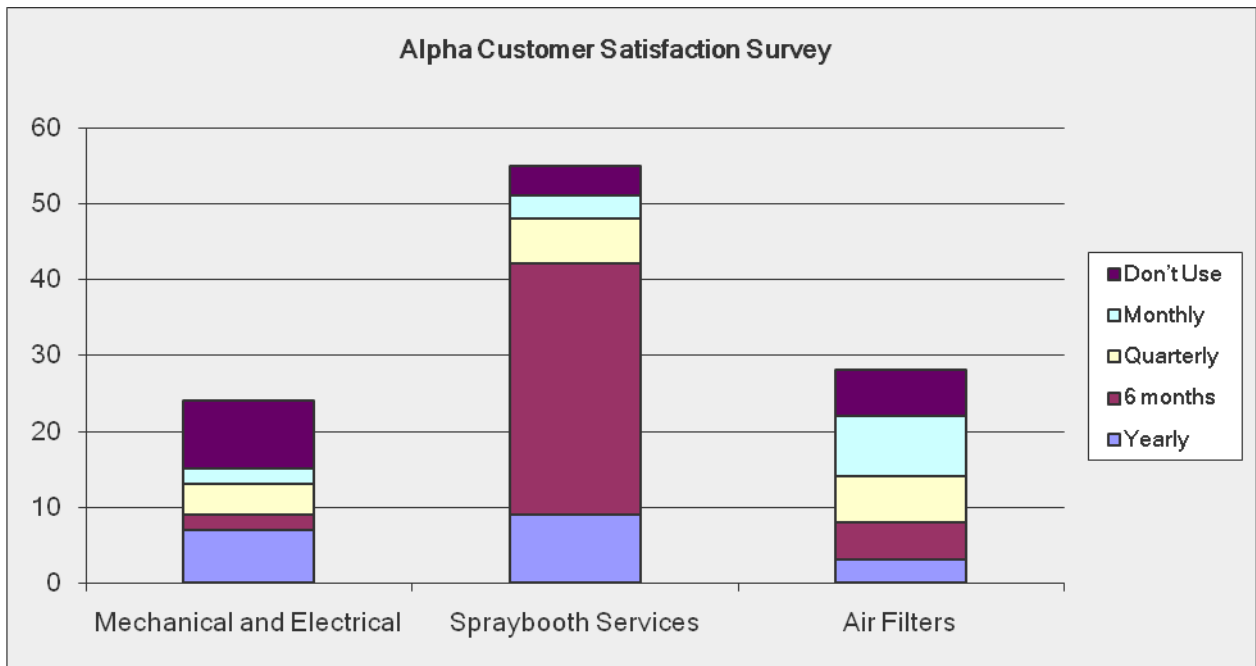
| How long have you been using our services? |                  |                |
|--|------------------|----------------|
| Answer Options                             | Response Percent | Response Count |
| Less than 6 months                         | 7.1%             | 5              |
| 6 months to less than 1 year               | 8.6%             | 6              |
| 1 year to less than 3 years                | 17.1%            | 12             |
| 3 years to less than 5 years               | 20.0%            | 14             |
| 5 years or more                            | 47.1%            | 33             |
| <i>answered question</i>                   |                  | <b>70</b>      |
| <i>skipped question</i>                    |                  | <b>2</b>       |



Question Six: How often do you use our services?

### Alpha Customer Satisfaction Survey

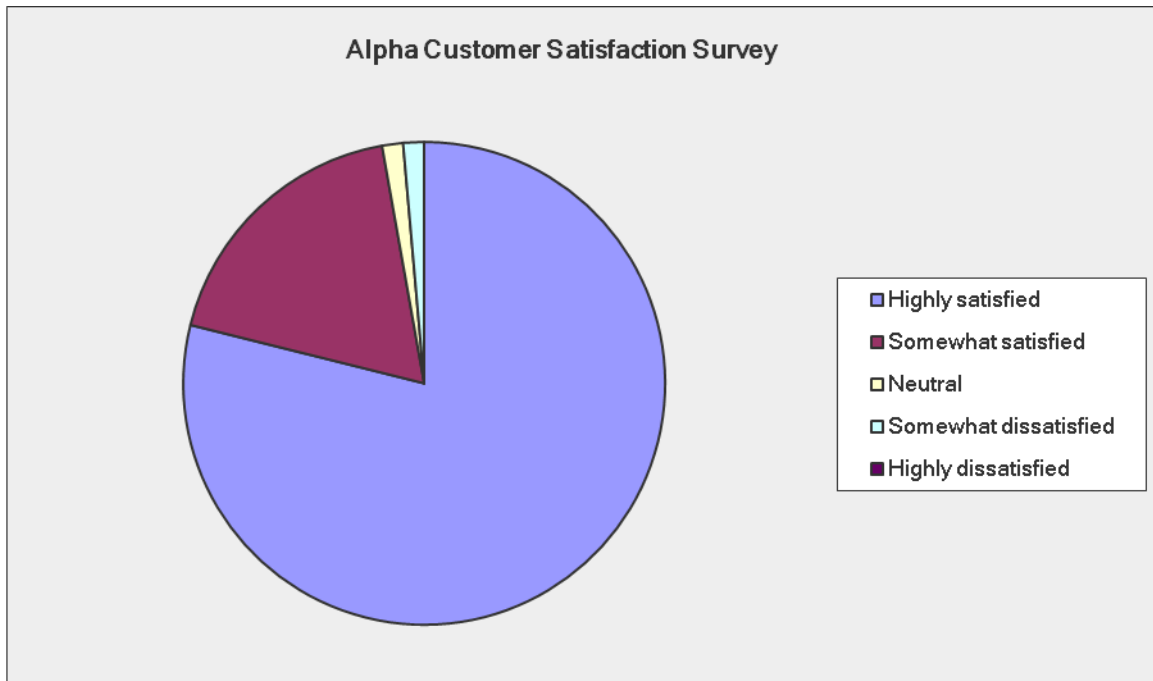
| How often do you use our services? |           |         |           |          |        |                |
|------------------------------------|-----------|---------|-----------|----------|--------|----------------|
| Answer Options                     | Don't Use | Monthly | Quarterly | 6 months | Yearly | Response Count |
| Mechanical and Electrical          | 9         | 2       | 4         | 2        | 7      | 24             |
| Spraybooth Services                | 4         | 3       | 6         | 33       | 9      | 55             |
| Air Filters                        | 6         | 8       | 6         | 5        | 3      | 28             |
| <i>answered question</i>           |           |         |           |          |        | 71             |
| <i>skipped question</i>            |           |         |           |          |        | 1              |



Question Seven: How would you rate your overall level of satisfaction with us?

### Alpha Customer Satisfaction Survey

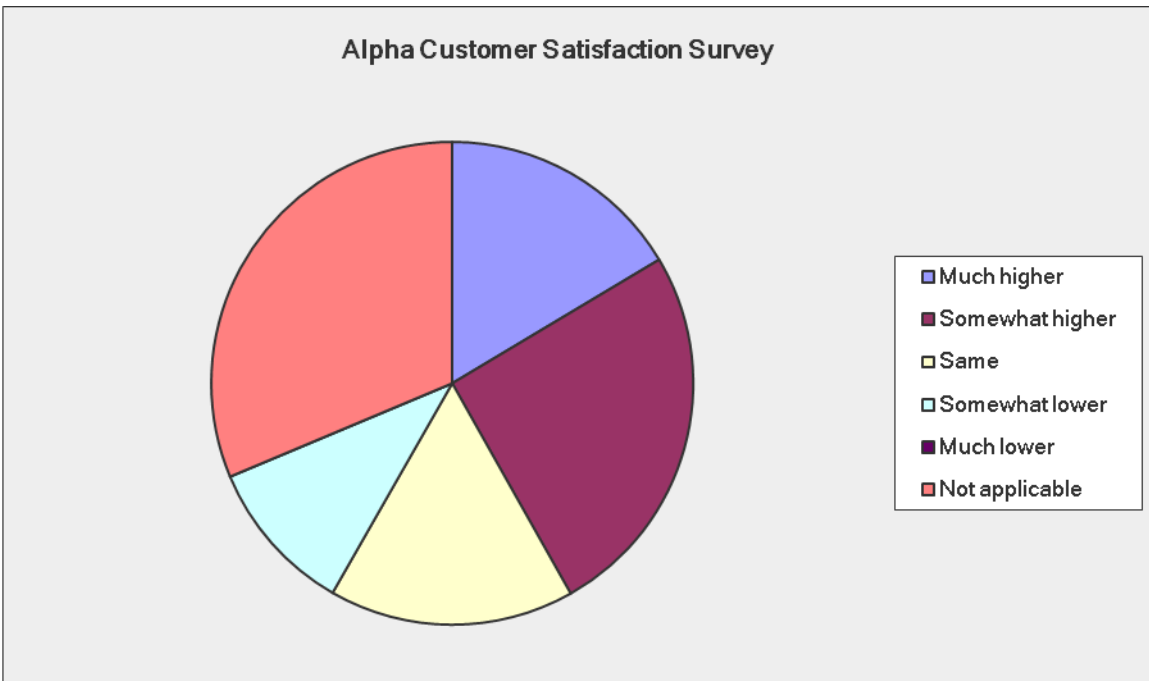
| How would you rate your overall level of satisfaction with us? |                  |                |
|--|------------------|----------------|
| Answer Options   | Response Percent | Response Count |
| Highly satisfied   | 78.9%            | 56             |
| Somewhat satisfied   | 18.3%            | 13             |
| Neutral  | 1.4%             | 1              |
| Somewhat dissatisfied  | 1.4%             | 1              |
| Highly dissatisfied  | 0.0%             | 0              |
| <i>answered question</i>                                       |                  | <b>71</b>      |
| <i>skipped question</i>  |                  | <b>1</b>       |



Question Eight: If you are using other companies that provide a similar service, how do we rate compared to them?

### Alpha Customer Satisfaction Survey

| If you are using other companies that provide a similar service, how do we rate compared to them? |                  |                |
|---|------------------|----------------|
| Answer Options  | Response Percent | Response Count |
| Much higher   | 16.4%            | 11             |
| Somewhat higher   | 25.4%            | 17             |
| Same  | 16.4%            | 11             |
| Somewhat lower  | 10.4%            | 7              |
| Much lower  | 0.0%             | 0              |
| Not applicable  | 31.3%            | 21             |
| <i>answered question</i>  |                  | <b>67</b>      |
| <i>skipped question</i>   |                  | <b>5</b>       |



***1c: Recorded Supplier Interview***

## ***Appendix 2: Research Consent***

**Research overview / Consent**

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**Section A. Research overview**

Alpha Group is continuously trying to improve its systems and ways of working for its staff. Currently, Alpha Group are going through a process of re-engineering the service back office, which involves improving present systems and where necessary introducing new systems to automate current processes. We would therefore, like to have your views in order to help Alpha Group to identify most appropriate ways for re-engineering of processes based on your experience at Alpha Group and any other organisations you might be aware of.

**The data will be collected by focus groups, interviews and questionnaires.** There are two parts of data collection to be used: firstly, we anticipate that this data will help in improving Alpha Group service related business processes. Secondly, data collected as part of the current study will be used by Anthony Chinedu Ofoegbu for studying at the University of Salford for an academic qualification and academic publications under the supervision of Aleksey Heinze and John Davies.

Please rest assured that:

- Your participation in the academic part of this work is voluntary – you don't have to participate
- Participation or refusal to co-operate in the academic part will have no bearing on your work at Alpha Group.
- You can always contact the researcher if you have any queries regarding this research
- Any information provided will remain confidential and be used only for this project
- You will not be identified, unless you agreed to do so
- Data held on computers and "hard" copy files will be held securely
- Data collected will be fed back to you so that you can make corrections
- Data analysis will be available on request
- Your name and signature are used only as proof of reading the consent statement below – these will not be used in any other way

***Please complete Section B or C at any one time - Thank you.***

---

**Section B. Consent:**

I have read and understood Section A above. By signing below I agree that the information that I am going to provide will be used for the above research purpose.

Print Name: ..... Signature: .....

Date: .....

Are you happy to be identified individually? .....YES / NO

---

Please forward the above Consent or Consent withdrawal below to Anthony Chinedu Ofoegbu,

Information Systems, Organisations and Society Research Centre, University of Salford, Maxwell building, 43 The Crescent, M5 4WT.

email: [a.c.ofoegbu@salford.ac.uk](mailto:a.c.ofoegbu@salford.ac.uk)



**Research overview / Consent Withdrawal**

---

**Section A. Research overview**

Alpha Group is continuously trying to improve its systems and ways of working better for its staff. Currently Alpha are going through a process of re-engineering the service back office, which involves improving present systems and where necessary introducing new systems to automate current processes. We would therefore, like to have your views in order to carry out a re-engineered process with user integration. **The data will be collected by focus groups, interviews and questionnaires.** The first part of this work has the practical element - We hope this research helps in practice in the service section of Alpha Group in improving its business processes. The second part of this research is used by Anthony Chinedu Ofoegbu in conducting the current study which could lead to academic qualification and publications under the supervision of Aleksej Heinze and John Davie.

Please rest assured that:

- Your participation in the academic part of this work is voluntary – you don't have to participate
- Participation or refusal to co-operate in the academic part will have no bearing on your work at Alpha Group.
- You can always contact the researcher if you have any queries regarding this research
- Any information provided will remain confidential and be used only for this project
- You will not be identified, unless you agreed to do so
- Data held on computers and "hard" copy files will be held securely
- Data collected will be fed back to you so that you can make corrections
- Data analysis will be available on request
- Your name and signature are used only as proof of reading the consent statement below – these will not be used in any other way

**Section C. Consent Withdrawal:**

I withdraw my consent to participate in research outlined above in Section A. By signing below I agree that any information given by me will not be used for the above research purpose. I also understand that this action **will not** influence my relationship with the researcher his supervisor, company involved or the University of Salford.

Print Name: ..... Signature: .....

Date: .....

---

Please forward the above Consent or Consent withdrawal below to Anthony Chinedu Ofoegbu, Information Systems, Organisations and Society Research Centre, University of Salford, Maxwell building, 43 The Crescent, M5 4WT.  
email: [a.c.ofoegbu@salford.ac.uk](mailto:a.c.ofoegbu@salford.ac.uk).

### ***Appendix 3: System Test script***

Title:

Service Solution Project Plan

| <u>Phases</u>  | <u>Days</u> | <u>Priority</u> | <u>Action</u> | <u>Start date</u> | <u>Sign Off</u> | <u>Comments</u>   |
|--|-------------|-----------------|---------------|-------------------|-----------------|---|
| 1. Workshop session  | 1           |                 | Vendor/Alpha  |                   |                 |   |
| 2. Review functional specification   | 0.5         |                 | Alpha         |                   |                 |   |
| 3. Develop and test software using scrum                                       | 8           |                 | Vendor        | 25/07/2011        | 04/08/2011      |   |
| 4. Create another test copy of the live database                               | 1/3         |                 |               |                   |                 |   |
| 5. Install Vendor service solution on the new test database and test           | 1/3         |                 |               |                   |                 |   |
| 6. Install Vendor service solution on the virtual machine                      | 1/3         |                 |               |                   |                 |   |
| 7. Walk through/train on new features and agree test plan                      | 1/2         | High            | Vendor        |                   |                 |   |
| 8. Introduce new functionalities and agree test plan with staff                |             | High            | Alpha         |                   |                 |   |
| Test installation for errors:  |             |                 |               |                   |                 |   |
| a. Confirm all fields specified in the blue print is contained in the solution |             | High            | SM            |                   |                 | Fields are contained however there are glitches that require being fixed. |
| b. Check the creation of items and consumables                                 |             | High            | SM            |                   |                 |   |
| 1. Test Using the following customer booth                                     |             | High            | SM            |                   |                 |   |
| C00001   |             |                 | SM            |                   |                 |   |
| C00002   |             |                 |               |                   |                 |   |
| C00003   |             |                 |               |                   |                 |   |
| C10001   |             |                 |               |                   |                 |   |

|   |  |      |  |                |  |  |
|---|--|------|--|----------------|--|--|
| C10002  |  |      |  |                |  |  |
| C10003  |  |      |  |                |  |  |
| C10010  |  |      |  |                |  |  |
| 2. Identify the generic booth to which booths belong  |  | High |  | SM             |  |  |
| 3. Create the CEC for each customer   |  | High |  | SM             |  |  |
| 4. Link the generic booth, then customise the consumables   |  | High |  | SM             |  |  |
| 5. Create contract where contract is required (Implication is that we get customers to agree to type of contract)                       |  | High |  | SM             |  |  |
| c. Delete items created and confirm success   |  | High |  | SM             |  |  |
| d. Link item(s) to 'Site Equipment Card' amend consumables and confirm it is unique to the customer and does not change the master item |  | High |  | SM             |  |  |
| e. Check item link with service contract  |  | High |  | SM             |  |  |
| f. Check service call links with items (equipments/consumables) and confirm you can select spraybooths as equipments.                   |  | High |  | Alpha/SM<br>SM |  |  |
| g. Confirm selected equipments are carried forward to the sales order   |  | High |  | SM             |  |  |
| h. Add and delete items in the sales order  |  | High |  | SM             |  |  |
| i. Check activity and the   |  |      |  |                |  |  |
|   |  |      |  |                |  | Although items are carried forward but when changes are made serviceable items don't come forward. |

|  |  |                                     |   |  |  |  |
|--|--|-------------------------------------|---|--|--|--|
| <p>accompanying UDF to confirm it is ready mobile application</p> <ul style="list-style-type: none"> <li>j. Check how the calendar works</li> <li>k. Check the marketing documents created in Crystal confirm they are linked</li> <li>l. Check marketing docs currently in SAP are OK (PLD &amp; Crystal)</li> <li>m. Check all existing modules are OK</li> <li>n. Check GL</li> <li>o. Check the current add-on features such as buttons work and the pop up box works</li> <li>p. List any issues</li> <li>q. Document specific required changes to be made on Vendor's add-on</li> <li>r. Add/delete items from item master consumables</li> <li>s. Add user to calendar group</li> <li>t. Create new calendar member group</li> <li>u. Delete created group</li> </ul> |  |                                     |   |  |  |  |
| <p>Review the above new functionalities with staff</p> <ul style="list-style-type: none"> <li>a. Complete list of new functionalities</li> <li>b. Give a presentation on the new system to all staff</li> <li>c. Get feedback from staff on the new system</li> <li>d. Communicate and review</li> </ul>   |  | <p>Low<br/>Low<br/>Low<br/>High</p> | <p>SM<br/>All<br/>All<br/>SM+Vendor</p> |  |  |  |

|  |   |      |        |  |  |  |
|--|---|------|--------|--|--|--|
| identified issues with Vendor  |   |      |        |  |  |  |
| <p>Test that current processes work with individual staffs:</p> <p>a. Check that all existing processes works</p> <p>b. Run through the processes with each staff that uses SAP B1 using Vendor service solution on the test database</p> <p>c. Check marketing documents/outputs work properly</p> <p>d. Check that all functionalities work properly</p> <p>e. List any issues</p> |   | High | All    |  |  |  |
|  |   | High | All    |  |  |  |
|  |   | High | All    |  |  |  |
|  |   | High | SM     |  |  |  |
| Vendor returns to review, test & resolve issues and provide additional training on system where required   | ½ | High | Vendor |  |  |  |
| Final test and use of new functionality. Report and resolve any issues before 'go-live'  |   | High | All    |  |  |  |
| 9. Perform installation on live system   | 1 |      | Vendor |  |  |  |
|  |   | High | Alpha  |  |  |  |
| a. Test processes and sign off<br>b. Confirm all processes run well on the live system   |   | High |        |  |  |  |
| 10. Post upgrade on-site support (If required)   | ½ |      | Vendor |  |  |  |

|  |  |  |       |  |  |  |
|--|--|--|-------|--|--|--|
| a. Trouble shoot where needed<br>b. Highlight any issues caused by installation<br>c. Further training as required |  |  | Alpha |  |  |  |
| 11. Project closure and sign off   |  |  |       |  |  |  |

**SAP B1 and Vendor Service Add-on Acceptance Test Log**

SYSTEM:

DATE: March 2011

Test By:

Test Manager:

**RESULT CODE:**

|          |                    |
|----------|--------------------|
| <b>A</b> | : Accepted         |
| <b>N</b> | : Not Accepted     |
| <b>P</b> | : Partial Failure  |
| <b>F</b> | : Complete Failure |

| Test Case  | Input | Expected Result | Actual Result | Issues | Result Code | Additional Comments |
|--|-------|-----------------|---------------|--------|-------------|---------------------|
| <b>CRM</b>   |       |                 |               |        |             |                     |
| <ul style="list-style-type: none"> <li>• Create activity</li> <li>• Find activity</li> <li>• Creating a new BP</li> <li>• Updating activity</li> <li>• Deleting a BP and activity</li> </ul> |       |                 |               |        |             |                     |
| <b>Sales</b>   |       |                 |               |        |             |                     |
| <ul style="list-style-type: none"> <li>• Create sales order</li> <li>• Duplicate sales order</li> <li>• Update sales order</li> <li>• Delete sales order</li> </ul>                          |       |                 |               |        |             |                     |
| <b>Quotation</b>   |       |                 |               |        |             |                     |
| <ul style="list-style-type: none"> <li>• Create sales quote</li> <li>• Duplicate sales quote</li> <li>• Convert to sales order</li> <li>• Close</li> </ul>                                   |       |                 |               |        |             |                     |
| <b>Service</b>   |       |                 |               |        |             |                     |



|  |  |  |  |  |  |  |
|--|--|--|--|--|--|--|
| <ul style="list-style-type: none"> <li>• Create a service call</li> <li>• Assign engineer</li> <li>• Updating service call</li> <li>• Using &amp; deleting service call</li> <li>• Create, use &amp; delete an activity</li> <li>• Link activities</li> </ul>  |  |  |  |  |  |  |
| <b>Purchasing</b>  |  |  |  |  |  |  |
| <ul style="list-style-type: none"> <li>• Creating a PO</li> <li>• Sending PO to customer</li> </ul>  |  |  |  |  |  |  |
| <b>GP Analysis</b>   |  |  |  |  |  |  |
| <ul style="list-style-type: none"> <li>• Sales analysis</li> <li>• Job costing work around</li> </ul>  |  |  |  |  |  |  |
| <b>Invoicing</b>   |  |  |  |  |  |  |
| <ul style="list-style-type: none"> <li>• Creating an invoice</li> <li>• Entering expense details</li> <li>• Updating an invoice</li> <li>• Hidden line</li> </ul>  |  |  |  |  |  |  |
| <b>Others</b>  |  |  |  |  |  |  |
| <ul style="list-style-type: none"> <li>• Delivery</li> <li>• Credit note</li> <li>• Item master data</li> <li>• Vendor add-on <ul style="list-style-type: none"> <li>• Create new item using the add-on</li> <li>• Explore other uses of add-on</li> </ul> </li> <li>• Review reconciliation</li> <li>• Banking <ul style="list-style-type: none"> <li>• Incoming</li> <li>• Outgoing</li> </ul> </li> </ul> |  |  |  |  |  |  |

| New Service functionality  |  |  |  |  |  |  |
|--|--|--|--|--|--|--|
| <ul style="list-style-type: none"> <li>• Create new master item (serviceable item)</li> <li>• Add consumables to the item</li> <li>• Create CEC               <ul style="list-style-type: none"> <li>- Add customer</li> <li>- Add equipments</li> <li>- Edit consumables</li> </ul> </li> <li>• Create service contract               <ul style="list-style-type: none"> <li>- Link CEC</li> </ul> </li> <li>• Create service call               <ul style="list-style-type: none"> <li>- Add activity</li> <li>- Check and update consumables</li> <li>- Create sales order</li> </ul> </li> <li>• Confirm calendar display               <ul style="list-style-type: none"> <li>- Check various groups/regions</li> </ul> </li> </ul> |  |  |  |  |  |  |

Name: .....

Sign: .....

Dept: .....

Date: .....