The relationship between lean service, activity-based costing and business strategy and their impact on performance

A thesis submitted in partial fulfilment of the requirements for the degree of Doctor of Philosophy

By

Wael Hadid

Brunel Business School
Brunel University London
April 2014

Abstract

Lean system has drawn the attention of researchers and practitioners since its emergence in 1950s. This has been reflected by the increasing number of companies attempting to implement its practices and the large number of researchers investigating its effectiveness and identifying important contextual factors which affect its implementation. The rising level of interest in lean system has led to the emergence of three distinctive streams of literature.

The first stream of literature has focused on the effectiveness of lean system. However, this literature was limited as it mainly examined the additive impact of lean practices on operational performance in the manufacturing context. The second stream of literature has focused on the role the accounting system in the lean context. In this body of literature, there was an agreement among researchers on the superiority of activity-based costing system (ABC) over the traditional accounting system in supporting the implementation of lean practices. However, most studies in this strand of literature were either conceptual or case-based studies. The third stream of literature has focused on the fit between business strategy and lean system. However, inconclusive results were reported in relation to the suitability of lean system to firms adopting the differentiation strategy and others adopting the cost leadership strategy.

The aim of this study is to develop and empirically test a conceptual model which integrates the three distinctive streams of literature to extend their focus and overcome their limitations. More specifically, the model developed in the current study highlights not only the additive impact of lean practices but also the possible synergy among those practices in improving both operational and financial performance of service firms. In addition, the model brings to light the potential intervening role of ABC in the strategy-lean association.

After identifying and reviewing the relevant literature, the socio-technical system theory and contingency theory were used to develop the conceptual model and associated hypotheses. A questionnaire instrument was designed to collect empirical data which was supplemented by objective data from the Financial Analysis Made Easy database in order to empirically test the conceptual model using partial least squares structural equation modelling (PLS-SEM).

The findings of this study indicated that while the technical practices of lean service improved only the operational performance of service firms, the social practices enhanced both operational

and financial performance. In addition, the two sets of practices positively interacted to improve firm performance over and above the improvement achieved from each set separately. Moreover, ABC was found to have a positive association with lean practice, and consequently an indirect positive relation with firm operational performance. Finally, both the differentiation and cost leadership strategy had a direct positive relationship with lean practices. However, while ABC was found to partially mediate the differentiation-lean association, it suppressed the cost leadership-lean association leading to a case of inconsistent mediation.

The current study contributes to the current literature at different levels. First, at the theoretical level, this study develops a conceptual framework which crosses different streams of literatures mainly, lean system literature, management accounting literature (with focus on ABC), and business strategy literature. Unlike previous studies, by integrating the perspective of socio-technical system theory and contingency theory, the model (i) highlights not only the additive but also the synergistic effect of lean service practices on firm performance, (ii) brings to light the direct impact of ABC and business strategy on lean service practices and the intervening role of ABC due to which the business strategy is assumed to have also an indirect influence on lean practices, and (iii) offers an alternative view on how ABC can improve firm performance by enhancing other organisational capabilities (lean practices) which are expected to improve performance . Second, at the methodological level, unlike previous studies, this study includes a large number of lean service practices and contextual variables to report more precisely on the lean-performance association. In addition, the inclusion of the financial performance dimension- measured by secondary data- in the model besides the operational performance is critical to understand the full capability of lean service in improving firm performance. Further, employing a powerful statistical technique (PLS-SEM) provides more credibility to the results reported in this study. Third, at the empirical level, this study is conducted in the UK service sector. As such, this study is one of the very few studies that have reported on lean service and examined how the adoption of ABC and a specific type of business strategy can affect its implementation using empirical survey data from this context.

Dedication

To my parents, brothers and sister for their enduring love, support and encouragement during my journey to complete this thesis.

Acknowledgement

I would like to express my gratitude to my supervisors Dr. Afshin Mansouri and Dr. David Gallear for their great help, support, advice, and encouragement throughout the PhD programme.

I would like to express my indebtedness to the Syrian Ministry of Higher Education for their financial and academic support during my period of study.

Last but not least, all my thanks go also to my officemates, PhD colleagues, and friends with whom I shared an important episode of my life.

Declaration

I hereby declare that the materials contained in this thesis have not been previously submitted for a degree in this or any other university. I further declare that this thesis is solely based on my own research.

I also declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct.

Wael Hadid

Publications associated with the thesis

Hadid, W. and Mansouri, A. (2014). The lean-performance relationship in services: A theoretical model. *International Journal of Operations and Production Management*, 34(6), 750-785

Table of Content

List of Tables

List of figures

List of abbreviations

ABC:	Activity-based costing
AVE:	Average variance extracted
AMT:	Advanced manufacturing technology
CT:	Contingency theory
CFL:	Changing facility layout
CFA:	Confirmatory factor analysis
DV:	Dependent variable
EFA:	Exploratory factor analysis
HRM:	Human resource management
IV:	Independent variable
JIT:	Just in time
LTPs:	Lean technical practices
LSPs:	Lean social practices
MAS:	Management accounting system
MCS:	Management control systems
NVAs:	Non value adding activities
PM:	Profit margin
PLS:	Partial least squares
ROI:	Return on investment
ROCE:	Return on capital employed
STS:	Socio-technical system theory
SEM:	Structural equation modeling
TAS:	Traditional costing systems
TE:	Turnover per employee
TQM:	Total quality management
TPM:	Total preventive maintenance
VSM:	Value stream mapping

Chapter 1 : Introduction

1.1 Research background

Globalisation and increasing competition have changed the market environment in which companies across different sectors operate (Alsmadi et al., 2012; Soltani et al., 2010; Askarany et al., 2010; Karmarkar, 2004). To survive in the new market environment, companies should tackle several conflicting aspects amongst which are increasing customers' expectations, achieving higher revenues and increasing expenses (Askarany et al., 2010; Allway and Corbett, 2002; Clarke and Mullins, 2001). To worsen this situation, increasing prices of products/services in order to achieve a pre-specified revenue is no longer an option for many companies across various industries (Stuebs and Sun, 2010). Consequently, the ancient formula (i.e. selling price = cost + profit margin) that has long been used to determine the selling price of products/services by adding a profit margin to the cost of products/services is not as valid as it has been in the past (Yu-Lee, 2011). As a result, it seems more effective for most firms in this new era to focus on and control their costs as a means for improving the increasingly uncontrollable revenue (Askarany et al., 2010; Stuebs and Sun, 2010; Clarke and Mullins 2001). To achieve that, new methods that are designed to analyse and control operations cost and satisfy customers' expectations should be adopted (Vlachos and Bogdanovic, 2013; Karmarkar, 2004).

The lean system has been proposed as an ideal, strategic option to confront the conflicting aspects facing companies in the new market environment (Arlbjørn and Freytag, 2013). Shah and Ward (2007, P.791) have defined lean system as "an integrated socio-technical system whose main objective is to eliminate waste by concurrently reducing or minimising supplier, customer, and internal variability". The elimination of activities that customers do not value is likely to lead to cost reductions, revenue improvements and higher customer satisfaction (Vlachos and Bogdanovic, 2013; Womack and Jones, 1996). Due to these expected benefits, lean practices have received special attention in practice

and academia (Taylor and Taylor, 2009; Maskell and Kennedy, 2007; Atkinson, 2004). This has been reflected by the growing number of researchers who have attempted to empirically validate the effectiveness of lean practices in delivering their purported benefits to adopters (e.g. Agarwal et al., 2013; Bonavia and Marin-Garcia, 2011; Rahman et al., 2010; De Menezes and Wood, 2006; Shah and Ward, 2003).

However, a common theme among most studies contributing to this stream of literature is (a) their focus on manufacturing operations (Arlbjørn and Freytag, 2013; Malmbrandt and Åhlström, 2013; Vlachos and Bogdanovic, 2013), (b) investigating mainly the additive impact (i.e. the independent effect of practices) of lean practices on operational performance with inconclusive results (Dabhilkar and Åhlström, 2013; Das and Jayaram, 2007), and (c) their general neglect to the potential influence of adopters' organisational context on the adoption of lean practices (Arlbjørn and Freytag, 2013; Fullerton et al., 2013; Malmbrandt and Åhlström, 2013; Shah and Ward, 2003). More specifically, the role of management accounting system (MAS) and business strategy in the adoption of lean practices have not been rigorously investigated. These shortcomings limit our knowledge on several aspects of the lean system and its integration with the context in which it operates in a number of ways.

First, there is limited empirical evidence on the possible non-additive (i.e. the interaction between practices) impact of lean practices on firm performance especially on financial indicators despite their importance to top management (Arlbjørn and Freytag, 2013; Camacho-Miñano et al., 2013; Dabhilkar and Åhlström, 2013; Das and Jayaram, 2007). This limited focus to only the additive impact of lean practices prevents the realisation of the full potential of lean system and the mechanism through which it affects firm performance. This, in turn, may lead to hindering the spread of lean system among firms and industries more widely (Fullerton and Wempe, 2009). Recently, a few researchers have highlighted the need to adopt the socio-technical system theory (STS) when examining the lean-performance association (e.g. Dabhilkar and Åhlström, 2013; Furlan et al., 2011; Das and Jayaram, 2007). The STS views organisations to be consisted of two separate, but interdependent, systems: a technical system and a social system (Appelbaum, 1997; Fox, 1995; Trist, 1981). The technical system comprises equipments, tools,

techniques and processes, while the social system comprises people and relationships among them (Trist, 1981; Trist and Bamforth, 1951). The argument in this theory is that optimal performance can be obtained only when there is a simultaneous implementation of practices from both the technical and social system (Fox, 1995; Huber and Brown, 1991; Trist and Bamforth, 1951). Therefore, although each system can be described as a stand-alone system with its own benefits, the optimal performance of an organisation can only be obtained by the joint optimisation of both systems (Zu, 2009; Manz and Stewart, 1997; Fox, 1995; Trist, 1981; Emery and Trist, 1965). Such argument implies that it is possible that the two systems of the STS interact to produce the highest possible outcome. To date, little work has been done on perceiving lean system as a socio-technical system and examining the interaction between the technical and social systems in improving firm performance (Dabhilkar and Åhlström, 2013; Furlan et al., 2011; Das and Jayaram, 2007).

Second, in spite of claims by proponents of lean service on the applicability and effectiveness of lean practices in the service context, very scant empirical information has been reported to date on the additive and non-additive effect of lean practices on the performance of service firms (Arlbjørn and Freytag, 2013; Malmbrandt and Åhlström, 2013; Vlachos and Bogdanovic, 2013). In its current status, the literature on lean system in services cannot be relied on to make informed conclusions on whether the applicability of lean system is universal across sectors or only relevant to manufacturing operations where it originated (Arlbjørn and Freytag, 2013; Malmbrandt and Åhlström, 2013).

Third, there is also a lack of sufficient information on what and how contextual factors can impact the adoption of lean practices (Arlbjørn and Freytag, 2013; Fullerton et al., 2013; Malmbrandt and Åhlström, 2013; Shah and Ward, 2003). From the contingency theory (CT) perspective, any management or organisational system cannot be similarly effective in all contexts (Rashidirad et al., 2013; Drazin and Van de Ven, 1985). As a result, a specific context can be more conducive for a specific system than other contexts, which positions the concept of fit at the heart of CT (Drazin and Van de Ven, 1985).

To date, there have been two streams of literature. The first stream of literature has attempted to highlight the role of MAS in the implementation of lean practices (e.g. Chiarini, 2012; Li et al., 2012; Cooper and Maskell, 2008; Kennedy and Widener, 2008; Maskell and Kennedy, 2007; Maskell, 2006; Grasso, 2005; Carnes and Hedin, 2005; Karlsson and Ahlstrom, 1996; South, 1993; Datar et al., 1991). The MAS focuses on collecting, analysing, and then providing managements with accurate information on resources consumed by their operations which can be used for different purposes including stock valuation, pricing, make/buy decisions, operating performance evaluation, planning and supporting improvement initiatives (Maiga and Jacobs, 2008; Fullerton and McWatters, 2004). The core argument in this stream of literature is that traditional accounting system (TAS) may hinder the adoption of lean practices and a more compatible system such as activity-based costing system (ABC) (e.g. Khataie and Bulgak, 2013; Chiarini, 2012) or lean accounting (Ruiz-de-Arbulo-Lopez et al., 2013; Cooper and Maskell, 2008) should be relied upon to support such adoption. However, very little empirical research exists which has specifically examined the role of ABC and/or lean accounting in the lean context (Fullerton et al., 2013; Banker et al., 2008). While conducting empirical research on lean accounting may be premature as it is a relatively recent concept and some companies may not be familiar with it (Ruiz-de-Arbulo-Lopez et al., 2013; Chiarini, 2012), ABC has been around for over two decades and a considerable number of companies have implemented it (Askarany et al., 2010; Kallunki and Silvola, 2008; Gosselin, 1997; Cooper and Kaplan, 1992).

The second stream of literature has empirically investigated the possible impact of business strategy on lean practices (e.g. Qi et al., 2011; Ward et al., 2007; Chenhall and Langfield-Smith, 1998). Business strategy usually expresses how a company chooses to compete against its competitors and attain a competitive advantage in the market (Bruggeman and Stede, 1993; Porter, 1980). Adopting the typology proposed by Porter (1980) which classified companies into differentiators or cost leaders, studies in this stream of literature have reported mixed results in terms of the relationship between lean system and business strategy. While Qi et al. (2011) have found cost leadership strategy to be more compatible with lean system than the differentiation strategy; others have

demonstrated the reverse (Ward et al., 2007; Chenhall and Langfield-Smith, 1998).

Studies in the two streams of literature presented above have a narrow focus on either the accounting-lean relationship (e.g. Fullerton et al., 2013; Banker et al., 2008) or the strategy-lean association (e.g. Qi et al., 2011; Ward et al., 2007). Consequently, neither of the reviewed studies has adopted a wider view by simultaneously examining the impact of the accounting system and business strategy on the lean system in one model. This simultaneous examination is critical for two reasons. First, it allows for highlighting the possible intervening role of the accounting system in the strategy-lean association. The intervening role of the accounting system can be uncovered by integrating the findings of the two previously reviewed streams of literature with the findings of studies documenting the impact of business strategy on the accounting system (e.g. Hammad et al., 2010; Auzair and Langfield-Smith, 2005; Chenhall, 2003; Gosselin, 1997).

Second, due to the anticipated impact of business strategy on both the accounting system and the lean system (Qi et al., 2011; Chenhall and Langfield-Smith, 1998; Chenhall, 2003; Gosselin, 1997), studying the impact of the accounting system on the lean system without accounting for the effect of business strategy will provide biased findings due to endogeneity issues caused by correlated omitted variables[1] (Larcker and Rusticus, 2007). Although the potential for endogeneity is present in almost all studies (Chenhall and Moers, 2007), including the impact of business strategy when studying the lean-accounting association addresses, at least partially, this issue.

1.2 Research motivations

This research is motivated by (1) the popularity of lean system to improve performance, (2) the importance of the service sector to most developed economies, (3) the urgent need to uncover and understand the full mechanism of lean system through which it impacts firm performance, (4) the importance of clarifying the full role of the accounting system

[1] Endogeneity caused by correlated omitted variables occurs as a result of excluding one or more variables which are expected to affect both the dependent and independent variable(s) in a model (Chenhall and Moers, 2007).

and business strategy in the implementation of lean practices, and (5) calls from several researchers for empirical studies to overcome the aforementioned limitations.

As mentioned before, the lean system has received a great deal of attention in both practice and academia due to the purported benefits that can be attained from its adoption (Taylor and Taylor, 2009; Maskell and Kennedy, 2007; Atkinson, 2004). Maskell and Kennedy (2007) report that around 50% of American manufacturing companies strive to achieve some level of a lean system in their plants. In addition, Taylor and Taylor (2009) find that lean methods are one of the eight topics that have received most of the attention in operations management research.

Furthermore, the contribution of the service sector to the gross domestic product outweighs that of other sectors in most developed economies (Malmbrandt and Åhlström, 2013; Soltani et al., 2012; Chase and Apte, 2007; Chenhall, 2003). Therefore, conducting more research to verify anecdotal evidence on the applicability and the effectiveness of lean practices in the service sector has the potential to provide significant benefits, perhaps at economy level (Apte and Goh, 2004; Brignall, 1997). If lean practices are proved to be effective, then more service companies must be encouraged to adopt them and enjoy their benefits (Fullerton and Wempe, 2009). On the other hand, if they are proved to be ineffective, the potential adopters can stop experimenting with those practices, saving time, effort and the resources required for their implementation (Arlbjørn and Freytag, 2013; Pavnaskar et al., 2003).

In addition, this research is also motivated by the serious limitations of the current lean system literature that has not provided insightful information on different aspects of lean system. First, as previously highlighted, there is a strong need to probe deeper into the mechanism through which lean system impacts firm performance. This necessitates going beyond the traditional lean-performance model by investigating not only the additive, but also the non-additive effect of lean practices on firm performance (Dabhilkar and Åhlström, 2013; Das and Jayaram, 2007; Shah and Ward, 2003). Second, the current lean literature falls short in terms of providing sufficient evidence on the capability of lean

practices to improve the financial performance of adopters although the financial performance is critical to the top management of most companies (Arlbjørn and Freytag, 2013; Camacho-Miñano et al., 2013; Womack and Jones, 1994). Overcoming both or either of these limitations is expected to allow for a better understanding of the full capability of lean practices. Third, investigating these two aspects of lean system in the service rather than manufacturing context cannot be overestimated (Malmbrandt and Åhlström, 2013; Suárez-Barraza et al., 2012; Voss, 2005). By doing so, we are able to examine the universality of lean system at sector level. In other words, examining lean system in the service context will provide evidence whether the manufacturing-oriented system can be effective in different contexts or it is limited to its origin. Fourth, more insights can be obtained on the role of MAS and business strategy in the lean context by integrating three distinctive streams of literature, namely the lean-accounting literature, the strategy-lean literature and the strategy-accounting literature. This integration allows for developing a more complex model which, through the mediation perspective of the contingency theory, can highlight the intervening role of MAS in the strategy-lean association and decompose the strategy effect into its direct and indirect elements (Luft and Shields, 2003; Shields et al, 2000). Consequently, an empirical examination of the new model provides a better understanding of the role played by both the MAS and business strategy in the adoption of lean practices which has been called for by several researchers (e.g. Fullerton et al., 2013; Malmbrandt and Åhlström, 2013).

1.3 Research problem

The research problem stems from the desire and urgent need to go beyond the traditional, limited lean-performance model and lean-context model that have been adopted by most researchers to date. The traditional lean-performance model focuses mainly on whether lean practices have any additive effect on operational performance of manufacturing firms. As such, this model does not take into account any likely collaborative influence of lean practices on performance (Dabhilkar and Åhlström, 2013; Kim et al., 2012; Shah and Ward, 2003). Investigating synergy resulting from possible interaction between lean practices could have a profound effect on how to best allocate resources among lean practices. In addition, providing rigorous findings on the outcome of lean practices at

financial level can be as important as reporting on operational performance, or even more so (Camacho-Miñano et al., 2013; Womack and Jones, 1994).

Allway and Corbett (2002) report that the lean practices used by service firms are very similar to those already adopted by manufacturing firms. However, there is no conclusive evidence on whether these practices originated in manufacturing can be effective in services as they have been claimed to be in manufacturing (Arlbjørn and Freytag, 2013; Malmbrandt and Åhlström, 2013; Vlachos and Bogdanovic, 2013). Our knowledge on lean service to date has mainly been derived from conceptual and case studies literature (Suárez-Barraza et al., 2012; Holm and Ahlstrom, 2010b). These types of research cannot, due to their known inherent limitations, provide practical and generalisable evidence on the effectiveness of lean service (Challis et al., 2002; Voss et al., 2002; Shields, 1995). To worsen this situation, anecdotal evidence supporting the effectiveness of lean service has faced some contrasting empirical results indicating that not all practices implemented in manufacturing could be relevant or effective in services (Alsamdi et al., 2012; Yasin et al., 2003). These findings are not unexpected given the well documented differences between the two sectors (Soltani et al., 2012; Sampson and Froehle, 2006; Nie and Kellogg, 1999).

Added to that, the sole focus by the vast majority of researchers on verifying the lean-performance association has directed attention away from the importance of understanding the role of MAS and business strategy in the lean context (Fullerton et al., 2013; Malmbrandt and Åhlström, 2013; Shah and Ward, 2003). However, even when the role of MAS and business strategy has been brought to light by some researchers, these variables have been examined in isolation (e.g. Fullerton et al., 2013; Qi et al., 2011; Amoako-Gyampah and Acquaah, 2008; Banker et al., 2008; Ward et al., 2007; Fullerton and McWatters, 2002). With this limited focus, only the additive effect of MAS and business strategy has been highlighted. This conceals more insightful findings that can be obtained from models which adopt a deeper view through decomposing the additive effect into its direct and indirect elements (Luft and Shields, 2003; Shields et al., 2000).

Collectively, these shortcomings represent the research problem that will be addressed in this thesis.

1.4 Research questions

To address the research problem discussed above, this study seeks to answer the following questions:

1. Do lean practices have an additive and/or non-additive impact on operational and/or financial performance of service firms?
2. Does each of the two contextual variables MAS and business strategy affect lean service practices? If so, is the effect of each variable independent of the other variable?

Several hypotheses are developed and reported later in chapter 3 to facilitate answering these research questions.

1.5 Aim and objectives of the research

The aim of this research is to go beyond the traditional lean-performance model and lean-context model by (a) focusing on not only the additive impact of lean practices on the performance of service firms, but also on their likely interaction impact, and (b) decomposing the additive impact of MAS and Business strategy on the adoption of lean practices into its direct and indirect elements.

To facilitate the achievement of the research aim, the following objectives are set out:

1) To conduct a systematic review of the relevant literature in order to identify lean service practices, performance indicators and contextual variables.
2) To develop a theoretical model that brings to light the mechanism through which the identified variables are linked.
3) To empirically assess relationships hypothesised in the theoretical model in the service context.

1.6 Research methodology

To achieve the aim and objectives of this study, a systematic search for lean service publications was conducted by surveying publications in five well-known databases using key words including “lean”, “process improvement”, “system thinking” and “more with less”. Those databases include: Business Source Premier, ABI/INFORM Research, Emerald, Science Direct and Scopus. In addition, a cross-sectional survey methodology relying on a questionnaire instrument developed for the current research was adopted. This is important for reporting more generalisable findings on the full potential of lean system and the impact of MAS and business strategy on the adoption level of the system. The questionnaire targeted mainly the operations managers of a sample of UK service firms identified via the Financial Analysis Made Easy database (FAME). The empirical analysis was conducted by utilising two appropriate and effective statistical techniques, namely Factor Analysis and Partial Least Squares Structural Equation Modelling (PLS-SEM).

1.7 Significance of the research

This study offers valuable insights to different streams of literature especially the lean service literature and the management accounting literature. This study provides fresh evidence from a large-scale survey on both the additive and non-additive impact of lean practices on the performance of service firms. Therefore, it is one of the very few studies that have adopted the survey methodology to examine lean practices in services (Arlbjørn and Freytag, 2013; Malmbrandt and Åhlström, 2013; Suárez-Barraza et al., 2012). The findings of this study are then critical as they help to determine whether lean system is universalistic across sectors or context-specific (Malmbrandt and Åhlström, 2013). Moreover, the focus on both additive and non-additive impact of lean practices allows for better understanding of the mechanism through which lean practices influence performance (Dabhilkar and Åhlström, 2013; Shah and Ward, 2003). Consequently, services managers can make informed decisions on how to best allocate resources among those practices. In addition, surveying various service industries undoubtedly generates more generalisable evidence (Wagner et al., 2012; Kallunki and Silvola, 2008; Challis et al., 2002).

Investigating the impact of MAS, represented by the activity-based costing system (ABC), and business strategy on the adoption of lean practices in services will also contribute significantly to the current literature in different ways. First, this study highlights the intervening role of ABC in the strategy-lean association. Therefore, the role of ABC as both a dependent and independent variable is simultaneously examined in the same model, in contrast to most accounting studies that treated the accounting system as either a dependent or independent variable (Fullerton et al., 2013; Banker et al., 2008; Luft and Shields, 2003). Second, most studies in the ABC literature have focused on the direct effect of ABC implementation on performance with inconclusive results (e.g. Sheu and Pan, 2009; Cagwin and Bouwman, 2002; Ittner et al., 2002; Kennedy and Affleck-Graves, 2001; Mishra and Vaysman, 2001; Shields, 1995). The current study provides an alternative view on how ABC may indirectly improve performance by focusing on its ability to develop other organisational capabilities (i.e. lean service) which, in turn, are expected to improve firm performance. To date, this alternative perspective has been rarely empirically investigated (Banker et al., 2008; Ittner et al., 2002). Finally, providing empirical evidence on the effect of ABC and business strategy on lean service helps service managers who are contemplating the implementation of lean service to be cognizant of that effect on lean service.

1.8 Structure of the thesis

This chapter has provided a brief background of the study, explicitly presented the research motivations, established the research problem and questions, and conveyed the aim and objectives along with the significance of this research. The remainder of this thesis is structured as follows:

Chapter 2 presents a review of the literature relevant to this current research and highlights the research gaps. More specifically, this chapter will provide some brief information on the evolution of lean system since its emergence in 1950s. This includes a review of the various definitions reported by different researchers along with highlighting the confusion surrounding the concept of lean system. In addition, the structure and mechanism through

which lean system is argued to improve the operations and performance of adopters are presented. Finally, the empirical literature of lean system and the literature of lean service are reviewed separately and critically assessed to expose their knowledge limitations and propose avenues for overcoming the determined limitations. The last section of this chapter details the shortcomings of the current lean literature that are addressed by the current study.

Chapter 3 presents the theoretical model and associated hypotheses aimed to be examined in this study. In this chapter the model constructs are identified. In addition, the theoretical foundation of the developed model of this study is discussed. More specifically, the notion of the socio-technical theory and the contingency theory are explicated and the importance of their use in the current study is highlighted. Finally, the research theoretical model is developed along with a number of hypotheses to be empirically examined in order to satisfy the aim and objectives of this research study.

Chapter 4 outlines the research methodology adopted in the current study. More specifically, explanation of the two main research paradigms (positivism versus interpretivism) is provided along with the rationale behind the adoption of the positivism paradigm. In addition, discussion of the different research approaches (deductive versus inductive) and research strategies is presented accompanied by justification of the choices made in adopting the deductive approach and the cross-sectional survey strategy. Moreover, comparison of the different data collection methods is provided and the various stages of developing the questionnaire instrument are reported. This chapter also identifies the research context, population and the sample from which the data will be collected. This is accompanied by detailed description of the study variables measured and process of administering the questionnaire instrument. Finally, a description of the statistical techniques along with the rationale behind their adoption will be also provided.

Chapter 5 elucidates the procedures employed to clean the empirical data collected and examine it against the assumptions of parametric tests. This includes a detailed discussion of the missing data analysis and the known assumption of parametric tests including

normality, linearity, and homogeneity of variance, outliers and multicollinearity. In addition, this chapter establishes the unidimensionality of constructs and examine their reliability and validity. Finally, descriptive statistics of all constructs are presented.

Chapter 6 illustrates the development and assessment of the PLS-SEM measurement and structural model in the second and third sections, respectively. The fourth section of this chapter presents the results of hypotheses testing and the last section provides a summary of this chapter.

Chapter 7 presents a detailed discussion of the hypotheses testing results reported in chapter 6. This chapter attempts to position the results achieved for each of the research hypotheses within the relevant extant literature so that differences are highlighted and implications are deduced.

Chapter 8 provides a summary of this research and report the main conclusions based on findings from testing the research hypotheses. This chapter also highlights the limitations of the current study and provides avenues for future research.

Chapter 2 : Literature review

2.1 Introduction

The lean system has attracted the attention of many academics and practitioners over the last few decades (Taylor and Taylor, 2009; Maskell and Kennedy, 2007; Atkinson, 2004). However, what do we mean by lean system? What is the structure of a lean system? What is the mechanism through which the lean system improves adopters' performance? What limitations does the current lean literature suffer from which hinders better insights to be obtained? This chapter revolves around providing answers to such questions. To achieve this aim, the chapter is divided into seven sections. The second section discusses the evolution of lean system highlighting its various definitions and the confusion surrounding the concept. The third section is devoted to clarify the structure of lean system and the mechanism through which it is expected to influence firm performance. Section four is dedicated to present and critically assess the empirical research examining the impact of lean system on firm performance to bring to light shortcomings in the body of literature. In section five, the literature of lean system in services is reviewed with critical assessment to help position the current study within this body of literature and to highlight drawbacks weakening this literature. The penultimate section critically reviews the literature focusing on the role of MAS and business strategy in the lean context to expose its shortcomings. Finally, the last section in this chapter concludes by summarising the main observations and explicitly articulating the research gaps.

2.2 The evolution of the lean system

Lean system was first implemented in Japan in 1950s in the automotive industry (Scott and Walton, 2010, Lee et al., 2008), and more specifically at Toyota Production Corporation (Liker and Morgan, 2006; Atkinson, 2004). The system was invented by Taiichi Ohno who combined the advantages of both handcraft production and mass production to establish the new developed management and production system, Toyota Production System (TPS) or lean (Holweg, 2007; Lewis, 2000; Womack et al., 1990). The system became of interest after the results of the International Motor Vehicle Program

were published in 1980s which highlighted the superior performance of Toyota in terms of productivity and waste reduction at all levels compared to its counterparts of Western car manufacturers (Holweg, 2007; Lewis, 2000). The term "Lean" was introduced by Jone Krafcik (1988) and later, in 1990, was popularised by Womack et al. (1990) in their seminal book "The machine that changed the world" (Worley and Doolen, 2006). Since then, a great deal of research has been published to clarify the concept and investigate the applicability of the Japanese system to other countries (Meier and Forrester, 2002; Ahlstrom, 1998; Oliver et al., 1994).

However, the increasing interest in lean system has led to a strong debate in the literature on what lean manufacturing is. For instance, some researchers believe that lean system is just an extended model of the well known Japanese system, Just-in-Time (JIT) (Fullerton and Wempe, 2009; Gorman et al., 2009; Smeds, 1994). On the other hand, Alagaraja (2010) supports the notion that lean system is a developed version of Total Quality Management (TQM). Similarly, Dahlgaard and Dahlgaard-Park (2006) review the relevant literature related to lean, TQM, and six sigma and emphasise that lean has the same origin as TQM and its practices should be viewed as supportive to the aim of TQM rather than as an alternative. Contrasting the above-mentioned findings, Pettersen (2009) reports that lean system is significantly different from its closest relative TQM leading to the conclusion that lean system is a management concept on its own. Mitigating the debate, Comm and Mathaisel (2005) and Radnor and Boaden (2008) state that when broken into individual parts, the lean system is not new, but as a holistic approach it can be considered as a new system. This statement is in line with the findings of critical research conducted by Shah and Ward (2003) who find lean system to consist of four bundles, namely JIT, TQM, Human Resource Management (HRM) and Total Preventive Maintenance (TPM) where each bundle has its own practices.

In an attempt to crystallise the concept of lean system, several definitions have been reported, each of which represents the authors' perspective and understanding of the system. For instance, Hinterhuber (1994, P. 275) defines lean system as an "integrated set of attitudes and decision and action methods with which a firm can achieve sustainable

competitive advantage and increase its value in a turbulent environment". Cooper and Mohapeersingh (2008, P. 110) state that "lean thinking is a process-based method that considers the interactions across the whole supply chain". While to Atkinson (2004, P. 18) lean system is "a concept, a process and a set of tools, techniques and methodologies that can be used to attain and maintain effective resource allocation". However, more insightful definitions of lean system are provided by Shah and Ward (2007, 2003) and Allway and Corbett (2002). Allway and Corbett (2002, P.45) consider lean system as "an approach focusing on eliminating non-value added activities from processes by applying a robust set of performance change tools, and emphasising excellence in operations to deliver superior customer services". Shah and Ward (2003, P.129) perceive lean system as "a multi-dimensional approach that encompasses a wide variety of management practices, including JIT, quality systems, work teams, cellular manufacturing, supplier management, etc. in an integrated system". Four years after their first definition, Shah and Ward (2007, P.791) proposed that lean system is "an integrated socio-technical system whose main objective is to eliminate waste by concurrently reducing or minimising supplier, customer, and internal variability". Given the variety of definitions provided, it seems unsurprising to hear claims that there is still no agreement on a precise definition of lean system that leads to some confusion when lean is considered for application (Kosuge et al., 2010; Jain and Lyons, 2009). Despite such claims, viewing lean system as a multi-dimensional, socio-technical system with several practices has been commonly acknowledged in the recent literature of lean manufacturing (Dabhilkar and Åhlström, 2013; Furlan et al., 2011; Birdi et al., 2008; Das and Jayaram, 2007). This perspective has also been adopted in the current research.

2.3 The structure and mechanism of lean system

To facilitate the understanding and implementation process of lean system and guide all companies across sectors in their journey towards being lean (Piercy and Rich, 2009), Womack and Jones (1996) provide practitioners and researchers with five general principles of lean that are based on the underlying assumption that all organisations are consisted of processes (Burgess et al., 2009):

i. Value: to identify what customers value and run the business accordingly;

ii. Value stream: to identify all activities required to produce a product or service whether adding or non-adding value;
iii. Flow: to ensure that adding-value activities necessary to produce and deliver a product or service flow without interruptions;
iv. Pull: to produce according to customers demand; and;
v. Perfection: to continuously seek improvements to the process.

In addition to the five principles introduced by Womack and Jones (1996), several researchers have provided their own roadmap of the transformation process from traditional systems to lean system. In that direction, Allway and Corbett (2002) describe the transformation process to be in five phases as follows:

Phase1: Assessment of the current state to identify weaknesses and strengths of the current processes.

Phase 2: Determining the target state to be as a guideline for needed improvements.

Phase 3: Stabilising the operations by focusing on root causes of weaknesses and inefficiencies in the processes.

Phase 4: Optimising the opportunities by introducing and applying methods and tools to eliminate the root causes of problems.

Phase 5: Institutionalising the lean approach through continuous improvements of processes to achieve the planned aims.

Atkinson (2004) proposes a more technical four-step model to consider for the transformation process to lean:

Step 1: Selling and communicating the lean philosophy where the focus should be on the results rather than focusing on the use of particular tools.
Step 2: Senior management commitment: where this commitment is crucial to successful implementation of the lean concept.
Step 3: Design of projects: requires considering some aspects necessary to the lean concept (e.g. Cross functional team, employees involvement).

Step 4: Selling the benefits of lean thinking.

In spite of the above presented models, the five principles introduced by Womack and Jones (1996) have been relied upon by many researchers and organisations as they are the keys to achieve benefits in operational and financial performance including customer satisfaction (Vlachos and Bogdanovic, 2013; Fillingham, 2007; Endsley et al., 2006; Lazarus and Andell, 2006; Jones et al. 1999).

These five famous principles indicate that the starting point of lean system is to focus on and deeply understand the value from a customer perspective (Vlachos and Bogdanovic, 2013; Malladi et al., 2010; Comm and Mathaisel, 2000). This value can be created, according to Hines et al. (2004), in two ways: (1) by eradicating wasteful activities from process leading to a reduction in the associated cost and resources, and (2) by providing better products and/or additional services at the same price leading to better value perceived by customers. Adopting the first method to create value for customers, lean system perceives any activity that does not add value to a product or service from a customer perspective as completely waste and should be eliminated or controlled to minimum (Petersen and Wohlin, 2010; Turesky and Connell, 2010; Grasso, 2005). For some, the term waste, defined as any activity that does not add value, might seem vague. Therefore, some researchers have made some attempts to classify the general term "waste" into smaller categories so that it would be better understood and easier to trace. Ohno (1988) provides seven categories of waste and Bodek (2007), in a more recent study, adds one more to end up with a list of eight types of waste that are presumed to be applicable to any area including office and administrative areas (Garrett and Lee, 2010). These eight types of waste include:

a) Overproduction: to produce more than needed.
b) Unnecessary inventory: to build up and maintain any kind of inventory to a higher level than needed.
c) Unnecessary motion: movement of staff that does not add value to a product from customer perspective.
d) Transporting: unnecessary movement of materials.

e) Defects: products that do not satisfy quality standards; scrap and rework in production.
f) Inappropriate processing: unnecessary processes that do not add value or not required by a customer.
g) Waiting: idle time spent by employees waiting to be able to process again.
h) Unused creativity: the lack of efficient use of humanity skills.

The identification of waste in a process is not the end point in the lean journey. Rather, it should be followed by actions to contain the avoidable waste (Ehrlich, 2006). Consequently, some researchers view lean system to consist of two levels: lean philosophy and lean practices (Bhasin and Burcher, 2006). While to others it is a three-level system, lean philosophy, lean principles and lean practices (Arlbjørn et al., 2011). The philosophy of lean focuses on the value from customer perspective and eliminating what exist from the eight categories of waste presented above to enhance that value. The second level involves the five principles introduced by Womack and Jones (1996) which can be a roadmap to achieve the first level. While the third level, practices, tools and techniques, is necessary to reflect the previous two levels practically and as a result, it represents the actions to be taken (Bhasin and Burcher, 2006). Others, for example Hines at al. (2004) perceive lean system as a two-level system involving strategic and operational levels. The strategic level concerns the focus on what customers are willing to pay for, while the operational level is related to the application of lean tools and techniques to approach the aim of the strategic level.

Using the lean philosophy to focus attention on customer value, lean principles to guide the transformation process and lean practices to identify and eliminate waste, lean system is argued to generate several benefits to all adopters whether in manufacturing or services (Shah and Ward, 2007, 2003). This claim has been subjected to considerable empirical examinations for validation purposes as presented in the next section.

2.4 Empirical literature on the lean-performance association

As mentioned before, lean manufacturing has been studied extensively in the academic literature since its invention. Various types of research have been used to report on this

system including conceptual studies (e.g. Cooper and Maskell, 2008; Dankbaar, 1997; Womack and Jones, 1996; Cusumano, 1994), case studies (e.g. Lasa et al., 2009; Kennedy and Widener, 2008; Karlsson and Ahlstrom, 1996, Oliver et al., 1994), simulation studies (e.g. Li et al., 2012; Meade et al., 2010), and survey studies (e.g. De Menezes et al., 2010; Fullerton and Wempe, 2009; Shah and Ward, 2007, 2003; Cua et al., 2001). However, given the aim of lean manufacturing to improve adopters' operations by increasing the value delivered to customers through eliminating non-value added activities (Womack and Jones, 1996), it is unsurprising that a considerable deal of attention has been devoted to examine its effectiveness.

Before moving on to present the literature focusing on the lean-performance association, there is an important aspect that deserves some attention. As indicated by the definitions provided by Shah and Ward (2003) and Allway and Corbett (2002), lean manufacturing involves a wide range of change practices that are usually implemented to achieve the aim of lean manufacturing. Therefore, although lean manufacturing has been expressed as a two or three-level system, the change practices have always been considered as the practical weapons to attain the aim of the other levels. Consequently, the vast majority of researchers have investigated the possible effect of lean practices (rather than its philosophy or principles) on firm performance assuming these practices reflect the other levels of lean manufacturing (Shah and Ward, 2003).

2.4.1 The effect of isolated lean practices on firm performance

When studying the impact of lean manufacturing practices on performance, some researchers have focused on the isolated effect of individual practices (Pont et al., 2008). For instance, to evaluate the effect of lean practices as well as the effect of using non financial measures on companies' profitability, Fullerton and Wempe (2009) conducted their empirical research with a sample size of 121 manufacturing executives. Three lean practices were considered, namely setup reduction, cellular manufacturing and quality improvement. The results indicated that lean practices had a positive relationship with the use of non financial measures. The important finding of this research was proving that the utilisation of non financial measures mediates the relationship between lean practices and

firms' profitability. Samson and Terziovski (1999) assessed the effect of six lean practices (i.e. leadership, people management, customer focus, strategic planning, information analysis, and process management) on operational performance of 1024 manufacturing companies. The findings of this study showed a positive impact of HRM practices on operational performance measured in terms of customer satisfaction, employee morale, productivity, quality of output and delivery. However, no impact could be captured for strategic planning and process management while information analysis negatively affected operational performance of adopters. Similarly, Kaynak (2003) investigated the interdependence between seven lean practices (i.e. management leadership, training, employee relations, supplier quality management, quality data and reporting, process management, and product/service design) and their impact on operational and financial performance of 214 firms of which 85% are manufacturing firms while only 15% are service firms. The author found that the use of HRM practices led to increase in the use of TQM practices which then improved operational and financial performance.

Further, Powell (1995) used data from 54 service and manufacturing firms to examine the impact of 17 HRM and TQM practices on financial performance measured in terms of profitability, sales growth and an overall index. Although the findings indicated a superior performance of TQM adopters over non-TQM adopters, only three individual practices were significantly related to performance, namely committed leadership, open organisation and employee empowerment. This credits the social practices over the technical ones for improving financial performance. Talib et al. (2013) reported on the impact of 17 lean practices on quality performance based on data collected from 172 service firms. Out of the 17 practices, training and education, quality system, benchmarking, quality culture and teamwork were proved to have relation with quality performance indicating superiority of the soft practices in affecting performance of service firms. Bonavia and Marin (2006) provided evidence on the influence of 11 lean practices on the operational performance of 76 manufacturing companies. Overall, the results revealed no relationship between the extent of use of lean practices and improvement in operational performance measured as internal quality, productivity, total stock and lead time. In a similar vein, using a sample of 143 UK manufacturing firms and 135 UK

service firms, Alsamdi et al. (2012) found that the 10 lean practices used in the study were employed similarly by service and manufacturing firms except for three namely, supplier feedback, set up time reduction and total productive maintenance. These practices were implemented more in the manufacturing context while employee and customer involvement were found to be implemented more in the service firms. Moreover, lean practices individually and collectively were found to have a significant association with the performance of manufacturing firms. For service firms, lean practices as a whole was significantly correlated with performance while individually only three (i.e. supplier development, set up time reduction and total productive maintenance) out of ten practices did not have a significant relationship with performance.

2.4.2 The effect of lean bundles

Kim et al. (2012) and Shah and Ward (2003) criticised the literature in the previous subsection (2.4.1) on the grounds that lean practices are interdependent, and therefore focusing on individual practices can be misleading. As such, they proposed that lean practices should be classified into and examined as sets of internally consistent groups of practices. Thus, Shah and Ward (2003) formally defined lean system as consisting of four bundles, namely JIT, TQM, HRM and TPM, where each bundle has its own practices. As a result, a new stream of research emerged which concentrated on the performance impact of lean bundles rather than individual practices comprising each bundle (e.g. Agarwal et al., 2013; Bonavia and Marin-Garcia, 2011; Rahman et al., 2010; De Menezes and Wood, 2006; Shah and Ward, 2003).

Among researchers in this stream of literature, Sakakibara et al. (1997) surveyed 41 plants in the manufacturing sector (i.e. transportation components, electronics and machinery industries) to study the relationship between JIT practices and its infrastructure practices with operational performance. The analysis indicated that JIT practices did not directly relate to operational performance. Moreover, the results showed that the previous results were changeable when introducing the infrastructure practices to the analysis. More important was the result indicating that the infrastructure practices without JIT practices had a direct effect on the operational performance. Cua et al. (2001) examined

the relationship of joint implementation of practices of three lean bundles (i.e. TQM, JIT, and TPM) and manufacturing performance. Based on a sample of 163 manufacturing plants in four countries, the authors found that manufacturing plants characterised with higher manufacturing performance were associated with higher level of joint implementation of both common and unique practices of TQM, JIT, and TPM. In addition, plants applying a combination of manufacturing practices of the three programs had higher manufacturing performance than plants focusing on only one program. However, although the results supported a positive relationship between lean practices and manufacturing performance, it was important to realise that different practices had different effect on different performance dimensions (i.e. quality, on-time delivery, flexibility and cost efficiency). Along this line, Shah and Ward (2003) conducted a survey study of 1757 manufacturing plants to study the effect of lean system represented by four bundles, namely JIT, TQM, TPM and HRM, on the operational performance represented by 5-year changes in manufacturing cycle time, scrap and rework cost, labour productivity, unit manufacturing cost, first pass yield and customer lead time. Each of the lean bundles consisted of several practices. The results indicated a positive effect of each of the lean bundles on operational performance.

Further, Pont et al. (2008) reported on the effect of three lean bundles (i.e. JIT, TQM and HRM) on operational performance. Through surveying 266 plants located in nine countries, the authors found a direct positive effect on operational performance (i.e. quality, flexibility, on-time delivery and unit cost of manufacturing) by the JIT and TQM bundles. However, the HRM bundle had its effect via the other two bundles. Rahman et al. (2010) attempted to verify the purported positive impact of 13 lean technical practices clustered into 3 factors on operational performance of 187 manufacturing firms. The results of regression analysis proved the expected impact of the three lean factors on operational performance. Based on data from 76 manufacturing firms, Bonavia and Marin-Garcia (2011) investigated the effect of 4 HRM practices and a composite measure of 7 lean technical practices on 9 operational performance indicators. The results demonstrated limited effectiveness of those practices given that 2 out of the nine discriminant models were significant, namely when the stock level and productivity were the dependent

variables. In addition, Agarwal et al. (2013) used data from 152 manufacturing firms to test the assumed positive impact of an index of lean practices on both operational and financial indicators. The results proved the influence of lean index on merely some of the performance indicators including sales, profit and profit margin.

2.4.3 The synergy between lean bundles

Shah and Ward (2003) proposed that the four lean bundles (i.e. JIT, TQM, TPM and HRM) could not only have an additive impact on firm performance, but also non-additive impact stemming from the expected synergy (also called interaction) among these bundles. However, the authors did not examine explicitly this notion. Only a few researchers to date have devoted their efforts to provide empirical evidence on the presence of synergy between the different lean bundles. These are discussed below.

Using data from 433 manufacturing and service firms, Cappelli and Neumark (2001) examined the impact of TQM, HRM and their synergy on operational performance. The results neither supported the effect of TQM on performance nor the synergistic effect of TQM and HRM on performance. The authors demonstrated that HRM practices did not improve productivity as no statistical relation could be detected between productivity and all but two practices, namely computer use by workers and job rotation. Computer use by workers was proved to be positively associated with productivity while job rotation was found to have an inverse relation with productivity. In addition, some of the HRM practices were evident to increase labour costs as they had a statistical positive relation with labour costs. Patterson et al. (2004) investigated the impact of Advanced Manufacturing Technology (AMT), TQM, JIT and HRM on firm productivity and profits based on data from 80 manufacturing firms. The authors demonstrated a positive impact of HRM on both productivity and profits. However, among the three technical bundles, only AMT was revealed to be positively related to productivity but not to profits. Moreover, no synergistic effect was detected in this study. Among the 10 interactions tested, only the one between AMT and job enrichment was significant, but disappointingly, indicating that AMT has stronger effect on productivity when job enrichment is low. Birdi et al. (2008) focused on the relationships between HRM (i.e.

empowerment, training and teamwork), TQM, JIT and AMT and the productivity of manufacturing firms. Their results proved a positive association between HRM and productivity. However, the technical side of lean system (i.e. TQM, JIT, and AMT) did not have any significant influence on productivity. Moreover, these authors detected positive interactions among only some of the variables tested. Specifically, they found a positive synergy between teamwork and training, teamwork and empowerment, TQM and JIT. No synergy between training and empowerment, teamwork and training and empowerment, AMT and JIT, TQM and AMT, AMT and TQM and JIT was captured.

Further, Furlan et al. (2011) examined the synergy between JIT and TQM bundles and the effect of HRM bundle on that synergy in improving operational performance of 266 manufacturing firms. The authors found that the expected synergy between TQM and JIT could be captured when HRM was high while under low values of HRM the synergy diminished. Dabhilkar and Åhlström (2013) investigated the synergy between a set of technical lean practices and a set of HRM practices by employing data from 127 manufacturing firms. The authors demonstrated a lack of synergy and lack of positive impact of HRM practices on operational performance indicators. However, the results supported a full mediation of the HRM impact on operational performance by the set of lean technical practices. Das and Jayaram (2007) adopted the socio-technical perspective to examine the synergy between four lean technical practices (i.e. kanban, group technology, JIT supply, TPM) and three HRM practices (i.e. cross-trained employees, operator teams, decentralised decision-making). Based on data from 322 manufacturing firms, the authors proved the expected synergy between the two sets of practices on operational performance. Flynn et al. (1995) studied the relationship between JIT and TQM practices and their synergistic effect on performance. Using data collected on 42 US plants, the results indicated that the infrastructure practices alone (information feedback, plant environment, management support, supplier relationship, and workforce management) contributed sufficiently to JIT performance represented by average cycle time. Unique JIT practices also improved cycle time significantly but the addition of unique TQM practices did not provide significant improvement to the cycle time. On the other hand, quality performance was significantly explained by the infrastructure practices

but not by neither unique JIT practices nor unique TQM practices. Although unique TQM practices did not contribute significantly and individually to JIT performance, they did not improve cycle time through their interaction with infrastructure practices and unique JIT practices and unique TQM practices. Similar results were reported on the effect of all of unique JIT and TQM practices and infrastructure practices by their interaction on quality performance. Using data from 1024 manufacturing firms, Challis et al. (2002) examined the effect of only technical practices in three lean bundles (i.e. JIT, TQM, AMT) and their interactions on employee and manufacturing performance. The results indicated a positive influence of the three bundles on employee performance but only JIT and TQM were proved significant in improving manufacturing performance. In addition, AMT was found to moderate the relationship between JIT and TQM and both employee and manufacturing performance. However, TQM was evident to enable AMT to positively impact both facets of performance. Table 2.1 presents a summary of the literature on the lean-performance association.

Table 2-1: Summary of the lean-performance association literature

					Focus of the articles					
					Performance		Additive		Interaction	
Article	**Sample size**	**Industry**	**Statistical analysis**	**lean practices/bundles**	**Operational**	**Financial**	**Individual practices**	**Bundles**	**Individual practices**	**Bundles**
Fullerton and Wempe (2009)	121	Manufacturing	SEM	Setup time reduction, cellular manufacturing, quality improvement, Shop-floor employee involvement	-	ROS	*			
Samson and Terziovski (1999)	1024	Manufacturing	OLS regression	Leadership, people management, customer focus, strategic planning, information analysis, and process management	Customer satisfaction, employee morale, productivity, quality of output, delivery	-	*			
Kaynak (2003)	214	85% manufacturing firms and 15% service firms	SEM	Management leadership, training, employee relations, supplier quality management, quality data and reporting, process management, and product/service design	Market share, market share growth, product/service quality, productivity, cost of scrap and rework, delivery lead-time of purchased materials, delivery lead-time of finished products/service, purchased material turnover, total inventory turnover	ROI, sales growth, profit growth	*			
Powell (1995)	54	Service and manufacturing	Correlation analysis	Executive commitment, adopting the philosophy, closer to customers, closer to suppliers, benchmarking, training, open organization, employee empowerment, zero-defect mentality, flexible manufacturing, process improvement, measurement.	-	Profitability, sales growth and an overall performance index	*			

Talib et al. (2013)	172	Service	OLS regression	Top-management commitment, Customer focus, Training and education, Continuous improvement and innovation, Supplier management, Employee involvement, Information and analysis, Process management, Quality systems, Benchmarking, Quality culture, Human resource management, Strategic planning, Employee encouragement, Teamwork, Communication, Product and service design	Quality performance (product, process and service quality, employee service quality, employee satisfaction, customer satisfaction, supplier performance)	-	*			
Bonavia and Marin (2006)	76	Manufacturing	Friedman's non-parametric test, Wilcoxon tests, Mantel-Haenszel common odds ratio	Group technology, pull system, quick set up time, multi-functional employees, visual factory-graphs or panels, visual factory-housekeeping, SPC, group suggestions program (quality circle), standardisation, TPM, quality controls	Internal quality, productivity, total stock, lead time	-	*			
Alsamdi et al. (2012)	278	Service and manufacturing	OLS regression	Supplier feedback, JIT delivery by suppliers, Supplier development, Customer involvement, Pull, Continuous flow, Set-up time reduction, TPM, SPC, Employee involvement	Customer satisfaction, employee satisfaction, cycle time, market share and labour productivity	ROA, production cost	*			
Sakakibara et al. (1997)	41	Manufacturing	Canonical correlation analysis	Infrastructure bundle (Quality management, work force management, manufacturing strategy, organisational characteristics, product design), JIT bundle (setup time reduction, schedule flexibility, maintenance, equipment layout, kanban, JIT supplier relation)	Inventory turnover, on-time delivery, lead time, cycle time, flexibility, quality, cost	-		*		

Cua et al. (2001)	163	Manufacturing	Discriminant analysis	TQM bundle (cross-functional product design, process management, supplier quality management, customer involvement), JIT bundle (setup time reduction, pull system, JIT delivery by supplier, equipment layout, daily schedule adherence), TPM bundle (autonomous and planned maintenance, technology emphasis, proprietary equipment development), common practices bundle (committed leadership, strategic planning, cross-functional training, employee involvement, information and feedback).	Unit cost, quality, delivery, flexibility, weighted performance	-		*		
Shah and Ward (2003)	1757	Manufacturing	Hierarchical regression analysis	TQM bundle (New process equipment or technologies, Competitive benchmarking, Quality management programs, Total quality management, Process capability measurements, Formal continuous improvement program), JIT bundle (Lot size reductions, JIT/continuous flow production, Pull system, Cellular manufacturing, Cycle time reductions, Focused factory production systems, Agile manufacturing strategies, Quick changeover techniques, Bottleneck/constraint removal, Reengineered production processes), TPM bundle (Predictive or preventive maintenance, Maintenance optimization, Safety improvement programs, Planning and scheduling strategies, New process equipment or technologies), HRM bundle (Self-directed work teams, Flexible, cross-functional workforce)	Cycle time, scrap and rework cost, labour productivity, unit manufacturing cost, first pass yield and customer lead time	-		*		

Pont et al. (2008)	266	Manufacturing	SEM	JIT bundle (production planning, facility layout, JIT material delivery, JIT, kanban, setup time reduction, small lot sizes), TQM bundle (proprietary equipment, statistical quality control, 5Ss, quality circles, error proofing), HRM bundle (team working, employee involvement, flat organisation, training, continuous improvement)	Quality, flexibility, on-time delivery and unit cost of manufacturing	-		*		
Rahman et al. (2010)	187	Manufacturing	OLS regression	JIT bundle (Reduction of inventory, Preventive maintenance, Cycle time reduction, Use of new process technology, Use of quick change-over techniques, Reducing set-up time), Waste minimization bundle (Eliminate waste, Use of error proofing techniques, Using pull-based production system (Kanban), Removing bottlenecks), Flow management bundle (Reducing production lot size, Focusing on single supplier, Continuous/one piece flow)	Quick delivery, unit of manufacturing cost, productivity, customer satisfaction	-		*		
Bonavia and Marin-Garcia (2011)	76	Manufacturing	ANOVA, discriminant analysis	training, employment security, internal promotion, contingent remuneration, lean index (visual factory-graphs or panels, visual factory-housekeeping, SPC, group suggestions program (quality circle), standardisation, TPM, quality controls, quick setup time)	Internal quality, productivity, total stock, lead time, minimum batch size, on-time delivery, employee turnover, employee absenteeism	-		*		

Agarwal et al. (2013)	152	Manufacturing	Panel data, OLS regression	Operations management bundle (Adoption of Lean Manufacturing, Rationale for the adoption, Process problem documentation, Operations Performance tracking, Operations Performance review, Operations Performance dialogue, Consequence management), Performance management bundle (Types of goals, Interconnection of goals, Time horizon, Setting stretch goals, Clarity of goals), people management bundle (Instilling a talent mindset, Rewarding top performance, Addressing poor performance, Promoting high performers, Attracting high performers, Retaining high performers)	Labor productivity (sales per employee, profit per employee)	Sales, profit, profit margin, ROE, 1 year sales growth		*		
Cappelli and Neumark (2001)	433	Service and manufacturing	Panel data	TQM, self-managed teams, regularly scheduled meeting, teamwork training, job rotation, cross training, pay-for-skill programs, gain sharing, benchmarking, computer use	Sales per worker, total labor costs per worker, the ratio of those two measures	-			*	

Patterson et al. (2004)	80	Manufacturing	Sequential regression	AMT (computer-numerically controlled machines; flexible manufacturing systems; computer-aided design and engineering; manufacturing resource planning; and any industry-specific equipment), TQM (quality of suppliers and incoming materials; methods of quality assurance applied to the company's production processes and own end-products; the extent of use of various techniques such as statistical process control and quality circles; the extent of training in quality for various staff groups and measures to evaluate quality and how they were used, including procedures to feed back quality performance to the workforce), JIT (reductions in product-lead times; methods to reduce set-up times; means of limiting the amount of work in progress; JIT purchasing initiatives; ways of limiting the volume of finished goods in stock; preventative maintenance procedures; and kanban), empowerment (job enrichment, skills enhancement)	Labor productivity (sales per employee)	Profit (sales-costs per employee before profit tax)				*
Birdi et al. (2008)	308	Manufacturing	Multilevel analysis	Empowerment: employee empowerment. Extensive training. Team-based working. Total quality management (Such practices include Kaizen and continuous improvement). Just-in-time production. Advanced manufacturing technology (such as CAD, CAM, computer-integrated manufacturing and flexible manufacturing systems). Supply-chain partnering.	Company productivity	-			*	

Furlan et al. (2011)	266	Manufacturing	ANOVA, Tukey test, OLS regression, F test	JIT(production scheduling, facility layout, small lots, JIT delivery, kanban, setup time reduction), TQM (5s, SPC, small group sessions, mistake proofing), HRM (team working, employee involvement, flat organisation, training, quality circle, continuous improvement)	Quality, dependability, speed, flexibility, cost	-				*
Dabhilkar and Åhlström (2013)	127	Manufacturing	Hierarchical regression	Lean bundle (work in progress reduction, Setup times reduction, Machine downtime reduction, transportation time reduction, quality system, JIT, pull system), HRM (team work, continuous improvements, quality control).	Productivity, manufacturing quality, on-time delivery, lead time	-				*
Das and Jayaram (2007)	322	Manufacturing	OLS regression	kanban, group technology, JIT supply, TPM, cross-trained employees, operator teams, decentralized decision-making	Cost reduction performance, Quality performance, Manufacturing cycle time, New product introduction Time, Delivery performance, Customization responsiveness.	-			*	
Flynn et al. (1995)	42	Manufacturing	Hierarchical regression	Plant environment, Management support, Supplier relationship, Statistical process control, Product design, Customer focus, Kanban, JIT scheduling, Lot size reduction	Cycle time and perceived quality	-			*	
Challis et al. (2002)	1024	Manufacturing	Correlation analysis, MANOVA, OLS regression	AMT, TQM, JIT	Employee performance (morale, productivity, skills, etc.), manufacturing performance (customer satisfaction, cash flow, total costs per unit, delivery time, defects rate)	-				*

2.4.4 Critical evaluation of the empirical literature on the lean-performance association

The impact of lean system on firm performance has accounted for a large proportion of the extant literature in the lean system field. However, a closer look at this body of literature reveals some limitations that should be considered to further advance this literature. First, as can be seen from table 2.1, in examining the impact of lean system on performance, several researchers focused on the direct influence of individual practices in isolation, as shown in the subsection 2.4.1. By doing so, these studies did not account for the likely collaboration between those practices in affecting firm performance (Kim et al., 2012; Shah and Ward, 2003). Consequently, these studies did not help to uncover the full potential of lean system. In addition, researchers in this part of the literature used different practices to represent lean system along with different measures of firm performance (De Menezes et al., 2010; Shah and Ward, 2003). Therefore, given the limited focus of these studies on individual practices of lean system in isolation and the use of different measures, these studies reported inconclusive results making it difficult to conclude about the effectiveness of lean system (De Menezes et al., 2010; Shah and Ward, 2003).

In an attempt to overcome shortcomings of the previous studies, a new stream of research emerged that assessed the performance impact of internally consistent groups of lean system practices (i.e. lean bundles) rather than that of individual practices included in each bundle as recommended by Shah and Ward (2003). However, despite advancing our knowledge on the performance effect of lean bundles, the new stream of research (subsection 2.4.2) mainly examined the direct and additive effect of lean bundles while ignoring the possible non-additive effect stemming from collaboration between lean bundles to improve performance (Dabhilkar and Åhlström, 2013; Furlan et al., 2011). Therefore, the full potential of lean system is still yet to be uncovered through more rigorous studies. In addition, almost all studies in this part of literature devoted their attention to the impact of lean bundles on operational performance. With the exception of Agarwal's et al. (2013) study, neither of the above studies has investigated the effect of the same bundles on financial performance.

To date, only a few researchers have made advanced efforts to highlight and examine the non-additive influence of lean bundles on firm performance as can be seen in subsection 2.4.3. Among these few attempts, some researchers focused merely on the synergy between the technical bundles of lean system (e.g. Furlan et al., 2011; Challis et al., 2002). However, other researchers who focused on the wider definition of lean as provided by Shah and Ward (2003) used a limited number of practices to represent each bundle (e.g. Dabhilkar and Åhlström, 2013; Birdi et al., 2008; Das and Jayaram, 2007; Patterson et al., 2004). Given these characteristics of this emerging body of literature, research to date has largely failed to provide a definitive statement on whether lean bundles interact together to generate an impact on performance over and above that expected from each bundle separately. Moreover, since the focus has shifted to lean bundles, the majority of studies have been limited in their focus to the effect of lean bundles on some operational indicators as are apparent in subsections 2.4.2 and 2.4.3. To be able to offer a stronger statement on the effectiveness of lean bundles on performance, there is an urgent need for empirical studies that examine not only the additive but also the non-additive effect of lean bundles on operational and financial performance using a wider set of practices to adequately represent lean bundles (Kim et al., 2012; Patterson et al., 2004; Kaynak, 2003; Shah and Ward, 2003). Finally, it is apparent that the reviewed and presented research in this section is biased towards investigating the lean-performance relationship in the manufacturing context. With the studies of Talib et al. (2013) and Alsamdi et al. (2012) as the exceptions, most researchers have focused on manufacturing including those who have employed a mixed sample in their studies due to the noticeable bias in the structure of their samples towards manufacturing firms (e.g. Kaynak, 2003; Powell, 1995). As a result, the findings of the above studies do not help in examining the universality of lean practices at sector level (i.e. manufacturing versus services).

2.5 Lean system in the service sector

It is clear from the preceding discussion that there is a large body of literature which has investigated lean practices in the manufacturing operations. The question that arises at this point is “what is about lean system in the service context?” More specifically, are lean

practices applicable to service operations? This section reviews the literature of lean service with critical assessment to its credibility which assists in suggesting avenues to improve the knowledge in this specific area.

2.5.1 The emergence of the lean service concept

The service sector has been growing rapidly in many developed countries (Chase and Apte, 2007; Ellram et al., 2004). Manufacturing companies have started to focus on the provision of services given the higher revenue generated from service operations and the need to supplement manufacturing capabilities in order to improve their competitive position (Wu and Wu, 2010; Chase and Apte, 2007; Voss, 2005). These facts together necessitate that more consideration and control should be devoted to service operations (Malmbrandt and Åhlström, 2013; Ellram et al., 2004). Consequently, attempts to apply some concepts such as lean system developed in the manufacturing and which has been assumed to deliver various benefits to adopters may result in significant outcome (Vlachos and Bogdanovic, 2013; Apte and Goh, 2004).

The transference of lean practices to services is relatively recent compared to the long history of applying lean practices in manufacturing. Womack and Jones (1996) formally introduced the term lean thinking that expanded lean manufacturing to include non-manufacturing processes indicating the applicability of lean system to processes other than manufacturing. Despite that, the term lean service was introduced explicitly in the academic literature in a pioneering article written by Bowen and Youndahl (1998) two years after the term lean thinking was reported (Suárez-Barraza et al., 2012).

Two main reasons are behind the late introduction of lean to the service sector. First, unlike manufacturing products, services are characterised by being intangible, perishable, labour-intensive, heterogeneous (Soltani et al., 2012; Nie and Kellogg, 1999; Brignall et al., 1991; Sasser, 1976), and most importantly the presence of customers during the delivery of services, which is the major difference between lean manufacturing and lean service (Abdi et al., 2006; Sampson and Froehle, 2006; Bowen and Youngdahl, 1998). Those unique characteristics are argued to expose service operations managers to some

difficulties which do not face their counterparts in manufacturing (Soltani et al., 2012; Sampson and Froehle, 2006; Nie and Kellogg, 1999). Mefford (1993) emphasises the difficulties associated with properly defining quality in services in addition to the variability inherent in services due to the labour intensity characterising most services. Moreover, the convergence between the production and consumption of services resulting from the presence of customers adds to that variability and to the difficulty of defining and measuring quality (Soltani et al., 2012; Sampson and Froehle, 2006; Brignall et al., 1991). As a result, manufacturing systems, tools and techniques are claimed to be insufficient and inadequate to services (Sampson and Froehle, 2006; Nie and Kellogg, 1999). In a similar vein, Piercy and Rich (2009) and Liker and Morgan (2006) underline the need for a higher level of reconsideration when applying lean system into industries lacking the presence of physical products.

Second, as shown in the introduction chapter, lean manufacturing has emerged as a result of the changing market environment accompanied by an increasing level of competition facing manufacturing firms (van Biema and Greenwald, 1997). Broadly speaking, service providers have not experienced a similar level of competition to that faced by manufacturing companies (van Biema and Greenwald, 1997). Thus, seeking more effective production and management systems such as lean service has not been a priority; thereby they lagged far behind their cousins in the manufacturing sector in considering such a new system (Schmenner, 1986).

However, given the continuing changes in economic conditions, several researchers have reported that the challenges of globalisation and accompanying competition have approached the service sector (Karmarkar, 2004). Consequently, there has been a serious need for service firms to reconsider their operations management methods (Vlachos and Bogdanovic, 2013; Schmenner, 1986). In addition, in spite of the unique characteristics of services reported above, lean system has been claimed to be relevant to services for at least one reason. Lean system is argued to focus on processes rather than products and all companies, manufacturing and non-manufacturing, are a compilation of processes that are used to provide customers with products and/or services (Jimmerson et al., 2005; Allway

and Corbett, 2002). In line with this perspective, Abdi et al. (2006) have discussed the five lean principles suggested by Womack and Jones (1996) and have explained the validity of those principles from a service point of view. Armed with this argument, several researchers have stressed the need and applicability of lean practices to services (e.g. Kosuge et al., 2010; Endsley et al., 2006; Jones et al., 1999). Consequently, the literature of lean service, whether in the public or private sector, is observed to be escalating. For instance, Radnor (2010) finds that 51% of the publications on the public sector focus on 'Lean' and 35% of those are in the Health Services. Despite the focus on lean service in healthcare, lean service can be found in other industries such as higher education, retailing, banking and financial services, telecommunication, software, fast food, airlines and others, as presented below.

2.5.2 Lean service in the healthcare sector

The literature of lean service has been dominated by applicability and implementation of lean practices in healthcare (Vlachos and Bogdanovic, 2013; Holm and Ahlstrom, 2010). Around 90 publications on lean service in healthcare were published in ten countries from 2002 onwards (Souza, 2009). 57% of these papers concerned the implementation of lean in the US healthcare sector which might reflect the success of lean in private sector while 29% was related to lean in the UK healthcare sector indicating increasing popularity of the concept in the public sector. That domination could be due in part to the importance of healthcare since it deals with human's life. Therefore, it is crucial to improve the performance of that sector especially when realising that many activities in healthcare do not directly add value from patients' perspective (Fillingham, 2007). It could also be due to the pressure exerted on the healthcare sector to seek methods to improve productivity, efficiency, quality of services and cut costs in response to cutting the related budget by associated governments (Radnor and Walley, 2008). In the following space, the literature of lean service in the healthcare sector is summarised.

Manos et al. (2006) believed that the eight types of waste (presented in section 2.3) originated in manufacturing did exist in healthcare although in slightly different forms. Thus, lean service could be sought to eliminate or at least reduce the level of that waste

(Cooper and Mohabeersingh, 2008; King et al., 2006; Manos et al., 2006) so that providing better care to patients. Ben-Tovim et al. (2007) stated that lean service might have a major positive effect on healthcare in Australia and elsewhere. Manos et al. (2006) supported the implementation of various lean techniques to the healthcare environment and provided a list of 18 lean tools and techniques that, they believed, were as applicable to healthcare as to manufacturing.

Cooper and Mohabeersingh (2008) reported on the necessity for the UK healthcare sector to strive for minimising waste, improving efficiency, creating a harmonious working environment. To attain this, they argued about the appropriateness of lean service. Therefore, they studied the implementation of lean service in five functions of the healthcare services and found it to improve efficiency; reduce waiting time and costs as indicators of waste. Moreover, they appraised lean as a tool which could be strategically significant in terms of cost reduction and achieving high turnaround using the same resources but in a more effective way. In a similar vein, Burgess and Radnor (2010) focused on the applicability and performance outcome of three lean practices, namely process mapping, 5S and cross functional employees in two hospital trusts in the UK. The results supported the applicability of lean practices and their capability in providing better understanding of the process, improving stock control, improving the understanding and resolution of the impact of variation, exposing problems and risk factors, reducing the "did not attend" rate and improving employees satisfaction and morale.

Other successful applications of lean service practices were reported from Flinders Medical Centre in Australia by King et al. (2006) and Ben-Tovim et al. (2007) in two separate studies. The authors found that process mapping followed by redesigning processes and the use of what is known in manufacturing as production cells led to improvement in patients flow, reduction in operational costs, increase in the number of patients treated, reduction in the overall time from a patient entry to discharge as well as in the average number of patients in the Emergency Department at any time. Moreover, lean implementation in Intermountain Health Centre was presented by Jimmerson et al. (2005). The centre enjoyed a reduction of a significant amount of wasted time of front-line

workers, reduction in the amount of errors occurred and improvement in employees and customers satisfaction with no or little investment.

More positive results on the powerful effect of lean service on hospitals processes were attained by Bolton Hospitals NHS Trust (Fillingham, 2007). The program consisted of determining the value from patient's perspective, examining whether current processes provide that value, redesigning the processes to eliminate non value-added activities, facilitating the process flow and finally, making sure that the redesigned processes deliver the wanted value by patients. To apply the program, some practices were needed such as 5S, value mapping, and visualisation. A 42% reduction in paperwork, an improvement in team working, a 38% reduction in the process time, a reduction in the total length of stay by 33% and a reduction of mortality by 36% were all achieved. Furthermore, Lodge and Bamford (2008) employed the following lean practices in the radiology department of the Pennine acute Hospitals NHS trust: automation, process simplification techniques and training. As a result, waiting time was reduced by 30%, control was enhanced, better understanding of capacity requirements was improved and access to patient information to answer queries became easier.

Personal experience in the deployment of lean service was reported by Bushell et al. (2002). The authors deployed four lean practices which were value stream mapping, standardised operations, workplace organisation and visual/audio controls. The authors were optimistic that lean implementation would improve the care delivery process at the Progressive Healthcare. Poksinska (2010) reviewed the literature concerning the implementation of lean production in health care. The results of the literature review revealed that the benefits from applying the lean service could be reported at two levels. The first level relates to the performance of the healthcare system including decreased overall time spent by patient on care, increased number of patients handled, reduced number of errors, reduced waiting times, increased patient and employees satisfaction, reduction of overtime and inventory costs. The second level relates to the development of employees and work environment including increased attention of employees to waste and their attitude to problem solving and having more organised work environment.

Kim et al. (2006) forwarded one more successful story on the implementation of lean service at Virginia Mason Medical Center (VMMC). This implementation resulted in a cost reduction of approximately a half million dollars, increased profit margins and improved space utilisation at its cancer centre resulting in a 57% increase in the number of patients treated in the same allocated space. Added to that, Esain et al. (2008) reported on the deployment of 5S as one of the lean service practices in a large NHS Trust. The authors argued that 5S was a helpful tool for improving the understanding of current processes and setting the foundations for changes although it had to be considered as a starting point of the change process. Examining the annual report and other archival data for 152 UK hospitals, Burgess et al. (2009) found that more than half (80 hospitals) of all English hospitals articulated the use of lean service practices in their annual reports. Based on this articulation, the authors classified the 80 hospitals into six categories. These categories were adopting a systemic approach, multiple projects, a few projects, rapid improvement events, productive ward only and 'tentative' to lean by piloting a small project. Moreover, the authors found no evidence of the effect of lean implementation approach on hospitals performance. However, this lack of evidence was attributed to having a very small number of hospitals which considered a systematic approach in adopting lean service.

2.5.3 Lean in other service sectors

Lean service is not confined to healthcare services among other service industries although they have dominated the lean service literature (Vlachos and Bogdanovic, 2013; Holm and Ahlstrom, 2010). A considerable number of researchers were found to be strong believers in the validity of lean service to the various service processes. For instance, Abdi et al. (2006) discussed the five lean principles suggested by Womack and Jones (1996) and explained their validity from a service point of view. Similarly, Ehrlich (2006) supported the applicability of lean principles such as the identification of customer value, simplification of process and pull system to all types of processes. In addition, Jones et al. (1999) claimed that waste reduction, employee empowerment and focusing on value-adding activities from customer perspective were universally applicable. Moreover,

Comm (1999) argued that lean was successfully deployed by service providers such as airlines, hotels and higher educations. Lee et al. (2008) referred in their article to the successful implementation of lean concepts in some service companies such as Jefferson Pilot Financial (a life insurance company), Zara (a Spanish clothier), and Fujitsu Services (an international IT services company).

2.5.3.1 Lean service and IT industry

Staats et al. (2011) examined the validity of lean service in a software service firm, Wipro Technologies. The authors found that lean service was capable of improving operational performance such as processing time and labour productivity. This study was particularly important because it proved that even in industries characterised by non-repetitive tasks and a high level of uncertainty concerning customers demand; lean practices were still applicable and yielded positive results. In a similar vein, Malladi et al. (2010) employed a case study methodology to report on the implementation of lean service in the IT industry. The results of their case study revealed that lean service improved efficiency which was translated to savings leading to value creation to customers and the organisation.

2.5.3.2 Lean service and call centers

Piercy and Rich (2009) studied the applicability of lean service to pure service processes, namely call centres of three financial service companies. The results of their study conveyed a significant improvement in the performance of all call centres examined. Lean service was found to reduce employee absenteeism, work in progress and process cycle time. It freed staff time and related costs and improved employees' morale and service quality, thereby improving customer satisfaction. Sprigg and Jackson (2006) reported on the effect of two lean service practices job-related strain among 836 call handlers from 36 call centres. The two practices were process simplification typified by dialog scripting and work flow integration typified by performance monitoring. The results indicated a negative effect of lean practices on job-related strain. Call handlers who were subject to higher levels of dialog scripting and performance monitoring experience higher job-related strain compared to others. Furthermore, the authors forwarded that this positive relationship between job-related strain and lean practices was virtually fully accounted for

by work design characteristics such as lower control over work methods and timing, lower task variety and skill utilisation, higher workload, role conflict and lower role clarity. In another study focusing on lean service in call centres, Piercy and Rich (2009) reported on the impact of three lean service practices (i.e. value stream mapping, process redesign and continuous improvement) on the performance of three call centres. The findings showed that lean practices led to a reduction in operational costs as well as an improvement in customer satisfaction by virtue of the reduction in waiting time to complete a customer request.

2.5.3.3 Lean service in the financial industry

The financial service industry was also found to be a good candidate for lean service given the high percentage of waste inherent in its processes (Atkinson, 2004). Atkinson (2004), through a study of eight functions in a 1200-person business in the financial sector, found that 200 work activities represented source of waste in the form of reworking the same activities often several times and that led to wastages in staff time quantified to about 40% of labour cost. This particular result could be used to add support to the effective way of making improvements by focusing on the deletion of non-value adding activities rather than attempting to improve the value added activities (Fillingham, 2007). Based on this finding, lean service practices could be used to eradicate such waste and improve processes. Swank (2003) described the implementation process of lean service in a financial service company where the results validated the findings of Atkinson (2004) and highlighted the effectiveness of lean service in such environment. At the aim of reducing process variability and improving its competitive advantage by providing customers with better service quality, Jefferson Pilot Financial (a life insurance company) examined its processes to identify major areas for improvements (Swank, 2003). Implementation of process mapping technique revealed suffering from long processing time and unnecessary costs. To overcome those problems the company initiated a lean service program which included the following techniques: 1- processing applications in small lots 2-group technology (placing linked processes near one another) 3- standardising procedures 4-eliminating loop-backs (where work returns to a previous step for further processing) 5-Setting a Common Tempo (employing the takt-time concept) 6- balancing workloads 7-

segregating complexity (to cluster tasks of similar level of difficulty into separate groups with their performance goals) 8- posting performance results. To measure the effect of the program the company had to rely on new performance measures which suited lean concept (Schonberger, 2008). The results indicated that the company reduced the average time from receipt of premier partner application to issuance of a policy by 50%, reduced labour cost by 26% and eliminated 40% of errors leading to reissuance. Based on that, service quality improved; employee and customer satisfaction increased and the company's competitiveness enhanced.

Bhatia and Drew (2007) proclaimed the experience of a European bank with lean service practices. The authors reported that the bank decreased time for mortgage applications from 35 days to only 5 days. As a result, revenues and cost savings were increased. Another successful story related to lean service in banks was forwarded by Yavas and Yasin (2001). The authors argued that four tools developed in the manufacturing context could be of high importance to banks. The use of root cause analysis, benchmarking, process re-engineering and continuous improvement yielded remarkable benefits in the bank they report on. The bank achieved an increase in customer satisfaction from 71% to 94%, a decrease in customer complaints by about 35%. In addition, waiting time for customers automatically reduced and the bank goodwill in terms of introducing the bank to other customers by the current customers increased from 68% to 89%.

2.5.3.4 Lean service and telecommunication industry

The telecommunication industry has also been invaded by lean service practices. Jones et al. (1999) focused on the implementation of three lean tools in BT, a telecommunication provider. The lean tools used were value stream analysis, root cause analysis and use of new technologies. BT improved customer service, reduced operating costs, reduced inventory and rework and increased the degree of flexibility to provide new services. In a similar vein, a European telecommunication company benefited from the implementation of some of the lean service practices (Bhatia and Drew, 2007). The company improved productivity by 40% and reduced recurring failures by 50% (Bhatia and Drew, 2007).

2.5.3.5 Lean service and education

In the education industry, Hines and Lethbridge (2008) stated that lean thinking was uncommon to university's processes and activities although it could result in impressive results. Comm and Mathaisel (2005 b) declared that institutions of higher education lacked real understanding of lean service and struggled to identify their primary customer. Therefore, higher education institutions were advised to educate employees on lean concepts, follow the five lean principles as introduced by Womack and Jones (1996), define appropriate metrics for success and concentrate on developing outsourcing, collaboration programs, and technology initiatives (Comm and Mathaisel, 2005b). Moreover, the same authors studied the suitability of lean system to higher education institutions by descriptively examining 13 private and 5 public universities. The authors believed that universities were good candidates for lean service due to being a compilation of departments, offices and divisions. Therefore, lean practices could be relied upon to eliminate waste form processes leading a university to focus on its main activity: teaching and doing research. Maguad (2007) argued that several lean tools could be used to eradicate different types of waste involved in the educational process. The author suggested the following tools to be used: 5Ss, mistake-proofing, value stream mapping, quick change over, self-inspection, TPM and kaizen. To facilitate the employment of those tools, the author stressed the need for teamwork spirit and strong communication. Following the procedure outlined above lean would improve workers understanding of their crucial role in the organisation and waste would be eliminated. Tatikonda (2007) recommended the implementation of lean techniques specifically quality function deployment and cell layout to improve the quality of accounting education. He stated that in 30 years of his experience, improvements of lean practices were not matched with any other improvement systems. In a similar vein, Emiliani (2004) examined the applicability of lean service to a graduate business course in order to improve the value delivered by the course, eliminate waste and improve quality. The lean service program employed consisted of the following practices: continuous improvement, 5Ss, JIT, load smoothing, respect for people, standard work and visual control. The program yielded a significant level of student satisfaction.

2.5.3.6 Lean service and housing services

Housing and construction services appear to be also appropriate for lean service practices. McQuade (2008) contended that lean service practices could be effective in improving business performance and responding to customers. In that context, the author communicated the implementation of lean practices in Flagship Housing Group. Existing processes in the company were examined and mapped to identify waste and value from customers' perspective. As a result of the new way of thinking, 80% waste was considered from a customer point of view. Redesigning the processes taking into account what customers value reduced failure demands from 70% to 30%, total time on repairs decreased from 129 days to 7.7 days, one million pound operational savings were achieved. Garrett and Lee (2010) examined the implementation of some of the lean tools into the construction submittal process. VSM, 5s, poka yoke, JIT, visual controls and failure mode and effect analysis were all implemented into different areas of the process. The results of those tools were measurable and impressive. Lead time decreased by 40%, process time improved by almost 25% and the number of activities decreased from 8 to 5.

2.5.3.7 Lean service and the distribution industry

Searcy (2009) described the lean initiatives conducted to expedite the performance of the billing department of AMG, a distributor company. The company introduced employees to the concept of lean through sessions of training, and then those employees were required to conduct process mapping activity to visualise the process. The use of modern cost accounting methods such as time-drive ABC helped the team to identify the amount of waste inherent in the process. The root causes of waste were traced and quality circles were established to find out how to eliminate them. The methodology followed by AMG reduced the number of errors occurring in the billing department as well as freeing staff time to be used in other departments. In addition, the results proved that training was crucial in sending signals about the high management commitment to lean concept. Communicating the initial results of lean transformation assisted in motivating employees to maintain lean principles and believed in their effects. Rajiv (2009) stated that

implementing lean service to warehousing operation in his company yielded 8 million savings over three years.

Value stream mapping and root cause analysis among other lean service practices were highly powerful in identifying and understanding waste in the transportation process of Mexican food distribution company (Villarreal et al., 2009). However, in contrast to the norm of striving to apply small lots technique, the company combined a set of orders together to improve vehicle capacity utilisation. The benefit of that action was estimated to reduce shipments by 25% which might translate to 1.8 million peso per year. Safari Park in the UK also enjoyed some benefits from employing lean service as reported by Julien and Tjahjono (2009). The park sought to increase its profit by eliminating waste and improving the efficiency of major activities while improving customer satisfaction. Therefore, value stream mapping, automation and 5S were employed in the feeding logistics at Safari Park. The deployment of those tools led to a more simplified process involving less waste and considerable financial savings of about 91000 pounds. It should be noted that involving employees was essential in the implementation process. Through surveying employees in two logistic service providers, the author found that lean system had a considerable positive effect on employees' performance through offering a higher level of autonomy and creativity and that will in turn improve the company effectiveness.

2.5.3.8 Lean service and office operations of manufacturing firms

More evidence on the applicability of lean practices to service operations could be highlighted from the adoption of these practices by manufacturing firms to improve their back offices operations. Lean system in general is designed to improve all activities in a process rather than focusing on isolated activities (Petersen and Wohlin, 2010; Scott and Walton, 2010; Arbos, 2002). Improving isolated activities simply means that problems or waste may shift to the adjacent activities, thereby offsetting improvements already achieved (Joosten et al., 2009; Hines and Lethbridge, 2008). Realising this fact, several manufacturing organisations have attempted to extend their implementation of lean system to non-manufacturing areas. For instance, Kato Engineering, a manufacturing company, realised that it could benefit from lean system in its offices as it did in its production

operations (Tonya, 2004). The problem in this company was that the reduction in the production cycle time achieved after the use of lean practices was offset by inefficiencies in sales, change-orders and on-paper process management. The company relied on process mapping and changing the physical layout as two lean practices. However, this attempt required cross functional team, training, employees involvement. The results of this implementation had been a reduction in the sales-order cycle time by 59%, in the engineering change-order cycle time by 91%, response time to customer request by 83% and employees errors by 69%. Rearranging work locations alone led to a reduction in the total distance employees travelled per day from 1886 feet to 262 feet (Tonya, 2004).

Similarly, Wayne (2005) reported on the implementation of lean practices to improve the performance of non-manufacturing areas at Bent River Machine after their successful implementation in the manufacturing operations. The company employed the same set of lean techniques used before in the manufacturing such as value stream mapping, 5S, visual control and automation. The company realised the importance of training as well as linking the benefits that the company would achieve to the benefits that employees would achieve from successful lean effort. Consequently, the company enjoyed a reduction in lead and processing time from 4 days to half a day, saved space and improved the organisation of offices. Kennedy and Widener (2008) detailed the implementation process of lean practices in the shop floor and accounting function of a manufacturing company, EBS, a subsidiary of Tri-Metal. After the implementation of lean practices in its shop floor, the company found it necessary that similar practices be applied in its accounting function to sustain the results achieved. To that end, the company streamlined transactions processes, ceased the use of standard costing in favour of actual costs, used kanban system to facilitate purchasing and finally, and changed its performance measurement system. That initiative resulted in freeing staff time in accounting function.

Reinertsen and Shaeffer (2005) supported the applicability of lean system to the R&D function. However, for lean to be successful, the authors emphasised the importance of understanding the differing nature between manufacturing and R&D functions. For instance, eliminating variability in manufacturing processes was favourable but it was not

in R&D processes because part of that variability added value in reality. However, employing the concept of small lots could easily be achieved and results in a reduction in idle time. The use of pull instead of push concept combined with the deployment of small lots could reduce queues and compress cycle time. In simple words, lean principles if applied carefully would improve cost, quality and speed of the R&D process (Reinertsen and Shaeffer, 2005). Haque and James-Moore (2004) addressed the suitability of lean principles and practices to the new product development process in aerospace industry in the UK. The findings of two case studies indicated that the five well-known principles of lean system were compatible with the product development process. In addition, several lean practices such as value stream mapping, takt time, standardisation, visual control, 5s, single piece flow and 5 whys were found to be easily transferable to the process provided that multi-functional team was present to facilitate the implementation of those practices.

2.5.4 Evaluation of the lean service literature

In subsections 2.5.2 and 2.5.3, studies which focused on the adoption and effectiveness of lean service were reviewed. However, my intention was not to present all publications in this area and I did not. Rather, I presented a sample of the 221 articles identified through a systematic search for publications on lean service explained in detail in subsection 3.2.1 of chapter 3. This sample of articles indicated a rising level of interest in lean service among academics and practitioners and wide diffusion of its practices across the various service industries. Classifying the whole population of lean service articles (221) per industry and over time reinforced this conclusion. Figure 2-1 presents the classification of 221 articles based on industry type. As shown in the Figure, healthcare and office operations have been the most popular application areas for lean practices in the service sector. However, Figure 2-1 also shows that lean service practices have not been totally uncommon to other service industries. The trend of publications on lean service since 1993 is illustrated in Figure 2-2. The Figure reveals an increasing interest in lean service among the academic community with around 30 publications in each of 2011 and 2012.

However, despite the rising interest in lean service and its wide spread among various service industries, this body of literature seems to suffer from two shortcomings. These

two shortcomings may hinder more advance knowledge to be acquired on lean service if not taken into consideration.

From Figure 2-1, the first observed limitation of this literature is its strong focus on healthcare and office operations at the expense of other areas especially hotels, consultancy services, telecommunication, banking and financial service. However, this observation is not limited to the lean service literature but it can be extended to the whole service operations management research as documented by Machuca et al. (2007) in their review of the associated literature. Therefore, more research in these areas is urgently needed to have more sufficient information on the applicability and effectiveness of lean service in these industries.

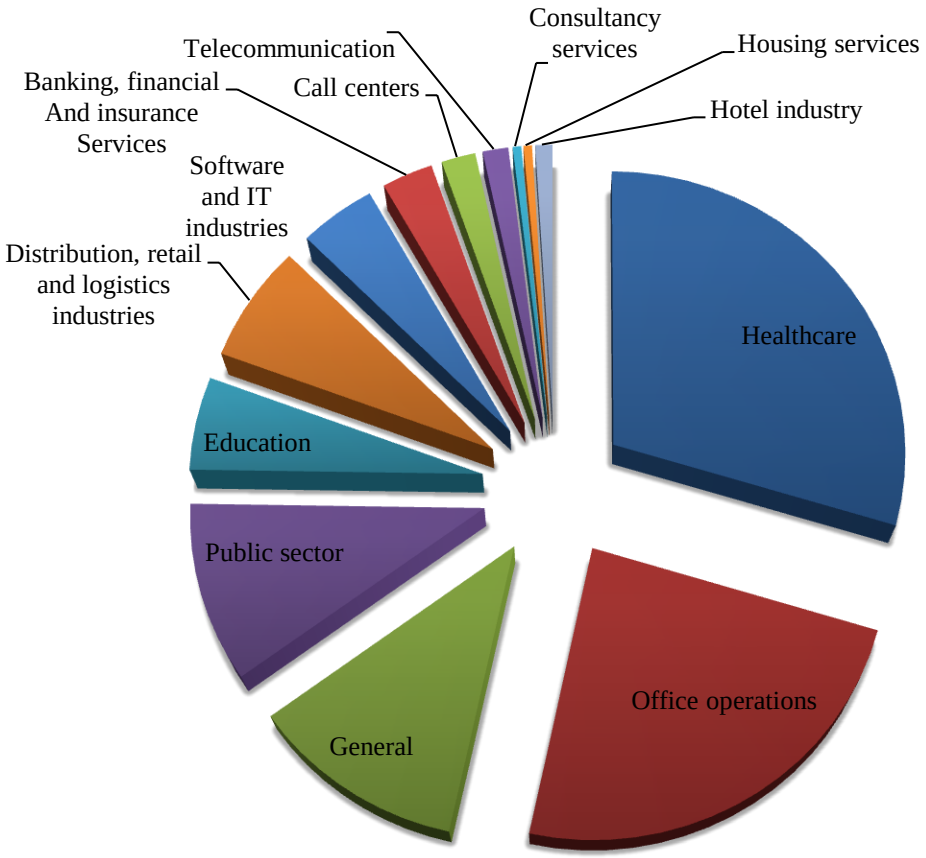

Figure 2-1: The classification of lean service literature per industry type

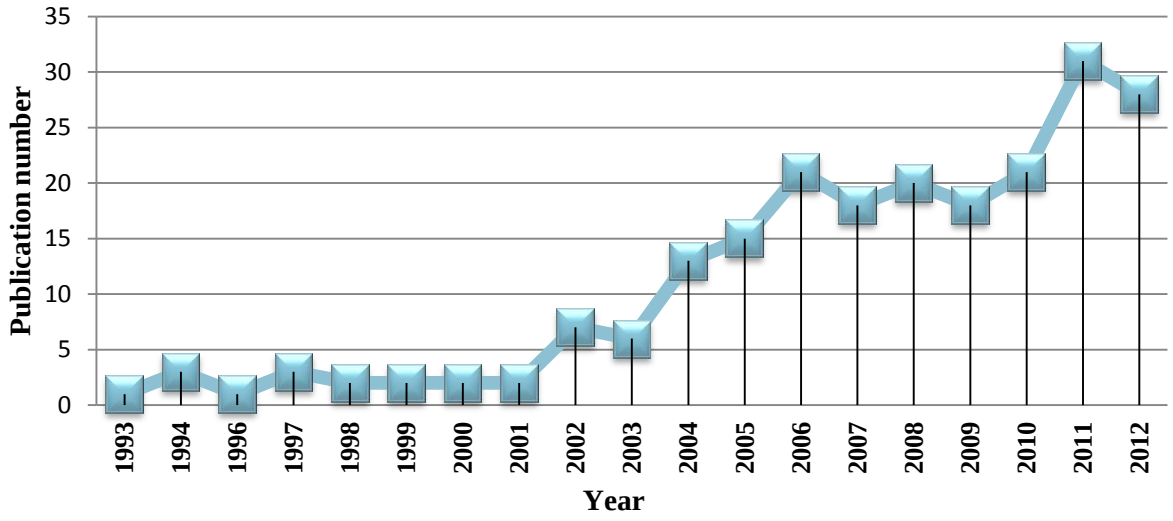

Figure 2-2: The trend of lean service publications

The second limitation of the existing literature of lean service concerns the type of studies dominating this literature. Synthesising information reported in section 2.5.2 and 2.5.3 reveals a significant reliance on conceptual (e.g. Allway and Corbett, 2002; Bowen and Youngdahl, 1998) and case studies (e.g. Staats et al., 2011; Staats and Upton, 2011; Swank, 2003; Arbos, 2002) to report on lean service. This observation supports previous findings reported in two recent literature review studies conducted by Holm and Ahlstrom (2010b) and Suárez-Barraza et al. (2012). Holm and Ahlstrom (2010b) have reviewed 56 articles on lean service and concluded that publications on lean service are dominated by conceptual and case studies while most of them have focused on the healthcare processes. Similar results have been reported by Suárez-Barraza et al. (2012) from reviewing 172 articles on lean service.

Conceptual and case studies are important for developing theory and generating research questions about a specific phenomenon (Challis et al., 2002; Voss et al., 2002). However, they suffer from inherent shortcomings that limit generalisation of their findings (Challis et al., 2002; Voss et al., 2002). In addition, although case studies convey evidence from real observations, they tend to be biased towards reporting positive findings which necessitates caution when using their conclusions (Kepes et al., 2012; Challis et al., 2002). This bias may justify the fact that the majority of case studies on lean service have supported its effectiveness and little, if any, failure attempts have been published in the

academic literature. Consequently, several researchers called for employing the survey methodology to report on lean service in order to provide more generalisable findings which enhances the knowledge on lean service and improves the quality of its literature (e.g. Arlbjørn and Freytag, 2013; Malmbrandt and Åhlström, 2013; Suárez-Barraza et al., 2012; Holm and Ahlstrom, 2010b).

The need for more survey studies on lean service is further reinforced by the findings forwarded by Alsamdi et al. (2012) and Yasin et al. (2003). Alsamdi et al. (2012) concluded that three lean practices (i.e. supplier feedback, set up time reduction and total preventive maintenance) are more relevant to manufacturing than to services while it is the reverse for employee and customer involvement. Yasin et al. (2003) fiound that operations-oriented modifications including standardisation of operations, modifying facility layout, increasing the level of automation neither decreased supplier-related problems nor did they impact performance in service firms, but they did for manufacturing firms. Thus, practices that are proved effective in manufacturing may not be in services. Based on that, examining lean practices in the service context, through rigorous empirical studies seems critical to advance the knowledge in this emerging area (Arlbjørn and Freytag, 2013; Malmbrandt and Åhlström, 2013; Suárez-Barraza et al., 2012; Holm and Ahlstrom, 2010b).

2.6 The literature on lean system, accounting system and business strategy

As can be seen from the previous sections of this chapter, there has been a considerable body of literature discussing and examining various aspects of lean system. This has included a focus on defining lean system, highlighting its philosophy and principles, identifying its practices and their interrelations, examining empirically the effectiveness of lean practices on firm performance, and more recently exploring the applicability of lean practices to other contexts than manufacturing. The question that can arise at this point concerns the relationship between lean practices and the context in which they operate.

Lean practices have been suggested in response to some external contextual factors (i.e. competition and changing market environment). However, considering merely the external contextual factors can be misleading to adopters who may experience a disappointing outcome accordingly. This happens when adopters or potential adopters do not have proper understanding of the effect of internal contextual factors on the adoption level of lean practices (Fullerton et al., 2013; Jain and Lyons, 2009; Shah and Ward, 2003). This can also be supported by the contingency theory stating that any organisational, management and operational system cannot be equally appropriate in all contexts and environments (Shah and Ward, 2003; Drazin and Van de Ven, 1985). As a result, finding out the conducive environment for lean practices can be highly significant for both theory and practice given that such practices may not be equally implemented in all organisational contexts (Fullerton et al., 2013; Malmbrandt and Åhlström, 2013; Shah and Ward, 2003).

To date, the available literature providing information on the possible internal contextual variables affecting lean practices can at best be described as sparse (Fullerton et al., 2013; Malmbrandt and Åhlström, 2013; Voss, 2005; Shah and Ward, 2003). Within this stream of literature, some researchers have highlighted the importance of management accounting system (MAS) (e.g. Banker et al., 2008; Kennedy and Widener, 2008), business strategy (e.g. Amoako-Gyampah and Acquaah, 2008; Ward et al., 2007), firm age and firm size (Shah and Ward, 2003) as potentially influential factors on the implementation of lean system.

2.6.1 Accounting system and lean system

The MAS is an integral element for most companies (Guilding et al., 2005; Mia and Clarke, 1999). It is needed to provide accurate information on resources consumed by a firm's operations which can be used for different purposes including stock valuation, pricing, make/buy decisions, operating performance evaluation, planning and supporting improvement initiatives (Maiga and Jacobs, 2008; Fullerton and McWatters, 2004). The role of the MAS in supporting other improvement initiatives has received a considerable level of attention. This has been reflected by the amount of discussion and research

comparing the different types of MAS to understand their impact in the lean context (e.g. Ruiz-de-Arbulo-Lopez et al., 2013; Schoute, 2011; Kennedy and Widener, 2008; Maskell and Kennedy, 2007; Grasso, 2005; Ittner, 1999).

For decades, the traditional accounting system (TAS) (i.e. variable costing system and absorption costing system) have played an important role in equipping managers with necessary information at an acceptable level of accuracy to perform a variety of managerial tasks (Mishra and Vaysman, 2001). The variable costing system collects information on merely cost items that change proportionally with the number of products/services produced and entirely ignores the fixed or overhead cost not directly related to products/services produced. Like the variable costing system, the absorption costing system track all variable costs but also assumes that all overhead costs are directly related to the level of products/services produced (Maskell, 2006). Therefore, it allocates overhead costs, usually accumulated at department level, to products/services based on volume-based drivers such as labour hours or labour costs (Al-Omiri and Drury, 2007).

The mechanism followed by the TAS could be acceptable in an operations environment where overhead costs constitute a small proportion of the overall operations costs and a relatively small number of standardised products/services are produced (Lamminmaki and Drury, 2001; Brignall et al., 1991, Datar et al., 1991; Cooper and Kaplan, 1988). However, the old operational environment in which such systems have been argued to be valid has changed (Drury and Tayles, 2005; Brignall, 1997). In the new environment, (i) the growing reliance on automation has increased substantially the proportion of overhead costs by reducing the labour content of operations; (ii) more customised products/services have been produced which has further increased the overhead costs (Lamminmaki and Drury, 2001; Brignall et al., 1991). Some researchers believe that these changes have brought the TAS to its end (Cooper and Kaplan, 1992). TAS, in the new operational environment, is argued to generate distorted cost information because of its reliance on volume-based cost drivers for allocating the increasing overhead costs which does not reflect the true resources consumed by products/services (Lamminmaki and Drury, 2001; Cooper and Kaplan, 1992; Datar et al., 1991).

By either totally ignoring the increasing overhead costs or merely focusing on absorbing all overhead costs (Khataie and Bulgak, 2013; Chiarini, 2012; Mishra and Vaysman, 2001), TAS is believed to generate aggregate and misleading information which keeps waste hidden in the overhead allocation rate and does not reveal areas for improvements (Khataie and Bulgak, 2013, Maskell, 2006; Kennedy and Affleck-Graves, 2001; Chenhall and Langfield-Smith, 1998; Toomey, 1994). According to Datar et al. (1991), TAS may stifle process improvement initiatives by providing inaccurate cost information to decision makers or sending incorrect signals in relation to the effectiveness of a process innovation which lead decision makers to mistakenly cease such an innovation. For example, this can happen when TAS through its distorted cost information reveals that a product/service A is profitable when in fact it is not while a product/service B is not profitable when in fact it is. In such scenario, a company may not attempt to improve the process of producing product/service A because it is seen to be profitable while the company may decide to apply lean practices, or others, to improve the process of producing product/service B. In this case, the need to improve the process of product/service A is concealed, while the attempt to improve product/service B may not result in a substantial improvement leading to questioning the effectiveness of the improvement program implemented. Both Datar et al. (1991) and Cooper and Maskell (2008) report examples of companies who were about to cease the implementation of lean practices mainly because of the misleading information of the TAS used. As a result, a new accounting system, called activity-based costing system (ABC), has been suggested as an alternative (Ruiz-de-Arbulo-Lopez et al., 2013; Abu Mansor et al., 2012; Grasso, 2005; Kennedy and Affleck-Graves, 2001; Cooper and Kaplan, 1992).

ABC improves the overhead cost allocation process in two different ways (Mishra and Vaysman, 2001). Unlike TAS, ABC (i) breaks down processes into activities and uses these activities to accumulate overhead cost, and (ii) relies not only on volume-based but also non-volume-based cost drivers to allocate overhead cost to final cost objects (e.g. products/services) (Banker et al., 2008; Datar et al., 1991). By doing so, ABC is thought to generate more accurate and detailed cost information at activity level and measure the true

levels of resources consumed by products/services (Khataie and Bulgak, 2013; Tsai and Lai, 2007; Cagwin and Bouwman, 2002; Clarke and Mullins, 2001; Mishra and Vaysman, 2001; Ittner, 1999; Cooper and Kaplan, 1992). By focusing on activities and their cost drivers, ABC seems to be a valuable method which supports lean system by (a) highlighting value-adding activities and non-value adding activities (NVA), (b) sending a correct signal to decision makers on processes which truly require improvements, and (c) helping lean companies prioritise their improvement efforts (Khataie and Bulgak, 2013; Banker et al., 2008; Larson and Kerr, 2007; Grasso, 2005; Ittner, 1999; Datar et al., 1991; Turney and Anderson, 1989).

Supporting the above argument on the relationship between ABC and lean system, Innes and Mitchell (1995) surveyed the largest UK companies and found them to depend on the measures generated from ABC to support other improvement initiatives such as continuous improvement, TQM and JIT considered essential parts of lean system. Adam (1996) argued that when ABC is used in conjunction with other process improvement systems such as quality and lean system, companies enjoy a higher level of benefits. Khataie and Bulgak (2013) used a system dynamics modelling tool and revealed the importance of ABC in achieving the aim of lean system. Another simulation study by Li et al. (2012) also showed that ABC has superiority over TAS in bridging the gap between operational and financial improvements of lean companies. Chiarini (2012) also demonstrated the advantages of ABC in a medium-sized lean firm. Banker et al. (2008) reported empirical evidence indicating that manufacturing companies adopting ABC are more likely to adopt lean practices in their operations. Abu Mansor et al. (2012) explored the usefulness of ABC information for decision making in a telecommunication company. Using data from 181 ABC users, Abu Mansor et al. (2012) found that ABC is critical for improving areas of budgeting, planning and uncovering avenues for improvement in other business areas which can be targeted by lean practices.

2.6.2 Business strategy and lean system

Business strategy usually expresses how a company chooses to compete against its competitors and attain a competitive advantage in the market (Bruggeman and Stede,

1993; Porter, 1980). Porter (1980) classifies business strategy into differentiation and cost leadership, while Miles and Snow (1978) differentiate between prospectors, analysers and defenders. These two taxonomies, as proposed in the strategic management literature, overlap in that differentiation/prospectors can be at one end of a continuum while cost leadership/defenders can be at the other end (Chenhall, 2003; Langfield-Smith, 1997). However, the inventors of those taxonomies argue that different organisational structure, accounting systems and priorities are required for the different strategies at the two ends of the continuum (Porter, 1980; Miles and Snow, 1978).

For instance, cost leaders/defenders are usually characterised with low variety and standardised products/services and operate in a relatively stable market environment (Ward et al., 2007; Gosselin, 1997; Lei et al., 1996; Ward et al., 1996; Bruggeman and Stede, 1993). They focus heavily on controlling and reducing cost especially in areas such as research and development and advertising (Frey and Gordon, 1999, Porter, 1980; Miles and Snow, 1978). In contrast, differentiators/prospectors operate in a relatively more volatile environment and compete through product/service innovation and market development (Gosselin, 1997; Bruggeman and Stede, 1993). They seek developing a wider range of more customised products/services with high focus on quality while they strive for flexibility in responding to changing customers' needs (Kennedy and Widener, 2008; Ward et al., 2007; Lei et al., 1996; Ward et al., 1996).

The relationship between business strategy and operations strategy has been studied by several researchers in the operations and strategic management literature (e.g. Ward et al., 2007; Lei et al., 1996; Ward et al., 1996). The core argument is that operations strategy should work in line with the objectives of the overall business strategy (Joshi et al., 2003). That is, business strategy is expected to shape the operations strategy to achieve firm specific objectives (Amoako-Gyampah and Acquaah, 2008; Ward and Duray, 2000). As a result, it is logical to expect an influence from the business strategy on the implementation of lean practices chosen as an operations strategy (Ward et al., 2007; Baines and Langfield-Smith, 2003; Chenhall and Langfield-Smith, 1998).

Empirical examinations of this premise in the service context are lacking and those in the manufacturing context provide mixed results. While Qi et al. (2011) have found cost leadership strategy to be more compatible with lean system than the differentiation strategy, others have demonstrated the reverse (Ward et al., 2007; Chenhall and Langfield-Smith, 1998).

2.6.3 Firm age and lean system

Firm age can influence the adoption of lean practices in different ways (González-Benito, 2005; Shah and Ward, 2003). On the one hand, old firms are more likely to be more experienced in running businesses in comparison with young firms (Coad et al., 2013; Glancey, 1998). This accumulated knowledge and experience may help old firms to be more efficient than less experienced firms and prevents the need for adopting lean practices to improve efficiency (Coad et al., 2013; Lundvall and Battese, 2000; Glancey, 1998). In addition, old firms may suffer from rigidity and inflexibility in responding to market changes and adopting new innovations such as lean practices (Coad et al., 2013; Wagner et al., 2012; González-Benito, 2005; Shah and Ward, 2003). However, while Shah and Ward (2003) found empirical evidence regarding the negative impact of firm age on the adoption of some lean practices (e.g. cross functional work force, cycle time reduction, JIT/continuous flow production, maintenance optimization, reengineered production process and self-directed work teams), they also found a positive relation between firm age and other lean practices (e.g. planning and scheduling strategies, safety improvement programs, and total quality management programs). Therefore, the authors concluded that the effect of firm age is not always in the predicted direction although it should be taken into account.

2.6.4 Firm size and lean system

Firm size can also have an impact on the adoption of lean practices. Large firms are argued to have more financial and human resources. The higher level of resources available for large firms can be advantageous by allowing for more experimentation with new technologies and innovations (e.g. lean practices) that may improve their productivity

and efficiency (Coad et al., 2013; Wagner et al., 2012; Galende and de la Fuente, 2003; Shah and Ward, 2003). In contrast, large firms have more complex operations administrative tasks and therefore can be more reluctant or slower in adopting innovative methods and techniques that are capable of improving their performance (Shah and Ward, 2003; Hannan and Freeman, 1984). In their empirical study, Shah and Ward (2003) found evidence of a positive association between firm size and 20 out of 22 lean practices. This highlights the importance of taking into account the effect of firm size when studying the lean-performance association.

2.6.5 Evaluation of the lean-context literature

Although the literature reviewed in the subsections 2.6.1 and 2.6.2 has been useful in providing information on the role of ABC and business strategy in the lean context, it still has some limitations that deserve to be considered. First, most studies which highlighted the shortcomings of the TAS and the advantages of ABC in the lean context were either conceptual or case-based studies. As a result, there has been very little empirical research devoted to verifying the anecdotal evidence suggested by those studies (Fullerton et al., 2013; Li et al., 2012; Banker et al., 2008). Empirical examinations of the possible effect of ABC on lean service are critical for the ABC literature as it offers an alternative view on how ABC can impact on firm performance. While the majority of researchers examined the direct impact of ABC on performance (e.g. Sheu and Pan, 2009; Cagwin and Bouwman, 2002; Ittner et al., 2002; Kennedy and Affleck-Graves, 2001), little attention has been paid to its potential indirect impact on performance acting through lean service (Banker et al., 2008).

Second, studies reviewed in the two subsections were distinctive in that they focused on either the lean-accounting association or the strategy-lean relationship. With the exception of the study of Baines and Langfield-Smith (2003), neither of the studies has attempted to integrate the lean-accounting literature with the strategy-lean literature despite the significant insights that can be obtained from that. The integration of the two streams of literature allows for taking into account the impact of business strategy on ABC documented by several researchers (e.g. Hammad et al., 2010; Baines and Langfield-

Smith, 2003; Chenhall and Langfield-Smith, 1998; Gosselin, 1997), which helps to uncover the intervening role of ABC in the lean-strategy association. Consequently, the impact of business strategy on lean service can be decomposed into its direct and indirect elements, which offers a better understanding of such impact (Luft and Shields, 2003; Shields et al., 2000). In addition, the inclusion of business strategy when examining the effect of ABC on lean service is essential to avoid endogeneity issues caused by correlated omitted variables and which bias the findings[2] (Chenhall and Moers, 2007; Larcker and Rusticus, 2007).

2.7 Conclusion and research gaps

In this chapter, the literature on lean system in manufacturing and services has been reviewed. This included the provision of information on the evolution of lean system since its introduction in 1950s. In addition, the various definitions of lean system along with its structure and mechanism for improving firm performance have been highlighted. Moreover, the literature concerning the possible role the accounting system and business strategy in the lean context has been critically reviewed.

The literature on lean system in manufacturing was found to be more developed compared to lean service. However, the empirical studies investigating the impact of lean manufacturing on performance were limited in scope by their focus on either the impact of individual practices or the additive effect of lean bundles on operational performance. The likely non-additive effect of lean bundles suggested by Shah and Ward (2003) and the effect on financial performance were far less investigated in this empirical literature.

The lean service literature was found to be growing with increasing number of publications although they were mostly conceptual and case studies. Despite the growth in the number of publications, the lean service literature was found to be strongly biased to healthcare at the account of other perhaps equally important service industries such as hotels, consultancy services, telecommunication industry, banking and financial service,

[2] Endogeneity caused by correlated omitted variables occurs as a result of excluding one or more variables which are expected to affect both the dependent and independent variable(s) in a model (Chenhall and Moers, 2007).

etc. Therefore, it is vital to supplement this growing body of literature with rigorous empirical studies that focus on the neglected sectors while learning from the manufacturing literature to overcome its limitations.

The focus on the lean-performance association directed the attention of researchers away from the importance of shedding light on the impact of contextual variables on the adoption of lean practices. Two distinctive streams of literature were found and reviewed which highlighted the impact of ABC and business strategy on the implementation of lean system. Although the current literature was clear in terms of the superiority of ABC over TAS in the lean context, it was largely dominated by conceptual and case-based studies. This fact necessitates rigorous empirical research to be conducted in order to verify the anecdotal evidence on the positive role of ABC in the lean service. Further, investigating the role of ABC and business strategy in the lean context in isolation was found to conceal significant insights on their effect. Hence, a better understanding of their role requires the integration of three different streams of literature, namely, the accounting-lean literature, the strategy-lean literature and the strategy-accounting literature.

In short, rigorous empirical research, that (a) covers a wide range of service industries to provide more generalisable results, (b) brings to light not only the additive but also the non-additive impact of lean bundles on both operational and financial performance, and (c) examines simultaneously the impact of ABC and business strategy on lean service can be of significant importance (Arlbjørn and Freytag, 2013; Fullerton et al., 2013; Malmbrandt and Åhlström, 2013; Suárez-Barraza et al., 2012; Holm and Ahlstrom, 2010b; Banker et al., 2008; Shah and Ward, 2003).

Chapter 3 : Theoretical framework and hypotheses development

3.1 Introduction

In the previous chapter, the shortcomings characterising the existing literature of lean system in manufacturing and services were exposed. In addition, limitations of the streams of literature focusing on the role of ABC and business strategy in the lean context were also highlighted. This chapter aims to address these limitations by developing a theoretical model that brings to light the full potential of lean service and clarifies the impact of ABC and business strategy on lean service. The remainder of this chapter is organised as follows. In the next section, the constructs forming the theoretical model developed in this study are identified and explicitly reported. In the third section, the two core theories guiding the development of the theoretical model are presented. Section four focuses on describing and explaining the theoretical model while section five articulates the hypotheses linking together the constructs of the theoretical model. The last section of this chapter provides a summary of information presented in this chapter.

3.2 Constructs of the theoretical model

3.2.1 Identification of the relevant literature

Given the service nature of this research, the first step in determining the constructs of this study is to define the term "service" and identify the relevant literature accordingly. To distinguish publications on lean system in services from those discussing lean system in non-service context, the following definition of services has been adopted: *service firms are any firm which is not involved in manufacturing, agriculture, mining and construction industries*. This residual perspective in defining services has been criticised by Sampson and Froehle (2006) who proposed an alternative way called the Unified System Theory to differentiate between services and non-services. However, the new method introduced by Sampson and Froehle (2006) differentiates between services and non-services at a process level. Consequently, the use of the Unified System Theory is less applicable to this

research given that the unit of analysis here is the firm rather than the process. In addition, the definition adopted in this study has been adopted by a large number of researchers (e.g. Zaman et al., 2013; Abdelaziz et al., 2011; Saidur et al., 2011; Christie et al., 2003).

Keeping in mind this definition, a systematic search for lean service publications began by surveying publications in five well-known databases using key words including "lean", "process improvement", "system thinking" and "more with less". Those databases included: Business Source Premier, ABI/INFORM Research, Emerald, Science Direct and Scopus. All articles reporting any of the aforementioned key words in the title, abstract or key words were collected for further examinations. The title and abstract of each article were examined to determine those articles on lean service. After identifying publications on lean service, references listed at the end of each article were traced to collect all possible relevant articles. Through this process, 221 articles have been found (up to the end of May 2013) and presented in chapter 2. In addition, these articles have been used to extract required information, i.e., lean practices and outcome of their implementation for constructing the model.

3.2.2 Identification of lean service practices

The identification of lean practices is not a trivial task given the confusion surrounding the concept (Lewis, 2000) (see section 2.2). For instance, the human-based practices are emphasised and argued to be crucial for any improvement system where lean is not an exception (Höök and Stehn, 2008). Based on that, some authors include explicitly or implicitly the human-based practices such as education/training, employees' involvement and empowerment, multi-skilled/multi-function employees and teamwork in the lean toolbox (e.g. Staats et al., 2011; Holden, 2010; Kuriger et al., 2010; Poksinska, 2010; Manos et al., 2006). Shah and Ward (2003) involve HRM practices in the lean toolbox to conclude that lean system comprises four bundles namely, JIT, TQM, TPM and HRM practices, each of which has its own items. In contrast, other researchers adopt a different perspective believing that HRM practices are important to a successful lean implementation, and consequently they are a prerequisite for lean system (e.g. Suarez-Barraza and Ramis-Pujol, 2010; Ehrlich, 2006; Comm and Mathaisel, 2005a). Pettersen

(2009) reports that the findings of his study contradict those of Shah and Ward (2003). He finds that HRM is not a basic characteristic of lean although it is important to present. Pont et al. (2008) consider HRM practices as one of the lean bundles and report the importance of their implementation first in the lean journey. That, however, implicitly supports the need to differentiate between HRM and other lean bundles. Fullerton and Wempe (2009) separate employees' involvement from other lean tools namely, cellular manufacturing and quality improvement. Finally, studying the impact of JIT practices on plants performance, Sakakibara et al. (1997) and Ahmad et al. (2003) perceive similar practices as supportive and infrastructure practices necessary for an effective JIT system. Consequently, in this study, I follow Shah and Ward (2007) in viewing lean service as a socio-technical system that has two distinctive sets of practices. HRM practices, however, discussed above and other practices identified in the literature will represent the social side of the system.

Changing the facility layout (CFL) is another controversial point. For instance, some researchers view CFL as a requirement for moving away from a department-based organisation to a process-based organisation (Yasin et al., 2003) which is needed for the group technology concept. In contrast, others consider CFL to be one of the lean techniques that could be employed to attack one or more of waste elements (Holden, 2010; Holm and Ahlstrom, 2010a; Poksinska, 2010; Manos et al., 2006; Tonya, 2004; Allway and Corbett, 2002). Theoretically and regardless of leading to a complete process-based layout, the layout of an organisation can be modified so that any unnecessary movements of employees and/or inefficient use of space can be eliminated (Hameri, 2010). Therefore, CFL will be included in the lean technical practices (LTPs) that an organisation can use to eliminate waste.

This differentiation between LTPs and lean social practices (LSPs) is highly important given that some companies may not adopt all practices (technical and social). Therefore, if the aforementioned LSPs are combined with LTPs in one comprehensive group, they may not be considered for implementation leading to a less successful overall outcome and consequently distorting the reputation of lean service. In addition, classifying lean service

practices into technical and social practices allows for applying and empirically testing the mechanism of STS explicated in section 3.3. Bearing in mind the above discussion, the 54 lean service practices identified through carefully reading the 221 publications have been classified into 37 LTPs and 17 LSPs as presented in Tables 3-1 and 3-2 with their supportive references. These two sets of practices represent the source of the two constructs of the theoretical model.

Table 3-1: Lean technical practices (*, ^)

No.	Practice	References
1	5Ss	Ehrlich(2006),Holden(2010),Poksinska (2010), Arlbjørn et al. (2011), Burgess and Radnor(2010), Manos et al. (2006), Fillingham (2007), Esain et al. (2008), Emiliani (2004), Bushell et al. (2002), Suarez-Barraza et al. (2009), Wayne (2005), Brewton (2009), Tiplady (2010), Finigan and Humphries (2006), Maguad (2007), Julien and Tjahjono (2009), Haque And James-Moore (2004), Keen (2011), Pedersen and Huniche (2011), Wenchao Song et al. (2009), Kaplan and Patterson (2008), Markovitz (2012), Chadha et al. (2012), Radnor et al. (2012), Schulze and Störmer (2012)
2	**A3 report**	Holden (2010), Jimmerson et al. (2005), Doman (2011), Qudrat-Ullah et al. (2012)
3	Automation	Holden (2010), Poksinska (2010), Bortolotti and Romano (2010), Manos et al. (2006), Ahluwalia et al. (2004), Lodge and Bamford (2008), Wayne (2005), Julien and Tjahjono (2009), Åhlström (2004), Carter et al. (2011), Wenchao Song et al. (2009), Bortolotti and Romano (2012)
4	**Change management**	Manos et al. (2006)
5	*Continuous improvement*	Dickson et al. (2009), Ehrlich (2006), Poksinska (2010), Piercy and Rich (2009a), Manos et al. (2006), Emiliani (2004), Alagaraja (2010), Maguad (2007), Kuriger et al. (2010), Yavas and Yasin (2001), Hagan (2011), Qudrat-Ullah et al. (2012)
6	**Eliminating loop-backs**	Swank (2003)
7	Group technology	Piercy and Rich (2009b), Ehrlich (2006), Holden (2010), Swank (2003), Arlbjørn et al. (2011), Nielsen and Edwards (2010), Burgess and Radnor (2010), Manos et al. (2006), Arbos (2002), Ben-Tovim et al. (2007), Alagaraja (2010), Hyer and Wemmerlöv (2002), Tatikonda (2007), Cuatrecasas (2004), Middleton et al. (2005)
8	Changing the facility layout	Allway and Corbett (2002), Holden (2010), Poksinska (2010), Holm and Ahlstrom (2010), Manos et al. (2006), Tonya (2004), Cuatrecasas (2004), Nelson-Peterson and Leppa (2007)
9	Just in Time	Cooper and Mohabeersingh (2008), Holden (2010), Poksinska (2010), Arlbjørn et al. (2011), Manos et al. (2006), Emiliani (2004), Alagaraja (2010), Åhlström (2004), Cuatrecasas (2004), Nelson-Peterson and Leppa (2007), Chadha et al. (2012)
10	Kaizen blitz	Dickson et al. (2009), Holden (2010), Arlbjørn et al. (2011), Burgess and Radnor (2010), Hines and Lethbridge (2008), Suarez-Barraza and Ramis-Pujol (2010), Suarez Barraza et al. (2009), Kress (2008), Papadopoulos and Merali (2008), Montabon (2005), Graban and Swartz (2012), Papadopoulos (2012), Radnor et al. (2012)
11	*Kanban*	Holden (2010), Poksinska (2010), Arlbjørn et al. (2011), Manos et al. (2006), Alagaraja (2010), Reinertsen (2005), Hagan (2011), Nelson-Peterson and Leppa (2007)
12	Mistakes proofing/Poka-Yoke	Ehrlich (2006), Cooper and Mohabeersingh (2008), Holden (2010), Poksinska (2010), Manos et al. (2006), Alagaraja (2010), Finigan and Humphries (2006), Maguad (2007), Kuriger et al. (2010), Mirehei et al. (2011), Hagan (2011), Doman (2011)
13	**Model cell, roll out**	Swank (2003), Graban and Swartz (2012)
14	**Outsourcing**	Comm and Mathaisel (2005b)
15	**Point of use storage**	Manos et al. (2006)
16	Policy deployment/Hoshin	Poksinska (2010), Swank (2003), Emiliani (2004), Alagaraja (2010), Pejsa and Eng (2011), Ball and Maleyeff (2003), Wayne (2005), Qudrat-Ullah et al. (2012)

	Kanri	
17	*Process redesign*	Piercy and Rich (2009a), McQuade (2008), Suarez-Barraza and Ramis-Pujol (2010),Yavas and Yasin (2001), Carter et al. (2011), Edwards et al. (2012), Chadha et al. (2012), Bortolotti and Romano (2012)
18	**Production levelling/Heijunka**	Poksinska (2010), Emiliani (2004), Staats et al. (2011), Pedersen and Huniche (2011)
19	Pull system	Ehrlich (2006), Cooper and Mohabeersingh (2008), Poksinska (2010), Holm and Ahlstrom (2010), Arlbjørn et al. (2011), Manos et al. (2006), Petersen and Wohlin (2010), Kuriger et al. (2010), Reinertsen and Shaeffer (2005), Reinertsen (2005), Kress (2008), Mirehei et al. (2011), Hagan (2011), Ball and Maleyeff (2003), Schulze and Störmer (2012)
20	**Quality circles**	Swank (2003), Searcy (2009b)
21	Quality function deployment	Emiliani (2004), Alagaraja (2010), Tatikonda (2007), Wang et al. (2012), Schulze and Störmer (2012)
22	Quick set up time	Arlbjørn et al. (2011), Manos et al. (2006), Arbos (2002), Finigan and Humphries (2006), Maguad (2007)
23	Root cause analysis	Ehrlich (2006), Holden (2010), Poksinska (2010), Jones et al. (1999), Petersen and Wohlin (2010), Searcy (2009b), Villarreal et al. (2009), Haque And James-Moore (2004), Yavas and Yasin (2001), Wang et al. (2012), Collar et al. (2012), Schulze and Störmer (2012)
24	**Segregating complexity**	Holm and Ahlstrom (2010), Swank (2003), Nielsen and Edwards (2010), King et al. (2006)
25	**Self inspection**	Manos et al. (2006), Maguad (2007)
26	**Simplification**	Bortolotti and Romano (2010), Bortolotti and Romano (2012)
27	*Single piece flow*	Poksinska (2010), Staats et al. (2011), Alagaraja (2010), Kuriger et al. (2010), Haque And James-Moore (2004), Kress (2008), Mirehei et al. (2011), Nelson-Peterson and Leppa (2007), Chadha et al. (2012), Bortolotti and Romano (2012)
28	Small lots	Ehrlich (2006), Swank (2003), Manos et al. (2006), Arbos (2002), Brewton (2009), Kuriger et al. (2010), Reinertsen and Shaeffer (2005), Reinertsen (2005), Kress (2008)
29	*Standardisation*	Allway and Corbett (2002), Ehrlich (2006), Holden (2010), Poksinska (2010), Holm and Ahlstrom (2010), Sprigg and Jackson (2006), Swank (2003), Bortolotti and Romano (2010), Kosuge et al. (2010), Nielsen and Edwards (2010), Manos et al. (2006), Emiliani (2004), Bushell et al. (2002), Staats et al. (2011), Alagaraja (2010), Haque And James-Moore (2004), LaGanga (2011), Hagan (2011), Wenchao Song et al. (2009), Kaplan and Patterson (2008), Nelson-Peterson and Leppa (2007), Middleton et al. (2005), Doman (2011), Carlborg et al. (2013), Wang et al. (2012), Qudrat-Ullah et al. (2012), Chadha et al. (2012), Bortolotti and Romano (2012), Jaca et al. (2012)
30	*Takt time*	Allway and Corbett (2002), Poksinska (2010), Holm and Ahlstrom (2010), Swank (2003), Arlbjørn et al. (2011), Arbos (2002), Emiliani (2004), Haque And James-Moore (2004), Reinertsen (2005), Kress (2008), Cuatrecasas (2004), Middleton et al. (2005)
31	Total preventive maintenance	Poksinska (2010), Arlbjørn et al. (2011), Manos et al. (2006), Arbos (2002), Emiliani (2004), Finigan and Humphries (2006), Maguad (2007), Åhlström (2004)
32	**Total quality**	Kuriger et al. (2010), Mirehei et al. (2011)
33	**Use of new technologies**	Jones et al. (1999), Hines and Lethbridge (2008), Comm and Mathaisel (2005b), Tischler (2006)
34	Value stream mapping	Dickson et al. (2009), Piercy and Rich (2009b), Ehrlich (2006), Holden (2010), Poksinska (2010), Arlbjørn et al. (2011), Bortolotti and Romano (2010), Piercy and Rich (2009a), Nielsen and Edwards (2010), Burgess and Radnor (2010), King et al. (2006), Jimmerson et al. (2005), Ahluwalia et al. (2004), Fillingham (2007), Jones et al. (1999), Lodge and Bamford (2008), Bushell et al. (2002), McQuade (2008), Suarez-Barraza and Ramis-Pujol (2010), Hines et al. (2008), Ben-Tovim et al. (2007), Suarez Barraza et al. (2009), Staats et al. (2011), Alagaraja (2010), Tonya (2004), Wayne (2005), Searcy (2009b), Tiplady (2010), Maguad (2007), Villarreal et al. (2009), Julien and Tjahjono (2009), Haque And James-Moore (2004), Keen (2011), Kress (2008), LaGanga (2011), Pedersen and Huniche (2011), Papadopoulos and Merali (2008), Wenchao Song et al. (2009), Tischler (2006), Chaneski (2005), Doman (2011), Wang et al. (2012), Chadha et al. (2012), Bortolotti and Romano (2012), Schulze and Störmer (2012), Vlachos and Bogdanovic (2013)
35	**Vertical information system**	Holm and Ahlstrom (2010), Åhlström (2004)

36	Visualisation	Holden (2010), Poksinska (2010), Arlbjørn et al. (2011), Manos et al. (2006), Fillingham (2007), Emiliani (2004), Bushell et al. (2002), Staats et al. (2011), Alagaraja (2010), Wayne (2005), Brewton (2009), Finigan and Humphries (2006), Haque And James-Moore (2004), Keen (2011), Wenchao Song et al. (2009), Tischler (2006), Kaplan and Patterson (2008), Nelson-Peterson and Leppa (2007)
37	Work load balancing	Swank (2003), Brewton (2009), Kuriger et al. (2010), Cuatrecasas (2004), Mirehei et al. (2011), Wenchao Song et al. (2009), Middleton et al. (2005)

* All practices printed in bold will not be included in the questionnaire because they were not reported by at least five studies (see subsection 4.10.1)

^ All practices printed in italics violated the normality assumption and therefore they will not be included in the factor analysis and further empirical examination (see subsection 5.2.2)

Table 3-2: Lean social practices*

No.	Social practices	References
1	An appropriate rewarding system	Piercy and Rich (2009b), Ehrlich (2006), Holden (2010), Wayne (2005), Jaca et al. (2012)
2	**Customer involvement**	Holm and Ahlstrom (2010), Suarez-Barraza and Ramis-Pujol (2010)
3	Effective Communication System	Allway and Corbett (2002), Holden (2010), Swank (2003), Manos et al. (2006), Hines and Lethbridge (2008), Suarez-Barraza and Ramis-Pujol (2010), Hines et al. (2008), Comm and Mathaisel (2005a), Pejsa and Eng (2011), Jaca et al. (2012)
4	Employee empowerment	Holden (2010), Jones et al. (1999), Comm and Mathaisel (2005a), Graban and Swartz (2012), deHaan et al. (2012), Bortolotti and Romano (2012), Collar et al. (2012)
5	Employees commitment	Dickson et al. (2009), Poksinska (2010), Carter et al. (2011), Bortolotti and Romano (2012), Schulze and Störmer (2012)
6	Employees involvement	Piercy and Rich (2009b), Ehrlich (2006), Holden (2010), Swank (2003), Bortolotti and Romano (2010), Manos et al. (2006), Suarez-Barraza and Ramis-Pujol (2010), Hines et al. (2008), Tonya (2004), Julien and Tjahjono (2009), Kress (2008), Graban and Swartz (2012), deHaan et al. (2012), Bortolotti and Romano (2012), Collar et al. (2012), Schulze and Störmer (2012), Jaca et al. (2012)
7	**Establishing a long-term relation with suppliers**	Swank (2003), Wang et al. (2012), Qudrat-Ullah et al. (2012)
8	**Establishing environment for change**	Comm and Mathaisel (2005a), Graban and Swartz (2012)
9	Having multifunctional employees	Dickson et al. (2009), Ehrlich (2006), Arbos (2002), Tonya (2004), Moayed and Shell (2009), Cuatrecasas (2004), LaGanga (2011), Chadha et al. (2012)
10	**Improving teamwork spirit**	Suarez-Barraza and Ramis-Pujol (2010), Graban and Swartz (2012), Jaca et al. (2012)
11	Leadership	Allway and Corbett (2002), Swank (2003), Suarez-Barraza and Ramis-Pujol (2010), Comm and Mathaisel (2005a), Jaaron and Backhouse (2011), Keen (2011), Qudrat-Ullah et al. (2012), Schulze and Störmer (2012)
12	**Modifying the terminology to suit services**	Hines et al. (2008)
13	Obtaining management support	Dickson et al. (2009), Allway and Corbett (2002), Piercy and Rich (2009b), Poksinska (2010), Holm and Ahlstrom (2010), Swank (2003), Bortolotti and Romano (2010), Piercy and Rich (2009a), Burgess and Radnor (2010), King et al. (2006), Jimmerson et al. (2005), Hines and Lethbridge (2008), Suarez-Barraza and Ramis-Pujol (2010), Tischler (2006), Towne (2006), Graban and Swartz (2012), Papadopoulos (2012), Jaca et al. (2012)
14	Performance measurement system	Piercy and Rich (2009b), Ehrlich (2006), Swank (2003), Burgess and Radnor (2010), Suarez-Barraza and Ramis-Pujol (2010), Bhasin (2008), Comm and Mathaisel (2005a), Comm and Mathaisel (2005b), Kennedy et al. (2007), Kress (2008), Bortolotti and Romano (2012)
15	**Posting performance results**	Swank (2003), Middleton et al. (2005)

16	**Providing justifications for implementing the practices**	Jaaron and Backhouse (2011)
17	Training	Dickson et al. (2009), Piercy and Rich (2009b), Ehrlich (2006), Holden (2010), Poksinska (2010), Holm and Ahlstrom (2010), Piercy and Rich (2009a), Burgess and Radnor (2010), Manos et al. (2006), King et al. (2006), Jimmerson et al. (2005), Suarez-Barraza and Ramis-Pujol (2010), Hines et al. (2008), Staats et al. (2011), Comm and Mathaisel (2005a), Comm and Mathaisel (2005b), Tonya (2004), Wayne (2005), Searcy (2009b), Keen (2011), Kress (2008), Cuatrecasas (2004), Mirehei et al. (2011), Carter et al. (2011), Tischler (2006), Graban and Swartz (2012), Schulze and Störmer (2012), Jaca et al. (2012)

* All practices printed in bold will not be included in the questionnaire because they were not reported by at least five studies (see subsection 4.10.1)

3.2.3 The performance outcome of lean service practices

The third critical construct in the theoretical model developed in this study is the benefits likely to result from the implementation of lean service practices. The systematic review of the existing lean service literature indicates the presence of 20 benefits that can be attributed to lean service practices as presented in Table 3-3 with associated references. The 20 benefits listed in Table 3-3 are comprehensive in that they represent not only operational performance of service firms but also their financial performance. Therefore, the items presented in Table 3-3 can capture the multi-dimensional nature of organisational performance to overcome limitations of the majority of previous empirical lean-performance studies which focused only on one dimension of organisational performance, namely the operational performance (as highlighted in the introduction chapter and subsection 2.4.4).

Table 3-3: Benefits of lean service*

N0.	Benefits	References
1	Freeing staff time	Piercy and Rich (2009b), Ehrlich (2006), Jimmerson et al. (2005), Searcy (2009), Hagan (2011), Papadopoulos (2012), Markovitz (2012), Bortolotti and Romano (2012)
2	Identification and elimination of waste	Ehrlich (2006), Swank (2003), Hines and Lethbridge (2008), McQuade (2008), Comm and Mathaisel (2005a), Maguad (2007), Julien and Tjahjono (2009), Kaplan and Patterson (2008), Nelson-Peterson and Leppa (2007), Chadha et al. (2012), Bortolotti and Romano (2012), Collar et al. (2012), Schulze and Störmer (2012)
3	Improvement in capacity	Holden (2010), Poksinska (2010), Nielsen and Edwards (2010), Burgess and Radnor (2010), King et al. (2006), Ben-Tovim et al. (2007), LaGanga (2011), Hagan (2011), Chadha et al. (2012)
4	Improvement in customer perception of product/service quality	Piercy and Rich (2009b), Ehrlich (2006), Bortolotti and Romano (2010), Arbos (2002), Hyer and Wemmerlöv (2002), Hagan (2011), Nelson-Peterson and Leppa (2007)
5	Improvement in customer satisfaction	Piercy and Rich (2009b), Ehrlich (2006), Poksinska (2010), Bortolotti and Romano (2010), Piercy and Rich (2009a), Jimmerson et al. (2005), Emiliani (2004), Hines and

		Lethbridge (2008), Suarez-Barraza and Ramis-Pujol (2010), Hines et al. (2008), Yavas and Yasin (2001), Pejsa and Eng (2011), Kaplan and Patterson (2008), Carlborg et al. (2013), Edwards et al. (2012), Bortolotti and Romano (2012)
6	Improvement in employees satisfaction and their performance	Piercy and Rich (2009b), Poksinska (2010), Swank (2003), Nielsen and Edwards (2010), Burgess and Radnor (2010), Jimmerson et al. (2005), Fillingham (2007), Hines et al. (2008), Pejsa and Eng (2011), Kaplan and Patterson (2008), deHaan et al. (2012), Edwards et al. (2012), Jaca et al. (2012)
7	Improvement in employees understanding of the process	Swank (2003), Burgess and Radnor (2010), Esain et al. (2008), Bushell et al. (2002), Maguad (2007), Radnor et al. (2012)
8	Improvement in operational efficiency	Cooper and Mohabeersingh (2008a), Bortolotti and Romano (2010), Cooper and Mohabeersingh (2008b), Malladi et al. (2010), Comm and Mathaisel (2005a), Carlborg et al. (2013), Collar et al. (2012)
9	**Improvement in process flexibility**	Bortolotti and Romano (2010), Kosuge et al. (2010), Chadha et al. (2012)
10	Improvement in productivity	Allway and Corbett (2002), Bortolotti and Romano (2010), Arbos (2002), Bhatia and Drew (2007), Staats et al. (2011), Pejsa and Eng (2011), Carlborg et al. (2013), Bortolotti and Romano (2012), Jaca et al. (2012)
11	**Improvement in the organisation of work areas**	Poksinska (2010), Manos et al. (2006), Suarez Barraza et al. (2009), Radnor et al. (2012)
12	Reduction in costs	Piercy and Rich (2009b), Ehrlich (2006), Cooper and Mohabeersingh (2008b), Poksinska (2010), Swank (2003), Bortolotti and Romano (2010), Piercy and Rich (2009a), Nielsen and Edwards (2010), Jimmerson et al. (2005), Jones et al. (1999), Arbos (2002), McQuade (2008), Ben-Tovim et al. (2007), Cooper and Mohabeersingh (2008a), Bhatia and Drew (2007), Malladi et al. (2010), Villarreal et al. (2009), Julien and Tjahjono (2009), Hagan (2011), Kaplan and Patterson (2008), Bortolotti and Romano (2012)
13	Reduction in inventory	Poksinska (2010), Bortolotti and Romano (2010), Manos et al. (2006), Jones et al. (1999), Kaplan and Patterson (2008)
14	Reduction in lead time and cycle time	Piercy and Rich (2009b), Ehrlich (2006), Cooper and Mohabeersingh (2008b), Holden (2010), Poksinska (2010), Swank (2003), Bortolotti and Romano (2010), Piercy and Rich (2009a), Nielsen and Edwards (2010), King et al. (2006), Fillingham (2007), Arbos (2002), Lodge and Bamford (2008), McQuade (2008), Suarez-Barraza and Ramis-Pujol (2010), Hines et al. (2008), Ben-Tovim et al. (2007), Cooper and Mohabeersingh (2008a), Bhatia and Drew (2007), Suarez Barraza et al. (2009), Staats et al. (2011), Hyer and Wemmerlöv (2002), Yavas and Yasin (2001), Hagan (2011), Tischler (2006), Nelson-Peterson and Leppa (2007), Papadopoulos (2012), Edwards et al. (2012), Radnor et al. (2012)
15	**Reduction in reworks**	Jones et al. (1999), Hyer and Wemmerlöv (2002)
16	**Reduction in staff turnover and absenteeism**	Piercy and Rich (2009b), deHaan et al. (2012)
17	Reduction in the number of human errors	Poksinska (2010), Swank (2003), Jimmerson et al. (2005), Searcy (2009), Hyer and Wemmerlöv (2002), Hagan (2011)
18	**Reduction in work in process**	Piercy and Rich (2009b), Ehrlich (2006), Swank (2003)
19	**Savings in space**	Nielsen and Edwards (2010), Manos et al. (2006), Suarez Barraza et al. (2009)
20	Profitability	Allway and Corbett (2002), Ehrlich (2006), Bhatia and Drew (2007), Pejsa and Eng (2011)

* All expected benefits printed in bold will not be included in the questionnaire because they were not reported by at least five researchers (see subsection 4.10.2)

3.2.4 Contextual variables

To spot potential contextual variables which may affect either firm performance or the adoption of lean practices or both, the service literature in the field of management accounting, business strategy, strategic management and the research focusing on the performance of service firms in general has been reviewed. However, given the scarcity of such literature, I followed Auzair and Langfield-Smith (2005) by including relevant research from the manufacturing literature. Auzair and Langfield-Smith (2005) pointed out that when focusing on for-profit service firms as the case of this research, the literature on manufacturing companies can be relied on as these types of companies share the same goal which is profit maximisation. The thorough search for likely influential contextual variables has resulted in a list of four contextual variables, namely firm size, firm age, management accounting system (represented by ABC in this study) and business strategy. More in-depth information about the role of each contextual variable is provided in section 5 of this chapter.

3.3 The theoretical foundation of the research

3.3.1 Socio-technical systems theory (STS)

The socio-technical system (STS) was developed at Tavistock Institute of Human Relations in London and was reported on through a series of research papers written by Eric Trist and his colleagues (e.g. Trist, 1981; Emery and Trist 1965; Trist and Bamforth, 1951). This theory underlines the notion that organisations consist of two separate, but interdependent, systems: a technical system and a social system (Appelbaum, 1997; Fox, 1995; Trist, 1981). The technical system comprises equipments, tools, techniques and processes, while the social system comprises people and relationships among them (Trist, 1981; Trist and Bamforth, 1951). The argument is that higher reliance on the technical system as a response to changes in the environment can be more effective if it is accompanied by a corresponding increase in the social system (Fox, 1995; Huber and Brown, 1991; Trist and Bamforth, 1951). Therefore, although each system can be described as a stand-alone system, the optimal performance of an organisation can only be obtained by the joint optimisation of both systems (Zu, 2009; Manz and Stewart, 1997;

Fox, 1995; Trist, 1981; Emery and Trist, 1965). In other words, the sole focus on one system at the expense of the other prevents adopters from enjoying a higher level of benefits that would have been realised if they would have focused on the other complementary system.

Given the notion of STS highlighted above, its use in the operations management literature is evidently growing whether in manufacturing or services (Baxter and Sommerville, 2011; Manz and Stewart, 1997). For instance, Manz and Stewart (1997) provide a theoretical model that presents TQM from the STS perspective and report five propositions where a synergy between the technical and social systems of TQM has been expected. Similarly, Huber and Brown (1991) conduct a critical theoretical work to convey an argument in which they highlight the importance of changes in the social practices as a result of adopting the cellular manufacturing concept for the latter to be more effective. In more recent work, Zu (2009) attempts to explain, using STS perspective, the controversial results reported on the effectiveness of quality management technical practices and quality management infrastructural practices. The author uses data from 226 manufacturing firms and finds that the infrastructural practices are strongly supportive to the technical practices in improving quality performance. In this line of empirical research adopting the STS perspective, the very few studies including those of Dabhilkar and Åhlström (2013) and Das and Jayaram (2007) found in the lean literature and explained earlier in subsection 2.4.3 can be included.

The importance of the STS to the current research stems from its use to (i) classify the long list of lean practices into LTPs and LSPs (see Tables 3-1 and 3-2), and (ii) to support the theoretical argument pointing to the expected synergy between the two sets of practices.

3.3.2 Contingency theory

The contingency theory (CT) is a critical approach that has contributed significantly to different research fields including operations management (e.g. Rashidirad et al., 2013; Zhang et al., 2012; Jayaram et al., 2010), management accounting (e.g. Al-Omiri and

Drury, 2007; Auzair and Langfield-Smith, 2005) and strategic management (e.g. Ward et al., 2007; Lei et al., 1996). CT adopts the premise that any organisational, management and operations system cannot be equally applicable and/or effective in all contexts and environments (Drazin and Van de Ven, 1985). Therefore, a specific context can be more conducive for a specific system than other contexts, which positions the concept of fit at the heart of CT (Drazin and Van de Ven, 1985). However, how the fit is defined by researchers can have a profound effect on the type of theory developed, data collection and the statistical analysis needed for testing the theory (Al-Omiri and Drury, 2007; Drazin and Van de Ven, 1985). To clarify the confusion surrounding the operationalisation of fit within the CT, different approaches have been suggested to define "fit" (Venkatraman, 1989; Drazin and Van de Ven, 1985). Drazin and Van de Ven (1985) have introduced three approaches for fit, namely the selection approach, the interaction approach and the system approach while Venkatraman (1989) has highlighted the moderation and mediation perspectives within the CT. Each of these different approaches is explained in detail below.

3.3.2.1 The selection approach

The selection approach perceives fit as a relationship or congruence between organisational context (e.g. technology, size, or environment) and organisational structure (e.g. formalisation, complexity) without paying any attention to the potential impact of that congruence on firm performance (Drazin and Van de Ven, 1985). This lack of attention to the impact of context-structure fit on performance has been justified using the natural and managerial perspectives (Drazin and Van de Ven, 1985).

The natural perspective contends that only high-performing organisations survive due to their continuous and gradual adaptation or fit to environment (Drazin and Van de Ven, 1985). Given this notion, it is considered sufficient to test only the association between context and structure without the need to include performance explicitly. The managerial perspective goes beyond the natural perspective by taking into consideration organisation design at both macro- and micro-level (Drazin and Van de Ven, 1985). This perspective assumes constraints are imposed by macro levels of an organisation on its micro levels

preventing the latter from fully adopting the structural design most appropriate for their particular conditions. Consequently, all structural variables constrained by macro levels can be analysed for their fit with context using the selection approach, while the structural variables not constrained can interact with context to predict variation in performance and so need to be analysed through the interaction approach (Drazin and Van de Ven, 1985).

3.3.2.2 The interaction approach

In contrast to the selection approach explained above, the interaction approach perceives fit as the interaction between two variables (e.g. context and structure) to explain variation in a third variable (e.g. performance) (Drazin and Van de Ven, 1985). Consequently, in this approach understanding the congruence between context and structure is not of high importance as it was the case in the selection approach. It is mainly the variation in performance that can be explained by the interaction between context and structure that is of importance in this approach (Drazin and Van de Ven, 1985). The interaction approach as a way of operationalising fit is widely spread in the academic literature although mixed results have been obtained in relation with the multiplicative term formed to represent the interaction in the regression equation (Luft and Shields, 2003; Drazin and Van de Ven, 1985). A considerable number of researchers have adopted this perspective in the reviewed literature (e.g. Dabhilkar and Åhlström, 2013; Birdi et al., 2008; Das and Jayaram, 2007; Patterson et al., 2004; Challis et al., 2002). This perspective will also be used in this research to test for the proposed interaction between lean service practices.

3.3.2.3 The system approach

The system approach criticises the previous two approaches to fit on the ground that they adopt a reductionism approach assuming that an organisation can be decomposed into several elements that can be investigated independently (Drazin and Van de Ven, 1985). More specifically, the selection and interaction perspective of fit tend to examine fit between single contextual variables and single structural variables and how each pair of variables interact to predict variation in performance (Drazin and Van de Ven, 1985). The results of each examination are then aggregated to make conclusions about the whole organisational system (Drazin and Van de Ven, 1985). To avoid the reductionism

problem, the system approach advocates a multivariate analysis in which the fit between several contingent, structural and performance variables is addressed simultaneously (Miller, 1981).

3.3.2.4 The moderation perspective

The moderation perspective within CT implies that a relationship between one independent variable and one dependent variable is dependent on the level of a third variable called "moderator" (Frazier et al., 2004; Venkatraman, 1989). Figure 3-1 depicts this type of relationship. However, a moderator can either moderate the form or strength of the assumed relationship where understanding the type of moderation is critical to determine the appropriate statistical analysis needed to detect it (Frazier et al., 2004; Venkatraman, 1989). Depending on the theoretical argument, a particular moderation form can be relied on along with the appropriate statistical analysis to test it.

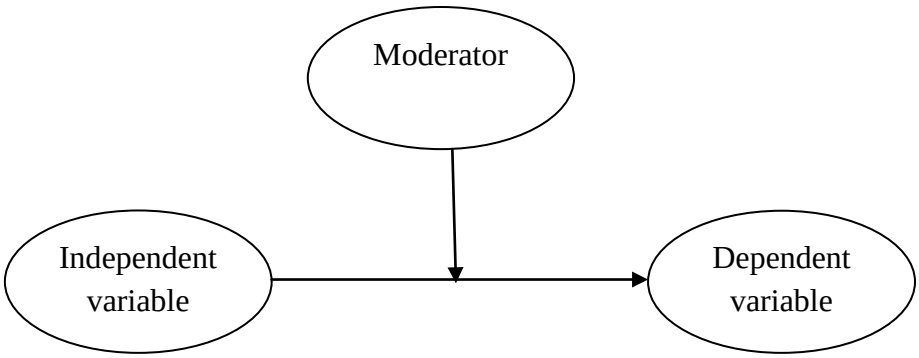

Figure 3-1: The moderation perspective

3.3.2.5 The mediation perspective

The mediation perspective represents a case where the relationship between a predictor and a criterion variable can be either completely or partially explained by a third variable called "mediator" (Frazier et al., 2004). This particular case is represented in Figure 3-2 where the variable C is a mediator variable. A mediator C can either account fully for the A-B association resulting in a complete mediation, or only decrease the A-B association resulting in a partial mediating effect.

The moderation and mediation perspectives represent two different theoretical concepts as clear from the explanation above. Therefore, a specific variable can be either a moderator or a mediator depending on the conceptual argument of the research, but the same variable can be conceptualised as a moderator in one study and as a mediator in another (Frazier et al., 2004).

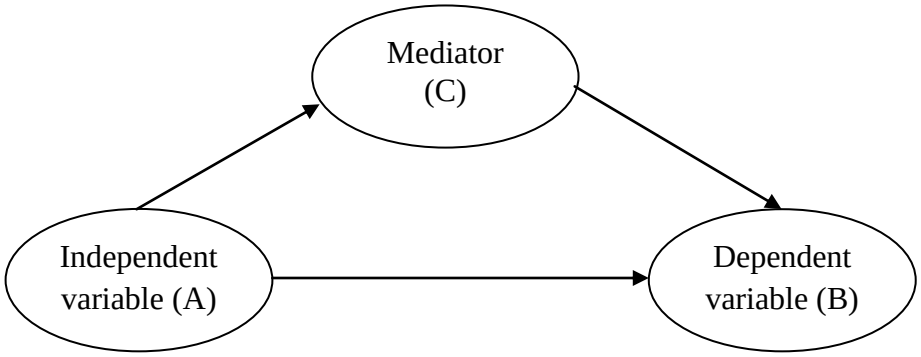

Figure 3-2: The mediation perspective

3.4 Theoretical model

The theoretical model developed in this present research makes use of the two well known theories discussed above, namely STS and CT. More specifically, lean service is viewed in this research as a socio-technical system following the perspective of Shah and Ward (2007, 2003). Therefore, lean service practices are classified into two categories or sides, technical side and social side as presented in Tables 3-1 and 3-2. By viewing lean service as a socio-technical system, the mechanism of the STS and the existing lean literature can then be used to develop an argument through which the main effect of each side and the expected synergy between the two sides in influencing firm performance are highlighted. In line with the STS perspective, the theoretical model proposed in this study assumes a direct positive impact of each side of lean service on both operational and financial performance of adopters. Moreover, this model expands the traditional lean-performance model by including the likely synergistic (i.e. non-additive) effect resulting from the

ability of each side of lean service to enhance the influence of the other side on firm performance. By doing so, the model in this research attempts to overcome limitations of previous studies that failed to uncover the full potential of lean service given their neglect to the non-additive impact of each side on performance (see section 2.4).

On the other hand, the CT, specifically the mediation perspective, will be essentially used to support the theoretical argument in relation to the effect of two contextual variables (ABC and business strategy) on LTPs. More specifically, by adopting the mediation perspective, the model suggests a direct positive impact of ABC on LTPs which, in turn, have an effect on performance. This highlights the possible indirect influence of ABC on performance through its effect on other organisational capabilities (LTPs) which are expected to affect performance. In addition, business strategy is expected to have a dual effect on LTPs directly and indirectly through its direct impact on ABC which highlights the core role of the accounting system in the case of lean service.

Finally, to provide robust findings in connection with the impact of lean service on firm performance, 3 contextual variables are included in the suggested model as control variables given their expected direct effect on firm performance. These variables include firm size, firm age and ABC. Figure 3-4 reflects this argument and depicts the theoretical model that will be tested in this present research study.

3.5 Research hypotheses

Based on the theoretical model presented in Figure 3-3, a number of hypotheses are developed and then empirically tested. These hypotheses can be divided into two groups. The first group of hypotheses (H1a-H6b) relates to the impact of lean service and contextual variables on firm operational and financial performance. The second group of hypotheses (H7-H11) relates to the effect of ABC and business strategy on the technical side of lean service. The research hypotheses in the order just mentioned are developed below.

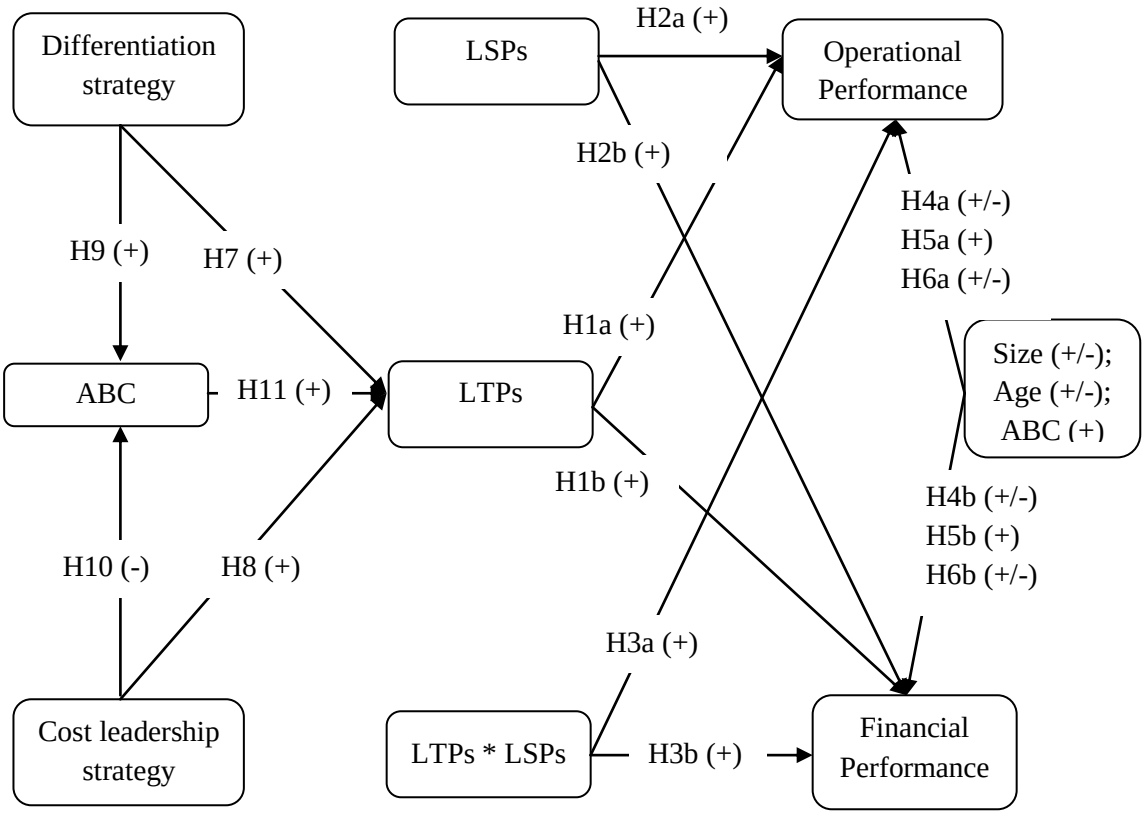

Figure 3-3: The theoretical model[3]

3.5.1 The impact of lean service and contextual variables on firm performance

3.5.1.1 Lean technical practices (LTPs) and firm performance

LTPs presented in Table 3-1 are introduced to improve customer value by identifying, measuring and eliminating non-value adding activities (NVAs) from processes (Ehrlich, 2006; Womack and Jones, 1996). By doing so, several benefits can be expected from those practices to adopters. The lean service literature, consisting mainly of conceptual and case studies, highlights such benefits as ameliorating lead and cycle time, increasing efficiency, improving flexibility, improving customer satisfaction and profitability (see Table 3-3 for a comprehensive list) (Staats et al., 2011; Piercy and Rich, 2009b; Bhatia and Drew, 2007; Abdi et al., 2006; Swank, 2003; Yavas and Yasin, 2001). However, the

[3] This theoretical framework was presented to and accepted by the International Journal of Operations and Production Management.

lack of systematic application of LTPs is argued to result in no improvement (Kim et al., 2012; Allway and Corbett, 2002), and in effect, such systematic application is not easy to attain (Robinson and Schroeder, 2009; Scherrer-Rathje et al., 2009; Bhasin, 2008; Maskell and Kennedy, 2007; Atkinson, 2004). Therefore, it is not inevitable that all adopters of LTPs can be expected to achieve the purported benefits of those practices (Bhasin, 2008). This inconclusive conclusion is supported by the contrasting results reported by empirical studies, mainly in manufacturing, which focus on the effectiveness of the LTPs. Some empirical evidence proves the theoretical argument of a positive relation between LTPs and performance (e.g. Dabhilkar and Åhlström, 2013; Shah and Ward, 2003; Cua et al., 2001). In contrast, no relation between LTPs and performance is also documented (e.g. Birdi et al., 2008; Patterson et al., 2004). However, as a larger number of researchers have proposed and supported a direct positive relation between LTPs and firm performance indicators shown in Table 3-3, the following hypotheses are reported:

H1a: *There is a direct positive relationship between LTPs and operational performance of service firms.*
H1b: *There is a direct positive relationship between LTPs and financial performance of service firms.*

Examining the impact of LTPs on operational and financial performance separately is important. In manufacturing, even a successful lean attempt may result in deterioration in net profit corresponding to liquidating high levels of inventory stored prior to implementing lean manufacturing (Meade et al., 2010). Liquidating inventory transfers the capitalised value of inventory to expenses charged to the year in which lean system requires reducing the amount of inventory acquired. Therefore, although lean system is successfully attacking one type of waste (inventory) to improve processes, it may lead to a reduction in net profit until the level of inventory has stabilised, and then an increase in profit can be expected (Meade et al., 2010). However, in most service industries there is no or low levels of inventory (Apte and Goh, 2004; Lowry, 1990; Dearden, 1978). But the argument here is about whether operational improvements obtained from lean service can overcome any costs (e.g. training sessions, CFL) associated with the adoption of lean

service. Consequently, having no materialised financial benefits should not be the only indication of lean failure. Operational benefits should be considered as well before doubting the successfulness of lean service.

3.5.1.2 Lean social practices (LSPs) and firm performance

Given the view of lean service as having two sides (i.e. LTPs and LSPs), the impact on performance does not seem to be restricted to LTPs only. LSPs are found to be independently capable of explaining variation in the performance of adopters (De Menezes et al., 2010; González-Benito, 2005; Patterson et al., 2004; Shah and Ward, 2003; Cua et al., 2001). For instance, investing in training programs is believed to advance the quality of employees by improving their current skills and helping acquire new skills so that they become multi-functional employees able to perform various tasks and serve in different locations when needed (Delaney and Huselid, 1996; Huselid, 1995). Consequently, a multi-skilled employee can smooth operations processes when a bottleneck appears at any point of a process by helping other employees working in that part of the process. However, multi-skilled employees like others need to be motivated and empowered to utilise their skills in this way (Liker and Morgan, 2006; Delaney and Huselid, 1996; Huselid, 1995). Therefore, an appropriate rewarding system that can align the interest of employees with that of an organisation along with decentralisation in the decision making process will be effective in motivating employees to achieve pre-specified goals (Delaney and Huselid, 1996; Huselid, 1995). In contrast to this positive view, there is little evidence indicating a lack of ability of LSPs to generate significant benefits to adopters (Bonavia and Marin, 2006). These mixing results are not confined to the operations-oriented literature; empirical evidence from the human resource literature also provides different views. While early evidence has proved a positive relation between HRMs and firm operational and financial performance (Delaney and Huselid, 1996; Huselid, 1995), later evidence has failed to capture such positive relation and has concluded that job rotation has negatively affected productivity and collectively HRMs have increased labour cost (Cappelli and Neumark, 2001). However, given that greater evidence suggests a direct positive relation between LSPs and performance, the following hypotheses are reported:

H2a: *There is a direct positive relationship between LSPs and operational performance of service firms.*

H2b: *There is a direct positive relationship between LSPs and financial performance of service firms.*

These hypotheses are highly important in the case of lean service for managements who get excited about the possible benefits that can be achieved from LTPs so that they rush to implement LTPs without realising the likely role of LSPs in independently improving performance.

3.5.1.3 The synergistic effect of LTPs and LSPs on performance

In addition to the direct relation proposed between LTPs and LSPs on the one hand, and firm performance on the other hand, the mechanism of the STS presented in Figure 3.4 suggests another indirect (non-additive) role of both LTPs and LSPs in improving firm performance (Dabhilkar and Åhlström, 2013; Kull et al., 2013; Das and Jayaram, 2007; Trist, 1981). The STS indicates that the best outcome of any socio-technical system can only be achieved by simultaneous emphasis on implementing practices from both subsystems (i.e. LTPs and LSPs) (Dabhilkar and Åhlström, 2013; Trist, 1981). This implies that there can be a synergy between LTPs and LSPs where the effectiveness of each set of practices on performance is enhanced by the other. For instance, in the case of lean service, the value stream mapping (VSM) can be applied to identify NVAs and bottlenecks. Inarguably, some of these deficiencies could be eliminated by untrained employees. It could be argued that trained and multi-skilled employees would be more effective in elimination of NVAs and bottlenecks if empowered to do so. However, if the NVAs were not identified, trained and multi-skilled employees would carry out all activities efficiently but not necessarily effectively. The gain achieved in each of the forgoing cases will be less than the gain that could be obtained in a third case where VSM is initially implemented by a company who has trained multi-skilled employees to improve its processes. Adopting this synergy perspective implies that each set moderates the form of relationship between the other set and performance, and therefore the traditional moderation perspective cannot be adopted here as it is not possible to determine

which set represents the independent variable and which one represents the moderator variable (Sharma et al., 1981). Some researchers have empirically examined the synergy perspective with high focus on the synergy between combinations of JIT, TQM and HRMs (Furlan et al., 2011; Cappelli and Neumark, 2001; Flynn et al., 1995). A few others who have focused on the wider definition of lean as provided by Shah and Ward (2003) used a limited number of practices to represent each bundle and reported inconclusive results on the synergistic effect (Dabhilkar and Åhlström, 2013; Birdi et al., 2008; Das and Jayaram, 2007; Patterson et al., 2004). While some studies forwarded positive indications on the presence of synergy (Birdi et al., 2008; Das and Jayaram, 2007), others failed to verify the assumed synergy (Dabhilkar and Åhlström, 2013; Patterson et al., 2004). However, the hypotheses are formulated in favour of the theoretical argument proposed by the STS as follows:

H3a: *There is a synergy between LTPs and LSPs in improving operational performance of service firms.*

H3b: *There is a synergy between LTPs and LSPs in improving financial performance of service firms.*

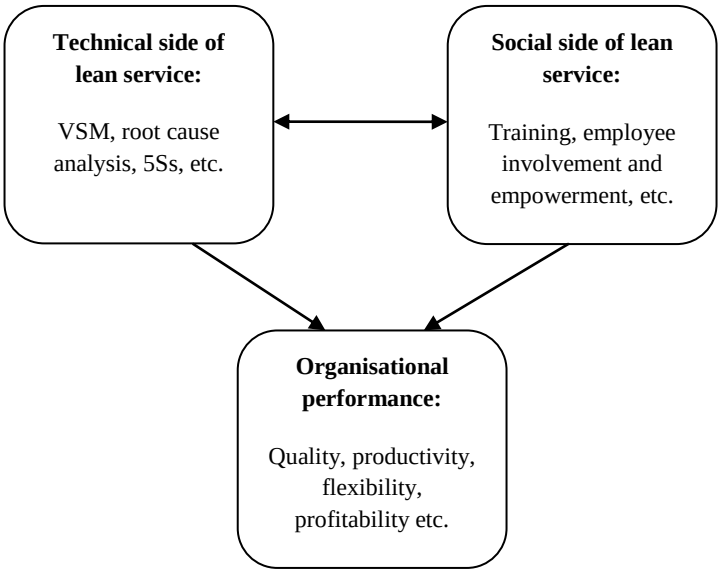

Figure 3-4: The mechanism of the socio-technical system theory
Adapted from: Manz and Stewart (1997)

3.5.2 The effect of contextual variables on performance and/or lean service

There can be several factors that may affect either companies' performance (Capon et al., 1990) or lean adoption or both (Shah and Ward, 2003). Several researchers in the literature of lean manufacturing have stressed the importance of contextual variables in determining the lean-performance association such as the nature of process, firm size and firm age (Shahrukh, 2011; Malladi et al., 2010; Pont et al., 2008; Shah and Ward, 2003; Cua et al., 2001; Christopher, 2000). Not fully taking into account the effect of such contextual variables might have been behind inconsistent empirical results concerning the lean- performance relationship (Staats et al., 2011; Shah and Ward, 2003). To identify the key potential contextual variables, the lean service literature, lean manufacturing literature, and the research focusing on the performance of the service sector including management accounting literature and business strategy literature were searched. Surveying the aforementioned different literatures, four important contextual variables have been identified and presented below.

3.5.2.1 Firm age and firm performance

Firm age can also play a role in determining the overall firm performance. Older firms can be assumed to have higher experience in running business in comparison with young firms (Coad et al., 2013; Glancey, 1998). Consequently, their accumulated knowledge and experience put them in a better position to run their operations more efficiently than less experienced firms leading to better performance (Coad et al., 2013; Lundvall and Battese, 2000; Glancey, 1998). In addition, older firms can rely on their established reputation, if exists, to achieve higher margins than those earned by new or young firms whose reputation has not been well established (Glancey, 1998). However, older firms may suffer from rigidity and inflexibility in responding to market changes and adopting new innovations which may negatively impact their productivity and responsiveness (Coad et al., 2013; Wagner et al., 2012; González-Benito, 2005; Shah and Ward, 2003). These two contrasting theoretical arguments in connection with the impact of age on performance have been supported by the mixing results reported from empirical studies.

Yasuda (2005) finds a negative relationship between firm age and firm growth based on a large sample of Japanese manufacturing firms. Lundvall and Battese (2000) report evidence based on data from 235 Kenyan manufacturing firms on the impact of firm size, age and technical efficiency. Their analysis detects a positive effect of firm size in two industries out of three, but similar effect has not been proved for firm age except for one industry (i.e. textile). Coad et al. (2013) provide empirical evidence from a panel of Spanish manufacturing firms suggesting a positive relation between firm age and performance but with diminishing rate. González-Benito (2005) shows by surveying 186 manufacturing companies that there is no relationship between operational and financial performance (represented by cost, quality, flexibility, reliability and speed and return on assets, respectively) and company size, type of industry and age of equipment. Furthermore, the results of Shah and Ward (2003) convey a significant negative effect of firm size and age on operational performance. Wagner et al. (2012), using empirical data from 259 manufacturing firms, prove a positive influence of firm size on financial performance while firm age is found to have no influence. Consequently, given this contradiction in theory and empirical findings on the nature of age-performance association, the following non-directional hypotheses are formulated:

H4a: *There is a direct relationship between firm age and operational performance of service firms.*

H4b: *There is a direct relationship between firm age and financial performance of service firms.*

3.5.2.2 Activity-based costing system and firm performance

The extensive competition facing service firms reduces the power of service firms to set arbitrary prices for their services as they used to do few years ago (Yu-Lee, 2011; Karmarkar, 2004). This underpins the need to focus more on cost and the importance of cost related information (Guilding et al., 2005). The nature of services further signifies this importance. Broadly speaking, services cannot be inventoried for later use and a significant amount of cost in service firms is fixed at least in the short term (Carenys, and Sales, 2008; Dearden, 1978). Therefore, if a sale transaction is not made, the associated

revenue is lost forever and the time-based overhead cost of the period will be added to that loss (Schlissel and Chasin, 1991). Consequently, having an advanced costing system to provide accurate information on service cost is essential for management to measure resources used, evaluate operating performance, and make informed decisions and price its products/services (Martinson, 2002; Clarke and Mullins, 2001; Kock, 1995; Hegde and Nagarajan, 1992; Anania, 1987).

Using data from 280 manufacturing and service firms, Guilding et al. (2005) demonstrate the increasing importance of cost information for pricing products/services for companies facing extensive competition and/or operating in the service sector. In their empirical study of 61 business unit managers, Mia and Clarke (1999) prove the positive and direct role of information provided by the MAS in improving firm operational and financial performance. Chong and Chong (1997) also verify the direct positive influence of the broad scope MAS information on firm performance using data from 62 Australian business managers. In a similar vein, Gerdin et al. (2005) suggests, based on data from 132 production managers, that the use of greater amounts of MAS information is positively related to firm performance. However, the results show no support to the assumed positive effect of the more frequent use of such information on firm performance. Pizzini (2006) provides more supportive evidence by studying the relationship between cost- design systems, managers' beliefs about the relevance and usefulness of cost data and financial performance using a sample of 277 US hospitals. The results indicate that managers consider cost data to be relevant and useful if it is provided with greater detail, classified according to behaviour and reported more frequently. In addition, reporting cost data with greater detail is proved to be associated with financial indicators namely, operating margin, cash flow and administrative expense.

Among the MASs currently available, traditional costing systems (TAS) including absorption costing provide a narrow range of cost information by relying on standard costing and assigning overhead costs based on volume-based factors (Sheu and Pan, 2009; Baggaley, 2006; Toomey, 1994; Chenhall and Langfield-Smith, 1998). In contrast to the traditional methods, activity-based costing (ABC) allows for the provision of more

detailed, useful and accurate cost information by linking costs to activities that cause those costs to occur (Khataie and Bulgak, 2013; Mishra and Vaysman, 2001; Adams, 1996).

Mishra and Vaysman (2001) examine the capability of ABC and TAS in improving the profitability of adopters. They find that ABC can lead to higher profitability when the uncertainty surrounding the managers' private information is high. However, when the level of uncertainty is low, TAS is capable of generating higher profits for adopters. For this reason Mishra and Vaysman (2001) conclude that ABC and TAS will co-exist in an economy. Similarly, Sheu and Pan (2009) investigate the level of profitability expected from ABC and TAS under high and low levels of knowledge uncertainty in a virtual enterprise of R&D activities. Like Mishra and Vaysman (2001), Sheu and Pan (2009) convey that ABC generates higher level of profits when the knowledge uncertainty surrounding the R&D member is high while TAS becomes superior in cases where this uncertainty is low.

Shields (1995) surveys 143 firms to investigate the level of success of ABC and the implementation variables associated with the level of success. The results indicate that adopters of ABC obtain a moderate level of success and attain financial benefits from adopting ABC. The success and financial benefits from ABC are found to be associated with six behavioural and organisational variables, namely top management support, linkage to competitive strategy especially quality and JIT/speed, linkage to performance evaluation and compensation, training in implementing ABC, non-accounting ownership, and adequate resources. Cagwin and Bouwman (2002) concentrate on the financial performance outcome of ABC and the conditions under which this outcome is improved. Employing data from 106 manufacturing and 98 non-manufacturing firms, Cagwin and Bouwman (2002) report empirical evidence suggesting no direct effect of ABC on ROI. However, a positive relationship between ABC and improvement in ROI is detected when ABC is adopted in complex and diverse firms, when cost information is important, when ABC is implemented concurrently with other initiatives like JIT and TQM, and when ABC is implemented by manufacturing firms. Kennedy and Affleck-Graves (2001) examine whether a sample of UK firms adopting ABC outperform their counterpart in

terms of financial performance. Their findings reveal that ABC firms achieve around 27% higher abnormal return than non-ABC firms. Finally, Ittner et al. (2002) also report empirical evidence on the direct positive impact of ABC on quality levels and cycle time. As a result of the above illustration, it is expected in this study that better operational and financial performance is related to the use of ABC.

H5a: *There is a direct positive relationship between the use of ABC and operational performance of service firms.*
H5b: *There is a direct positive relationship between the use of ABC and financial performance of service firms.*

3.5.2.3 Firm size and firm performance

Firm size has usually been considered an important determinant of firm performance. Large firms are argued to have more financial and human resources and therefore they may enjoy the benefits of economies of scale leading to better performance (Jayaram et al., 2010; Shah and Ward, 2003; Glancey, 1998). In addition, the higher level of resources available for large firms can be advantageous by allowing for more experimentation with new technologies and innovations that may improve their productivity and efficiency (Coad et al., 2013; Wagner et al., 2012; Galende and de la Fuente, 2003; Shah and Ward, 2003).

In contrast, large firms can be more reluctant or slower in adopting innovative methods and techniques that are capable of improving their performance given the complexity of their operations (Shah and Ward, 2003; Hannan and Freeman, 1984). This reluctance highlights the possible negative effect of firm size on performance. These two contrasting theoretical arguments in connection with the impact of size on performance have been supported by the mixing results reported from empirical studies.

Yasuda (2005) finds a negative relationship between firm size and firm growth based on a large sample of Japanese manufacturing firms. Lundvall and Battese (2000) report evidence based on data from 235 Kenyan manufacturing firms on the impact of firm size,

age and technical efficiency. Their analysis detects a positive effect of firm size in two industries out of three, but similar effect has not been proved for firm age except for one industry (i.e. textile). González-Benito (2005) shows by surveying 186 manufacturing companies that there is no relationship between operational and financial performance (represented by cost, quality, flexibility, reliability and speed and return on assets, respectively) and company size, type of industry and age of equipment. Furthermore, the results of Shah and Ward (2003) convey a significant negative effect of firm size and age on operational performance. Wagner et al. (2012), using empirical data from 259 manufacturing firms, prove a positive influence of firm size on financial performance while firm age is found to have no influence. Consequently, given this contradiction in theory and empirical findings on the nature of size-performance association, the following non-directional hypotheses are formulated.

H6a: *There is a direct relationship between firm size and operational performance of service firms.*

H6b: *There is a direct relationship between firm size and financial performance of service firms.*

3.5.2.4 Business strategy and lean technical practices

The core of lean service practices is to improve the value delivered to customers and respond more quickly to their increasingly changing needs (Shah and Ward, 2003; Womack and Jones, 1996). With this objective, lean service goes in line with the objectives of a differentiation strategy (Kennedy and Widener, 2008). Differentiators operate in an uncertain environment where customer needs change constantly and they are likely to experience lower levels of productivity because of their higher levels of products/services customisation (Kumar and Telang, 2011; Gosselin, 1997; Bruggeman and Stede, 1993). It follows that differentiators can be motivated to implement lean practices that have proved effective in developing new products/services quicker and with high quality to respond faster to changes in customer needs (Qudrat-Ullah et al., 2012; Cooper and Maskell, 2008; Kennedy and Widener, 2008; Karlsson and Ahlstrom, 1996). In addition, although differentiators are usually able to ask for price premium to

compensate for any extra cost incurred, they do not completely ignore their operating costs and this can be seen from their tendency to implement ABC for more accurate cost information (Chenhall and Langfield-Smith, 1998). This can be an additional impetus for differentiators to use lean practices in order to exert some control over their operating costs by eliminating non-value added activities from their processes (Qi et al., 2011).

On the other hand, the mechanism through which lean service is assumed to improve customer's value is the identification and elimination of non-value adding activities (NVA) which usually leads to cost reduction and efficiency improvement (Shah and Ward, 2007, 2003; Womack and Jones, 1996). Because of that lean service has been perceived by many companies as a cost reduction program although cost reduction is an outcome rather than a main objective (Hartwell and Roth, 2010; Atkinson, 2004). In consequence, cost leaders, who usually compete on the price base and therefore they seek cost reduction and efficiency in all possible areas (Ward et al., 2007; Frey and Gordon, 1999, Porter, 1980), are anticipated to also have a strong motivation to implement this system (Qi et al., 2011).

Only a few researchers have endeavoured to empirically examine the aforementioned argument and reported mixing results. Among those few researchers, Chenhall and Langfield-Smith (1998), using empirical data from 78 manufacturing firms, highlights the positive fit between lean practices and differentiation strategy where better performance is achieved when lean practices are used under the differentiation strategy. In addition, Baines and Langfield-Smith (2003) use data from 140 manufacturing firms and forward evidence suggesting that adopting differentiation strategy will lead to increased use of Just-in Time (JIT) and Total Quality Management practices (TQM) considered part of the lean system (Shah and Ward, 2003). In a similar vein, Ward et al. (2007) report empirical evidence revealing significant differences on some operations decisions between three distinctive business strategies, namely price leaders, differentiators and broad-based competitors that combine the focus of the first two strategies. The results indicate that broad-based competitors are characterised with the highest implementation level of JIT and quality practices while no clear difference between differentiation strategy and price

leaders could be detected. In contrast to the above literature, Qi et al. (2011) demonstrate through an empirical study of 604 Chinese manufacturing companies that companies adopting cost leadership strategy are more likely to implement lean system compared to differentiators. In summary, the empirical evidence from the few studies found in the literature suggests a direct positive relation between differentiation strategy and lean practices while the empirical evidence is rather weak for the cost leadership strategy. However, as mentioned before, cost leaders can, at least theoretically, be motivated to make use of and benefit from lean practices too. Therefore, the following hypotheses from a theoretical perspective are reported:

H7: *There is a direct positive relation between differentiation strategy and the implementation of LTPs.*

H8: *There is a direct positive relation between cost leadership strategy and the implementation of LTPs.*

3.5.2.5 Business strategy and activity-based costing system

Given the dissimilarities between the two types of strategies (differentiators/prospectors vs. cost leaders/defenders) highlighted before, the accounting system used by prospectors/differentiators on the one hand and defenders/cost leaders on the other hand is expected to differ (Porter, 1980; Miles and Snow, 1978). Hammad et al. (2010) propose that business strategy adopted will have a direct effect on the design and functionality of MAS. Gosselin (1997) points out that as prospectors/differentiators operate in highly uncertain environment compared to defenders/cost leaders; they usually require a broader scope of information which can be fulfilled through the use of ABC. Moreover, prospectors usually devote more resources to experiment with innovations and consequently they are more likely to invest in innovative systems such as ABC than defenders (Chenhall, 2003; Chenhall and Langfield-Smith, 1998; Gosselin, 1997).

Further, as differentiators compete by producing more customised products/services to be perceived as unique by customers (Ward et al., 2007; Bruggeman and Stede, 1993; Porter,

1980), these companies may prefer ABC given its superiority over TAS in generating unbiased cost information on their various and more customised products/services (Khataie et al., 2011; Cagwin and Bouwman, 2002; Gosselin, 1997; Cooper and Kaplan, 1992). Conversely, as TAS can provide less distorted cost information for companies with a relatively limited group of standardised products/services and at lower cost, cost leaders may be more likely to rely on TAS rather than ABC (Lamminmaki and Drury, 2001; Gosselin, 1997). Although Abdel-Kader and Luther (2008) find no difference between cost leadership and differentiation strategies in terms of the level of their MAS sophistication, several researchers have documented a strong effect of the type of strategy adopted on the MAS in use as presented below.

Baines and Langfield-Smith (2003) use data from 140 manufacturing firms and forward evidence suggesting that adopting differentiation strategy will lead to increased use of advanced MASs including ABC, target costing and life cycle costing. Amir et al. (2010) examine the impact of service process type, business strategy, intensity of competition on the use of advanced performance measurement system (PMS). They find that firms adopting differentiation strategy are more likely to use advanced PMS than firms adopting low cost strategy regardless of being mass or professional services. Chenhall (2003) finds that differentiators require an organic MCS with broad scope while cost leaders require a mechanistic MCS. In addition, he proposes that organic organisational structures perceive ABC to be highly effective in contrast to the mechanistic structure. Based on data collected from 121 UK service firms, Auzair and Langfield-Smith (2005) support the findings of Chenhall (2003) by concluding that mass services and cost leaders are more likely to adopt more formal MCS –which does not support ABC- while professional services and differentiators will adopt informal MCS which supports ABC. Gosselin (1997) uses data from 161 manufacturing firms and examines the effect of business strategy and organisational structure on the adoption of activity management (AM) decomposed into activity analysis (AA), activity cost analysis (ACA) and ABC. The author demonstrates that prospectors are more likely to adopt ABC than defenders. Frey and Gordon (1999) reveal through empirical evidence that the choice of business strategy does not influence the decision to adopt ABC. However, they find that differentiators

achieve higher level of benefits from ABC than cost leaders. Similarly, Chenhall and Langfield-Smith (1998) prove empirically that ABC benefits differentiators more than cost leaders because they use ABC not only to manage costs but also to understand value-added activities that enhance product differentiation.

H9: *The differentiation strategy is positively related to the use of ABC*

H10: *The cost leadership strategy is negatively related to the use of ABC.*

3.5.2.6 Activity-based costing system and lean technical practices

The importance of ABC in the lean context stems from its ability to overcome the limitations of TAS which have been argued to affect the implementation of lean service practices (Banker et al., 2008; Datar et al., 1991). Several conceptual and case studies have discussed the role of the accounting system in the lean context (e.g. Chiarini, 2012; Cooper and Maskell, 2008; Kennedy and Widener, 2008; Grasso, 2005; Karlsson and Ahlstrom, 1996; South, 1993; Datar et al., 1991). In this body of literature, there is almost a consensus among researchers on the detrimental effect of TAS on the implementation of lean practices. The core argument is that lean service seeks to identify and eliminate non-value adding activities in order to improve processes (Shah and Ward, 2007; 2003; Womack and Jones, 1996). However, the main focus of TAS is on the allocation of all overhead costs to cost objects, and therefore it generates aggregate cost information. This leads to waste being hidden in the overhead allocation rate and conceals areas which require improvements (Maskell, 2006; Chenhall and Langfield-Smith, 1998; Toomey, 1994).

According to Datar et al. (1991), TAS may stifle process improvement initiatives by providing inaccurate cost information to decision makers which sends incorrect signals in relation to the effectiveness of a process innovation leading decision makers to mistakenly cease such innovation. For example, this can happen when TAS, due to its distorted information, reveals that a product/service A is profitable when in fact it is not while a product/service B is not profitable when in fact it is. In such scenario, a company may not

attempt to improve the process of product/service A because it is seen to be profitable while the company may decide to apply lean practices to improve the process of product/service B. In this case, the need to improve the process of product/service A is concealed. In addition, the attempt to improve product/service B may not result in the desired improvement leading to questioning the effectiveness of the improvement program implemented. Similar examples have been reported by several researchers who have explicated how some companies have been about to cease the implementation of lean practices because of the misleading information generated from their TAS (e.g. Cooper and Maskell, 2008; Datar et al., 1991; Turney and Anderson, 1989).

As lean system focuses on processes which consist of a series of activities, it is argued that lean system can be supported by an activity-oriented costing system (Khataie and Bulgak, 2013). ABC breaks down a process into its constituent activities and traces overhead costs to these activities, and then allocates the accumulated overhead costs to cost objects through both volume-based and non-volume based cost drivers (Askarany et al., 2010; Banker et al., 2008; Cooper and Kaplan, 1992). Based on that, ABC is believed to improve the visibility of what truly drives cost and consumes resources which results in more accurate cost information (Ruiz-de-Arbulo-Lopez et al., 2013; Schoute, 2011; Spedding and Sun, 1999; Cooper and Kaplan, 1992). As a result, ABC is thought to overcome the limitations of TAS and support lean service in different ways.

First, because ABC accumulates costs at activity level, it helps differentiate between value adding and non-value adding activities, which is critical for lean service (Banker et al., 2008; Maiga and Jacobs, 2008; Larson and Kerr, 2007; Clarke and Mullins, 2001; Gunasekaran and Sarhadi, 1998). In addition, highlighting the cost of non-value adding activities can be a critical factor for justifying the need to adopt lean practices in order to eliminate such cost (Ittner et al., 2002). Ittner (1999) explicates how ABC can be used to prioritise quality improvement efforts. Second, cost information from ABC is argued to result in more realistic budgets and variance analyses exposing the true negative variances (Abu Mansor et al., 2012; Grasso, 2005; Innes and Mitchell, 1995; Cooper and Kaplan, 1992). Consequently, implementing lean practices to improve those negative variances is

less likely to yield a disappointing outcome which usually leads to questioning the effectiveness of lean practices and finally abandoning them (Banker et al., 2008; Larson and Kerr, 2007; Datar et al., 1991).

In favor of the above argument, Innes and Mitchell (1995) survey the largest UK companies and find them to depend on the measures generated from ABC to support other improvement initiatives such as continuous improvement, TQM and JIT. Adam (1996) argues that when ABC is used in conjunction with other process improvement systems such as quality and lean system, companies enjoy a higher level of benefits. Along this line, Khataie and Bulgak (2013) use system dynamics modeling tool and reveal the importance of ABC in achieving the aim of lean system. Another simulation study by Li et al. (2012) also shows that ABC has superiority over TAS in bridging the gap between operational and financial improvements of lean companies. Adopting a case study methodology, Chiarini (2012) demonstrates the advantages of ABC in a medium-sized lean firm. Finally, Banker et al. (2008) report empirical evidence indicating that manufacturing companies adopting ABC are more likely to adopt lean practices in their operations. Therefore, the following hypothesis is formulated:

H11: *There is a positive relation between the use of ABC and the implementation of LTPs.*

3.6 Summary of chapter 3

In this chapter all constructs required to develop the theoretical model attempting to overcome limitations in the existing literature have been identified. The two core theories (i.e. STS and CT) guiding and supporting the developed model of this study have been discussed and the way and importance of their use in the current study have been explained and justified. The theoretical model views lean service as a socio-technical system with two distinctive but interdependent sides. Consequently, the 54 lean service practices identified through the systematic review of lean service literature have been classified into those that represent the technical side of the system (i.e. 37 practices as in Table 3-1) and those symbolising the social side of the system (i.e. 17 practices as in Table 3-2). Based on the STS and the lean service literature, the model expects a direct

positive influence of each side on firm performance. In addition, the two sides are expected to synergistically interact to improve firm performance over and above the level resulted from each side separately. Furthermore, four contextual variables have been identified due to their expected direct and/or indirect influence on LTPs and/or performance. These variables include ABC, business strategy and firm size, firm age. Finally, the model of this study has generated a number of hypotheses (summarised in Table 3-4) which link together the various constructs of the model and will be the input for chapter 5 which focuses on the empirical verification of those hypotheses.

Table 3-4: Summary of the research hypotheses

No.	Hypotheses	Expected result
H1a	*There is a direct positive relationship between LTPs and operational performance of service firms.*	+
H1b	*There is a direct positive relationship between LTPs and financial performance of service firms.*	+
H2a	*There is a direct positive relationship between LSPs and operational performance of service firms.*	+
H2b	*There is a direct positive relationship between LSPs and financial performance of service firms.*	+
H3a	*There is a synergy between LTPs and LSPs in improving operational performance of service firms.*	+
H3b	*There is a synergy between LTPs and LSPs in improving financial performance of service firms.*	+
H4a	*There is a direct relationship between firm age and operational performance of service firms.*	+/-
H4b	*There is a direct relationship between firm age and financial performance of service firms.*	+/-
H5a	*There is a positive relationship between the use of ABC and operational performance of service firms.*	+
H5b	*There is a positive relationship between the use of ABC and financial performance of service firms.*	+
H6a	*There is a direct relationship between firm size and operational performance of service firms.*	+/-
H6b	*There is a direct relationship between firm size and financial performance of service firms.*	+/-
H7	*There is a direct positive relation between differentiation strategy and the implementation of LTPs.*	+
H8	*There is a direct positive relation between cost leadership strategy and the implementation of LTPs.*	+
H9	*The differentiation strategy is positively related to the adoption of ABC*	+
H10	*The cost leadership strategy is negatively related to the adoption of ABC.*	-
H11	*There is a positive relation between the use of ABC and the use of LTPs.*	+

Chapter 4 : Research Methodology

4.1 Introduction

In the previous chapter, the conceptual framework with associated hypotheses representing the theory of this research has been developed. This chapter sets the foundation for the empirical analysis by identifying the appropriate methodology that should be adopted to examine the theory developed in this research and achieve the overall aim of this thesis. However, identifying the appropriate methodology requires a proper understanding of the different research paradigms, approaches, strategies and methods available for researchers to choose from.

This chapter is divided into 12 sections. A brief but insightful review of research paradigms, approaches and strategies is provided in sections 2, 3 and 4 respectively. Section 5 presents the different data collection methods along with their advantages and disadvantages to justify the selected method in this research. In section 6 the context of this research is determined alongside the rationale behind choosing this specific context to host the current study. Sections 7 and 8 discuss the techniques used to identify the population and the sample from which the empirical data is going to be collected for testing statistically the previously developed sets of hypotheses. The stages of developing the questionnaire instrument and measures of the variables included are reported in details in sections 9 and 10 respectively. Section 11 will determine the statistical techniques that will be used to test the research hypotheses. Finally, section 12 concludes this chapter by summarising its content.

4.2 Research Paradigms

The research paradigm can be thought of as the philosophical view and assumptions of a researcher which determine how research should be conducted (Collis and Hussy, 2009). Research paradigms can be presented on a continuum with two extremes, namely positivism and interpretivism (Bryman and Bell, 2007). Adopting either of these two paradigms is argued to have a significant implication on the research approach and method

employed for achieving the purpose of a research study (Collis and Hussy, 2009). Table 4-1 lists the assumptions of the two main paradigms as presented in Collis and Hussy (2009, P.58). Features of the two main paradigms are presented in Table 4-2, taken from Collis and Hussy (2009, P.62).

Table 4-1: The assumptions of the positivism and interpretivism paradigms

Philosophical Assumption	Positivism	Interpretivism
Ontological Assumption (The nature of reality)	Reality is objective and singular, regardless of the researcher stance	Reality is subjective and multiple, as observed by participants
Epistemological Assumption (What constitutes valid knowledge)	Researcher is independent of what is being researched	Researcher interacts with that being researched
Axiological Assumption (The role of values)	Research is value-free and unbiased	Research is value-laden and biases are present
Rhetorical Assumption (The language of research)	The writing is formal with passive voice and use of accepted quantitative words.	The writing is informal with personal voice and accepted qualitative words.
Methodological Assumption (The process of research)	Process is deductive. Study of cause and effect with a static design (categories are isolated beforehand). Research is context free. Generalisations lead to prediction, explanation and understanding. findings are reliable and precise through validity and reliability	Process is inductive. Study of mutual contemporaneous shaping of factors with an emerging design (categories are identified during the process). Research is context bound. Patterns and/or theories are developed for understanding. Findings are reliable and precise through verification.

Source: Collis and Hussy (2009, P. 58)

Table 4-2: The main features of the positivism and interpretivism paradigms

Positivistic paradigm	Interpretivistic paradigm
Most likely to produce quantitative data	Most likely to produce qualitative data
Employs large samples	Employs small samples
Focuses on hypotheses testing	Focuses on hypotheses and theory generation
Data is highly specific and precise	Data is rich and subjective
The location is artificial	The location is natural
Data reliability is high	Data reliability is low
Validity is low	Validity is high
Generalises to population from sample	Generalises from one setting to another

Source: Collis and Hussy (2009, P. 62)

4.2.1 Positivism

Positivism is "an epistemological position that advocates the application of the methods of the natural sciences to the study of social reality and beyond" (Bryman and Bell, 2007: p.16). This paradigm assumes that the existence of social reality is not dependent on us or if we are aware of it (Collis and Hussy, 2009). Positivism is based on some principles, among which are that knowledge is the facts gathered which provide the foundation for laws and can be confirmed by the senses. In addition, from positivistic perspective, the aim of theory is to produce testable hypotheses (Bryman and Bell, 2007; Saunders et al., 2009). Positivism may involve aspects of both inductive and deductive approaches (Bryman and Bell, 2007). However, through its practical implementation, positivism relies more on the deductive approach with quantitative methods rather than the inductive approach with qualitative methods (Collis and Hussy, 2009; Saunders et al., 2009).

4.2.2 Interpretivism

Interpretivism is the extreme opposite position on a spectrum including positivism and interpretivism at its two ends (Collis and Hussy, 2009). Proponents of interpretivism acknowledge the differences between subjects of the social and natural sciences where

studying them necessitates the reliance on different logics of research to reflect these differences (Bryman and Bell, 2007; Collis and Hussy, 2009). Unlike positivism, interpretivism assumes social reality to exist within us and consequently an examination of that reality will have an effect on it (Collis and Hussy, 2009). As a result, interpretivism predicates that differences between people and objects of the natural sciences should be acknowledged and respected which requires social scientists to attain the subjective meaning of social actions (Saunders et al., 2009).

4.2.3 Rationale for adopting the positivist paradigm

Given the different assumptions underlying the positivism and interpretivism paradigms, the positivism paradigm is considered more relevant and in line with the assumptions made in this current research. First, in line with the ontological assumption of reality in the positivism paradigm (Collis and Hussy, 2009), it is assumed in this research that the reality of a phenomenon like the lean-performance association or the lean-context association exists regardless of our awareness of its existence. Second, in line with the epistemological assumption (Bryman and Bell, 2007), it is also assumed that investigating a phenomenon like the lean-performance association or the lean-context association by researchers will not have any effect on the presence of those relations. Third, as stated by Bryman and Bell (2007) and Collis and Hussy (2009), the freedom of a researcher to decide on what research paradigm to use is constrained by the need of the paradigm to dovetail with the nature of his/her research and the research problem. Consequently, given the aim of this research to empirically validate the theoretical framework and hypotheses proposed, the positivism paradigm is considered more consistent and supportive for achieving this aim (Saunders et al., 2003).

4.3 Research approach (Deductive versus inductive approach)

After deciding on the research paradigm to be adopted, the researcher needs to make another important decision in regard with the research approach to be used (Saunders et al., 2009). There are two main research approaches usually used by researchers, namely the deductive approach and the inductive approach (Bryman and Bell, 2007; Collis and Hussy, 2009).

4.3.1 The deductive approach

In the deductive research, a researcher starts with information known about a specific phenomenon to develop his/her research hypotheses that will be subject to empirical examination in the next stage of a research project (Bryman and Bell, 2007; Saunders et al., 2009). With the positivism paradigm being adopted, a researcher usually relies on the available literature to develop a theory and hypotheses that need to be verified using appropriate statistical analyses (Collis and Hussy, 2009). In other words, the deductive research moves from the general to the specific (Collis and Hussy, 2009). Six stages are normally subsumed in the deductive approach: (1) theory, (2) hypothesis, (3) data collection, (4) findings, (5) hypotheses confirmed or rejected, and (6) revision of theory. This process is depicted in Figure 4-1below.

Figure 4-1: The six stages of the deductive approach

Source: Bryman and Bell (2007, P.11)

4.3.2 The inductive approach

In contrast to the deductive approach previously explained, a researcher adopting the inductive approach starts with real observations on a specific phenomenon and uses

his/her findings to generate theory (Bryman and Bell, 2007). In simple words, the inductive approach follows the following sequence: observations/findings ⟶ theory, which means moving from the particular to the general (Collis and Hussy, 2009). The main differences between the deductive and inductive approaches are presented in Table 4-3 adopted from Saunders et al. (2009, P. 127).

Table 4-3: The main differences between the deductive and inductive approaches

Deduction approach	Induction approach
Scientific principles	Gaining understanding of the meanings humans attach to events
Moving from theory to data	A close understanding of the research context
The need to explain causal relationships between variables	The collection of qualitative data
The collection of quantitative data	A more flexible structure to permit changes of research emphasis as the research progresses
The applications of controls to ensure validity of data	A realisation the researcher is part of the research process
The operationalisation of concepts to ensure clarity of definitions	Less concern with the need to generalise
A highly structured approach	
Researcher independence of what is being researched	
The necessity to select samples of sufficient size in order to generalise conclusions	

Source: Saunders et al. (2009, P. 127)

4.3.3 Rationale for adopting the deductive approach

Collis and Hussy (2009) emphasise the need for adopting a research approach that supports achievement of the research aim and objectives. This research develops a theoretical model with associated hypotheses based on the existing literature with the aim to measure and provide empirical verification of their validity. Therefore, given the focus and nature of the current research, the deductive approach that emphasises measurement and empirical examination of theories and relationships between variables seems more relevant than the inductive approach (Bryman and Bell, 2007; Saunders et al., 2009). In addition, this approach supports more the use of large samples to improve generalisation of results (Saunders et al., 2009) which provides an additional reason for its adoption in this study.

4.4 Research strategy

The research strategy is the general plan of how the research questions are going to be answered (Bryman and Bell, 2007; Saunders et al., 2009). The research strategy is usually influenced by the research paradigm chosen (Collis and Hussy, 2009). Collis and Hussy (2009, P.74) and Saunders et al. (2003) classify the various research strategies in terms of their appropriateness to the two main paradigms discussed in subsection 4.2 as presented in Table 4-4.

Table 4-4: Research strategies under the two main research paradigms

Positivism	Interpretivism
Cross-sectional studies	Action research
Experimental studies	Case studies
Longitudinal studies	Ethnography
Surveys	Feminist perspective
	Grounded theory
	Hermeneutics
	Participative enquiry

Given the adoption of the positivism paradigm in this study, the focus will be on research strategies listed in the first column of the above table. I will start by excluding those research strategies that are believed to be irrelevant given the settings and nature of the current research.

Experimental studies can be conducted either in a laboratory or a natural setting in a systematic manner (Collis and Hussy, 2009). This type of research strategy allows for detecting causal relations because the researcher will have control over all variables included in the study and can manipulate the independent variable to observe the impact on the dependent variable (Saunders et al., 2009). However, experimental studies can be argued to be irrelevant to this research for different reasons. First, the unit of analysis in this research will be the firm which is difficult to be influenced (Bryman and Bell, 2007). Therefore, it is not easy to arrange experiments in business research (Bryman and Bell, 2007; Collis and Hussy, 2009). Second, the researcher cannot have control over or manipulate the variables included in the study which renders this research strategy irrelevant to this current research (Bryman and Bell, 2007; Collis and Hussy, 2009).

Longitudinal studies are concerned with studying a variable or group of subjects over a period of time (Collis and Hussy, 2009). This will permit detection of any change or development of the relations or behaviours under examination (Bryman and Bell, 2007; Saunders et al., 2009). However, this strategy is very time and resource consuming (Collis and Hussy, 2009). Furthermore, the data needed for the empirical analysis of this research is mainly internal data that can be obtained from knowledgeable members of firm management. As a result, persuading such busy people to provide information on the same variables more than one time can be troublesome and may bring about the inability to obtain enough sample size to allow for generalisation of findings.

In regard to the cross-sectional and survey strategies, they are believed to be appropriate for addressing the research problem and questions of the current study. As defined by Bryman and Bell (2007, P. 55), Cross-sectional studies “entail the collection of data on more than one case (usually quite a lot more than one) and at a single point in time in

order to collect a body of quantitative or quantifiable data in connection with two or more variables, which are then examined to detect patterns of associations". This strategy is usually combined with the survey strategy to collect a large quantity of data from a large population in a very economical way (Saunders et al., 2009). By adopting a combination of these two research strategies, a large number of firms can be sought for participation in this study which helps in producing more generalisable results (Bryman and Bell, 2007). Furthermore, participants will be asked to provide the required information only once which may prevent reducing the already decreasing response rate (Collis and Hussy, 2009; Saunders et al., 2009).

4.5 Data collection method

Different data collection methods can be used to collect the data required for this research given the adoption of the survey research strategy. Such methods may include interview and questionnaire. Determining the most appropriate and efficient method is always dependent on the advantages and disadvantages of each method and the aim and objectives of the research. This research aims at conducting a large-scale empirical examination of a theoretical model highlighting the lean-performance and lean-context associations in service firms to provide generalisable results which overcomes limitations of the previous literature. Most of the data needed to achieve the research aim and objectives are internal (e.g. data on lean practices and MAS, etc.) and not available from any external sources. This sort of data is mainly available in the mind of knowledgeable management members. The two data collection methods revealing relevancy of each method to this research are briefly reviewed below.

4.5.1 Interview method

The interview method can have different forms such as unstructured, semi-structured and structured interview. The first two forms are mostly used to probe deeply a phenomenon and build theory so that they are more relevant to the inductive approach not adopted in this study (Collis and Hussy, 2009). Moreover, these methods are very time consuming and expensive (Saunders et al., 2009). In addition, with these methods, there is also the issue of the interviewer bias resulting from the possible variability in the way interviews

are conducted and questions are asked (Collis and Hussy, 2009). In contrast, the structured interview in which questions are pre-developed and closed is suggested for the deductive approach adopted in this study (Collis and Hussy, 2009). Therefore, this method can be useful to obtain the necessary data for this research. However, because of the intention to survey a large number of firms, this method seems very costly in terms of both time and financial resources (Saunders et al., 2009). Furthermore, this method may not be convenient to participants who have a daily busy schedule in addition to the possible interviewer bias just explained (Collis and Hussy, 2009; Clarke and Mullins, 2001).

4.5.2 Questionnaire method

Collis and Hussy, (2009, P. 191) define a questionnaire as "a list of carefully structured questions, chosen after considerable testing, with a view to eliciting reliable responses from a chosen sample". Questionnaires are a common method for data collection in business research and there is more than one method to distribute questionnaires to sample participants (Collis and Hussy, 2009). Such methods can be by post, online, telephone or face-to-face (Saunders et al., 2009).

In the face-to-face method, the questionnaire can be presented at any place and time convenient to the participant (Saunders et al., 2009). Consequently, this method becomes very expensive and time consuming when the aim is to survey a large sample geographically dispersed as is the case of this research (Collis and Hussy, 2009). Therefore, this method will not be employed in this research.

The telephone method of distributing questionnaires has the advantage of being able to survey a large sample at low cost (Saunders et al., 2009). However, like the interview method, the telephone method introduces the issue of personal contact with its possible related bias and may restrict the sample to those who accept to respond in this way (Collis and Hussy, 2009). As a result, this method is also not employed in this research.

The online method seems more attractive as it reduces cost, speeds the process of distributing questionnaires, and allows for targeting a large sample (Saunders et al., 2009).

In this method, a questionnaire is constructed and can be sent via email to a large number of specified participants. However, this method requires availability of the email address of the targeted participants. When such email addresses are not available as the case for this study, such method cannot be relied on.

The self-administered questionnaire is the main adopted method for data collection in the current study. This method has been chosen as it allows for surveying a large number of firms using their addresses available easily in most databases (Clarke and Mullins 2001; Shields, 1995). In addition, this method is widely known, economical in terms of time and resources, more convenient to participants as they have freedom in regards to when to fill in the questionnaire (Bryman and Bell, 2007; Collis and Hussy, 2009). However, one of the disadvantages of this method is related to the number of questions that can be included in a questionnaire which have a direct impact on the response rate (Collis and Hussy, 2009; Saunders et al., 2009). Therefore, archival data are also used in this research to reduce the number of questions included in the questionnaire where this includes information about firm age, firm size and three financial indicators as explained in section 4.10 of this chapter. Despite its disadvantage, the self-administered questionnaire is considered the most appropriate method given the nature and overall aim of this research and its wide use in the academic literature (e.g. Fullerton et al., 2013; Vlachos and Bogdanovic, 2013; Banker et al., 2008; Bayo-Moriones et al., 2008; Al-Omiri and Drury, 2007; Auzair and Langfield-Smith, 2005; Shah and Ward, 2003). Figure 4-2 summarises the methodological choices adopted in this research.

After identifying the suitable research paradigm, approach, strategy and the data collection method, the next step is to specify the research context, population and sample that will provide necessary data for the empirical part of this research.

4.6 Research context

The research context is an important aspect for successful theory testing in quantitative studies (Anderson and Widener, 2007). Its importance stems from the need to ensure (i) appropriate unit of analysis; (ii) data is available for hypotheses testing; (iii) a large

sample can be obtained for rigorous empirical analysis (Anderson and Widener, 2007). Bearing in mind these considerations, the research context of this research has been chosen to be the United Kingdom for several reasons.

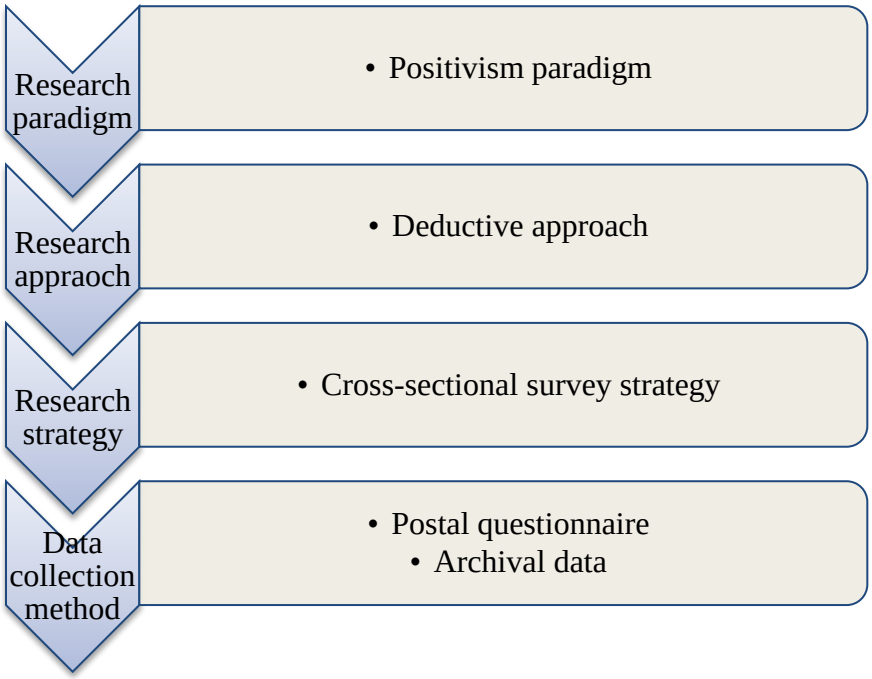

Figure 4-2: Summary of the methodological choices adopted in this research

First, this research is interested in testing a theoretical model at firm level in the service context as stated earlier. Therefore, a study with this focus should be conducted within a country that has an established service sector where that facilitates the identification of a suitable population and sample sufficient for data collection. Given that the UK is a proved developed service-driven economy (Windrum and Tomlinson, 1999), it seems an ideal context for hosting the current research.

Second, although the lean service is a recent concept that might not have been adopted by service firms in some developed countries, lean service in the UK sounds to have been experienced to some extent by not only the UK healthcare sector (not included in this research), but also other service sectors as indicated by the empirical work of Alsamdi et al. (2012). This initial indication of the familiarity of UK service firms with lean service

secures obtaining the required information for the empirical testing of the theoretical model.

Third, during the period of conducting the current research, the researcher was resident in the UK. As a result, contacting service firms within the UK and administration of the postal questionnaire instrument could be easier and saved time and financial resources in comparison with other research contexts than the UK.

4.7 Research population

A population is "the universe of units from which the sample is to be selected" (Bryman and Bell, 2007, p. 182). The term units in this definition may indicate to people, nations, cities, firms, etc. Given the research context determined above, the research population of this study includes medium and large for-profit service firms (> 50 employees) located in the UK and that have their data on age, turnover and number of employees available on the FAME database for three years ending in 2011 included. The reason for restricting the population of this study to only medium and large service firms is that small firms (<50 employees) are less likely to have the required resources or needs to invest in innovative management and accounting systems such as lean service and ABC (Abdel-Kader and Luther, 2008; Bayo-Moriones et al., 2008). Consequently, such firms may not be able to provide relevant data needed for the empirical analysis of this research. In addition, archival data on age and size (number of employees) is required to reduce the number of questions asked to participants and not to rely solely on perceptual measures.

4.8 Research sampling

Identifying a sample of a population is critical for almost all quantitative studies (Collis and Hussy, 2009). A sample is "the segment of population that is selected for investigation" (Bryman and Bell, 2007, p. 182). The need to sample stems from the inability of researchers in most cases to survey the whole population due to reasons such as time and resources limitations (Bryman and Bell, 2007). In such cases, a representative sample needs to be identified and used in the empirical analysis where the results of this

analysis will be generalised to the whole population from which the sample was drawn (Collis and Hussy, 2009). There are usually two main methods for sampling (1) probability sampling and (2) non-probability sampling (Bryman and Bell, 2007).

A probability sample is "a sample that has been selected using random selection so that each unit in the population has a known chance of being selected" (Bryman and Bell, 2007, P. 182). Although this type of sampling does not eliminate completely sampling errors, it helps in reducing them to the absolute minimum (Bryman and Bell, 2007). Furthermore, adopting probability sampling permits the use of tests of statistical significance that allow for inferences to be made about the population from which the sample has been drawn (Collis and Hussy, 2009). Different methods can be used to ensure that probability sampling is followed such as simple random, stratified random, systematic and multi-stage cluster (Bryman and Bell, 2007).

In contrast to the probability sample, a non-probability sample is "a sample that has not been selected using a random selection method" (Bryman and Bell, 2007, P. 182). In fact, this implies that some units in the population are more likely to be selected than others. Consequently, relying on non-probability samples yields results less generalisable to the population in comparison with those obtained from probability samples (Bryman and Bell, 2007). Like probability sampling, different methods can be used to identify a non-probability sample such as convenience sampling, snowball sampling and quota sampling (Bryman and Bell, 2007).

Given the aim of conducting tests of statistical significance and making inferences about the population, probability sampling is used in this study. More specifically, stratified random sampling is employed rather than other types of probability sampling as this method can ensure that the distribution of firms in the sample identified will resemble that of the population in terms of one or more criterion (Bryman and Bell, 2007; Collis and Hussy, 2009). The criterion used in this study to form strata is the industry type.

Having determined the population and sampling technique that is going to be used, the sampling frame should be identified. Sampling frame is "the listing of all units in the population from which the sample will be selected" (Bryman and Bell, 2007: p. 182). Obtaining an adequate and precise sampling frame is critical in quantitative studies to prevent sampling bias and generate more generalisable results (Collis and Hussy, 2009). In the current study, the Financial Analysis Made Easy database [4] (FAME) has been used to obtain the listing of all service firms in the population. This database has been chosen as it provides detailed information on a large number of companies registered in the UK. The sampling frame has included all medium and large (>50 employees) for-profit service firms that provided sufficient information on its turnover and number of employees in the three years between 2009 and 2011. In addition, the same database has been relied on to attain details on key informants (management board members) including their names, titles, phone numbers and addresses.

4.9 Questionnaire development

Designing a questionnaire instrument requires a large amount of care if it is to yield a satisfactory response rate along with reliable and valid information (Collis and Hussy, 2009). This is because data can, in most cases, be collected from respondents only once (Bryman and Bell, 2007). However, there are some critical recommendations that help to design a more user-friendly questionnaire that allows for obtaining a high response rate along with reliable and valid data. Among these recommendations can be creating an attractive layout of the questionnaire, maintaining the questionnaire as short as possible, providing clear instructions for answering the questionnaire, combining the questionnaire with a covering letter personally addressed to each respondent and a pre-stamped return envelope (Bryman and Bell, 2007).

Consequently, a special care in this study has been given to the design process of the questionnaire in light of the above recommendations to produce as a user-friendly questionnaire as possible which allows for attaining sufficient, reliable and valid data for

[4] FAME database contains financial information on over 8 million private and public companies operating in UK and Ireland. It also provides contact information for management board members of those companies.

conducting a rigorous empirical analysis. The final version of the questionnaire in this study consists of three sections with 10 questions distributed over three one-sided A4 pages. The length of the questionnaire concurs with the acceptable range of lengths provided by Saunders et al. (2009) which are between 4 to 8 A4 pages. The first section of the questionnaire involved four questions focusing on lean service practices and their expected benefits. The second and third section involved 2 and 4 questions respectively that focused on contextual variables and some demographic information. The full and final version of the questionnaire is presented in Appendix 1.

4.9.1 Questions type and format

In a questionnaire, questions can be either closed or open questions (Collis and Hussy, 2009). However, most researchers have advocated more reliance on closed questions for positivistic studies (Collis and Hussy, 2009), which allows for choosing from a predetermined list of answers, as they are easier and quicker to answer given of course the salience of the topic to the participants (Bryman and Bell, 2007). Based on that, all questions included in the questionnaire have been closed questions hoping to improve the response rate given the length of the questionnaire. However, different response formats can be used to generate closed questions (Collis and Hussy, 2009), but mostly rating questions (e.g. Likert-type questions) and categorical questions have been used in the questionnaire of the current study. All rating questions have adopted the six-point type format which allows participants more options to express their opinion on the aspect presented in each question.

4.9.2 Questionnaire layout and questions flow

Questionnaire layout can be critical for two main reasons: (1) to reduce non response rate and (2) to avoid response errors (Dillman, 2007). The questionnaire layout is recommended to be attractive so that participants are more inclined to fully fill in the questionnaire (Collis and Hussy, 2009; Saunders et al., 2009). For these reasons, the questionnaire has been printed out with high quality papers (A4) to make it more likable and attractive to the participants (Dillman, 2007). Moreover, there has been an attempt to avoid having a cramped-like questionnaire in terms of the page margins and space

separating the different questions (Bryman and Bell, 2007). In addition to that, the matrix style for rating questions has been employed to save spaces (Saunders et al., 2009) and grid line format has been used to ease the process of following questions to readers. Furthermore, given the importance of the questions flow within a questionnaire, the recommendation of Bryman and Bell (2007) to start the questionnaire with the most important questions presented with logical order has been relied on.

4.9.3 Covering letter

Although the importance of covering letter accompanying the questionnaire to the response rate has not been firmly established (Bryman and Bell, 2007), a considerable amount of attention has been given to its content in the current study. The content of the covering letter has revolved around providing clear and sufficient information on the purpose and importance of the research, the reasons for which the specific participant has been contacted and the significant impact of his/her participation, the confidentiality of the information provided by the respondent, some instructions for answering the questions, contact details of the researcher in the case any information or clarification has been needed. As a way of improving response rate, each covering letter was personally addressed to the targeted person and a promise has been made to all participants to receive a copy of the research results as recommended by Dillman (2007). A copy of the covering letter is presented in Appendix 2.

4.9.4 Questionnaire pre-testing process

Piloting a questionnaire instrument is an invariably essential step especially when considering the fact that the data can be collected only once from participants (Bryman and Bell, 2007; Collis and Hussy, 2009). The importance of this step also stems from its expected benefits in (1) highlighting problems in the readability of the questionnaire, (2) exposing insufficient or unclear instructions to answer the questionnaire, (3) pointing to limitations that question the comprehension of the questionnaire to adequately cover the topic it is intended to cover, (4) helping to identify troubling items and questions which make respondents uncomfortable, and (5) providing a great opportunity to have suggestions on including, dropping, or modifying some items to improve the flow, content

and understanding of the questions (Bryman and Bell, 2007). According to Bryman and Bell (2007), to achieve the expected benefits of the pilot study, it is desirable to identify a small group of participants who resemble to participants in the population from which the sample for the full study will be drawn. As a result, the questionnaire of this study was tested by 15 professionals from the UK service sector who are members of the Lean Business System Group on LinkedIn. This group of participants was considered appropriate given their expertise in the service operations and knowledge in the lean system. All participants in the pilot study were asked to fill in the questionnaire and provide constructive feedback in connection with clarity, readability, validity of items, layout and flow of questions, and the need to add and/or delete items of the questionnaire.

Important feedback was received from participants in this pilot study. This included suggestions to reposition some questions to improve the layout and flow of questions which makes it easier to fill in the questionnaire. Participants appreciated the comprehension of the questionnaire. All comments received were seriously acted on and the questionnaire was modified accordingly to have its final version as presented in Appendix 1.

4.9.5 Questionnaire administration

After amending the questionnaire instrument based on the feedback received from the pilot study, the questionnaire was ready to be administered to the whole sample to collect data for the main empirical analysis. Initially, 1000 questionnaires were printed out to target the pre-identified 1000 UK for-profit service companies. Despatching questionnaires to the targeted participants started on 10 October 2012.

A questionnaire was addressed personally to operations managers/directors when possible. Otherwise it was personalised to other positions including chairman, CEO, managing director or director in the management board. It was believed that people in charge of such positions are able to provide valid and comprehensive information requested in the questionnaire. Respondents were advised to share questions with knowledgeable persons in their firm if they feel that would enhance accuracy and validity of information. In majority of the cases, the targeted person completed the questionnaire. Although

collecting information from more than one informant per firm is desirable, this method is expected to have a detrimental effect on the response rate (Harris, 2001). In addition, relying on a single informant per firm is very common in the literature (e.g. Askarany et al., 2010; Amoako-Gyampah and Acquaah, 2008; Maiga and Jacobs, 2008; Al-Omiri and Drury, 2007).

A respondent received a copy of the questionnaire, pre-stamped envelope and introductory letter (Appendix 2) highlighting the aim of research, providing instructions for responding and making a clear promise to share the research results with all interested respondents. In addition, to interpret LTPs consistently, a glossary sheet (Appendix 3) was developed based on literature to provide participants with definition of the 23 LTPs. A reminder letter was sent to all non-respondents almost three weeks after sending the questionnaire. Finally telephone calls were made to encourage remaining non-respondents to participate. Out of this process, 70 questionnaires were returned due to wrong address and 186 questionnaires were received from respondents giving a response rate of 20%[5]. Out of the 186 questionnaires received, 81 were returned empty for several reasons highlighted in Table 4-5. The most frequent reasons for declining to participate were "lack of time (21 firms)" "the intended person is no longer available (20 firms)" "The questionnaire does not apply to their industry (18 firms)". Table 4-6 reveals that although the literature of lean service strongly supports applicability of lean practices to all service industries, 18 firms (22%, 18/81) indicate irrelevancy of the questionnaire to their firms.

Of the 105 remaining questionnaires, six were not useable due to a large amount of missing data leaving a final sample of 99 questionnaires. The low response rate can be attributed to the length of questionnaire and sensitivity of information required in addition to seeking responses from top management within the targeted organisations. However, it is still comparable with other rates recently obtained in this field: 7.9% by Inman et al. (2011), 10.6% by Kim et al. (2012) and 14.9% by Auzair and Langfield-Smith (2005).

[5] Returning questionnaires due to wrong address is very common in survey studies. For example, among the studies which reported this information, 469 questionnaires out of 1973 were returned due to wrong address in the study of Kroes and Ghosh (2010), 136 out of 817 in the study of Rexhausen et al. (2012), and 102 out of 1000 in the study of Al-Omiri and Drury (2007).

Table 4-6 provides information on our sample distribution which indicates coverage to a wide range of service industries. The mean (median) general experience of respondents are 18 (17) years and 9 (6) years at their current firm respectively. This provides initial evidence on the credibility of data collected in this study.

Table 4-5: Reasons for non-participation

Reason	Total
No time	21
The intended person is no longer available	20
The questionnaire does not apply to their industry	18
Company policy	9
Small company	8
Confidential information	3
High demand for participation in research studies	2
Total	**81**

Table 4-6: The sample distribution

Industry	Number of respondents
Banks	13
Education	9
Hotels & restaurants	16
Insurance companies	7
Other services	24
Post and Telecommunications	8
Transport	6
Wholesale & retail trade	16
Total	**99**

4.9.5.1 Non-response bias

One important task of quantitative researchers employing self-administered questionnaire to collect data is to ensure that respondents to the questionnaire do not differ from those who decline to participate in their research (Collis and Hussy, 2009). This is known as checking for non-response bias. Simply put, if some members of the research sample do not participate in the research and they are different from who have participated in the research, the research findings cannot be generalised to the population from which the sample has been identified (Bryman and Bell, 2007).

Non-response bias has been tested in two different ways. First, Non-response bias has been checked using ANOVA test on age and turnover as commonly used variables for this purpose (e.g. De Leeuw and Berg, 2011; Craighead et al., 2009). Given the difference in size between the sample respondents (99) and non-respondents, a random sample of 99 non-respondents was identified to be used for testing non-response bias (Hair et al., 2010; Tabachnick and fidell, 2007). The results of ANOVA have indicated equality in means on each variable (P-value $_{(turnover)}$ = 0.47, P-value $_{(age)}$ = 0.79) which implies non-response bias does not seriously threaten the validity of findings in this study. The second method used for testing non-response bias has been the wave method suggested by Armstrong and Overton's (1977) and used largely in the literature (e.g. Grafton et al., 2010; Abdel-Kader and Luther, 2008; Al-Omiri and Drury, 2007; Auzair and Langfield-Smith, 2005; Chong, 1996). According to this method, late respondents are expected to resemble non respondents. Consequently, data provided by early respondents can be compared to data from late respondents to examine non-response bias. Comparing early and late respondents in terms of industry (χ^2 = 3.75, P-value = .81) and accounting system used (χ^2 = .88, P-value = .35) has indicated no significant difference. Similarly, ANOVA has been used to test for differences between early and late respondents on all items measuring lean service and business strategy. The results of these tests have been positive suggesting that non-response bias does not seriously threaten the validity of findings in this study.

4.10 Variables measurement

The decision on how to measure research variables is one of the most critical and influential decisions researchers must make. This is so due to its direct effect on the reliability and validity of data collected and consequently on the results achieved. Therefore, Bryman and Bell (2007) advocate the use of existing measures whenever possible especially if those measures have already been piloted and their reliability and validity have been established. As a result, in the current study, the available literature for existing measures of the variables included in this research has been thoroughly searched so that such measures could be adopted or adapted in line of the research aim and objectives.

4.10.1 Lean service measurement

As indicated before, the lean service concept is very recent and little empirical research has been conducted in this area. Consequently, LTPs and LSPs presented in Table 3-1 and Table 3-2 were obtained mainly from conceptual and case studies. Because of that a conservative approach has been adopted to construct the final list of practices to be measured and the number of references reported in the associated tables has been used as a criterion. Specifically, for a practice to be included in the questionnaire it should be mentioned by at least five researchers. By adhering to this criterion, 14 LTPs practices printed bold in Table 3-1 have not been included in the questionnaire for measurement and empirical analysis. Similarly, 7 LSPs practices printed bold in Table 3-2 have not been included in the questionnaire for measurement and empirical analysis.

The remaining 23 LTPs and 10 LSPs presented in Table 3-1 and Table 3-2 respectively were measured on six-point Likert type scale adapted from the existing literature. The use of the 23 LTPs (Table 3-1) was measured using the measurement scale developed by Fullerton et al. (2003) with slight modification. Specifically, the first point in this measurement scale was "no consideration" in the original study, but in the current study it was changed to "no implementation" based on feedback from the pilot study. Respondents were asked to indicate the extent to which each of the 23 LTPs has been implemented in their firm. Possible answers for this question were (1) no implementation, (2) considering, (3) beginning, (4) partially, (5) substantially and (6) fully. LSPs were measured using the measurement scale developed by Yasin et al. (2003) with slight modification regarding the scales points to ensure consistency with the previous scale. Specifically, the original scale was based on ten points but in the current study only six points were used. To measure LSPs (Table 3-2), respondents were asked to indicate the level of effort spent on each of the 10 LSPs (anchors 1= no effort to 6 = highest level of effort).

4.10.2 Organisational performance measurement

In a similar approach to that adopted for LTPs and LSPs explained in the subsection 4.10.1, all benefits presented in Table 3-3 and cited by less than 5 articles have not been

included in the questionnaire for measurement and empirical analysis. All six benefits printed in bold in Table 3-3 have been dropped. The remaining 14 performance indicators in Table 3-3 were separated into financial dimension (i.e. profitability) and operational dimension (i.e. the other 13 indicators). To measure operational performance, the measurement scale used by Yasin et al., 2003 was employed. Specifically, Respondents were requested to indicate the level to which lean service practices have been effective in delivering each of the 13 operational benefits as shown in Table 3-3 (answers: 1= strongly disagree to 6= strongly agree).

The financial dimension of firm performance was measured by secondary data obtained from the FAME database. Secondary data can be defined as the data not collected directly by the researcher (Bryman and Bell, 2007: p. 326). Such data can be in different forms such as published summaries collected by other organisations, or archival data stored in databases like FAME, UK Nexus, and DataStream. Secondary data can be of high importance to and will be primarily used by researchers who are interested in conducting empirical comparison studies at national or international level (Saunders et al., 2009). Compared to primary data, secondary data can be obtained at low cost and less time (Bryman and Bell, 2007). Having said that does not mean that secondary data is free of disadvantages. Researchers who use secondary data often face some difficulties regarding the complexity and unfamiliarity with such data in addition to the lack of control over the quality of data. However, researchers often rely on secondary data to cross validate the primary data they have collected and consequently, both primary and secondary data are used to answer their research questions (Saunders et al., 2009). In this research, secondary data will be collected for two reasons: (1) to reduce the numbers of questions in the questionnaire instrument in order to improve the response rate, and (2) to cross-validate the findings obtained through analysing primary data collected via questionnaire instrument (Swink and Jacobs, 2012; González-Benito, 2005). More specifically, secondary data will be collected on firm size, firm age and three performance measures, namely profit margin, turnover per employee, and return on capital employed.

Three different measures of financial performance highly used in the literature were used which included profit margin (PM), turnover per employee (TE) and return on capital employed (ROCE) (e.g. Agarwal et al., 2013; Bhasin, 2012; Davidson and Stern; 2004; Patterson et al., 2004). Secondary data has been always perceived as a more reliable source of data compared to the perceptual measures of performance. Therefore, by combining both perceptual and secondary performance data, the findings of this study is expected to be more robust in comparison to other studies which relied only on perceptual measures of performance (Swink and Jacobs, 2012; González-Benito, 2005).

However, to avoid entirely arbitrary measurement of performance, the initiation year of lean service provided by respondents has been relied on. 38 respondents answered the question regarding the initiation year and their responses indicated that on average lean service was implemented in 2009. This is not surprising given that lean service is a recently developed concept (Malmbrandt and Åhlström, 2013). The year *2009* has been perceived as the best estimate available for the implementation year of lean service based on which financial data can be collected[6]. Therefore, data on the three performance indicators have been collected on all available years since 2009 (i.e. 2009-11 included) for all companies in the sample. The median value has then been calculated for each firm included in the study for each financial indicator. However, because the values of these indicators differ across industries and the sample in this study includes a wide range of industries, an industry-adjusted median value for each firm has been calculated by subtracting the industry median value from a firm median value (Shafer and Moeller, 2012; Swink and Jacobs, 2012; Patterson et al., 2004, Ittner et al., 2002).

In addition, current objective financial measures are expected to be correlated with past objective financial measures, and therefore controlling for the effect of past performance is necessary (Swink and Jacobs, 2012; Hillman, 2005; Patterson et al., 2004). Therefore, data on PE and TE and ROCE from the preceding three years (i.e. 2006-08 included) have

6 Ensuring that the financial data is collected after the introduction of an innovation method helps in partially addressing the issue of reverse causality (Gues et al., 2003; Luft and Shields, 2003).

been obtained and an industry-adjusted median value has been computed for each firm and used to control for the effect of past performance[7].

4.10.3 Contextual variables measurement

Age and size were measured by objective data obtained from FAME database. Age was measured by the number of years since inception. Size was measured by the average total number of employees of the last three years for which data was available (2009-11). The measurement scale for business strategy was adopted from Auzair and Langfield-Smith (2005) in which cost leadership and differentiation strategies were measured separately using 4 and 7 items respectively. Low values on either scale indicated low emphasis on the corresponding strategy while high values represented the reverse. In consistence with previous studies (e.g. Pavlatos, 2010; Banker et al., 2008; Gosselin, 1997), respondents have been asked to indicate the type of accounting system used in their firms with the following possible categories: variable costing, absorption costing, ABC, and others. All categories other than ABC have been combined to represent TAS. Then a dummy variable has been created in which 1 indicates the use of ABC and 0 otherwise (i.e. TAS). This dummy variable has been used in the main analysis.

4.10.4 Common method bias

Given that one informant provided all data, this could raise the issue of common method bias. Common method bias was tested statistically using Harman's single-factor test (Podsakoff et al., 2003). Thus, all items (LTPs, LSPs, outcome; and business strategy) were subjected to factor analysis and the unrotated solution was examined. The result indicates that 15 factors can be extracted with eigenvalue >1 where the first factor explains only 19% of the total variance. This result implies that single-source bias is of little concern in this study.

7 Controlling for past performance also assists in accounting for the possibility that past performance may explain the implementation of lean service (Gues et al., 2003).

4.11 Statistical techniques

In addition to the rigor required in developing a theoretical model, researchers have stressed the need to accompany this with rigorous methodologies and statistical analyses to verify and test the proposed theoretical model (Shields and Shields, 1998; Ittner and Larcker, 2001; Chenhall, 2003). One of the most important statistical techniques which has been argued to offer the level of rigor desired for theory development and testing is Structural Equation Modelling (SEM) (Hair et al., 2010).

4.11.1 Structural Equation Modelling

SEM was first used in marketing research in the early 1980s while limited use of this technique was observed in other fields such as operations management and management accounting (Shah and Goldstein, 2006; Smith and Langfield-Smith, 2004). However, given the valuable advantages of SEM, its increasing level of use has been witnessed in different fields (Hair et al., 2011).

SEM can be thought of as "a set of multivariate techniques that allow for the simultaneous study of the relationship between directly observable and/or unmeasured latent variables, while incorporating potential measurement errors" (Henri, 2007: p. 76). It is proved particularly useful for models in which a dependent variable in one equation becomes an independent variable in another subsequent equation (Hair et al., 2010). In addition, SEM has a superior power over other statistical techniques such as multiple regression analysis, factor analysis, canonical correlation and path analysis in that it can test simultaneously both the measurement properties and the theoretical relations of models (Hair et al., 2010). Further, SEM overcomes limitations of traditional techniques (e.g. multiple regression and path analysis) which assume an error-free measurement of constructs by explicitly accounting for measurement errors in the estimation process (Hair et al., 2010). Based on this description, SEM is perceived to be a three-in-one technique that combines the features of multiple regression, factor analysis and path analysis (Hair et al., 2010).

However, it is crucial to point out that SEM can be regarded as a family of techniques (Peng and Lai, 2012; Hair et al., 2011; Smith and Langfield- Smith, 2004), which encompass covariance-based SEM (CB-SEM) and variance-based SEM or Partial Least Squares SEM (PLS-SEM). In the following section, the main characteristics and differences between the two streams will be discussed.

4.11.2 Comparison between CB-SEM and PLS-SEM

When the term SEM is used, many academics think of CB-SEM that is usually implemented by well-known software like AMOS and LISREL (Chin, 1998; Hair et al., 2011). However, SEM is not limited to CB-SEM and it includes another distinctive but relatively less popular technique, namely PLS-SEM (Peng and Lai, 2012).

PLS-SEM is "a causal modelling approach aimed at maximising the explained variance of the dependent latent constructs" (Hair et al., 2011, P. 139). Consequently, it differs from CB-SEM's objective which mainly concerns reproducing the theoretical covariance matrix, without focusing on explained variance (Hair et al., 2011). Specifically, CB-SEM attempts to produce a set of parameter estimates which minimise the differences between the estimated covariance matrix and the sample covariance matrix (Hair et al., 2011). In contrast, PLS-SEM attempts to estimate a set of parameter estimates that minimise the residual variances of latent dependent constructs (Hair et al., 2012).

Apart from the objective of the two techniques, CB-SEM model estimation requires a number of assumptions to be fulfilled such as the multivariate normality of data, number of indicators per construct and large sample size (Hair et al., 2011). When these assumptions cannot be met, and they are usually difficult to be met in business research (Peng and Lai, 2012), CB-SEM may not result in precise estimation parameters (Hair et al., 2011; Hair et al., 2010). In such cases, PLS-SEM can be preferred given its capability of handling small sample sizes and not normally distributed data in addition to allowing the use of constructs with only one or two indicators (observed variables) (Hair et al., 2011; Hair et al., 2012; Peng and Lai, 2012; Lee et al., 2011). However, when the assumptions of CB-SEM are met, CB-SEM is preferred as it produces more precise

parameter estimates (Hair et al., 2010). One more difference between PLS-SEM and CB-SEM is that the latter produces goodness of fit indices necessary for theory testing while the former does not. Therefore, when the research objective is theory testing and confirmation, CB-SEM is more appropriate, while PLS-SEM is more suitable for theory development (Peng and Lai, 2012; Hair et al., 2011; Hair et al., 2010). Form the above discussion it can be seen the advantages of PLS-SEM are the disadvantages of CB-SEM and vice versa, and consequently the two approaches are complementary rather than competitive (Hair et al., 2012). Therefore, researchers should choose the technique that best suits their research objective, data characteristics and model complexity (Hair et al., 2012). To help researchers in choosing between the two approaches, Hair et al. (2011, P. 143) state that "when CB-SEM assumptions are violated with regard to normality of distributions, minimum sample size, and maximum model complexity, or when related methodological matters emerge.... PLS-SEM is a good methodological alternative for theory testing".

In the current study, PLS-SEM is adopted for three reasons. First, the subjective and objective data collected somewhat violate the normality assumption necessary for CB-SEM. Second, the model proposed is complex given the number of constructs included and the number and nature of structural relations hypothesised. Third, the sample size in this research is relatively small.

4.11.3 Overview of PLS-SEM

Like CB-SEM, PLS-SEM has two components for testing latent variable models, namely measurement (outer) model and structural (inner) model (Hair et al., 2011). The measurement model associate observed indicators to their respective latent variables, while the structural model links endogenous latent variables to exogenous latent variables (Hair et al., 2010). Endogenous latent variables represent dependent variables and exogenous latent variables are similar to independent variables in multiple regression analysis (Hair et al., 2010). PLS-SEM can handle two types of measurement model, reflective and formative models (Hair et al., 2011). Reflective models accommodate reflective constructs where a change in the latent construct leads to change in the

associated indicators. In contrast, formative model encompass constructs where a change in the observed indicators of a construct leads to change in the construct (Hair et al., 2010). However, all constructs in the current research are reflective and the procedures appropriate for evaluating the reflective measurement models are followed in this study. To estimate the proposed model, the PLS-SEM algorithm uses a two-stage approach (Hair et al., 2011). The latent variables' scores are estimated in the first stage while the final outer weights and loadings are calculated in the second stage (Hair et al., 2011).

4.11.3.1 Assessing the Measurement Model under PLS-SEM

The first step in assessing PLS-SEM is to evaluate to the measurement model in terms of its measures' reliability and validity. The measures' reliability can be assessed through different criteria such as internal consistency (composite reliability) and indicator reliability (Hair et al., 2011). Construct validity is usually evaluated through convergent and discriminant validity (Hair et al., 2010). More details on testing constructs reliability and validity will be presented later in the next chapter.

4.11.3.2 Assessing the Structural Model under PLS-SEM

As mentioned before, PLS-SEM seeks to estimate model parameters that maximise the variance of the dependent latent constructs explained by the latent independent constructs. Therefore, R^2 and path coefficient along with their significance should be the primary assessment criteria (Hair et al., 2011). Because PLS-SEM relaxes the distribution assumption of the data, the significance of path coefficients are evaluated using re-sampling techniques such as bootstrapping or jackknifing (Hair et al., 2011). However, bootstrapping is usually perceived to be superior to the jackknifing method (Chin, 1998) and therefore it is adopted in this study. Another important criterion for assessing the structural model is its predictive capability (Hair et al., 2011). The predictive capability of the model is usually evaluated by the Stone-Geisser Q^2 value (Geisser, 1974; Stone, 1974), which assumes that the model must be able to predict each endogenous latent construct's indicator (Hair et al., 2011). This Q^2 value is calculated using the blindfolding technique which omits part of the data systematically and uses the resulting estimates to predict the omitted part of the data (Hair et al., 2011).

4.11.3.3 PLS-SEM Software

PLS-SEM algorithms were developed few decades ago although their use in business research has not been observed until recently (Hair et al., 2011). This limited use of PLS-SEM can in part be attributed to the slow progress in developing user friendly, yet rigorous, software for rigorous PLS-SEM analysis in business and management research (Temme et al., 2010). However, these days there are different software packages that support PLS-SEM such as PLS-GUI, Visual-PLS, PLS-Graph, Smart PLS, SPAD-PLS (Temme et al., 2010). Although all the aforementioned software packages support PLS-SEM, each has some distinctive features in terms of options available. In this study, Smart-PLS will be used as it offers all necessary options to evaluate a PLS model. First, compared to other packages Smart-PLS is a free-to-use package that can be downloaded from Smart-PLS community website. Second, Smart-PLS allows for automatically building product terms for interaction and moderation analysis. Third, this package has the blindfolding feature required to evaluate the predictive relevance of the model. On the other hand, one limitation of Smart-PLS package is that it does not offer P-value to assess the significance of path coefficients. However, it does provide t-statistics through the bootstrapping procedure which can be used to assess the significance of path coefficients.

4.12 Summary of chapter four

In this chapter the research methodology adopted in this research study has been discussed in details. By doing so, the research paradigm, approach and strategy were all identified and justified after exploring the other alternatives adopted in social sciences. More specifically, this study adopted the positivism paradigm with a deductive approach and the cross-sectional survey strategy to test the theoretical model and associated hypotheses developed in this study. For data collection, the postal questionnaire was found to be the ideal option given the setting and aim of the research. Consequently, the measurement scales of variables were determined and the questionnaire instrument was developed, piloted and refined. Moreover, this chapter discussed the research context, population and the required sample for providing empirical data. The administration process of the questionnaire was presented along with some descriptive statistics on respondents and the

test of non-response bias and common method bias. The results of these tests indicated that non-response bias and common method bias should not be of high concern to the current study. Finally, a description of the statistical techniques to be used in this study was provided along with the rationale behind their adoption.

Chapter 5 : Data preparation and examination

5.1 Introduction

This chapter is devoted mainly to examine and prepare the data collected for conducting the empirical analysis through PLS-SEM. The second section of this chapter explicates the procedures adopted for screening the empirical data collected through the questionnaire instrument. This includes a detailed discussion of the missing data analysis and the known assumption of parametric tests including normality, linearity, and homogeneity of variance, outliers and multicollinearity. The third section of this chapter revolves around verifying the validity, reliability and unidimensionality of the constructs subsumed in the theoretical model of this study. After establishing the validity, reliability and unidimensionality of constructs, the descriptive statistics of those constructs including mean, standard deviation, skewness and kurtosis are reported in section four.

5.2 Preliminary screening of data

5.2.1 Missing data analysis

Missing values happen when a respondent does not provide his/her answer to one or more of the survey questions. As a result, valid values for those questions will be missing from the analysis, which necessitates evaluation of the pattern and extent of the missing data, to probe the reasons behind the missing data (Hair et al., 2010).

A proper understanding of the reasons behind the missing data assists in determining the optimal method to deal with it (Hair et al., 2010). As per Hair et al. (2010), there can be two types of missing data. First, ignorable missing data (<10%) is that anticipated given the research design and the technique used. This type of missing data does not need specific remedies. Second, non-ignorable missing data (>10%) is the one that occurs due to some procedural factors or factors pertinent to the respondents. This type of missing data necessitates finding appropriate remedies. To identify the type of missing data in a data set, Hair et al. (2010) recommends examining the extent and patterns of the missing data.

Examining the extent of missing data in this research study using the SPSS package shows that missing values (<2%) are within the ignorable level (10%) of missing data for all variables. Furthermore, the Little's MCAR test has been relied upon to examine the pattern of missing data. This test investigates whether the missing data have any systematic pattern or they are missing completely at random (Hair et al., 2010; Tabachnick and Fidell, 2007). The results of Little's MCAR test (Chi-square 127.112, p = 0.27) indicate that the data does not suffer from any systematic error, which allows for higher flexibility in choosing the method for treating the missing data (Hair et al., 2010). As a result, this study adopts the mean substitution method for missing values, as one of the most common ways to compute missing values (Tabachnick and Fidell, 2007; Hair et al., 2010).

5.2.2 Examining the assumptions of parametric tests

To the extent that one or more of the parametric tests will be used to examine the research hypotheses, the first step after the quantitative data has been collected is then to ensure its validity in connection with the assumptions of parametric tests (Hair et al., 2010). This includes examining the raw data for its normality, linearity, homogeneity of variance and outliers (Hair et al., 2010). The skewness and kurtosis of the data were used to examine its normality while linearity and homogeneity of variance were checked using the scatter plot graph as recommended by Hair et al. (2010). The Z-score of higher than 3.3 was relied on to identify potential outliers in the data set (Hair et al., 2010).

Given their effect on other assumptions, the screening process started by attempting to identify the potential outliers in the data set. Observations with Z score larger than 3.3 were winsorised to avoid reducing the sample size. When examining the normality assumption, 6 LTPs (italic in Table 3-1) were found to have a significantly skewed distribution (P<.001). Their distributions could not be improved by different transformations and consequently they were deleted from further analysis. In terms of the linearity and homogeneity of variance assumptions, scatter plots of a large sample of pairs of variables indicated no apparent violation to these assumptions. Consequently, the

screening process ended after ensuring that 17 LTPs (Table 3-1), 10 LSPs (Table 3-2) and 13 operational performance indicators (Table 3-3) were valid input for the factor analysis (Hair et al., 2010).

5.3 Validity, reliability and unidimensionality of constructs

Examination of the validity, reliability and unidimensionality of measures used in a quantitative study is an essential task (Hair et al., 2010; Bryman and Bell, 2007). This is so because each of these aspects has a significant influence on the extent to which a researcher can be confident about his/her findings resulted from the use of statistical tests to examine the research hypotheses (Hair et al., 2010). More specifically, validity and reliability of measures provide indications on the level of measurement error present in a data set which is a direct influential factor on the credibility of a research's findings.

5.3.1 Content validity

Content validity, known also as face validity, concerns the assessment of the appropriateness of variables used to represent a specific concept in really reflecting the content and the theoretical definition of that concept (Bryman and Bell, 2007). This type of validity is usually examined subjectively through seeking feedback from experts on the concepts being investigated or pre-tests with some subpopulations (Hair et al., 2010). Ensuring the content validity of constructs in this study was achieved through a relatively large-scale pilot study that sought feedback from 15 experts in the concepts measured in this study (see subsection 4.9.4).

5.3.2 Unidimensionality of constructs

The unidimensionality of a construct implies that all indicators of that construct are strongly correlated with each other and represent only that specific construct (Hair et al., 2010). The importance of establishing the unidimensionality of all constructs in a model stems from the confusion that may arise when some indicators represent more than one construct. Factor analysis, such as exploratory factor analysis (EFA) and confirmatory factor analysis (CFA), is a critical statistical tool usually used to empirically establish the unidimensionality of constructs. The test using the factor analysis technique revolves

around making sure that all indicators of a factor load highly and significantly only on that factor (Hair et al., 2010).

In this study, EFA is employed to empirically assess the dimensionality of constructs included in the model using the SPSS software package. In this analysis the principal component method with varimax rotation and eigenvalue greater than 1 was used as a criterion for factor extraction. The principal component method was chosen because it takes into consideration the total variance including common, specific and error variances (Hair et al., 2010). Moreover, the varimax orthogonal rotation method was adopted as in most cases the un-rotated solutions are neither sufficient nor clear (Hair et al., 2010). In addition, the orthogonal rotation methods have been relied on more widely in comparison to oblique rotation methods (Hair et al., 2010).

The recommendations given by Hair et al. (2010) for a reliable factor analysis were followed for all constructs. Kaiser-Meyer- Olkin (KMO) test for sampling adequacy was used at a scale and individual item level with a minimum value of 50% being acceptable. All items in a scale should have communalities of at least 50% and their loadings should be >= 55% given the sample size of about 100 observations (Hair et al., 2010). Any item that did not satisfy these conditions was removed from the analysis and a new factor solution was requested again until all items had satisfied the required conditions.

5.3.3 Reliability of constructs

Reliability is an assessment of the consistency of a measure of a concept (Bryman and Bell, 2007, P. 163). There are two different forms or meanings of the term reliability, namely stability also called test-retest method and internal reliability (Hair et al., 2010).

5.3.3.1 The stability method

The stability method concerns the consistency of a measure in providing almost similar results at two different points in time (Bryman and Bell, 2007). By adopting this method, a measure should be administered to a sample on one occasion and then re-administered to the same sample on another occasion. The measure is said to be reliable if the results

obtained from the two administrations are highly correlated (Hair et al., 2010). However, this method has some limitations which render it inapplicable to this research. First, in the case of questionnaire data, a respondent's answers at time 1 may influence his/her answers at time 2 (Bryman and Bell, 2007). Second, this method obviously requires administration of the same measures twice to the same respondents which is expensive, time consuming and needs convincing participants to provide the same information twice.

5.3.3.2 The internal reliability method

This method applies to multiple-indicator constructs where data collected on all indicators is aggregated to make an overall score for the associated construct (Hair et al., 2010). The objective of this method is to ensure that the multiple indicators which measure a specific construct are related to each other because they all measure the same construct (Bryman and Bell, 2007). Cronbach's alpha is one of the most used techniques for testing the internal reliability of multiple-indicator constructs when factor analysis is used (Hair et al., 2010; Bryman and Bell, 2007). In general, there is an agreement among researchers that a Cronbach's alpha value of 70% should be the lowest acceptable limit for this coefficient (Hair et al., 2010). However, given the sensitivity of this coefficient to the number of indicators in a construct (i.e. the value of Cronbach's alpha increases with the increase in the number of indicators used in measuring a construct, even with the same degree of inter-correlation), a coefficient value of 60% (Hair et al., 2010) or 50% (Nunnally, 1978) can be acceptable especially in exploratory research or for constructs with low number of indicators (Hair et al., 2010; Grafton et al., 2010; Cortina, 1993).

A second measure of internal reliability is the composite reliability measure (Hair et al., 2011). Unlike Cronbach' alpha, the composite reliability measure does not suppose that all indicators are equally reliable and this makes it more appropriate for PLS-SEM used in this study (Hair et al., 2011). Satisfactory reliability can be assumed when the value of the composite reliability ranges between 0.7 and 0.9 for advanced research while a value of 0.6 is considered acceptable for exploratory studies (Hair et al., 2011).

In the current research, both Cronbach's alpha and composite reliability measure will be checked to ensure that the measures used in this study are satisfactorily reliable.

5.3.4 Validity of constructs

After ensuring the unidimensionality, reliability of a construct and its measures, the final step is to examine the construct validity (Hair et al., 2010). Construct validity can be defined as "the extent to which a scale or set of measures accurately represent the concept of interest" (Hair et al., 2010: p. 126), or "the issue of whether or not an indicator (or set of indicators) that is devised to gauge a concept really measures that concept" (Bryman and Bell, 2007, P. 165). In addition to the content validity explained earlier in subsection 5.3.1, two other forms of construct validity can be measured and empirically tested, namely convergent validity and discriminant validity (Hair et al., 2010).

5.3.4.1 Convergent Validity

Convergent validity concerns the evaluation of the extent to which indicators of a specific construct converge or share a high amount of variance in common (Hair et al., 2010). Convergent validity can be empirically assessed by different ways among which can be the reliance on factor loadings or the average variance extracted (AVE) when performing CFA (Hair et al., 2010). When using the factor loadings method to assess the convergent validity of a construct, the standardised loading of each indicator measuring that construct should be examined. A standardised loading value of 0.5 and ideally 0.7 can be an indication of convergent validity (Hair et al., 2010). Regarding the second method, the AVE can be calculated as the sum of all squared standardised factor loadings divided by the number of items. An AVE value of 0.5 or higher can indicate a good level of convergent validity (Hair et al., 2010). This is because when the AVE value falls below 0.5, it implies that, on average, the items variance explained by the latent factor is less than the error variance remains without explanation.

5.3.4.2 Discriminant Validity

Discriminant validity assesses the level to which each construct is distinct from other constructs (Hair et al., 2010). Like convergent validity, discriminant validity can be

empirically examined by two methods, namely the cross-loadings method and AVE method. By adopting the cross-loadings method, discriminant validity can be supported by ensuring higher loadings of indicators on their specified construct in comparison with their loadings on other constructs (Hair et al., 2010; Chin, 1998). However, the AVE method, usually accompanying CFA, to assess the discriminant validity requires that AVE for any two constructs to exceed the squared value of the correlation estimate between these two constructs (Hair et al., 2010).

5.3.5 Empirical examination of unidimensionality, reliability and validity of constructs

As explained in the previous subsections of this chapter, EFA is implemented to assess the validity and unidimensionality of the model constructs which will be confirmed by the measurement model of PLS-SEM used in this study.

5.3.5.1 Assessing unidimensionality, reliability and validity of LTPs

After deleting 6 LTPs because they violate some of the assumptions of parametric tests (see subsection 5.2.2), the remaining 17 LTPs presented in standard format in Table 3-1 were subjected to EFA. Table 5-1 presents the results of the factor analysis of the 17 LTPs. As can be seen from Table 5-1, four factors were extracted that explained 62% of the data variance. However, one practice "Mistake proofing" was dropped as it had no significant loading (>55) on any factor. The factor solution presented in Table 5-1 confirmed the unidimensionality of each factor extracted. All indicators related to a specific factor were loading significantly (>55%) on only that factor with values ranging from 61% to 83%. In addition, no high cross loadings were evident. Therefore, the results of Table 5-1 also confirmed the convergent and discriminant validity of the four factors extracted. Kaiser's measure of sampling adequacy (0.78) indicated that EFA is appropriate and within acceptable levels (Hair et al., 2010).

The reliability of each factor was estimated using the Cronbach's alpha. As shown in Table 5-1, all factors possessed a satisfactory reliability value ranging from 0.68 to 0.83. Based on the indicators (i.e. LTPs) loaded on each factor, the four factors were labelled as

process factor, physical structure factor, customer value factor and error prevention factor, respectively.

Table 5-1: Factor analysis and reliability analysis of lean technical practices

Practices	Factor loadings				Communality
	1	2	3	4	
Automation	**0.702**	0.170	0.003	-0.178	0.554
Just in Time	**0.620**	0.441	0.006	-0.118	0.593
Pull system	**0.760**	0.024	0.175	0.306	0.703
Work load balancing	**0.731**	0.066	0.231	0.179	0.624
Quick set up time	**0.708**	0.067	0.256	0.296	0.659
Small lots	**0.643**	0.352	0.158	-0.209	0.606
5Ss	0.063	**0.706**	0.146	0.189	0.560
Group technology	0.231	**0.768**	0.211	0.090	0.696
Improving facility layout	0.177	**0.820**	0.080	0.217	0.757
Visualisation	0.166	**0.607**	0.354	0.052	0.524
Kaizen blitz	0.402	0.135	**0.607**	0.096	0.557
Policy deployment/Hoshin Kanri	0.155	0.098	**0.799**	0.109	0.684
Quality function deployment	0.167	0.201	**0.697**	0.200	0.594
Value stream mapping	-0.025	0.308	**0.598**	-0.272	0.527
Root cause analysis	-0.026	0.202	0.167	**0.736**	0.612
Total preventive maintenance	0.127	0.177	-0.020	**0.831**	0.738
Measure of sampling adequacy (Whole model)	0.777				
Variance extracted by the model	62.417				
Cronbach's alpha	0.832	0.81	0.711	0.677	

5.3.5.2 Assessing unidimensionality, reliability and validity of LSPs

Table 5-2 presents the results of factor analysis of the 10 LSPs listed in Table 3-2. As can be seen from Table 5-2, two factors were extracted that explained 75% of the data variance. However, one practice (multifunctional employees) was dropped due to low communality value. The factor solution presented in Table 5-2 confirmed the unidimensionality of each factor extracted. All indicators related to a specific factor were loading significantly (>55%) on only that factor with values ranging from 82% to 89%. In addition, no high cross loadings were evident. Therefore, the results of Table 5-2 also confirmed the convergent and discriminant validity of the two factors extracted. Kaiser's

measure of sampling adequacy (0.85) indicated that EFA is appropriate and within acceptable levels (Hair et al., 2010).

The reliability of each factor was estimated using the Cronbach's alpha. As shown in Table 5-2, all factors possessed a satisfactory reliability value ranging from 0.90 to 0.91. Based on the indicators (i.e. LSPs) loaded on each factor, the two factors were labelled as motivation factor and human factor, respectively.

Table 5-2: Factor analysis and reliability analysis of lean social practices

Practices	Factor loadings		Communality
	1	2	
Reward system	**0.837**	0.064	0.705
Communication system	**0.845**	0.121	0.729
Management support	**0.867**	-0.046	0.753
Performance measures	**0.875**	0.111	0.779
Training	**0.822**	0.167	0.704
Employee empowerment	0.034	**0.873**	0.763
Employee commitment	0.066	**0.886**	0.789
Employee involvement	0.120	**0.887**	0.801
Leadership	0.117	**0.853**	0.742
Measure of sampling adequacy (Whole model)	0.848		
Variance extracted by the model	75.156		
Cronbach's alpha	0.907	0.902	

5.3.5.3 Assessing unidimensionality, reliability and validity of organisational performance

The 13 operational performance indicators presented in Table 3-3 were factor analysed. As can be seen from Table 5-3, three operational performance factors were extracted explaining 68% of the data variance. However, two operational indicators "reduction in inventory and improvement in capacity" were dropped because of low sampling adequacy (<50%) and low communality value (<50%) respectively. The factor solution presented in Table 5-3 confirmed the unidimensionality of each factor extracted. All indicators related to a specific factor were loading significantly (>55%) on only that factor with values ranging from 67% to 85%. In addition, no high cross loadings were evident. Therefore, the

results of Table 5-3 also confirmed the convergent and discriminant validity of the three factors extracted. Kaiser's measure of sampling adequacy (0.82) indicated that EFA is appropriate and within acceptable levels (Hair et al., 2010).

The reliability of each factor was estimated using the Cronbach's alpha. As shown in Table 5-3, all factors possessed a satisfactory reliability value ranging from 0.71 to 0.83. Based on the indicators loaded on each factor, the three factors were labelled as customer satisfaction, waste elimination and process time reduction, respectively.

Table 5-3: Factor analysis and reliability analysis of operational performance

Practices	Factor loadings			Communality
	1	2	3	
Customer perception of product/service quality	**0.789**	0.290	0.193	0.745
Customer satisfaction	**0.848**	0.232	0.051	0.776
Employees satisfaction and their performance	**0.834**	0.132	0.229	0.765
Employees understanding of the process	**0.709**	0.248	0.274	0.639
Identification and elimination of waste	0.108	**0.668**	0.323	0.562
Operational efficiency	0.394	**0.703**	0.095	0.658
Productivity	0.250	**0.712**	0.276	0.645
Reduction in costs	0.182	**0.812**	-0.071	0.697
Freeing staff time	0.309	0.225	**0.742**	0.696
Reduction in lead time and cycle time	0.077	-0.002	**0.814**	0.668
Human errors	0.211	0.228	**0.781**	0.707
Measure of sampling adequacy (Whole model)	0.823			
Variance extracted by the model	68.712			
Cronbach's alpha	0.828	0.708	0.768	

5.3.5.4 Assessing unidimensionality, reliability and validity of business strategy

Indicators of the cost leadership and differentiation strategy were factor analysed separately. Table 5-4 and Table 5-5 summarise the results of the factor analysis for these scales. As shown in Table 5-4, cost leadership items loaded on one factor explaining 63% of the variance. Similarly, items measuring differentiation strategy loaded on one factor explaining 69% of the variance as indicated in Table 5-5. The factor solution for both scales confirmed the unidimensionality of the two factors extracted. All indicators loaded

significantly (>55%) on their related factor with values ranging from 73% to 85% and 75% to 88% for cost leadership and differentiation respectively. Therefore, the results also confirmed the convergent and discriminant validity of this construct. Kaiser's measure of sampling adequacy was 0.72 (0.89) for cost leadership (differentiation) models which indicated that EFA is appropriate and within acceptable levels (Hair et al., 2010). The alpha level was 81% and 93% for cost leadership and differentiation respectively which provided support to the respective scales.

5.4 Descriptive statistics

This section presents the descriptive statistics of variables measured in the questionnaire and objectively collected from the FAME database. These descriptive statistics are important as they provide initial view of the nature of the data used in the main statistical analysis (Tabachnick and Fidell, 2007). The mean, standard deviation, minimum value, maximum value, skewness and kurtosis of LTPs, LSPs, organisational performance, business strategy, MAS, firm size, firm age, unionisation, and internationalisation are reported below.

5.4.1 Descriptive statistics of LTPs

As found in subsection 5.3.5.1, four factors reflected the technical side of lean service. Table 5-6 conveys the descriptive statistics of these dimensions along with their associated indicators. First, by examining the average score (printed in bold) of the four factors of the technical side, Table 5-6 indicates that on average these factors have not widely been implemented by the service firms included in the sample.

The average score of each factor is just slightly above the average score of the scale (3 out of 6). Among the four factors, error prevention factor and customer value factor have, on average, the highest scores of 3.73 and 3.24 respectively. This can be a positive sign in that it implies that service firms in the sample understand the core of lean service which is to improve the value delivered to customers. As indicated by Womack and Jones (1996) the first principle of lean service is to understand the value from customer perspective.

Table 5-4: Factor analysis and reliability analysis for cost leader strategy

Practices	Factor loadings	Communality
	1	
Achieving lower cost of services than competitors	0.727	0.528
Making service/procedures more cost efficient	0.845	0.714
Improving the cost required for coordination of various services	0.811	0.659
Improving the utilisation of available equipment, services and facilities	0.794	0.630
Measure of sampling adequacy (Whole model)	0.722	
Variance extracted by the model	63.272	
Cronbach's alpha	0.805	

Table 5-5: Factor analysis and reliability analysis for differentiation strategy

Practices	Factor loadings	Communality
	1	
Providing high quality services	0.750	0.562
Customising services to customers need	0.881	0.776
Providing after-sale services and support	0.831	0.691
Introducing new services/procedures quickly	0.856	0.733
Providing services that are distinct from that of competitors	0.848	0.719
Offering a broader range of services than the competitors	0.815	0.664
Improving the time it takes to provide services to customers	0.828	0.686
Measure of sampling adequacy (Whole model)	0.891	
Variance extracted by the model	69.027	
Cronbach's alpha	0.925	

At individual indicator level, Table 5-6 highlights few practices that have an average score below the average score of the scale. This includes JIT (2.84 out of 6), quick set up (2.94 out of 6), small lots (2.59 out of 6) and value stream mapping (2.86). These results support the findings of Alsmadi et al. (2012) who also find that some lean practices (quick set up) implemented in manufacturing to be of less relevance to services. Collectively, Table 5-6 indicates that service firms subsumed in the sample are at the early stage of implementing LTPs and their focus on understanding the value from customer perspective can be a positive sign for a successful implementation of the program.

An examination of the skewness and kurtosis of factors and individual indicators presented in the last two columns of Table 5-6 demonstrates no serious violation of the normality assumption ($p < 001$).

Table 5-6: Descriptive statistics of LTPs factors and indicators

Construct	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
Process factor	**1**	**6**	**3.01**	**1.63**	**0.20**	**-1.14**
Automation	1	6	3.22	1.64	-0.08	-1.32
Just in Time	1	6	2.84	1.59	0.41	-0.95
Pull system	1	6	3.20	1.68	0.11	-1.32
Work load balancing	1	6	3.28	1.43	-0.17	-0.98
Quick set up time	1	6	2.94	1.77	0.37	-1.18
Small lots	1	6	2.59	1.68	0.59	-1.11
Physical structure factor	**1**	**6**	**3.14**	**1.66**	**0.00**	**-1.36**
5Ss	1	6	3.07	1.71	0.13	-1.41
Group technology	1	6	3.04	1.56	-0.02	-1.34
Improving facility layout	1	6	3.46	1.72	-0.26	-1.39
Visualisation	1	6	2.99	1.66	0.17	-1.33
Customer value factor	**1**	**6**	**3.24**	**1.65**	**-0.06**	**-1.25**
Kaizen blitz	1	6	3.38	1.65	-0.12	-1.16
Policy deployment/Hoshin Kanri	1	6	3.34	1.69	-0.21	-1.30
Quality function deployment	1	6	3.37	1.70	-0.07	-1.33
Value stream mapping	1	6	2.86	1.58	0.14	-1.23
Error prevention factor	**1**	**6**	**3.73**	**1.57**	**-0.40**	**-0.89**
Root cause analysis	1	6	3.74	1.50	-0.32	-0.85
Total preventive maintenance	1	6	3.72	1.65	-0.48	-0.93

5.4.2 Descriptive statistics of LSPs

The social side of lean service has been reflected by two factors as shown in subsection 5.3.5.2. Unlike the four LTP factors, all LSP factors have mean values which exceed the average value of their associated scale, that is, over 3. It seems from Table 5-7 that, on average, UK service companies in the sample employed in this study have focused exceptionally on the human factor (3.97 out of 6) followed by the motivation factor (3.72 out of 6). The higher focus on the social side of lean service observed in Table 5-7 emphasises earlier evidence reported by Alsamdi et al. (2012) who also notice higher

interest in the social practices among service firms compared to manufacturing firms. At individual indicator level, training (4.05 out of 6) and management support (3.82 out of 6) present themselves as the most important elements of the motivation factor. Regarding the human factor, leadership (4.21 out of 6) and employee involvement (4.13 out of 6) seem to be the most important elements.

An examination of the skewness and kurtosis of factors and individual indicators presented in the last two columns of Table 5-7 demonstrates no serious violation of the normality of the data. All factors and indicators have skewness and kurtosis values less than 3.29 ($p < .001$) as recommended by Hair et al. (2010).

Table 5-7: Descriptive statistics of LSP factors and indicators

Construct	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
Motivation factor	**1**	**6**	**3.72**	**1.43**	**-0.20**	**-0.84**
Reward system	1	6	3.39	1.44	0.22	-0.95
Communication system	1	6	3.69	1.45	-0.25	-0.70
Management support	1	6	3.82	1.30	-0.25	-0.79
Performance measurement system	1	6	3.65	1.49	-0.30	-0.95
Training	1	6	4.05	1.45	-0.44	-0.83
Human factor	**1**	**6**	**3.97**	**1.31**	**-0.33**	**-0.67**
Employee empowerment	1	6	3.65	1.39	-0.03	-0.97
Employee commitment	1	6	3.89	1.22	-0.30	-0.72
Employee involvement	1	6	4.13	1.31	-0.36	-0.68
Leadership	1	6	4.21	1.33	-0.64	-0.32

5.4.3 Descriptive statistics of organisational performance

As mentioned before, organisational performance is measured at both operational and financial levels. Operational performance is measured with subjective data obtained from respondents while financial performance is measured by secondary data on three indicators, namely profit margin (PM), return on capital employed (ROCE) and turnover per employee (TE).

Table 5-8 presents the descriptive statistics of the operational performance factors and their indicators. As can be seen, respondents seem to be optimistic about the outcome of implementing lean service practices. The three operational performance factors have an average score higher than the average score of the measurement scale (i.e. 3). However, Table 5-8 reveals that, on average, the highest improvement achieved by the sample firms of this study is in the customer satisfaction with mean value of 4.23 (out of 6). In addition, waste elimination seems to be the second most appreciated improvement factor attributed to lean service given its mean value of 4.10 (out of 6). This is an interesting result in that it supports the capability of lean service to fulfil its promise in improving the customer value by eliminating waste from processes (Ehrlich, 2006; Womack and Jones, 1996).

An examination of the skewness and kurtosis of the three factors and individual associated indicators presented in the last two columns of Table 5-8 demonstrates no serious violation of the normality of the data. All factors and indicators have skewness and kurtosis values less than 3.29 ($p < .001$) as recommended by Hair et al. (2010).

Table 5-9 presents the descriptive statistics of the three financial indicators used in this study. Examining the minimum, maximum and mean columns in Table 5-9 highlights a wide variation in the three financial measures and the potential for outliers which together render the data of these variables non-normally distributed. The data of these variables will be cleaned as indicated in subsection 5.2.2 before using it in the main analysis.

5.4.4 Descriptive statistics of business strategy

Table 5-10 presents the descriptive statistics of the cost leadership and differentiation strategy. As can be seen, the sample firms in this study on average emphasises the differentiation strategy to a larger extent compared to the cost leadership strategy indicated by the higher mean score of the former (4.10 out of 6) in comparison with the latter (3.83). In connection with individual indicators, all indicators for both strategies have a mean score higher than the average of the scale (over 3).

Table 5-8: Descriptive statistics of operational performance factors and indicators

Construct	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
Customer satisfaction	**1**	**6**	**4.23**	**1.22**	**-0.44**	**-0.29**
Customer perception of product/service quality	1	6	4.31	1.32	-0.57	-0.25
Customer satisfaction	1	6	4.37	1.24	-0.46	-0.55
Employees satisfaction and their performance	1	6	4.07	1.15	-0.27	-0.19
Employees understanding of the process	1	6	4.16	1.18	-0.47	-0.19
Waste elimination	**1**	**6**	**4.10**	**1.11**	**-0.23**	**-0.22**
Identification and elimination of waste	1	6	4.10	1.14	-0.20	-0.07
Operational efficiency	1	6	4.18	1.11	-0.23	-0.42
Productivity	1	6	4.07	0.96	-0.07	0.34
Reduction in costs	1	6	4.04	1.23	-0.42	-0.74
Process time reduction	**1**	**6**	**3.44**	**1.33**	**0.04**	**-0.79**
Freeing staff time	1	6	3.48	1.36	0.15	-0.82
Lead time and cycle time	1	6	3.29	1.41	0.10	-0.90
Number of human errors	1	6	3.56	1.22	-0.11	-0.64

Table 5-9: Descriptive statistics of financial performance

Construct	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
Profit Margin	-49.70	70.71	7.36	13.45	1.44	9.94
ROCE	-14.12	371.72	33.22	56.09	3.57	15.94
Turnover per employee	8,227.59	2,027,750	276,005.71	364,629.05	2.47	6.80

However, the most emphasised items in the cost leadership strategy are "making service/procedures more cost efficient" with an average score of 4 out of 6 and "Improving the utilisation of available equipment, services and facilities" with an average score of 3.85 out of 6. On the other hand, the most emphasised indicators for the differentiation strategy are "Providing high quality services" with an average score of 4.47 out of 6 and "Customising services to customers need" with an average score of 4.30 out 6. This underlines the very different focus and priorities for the two different strategies as stated by Porter (1980).

An examination of the skewness and kurtosis of the two factors and individual associated indicators presented in the last two columns of Table 5-10 demonstrates no serious

violation of the normality of the data. All factors and indicators have skewness and kurtosis values less than 3.29 ($p < .001$) as recommended by Hair et al. (2010).

Table 5-10: Descriptive statistics of business strategy

Construct	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
Cost leadership strategy	**1**	**6**	**3.83**	**1.31**	**-0.21**	**-0.61**
Achieving lower cost of services than competitors	1	6	3.77	1.35	-0.26	-0.61
Making service/procedures more cost efficient	1	6	4.00	1.24	-0.26	-0.40
Improving the cost required for coordination of various services	1	6	3.71	1.27	-0.13	-0.43
Improving the utilisation of available equipment, services and facilities	1	6	3.85	1.40	-0.18	-1.02
Differentiation strategy	**1**	**6**	**4.10**	**1.48**	**-0.41**	**-0.84**
Providing high quality services	1	6	4.47	1.51	-0.74	-0.57
Customising services to customers need	1	6	4.30	1.46	-0.63	-0.59
Providing after-sale services and support	1	6	3.93	1.55	-0.30	-1.05
Introducing new services/procedures quickly	1	6	3.92	1.49	-0.18	-0.95
Providing services that are distinct from that of competitors	1	6	4.10	1.48	-0.41	-0.95
Offering a broader range of services than the competitors	1	6	3.84	1.54	-0.19	-1.13
Improving the time it takes to provide services to customers	1	6	4.12	1.32	-0.42	-0.61

5.4.5 Descriptive statistics of MAS

The costing system used by service firms is measured categorically as shown in Table 5-11. The frequency table below indicates that (37%) of service firms in the sample rely on ABC to provide information about their processes and services. In addition, the second most used costing system is the absorption system (33%) followed by the variable costing system (27%).

Table 5-11: Descriptive statistics of MAS

MAS		
Type of Costing System	**Frequency**	**Percent**
Variable costing	27	27
Full absorption costing	33	33
Activity-based costing (ABC)	37	37
Others	2	2
Total	99	100

5.4.6 Descriptive statistics of internationalisation and Unionisation

Table 5-12 reveals the level of internationalisation and unionisation of the sample firms participated in this research study. As can be seen, around 27% and 61% of the sample firms have zero level of internalisation (foreign sales) and unionisation respectively. However, about 55% (41+14) of firms have up to 50% of their sales from foreign markets while 32% (29+3) are unionised up to 50%.

Table 5-12: Descriptive statistics of internationalisation and unionisation

	Internationalisation		Unionisation	
Level of internationalisation/Unionisation	**Frequency**	**Percent**	**Frequency**	**Percent**
0	27	27.27	60	60.6
1-25%	41	41.41	29	29.3
26-50%	14	14.14	3	3
51-75%	14	14.14	4	4
76-100%	3	3.03	3	3
Total	99	100	99	100

5.4.7 Descriptive statistics of firm age and size

Table 5-13 shows that the average age of firms in this study is 31 years which indicates that more mature companies at the account of young companies are represented. The skewness and kurtosis values are above the acceptable level of 3.29 suggested by Hair et al. (2010) which highlights violation to the normality assumption. Similarly, the average number of employees in this study is around one thousand which is far away from the maximum value of twelve thousands and the minimum value of 50. Moreover, the high skewness (3.41) and kurtosis (13.52) values assure violation of the normality assumption. For this reason PLS-SEM has been chosen as it does not assume normality of the data (Hair et al., 2011).

Table 5-13: Descriptive statistics of firm age and firm size

Indicator	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
Age	9.00	120.00	31.03	24.89	1.99	3.72
Number of employees	50.00	11,989.00	1,014.15	1,923.63	3.41	13.52

5.4.8 Correlations and multicollinearity

Multicollinearity takes place when independent variables in a model are strongly associated with each other. The ideal situation for a researcher is to have a high correlation between the independent variables and the dependent variable, but no or little correlation between the independent variables (Hair et al., 2010). High levels of multicollinearity negatively impact the validity of results produced by the examined model because they effect imprecise estimation of the regression coefficients and sometimes their sign too (Hair et al., 2010). "As multicollinearity increases, the total variance explained decreases. Moreover, the amount of unique variance of independent variable is reduced to levels that make estimation of their individual effects quite problematic" (Hair et al., 2010, p. 201). One method for assessing multicollinearity is to examine the correlation matrix of independent variables. The presence of high correlations between independent variables (0.90 or more) can be an indication of a multicollinearity problem (Hair et al., 2010). The correlation matrix of the IVs, reported in Table 5-14, included in this study has been scrutinised to spot all high correlations indicating a multicollinearity problem. The correlations presented in Table 5-14 do not indicate the presence of multicollinearity problem given that the highest correlation is 49% which is far less than the 90% value suggested by Hair et al. (2010). Table 5-15 presents the correlation matrix of all DVs and IVs of this study.

Table 5-15 offers some insights into the relationships between lean service factors and firm operational and financial performance. As can be seen from the table, all correlations between lean service factors and performance factors are positive although not necessarily significant. Surprisingly, none of the correlations between lean service factors and waste elimination is significant at 5% significance level. However, a large number of significant correlations are evident between lean service factors and the other two operational factors,

namely customer satisfaction and process time reduction. At financial level measured by secondary data, Table 5-15 reveals a relatively weaker association between lean service factors and the three financial variables.

Table 5-14: The correlation matrix of the independent variables

	Independent Variables	1	2	3	4	5	6	7	8	9	10	11
1	Age	1										
2	ABC	-0.095	1									
3	Differentiation strategy	0.116	.273**	1								
4	Leadership strategy	0.101	-.261**	0.12	1							
5	Motivation factor	-0.182	-0.134	0.065	.272**	1						
6	Human factor	-0.096	-0.037	.269**	0.051	0.19	1					
7	Process time factor	-0.102	.201*	.281**	.260**	0.139	.269**	1				
8	Physical structure factor	-0.145	.213*	0.139	.220*	.207*	0.184	.463**	1			
9	Customer value factor	-0.033	.202*	.307**	0.172	.200*	.240*	.456**	.491**	1		
10	Error prevention factor	-0.172	0.015	0.06	-0.03	0.123	0.156	0.177	.325**	.219*	1	
11	Size	.333**	-0.129	-0.14	0.096	-0.122	-0.041	-0.072	0.073	0.086	-0.079	1

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 5-15: The correlation matrix of all DVs and IVs of this study

Variables	Customer satisfaction	Waste elimination	Process time reduction	PM	ROCE	TE
ABC	0.05	-0.09	0.08	0.06	-0.15	0.10
Differentiation strategy	.230*	.214*	0.15	.202*	0.04	0.05
Leadership strategy	.309**	.358**	.304**	-0.03	0.09	0.08
Motivation factor	.203*	0.20	.285**	.337**	.211*	0.14
Human factor	0.07	0.10	0.01	0.17	.312**	0.07
Process factor	.279**	0.12	.280**	0.18	0.13	0.05
Physical structure factor	.296**	0.13	.314**	.244*	0.05	0.06
Customer value factor	.365**	0.07	.348**	0.15	0.11	0.10
Error prevention factor	0.08	0.09	.251*	0.04	0.04	0.00
Age	0.00	0.10	0.08	-0.09	-0.19	-0.07
Size	0.01	0.00	0.05	-0.13	0.03	-.232*

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

5.5 Summary of chapter five

In this chapter, the empirical data collected through the questionnaire instrument in addition to the secondary financial data were screened, cleaned and tested against the assumption of parametric tests. Using EFA, the unidimensionality, validity and reliability of measures were examined. In consequence, lean technical factors, lean social factors and operational performance factors were established. Finally descriptive statistics of all constructs included in this study were presented.

Chapter 6 : Statistical analysis using PLS-SEM

6.1 Introduction

This chapter will focus on testing the theoretical model and associated hypotheses developed in chapter 3 of this study by a means of PLS-SEM. PLS-SEM estimates simultaneously the measurement and structural model (Peng and Lai, 2012; Hair et al., 2012). However, the measurement model should first be evaluated to ensure construct reliability and validity and then the structural model representing the research hypotheses can be examined (Hair et al., 2011; Lee et al., 2011).Therefore, in the second section of this chapter, the measurement model linking the various constructs presented in the previous chapter and in Figure 3-3 will be evaluated. In the third section of this chapter, the structural model representing the set of hypotheses developed in chapter three will be formally tested.

6.2 Measurement model

The aim of the measurement model is to ensure that all constructs employed in the model are reliable and valid for testing the structural relations, as there is no point of testing such relations with invalid and/or unreliable measures (Hair et al., 2011). The first step for constructing the measurement model is to identify all constructs along with related indicators that should be included in the measurement model. Constructs included in the measurement model will be reported below.

6.2.1 Constructs of the measurement model

Information on the constructs of the measurement model will be obtained from the analysis conducted in the previous chapter. First, the measurement model will include the four factors representing the technical side of lean service along with their associated indicators presented in Table 5-6. In addition, the model will include the two factors representing the social side of lean service along with their associated indicators reported in Table 5-7. Further, two constructs indicating the type of business strategy adopted (differentiation vs. cost leadership) which has been established in Table 5-10 will also be

involved. As shown in Table 5-11, the costing system used by the sample firms has been measured by a categorical measure with three categories, namely variable costing system, absorption costing system and ABC. Therefore, the first two categories are combined to represent companies using traditional accounting systems. A dummy variable is then formed in which ABC is decoded 1 and 0 otherwise. Operational performance will be represented by the three factors presented in Table 5-8 along with their associated indicators. In regard to the financial performance, the three financial performance measures reported in Table 5-9 will also be included. However, because objective financial measures are usually different for different industries, these three measures have been adjusted by subtracting the industry median performance from the performance of the sample firms (Shafer and Moeller, 2012; Swink and Jacobs, 2012). Finally, firm size and age as presented in Table 5-13 and three variables to control for the effect of past performance of PM, ROCE and TE are added. Figure 6-1 depicts the measurement model. The associated indicators of each construct have not been added for simplicity. However, these indicators can be found in Tables 5-5 to 5-13 as has been explained above.

6.2.2 Measurement model evaluation

6.2.2.1 Construct reliability

To evaluate construct reliability in PLS-SEM, Hair et al. (2011) suggest the reliance on composite reliability measure rather than Cronbach's alpha as the former does not assume all indicators are equally reliable which makes it more suitable to PLS-SEM. A construct is said to be reliable if its composite reliability value is above 0.70 for advanced research or above 0.60 for exploratory research (Hair et al., 2011).

However, Smartpls calculates both the composite reliability measure and Cronbach's alpha value for each construct. These are shown in Table 6-1. As can be seen from Table 6-1, the composite reliability value for all constructs is well beyond the acceptable value of 0.70. In addition, the Cronbach's alpha for all but "Error prevention factor" is higher than 0.70. This strongly supports the reliability of constructs used in this study.

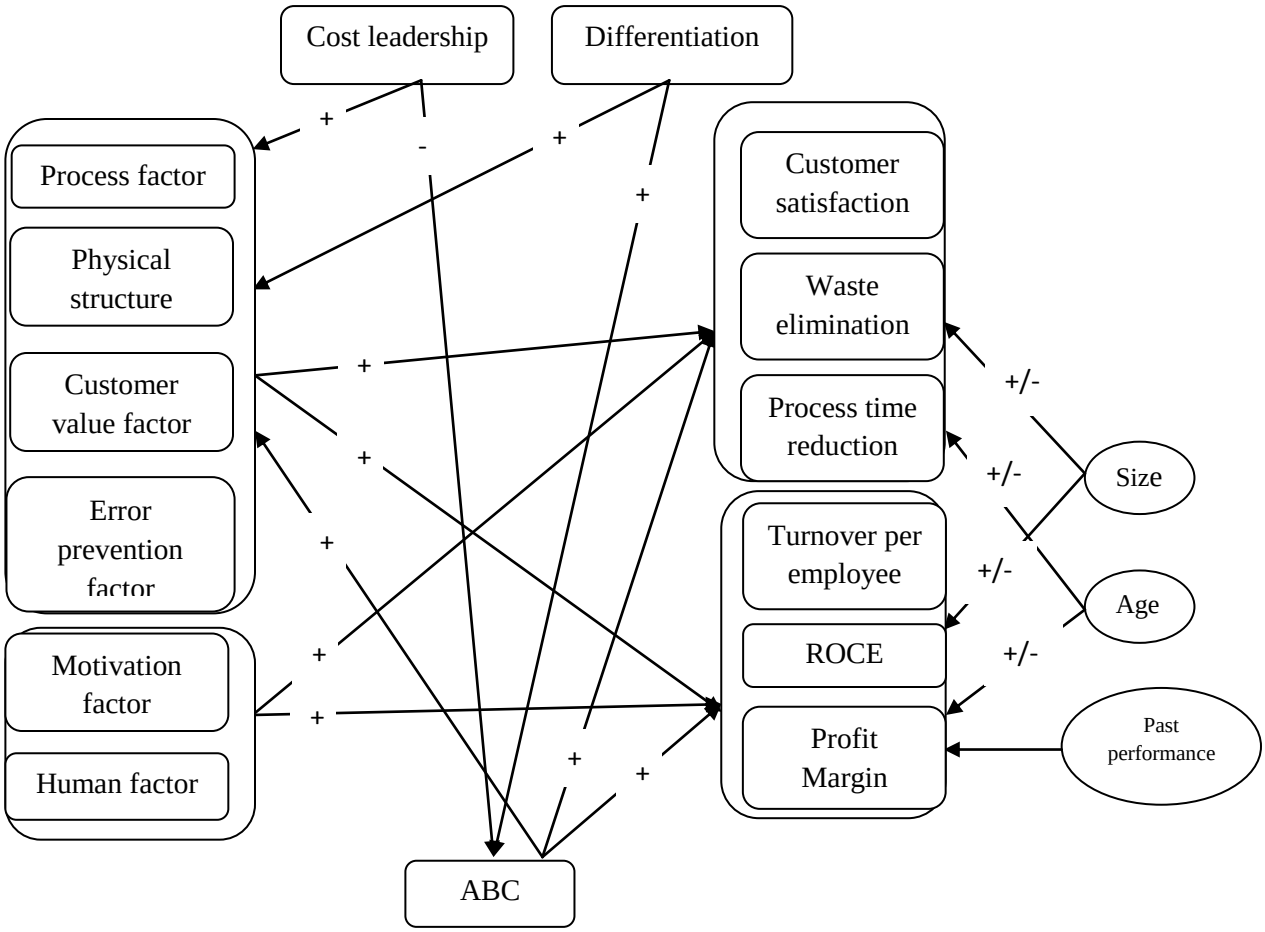

Figure 6-1: The measurement and structural model

6.2.2.2 Construct validity (convergent and discriminant)

Hair et al. (2011) point out that construct validity in a reflective measurement models like the one in this study can be assessed by examining the convergent and discriminant validity (see subsection 5.3.4). Convergent validity of a construct is evident if AVE of that construct is 0.5 or higher (Hair et al., 2011). With regard to the discriminant validity, two methods can be used the Fornell-Larcker criterion and cross loadings (Hair et al., 2011). For a construct to have a discriminant validity under the Fornell-Larcker criterion (Fornell and Larcker, 1981), AVE of that construct should be higher than the squared correlation of that construct with any other construct in the model. This method can also be applied by comparing the square root of AVE of a specific construct with its correlations with other constructs in the model (Hair et al., 2010). Under the second method (i.e. cross loadings),

discriminant validity is evident when an indicator's loading with its associated construct is higher than its loading with any other construct in the model (Hair et al., 2011).

Table 6-1: Reliability and validity measures of constructs

Construct	AVE	Composite Reliability	Cronbach's Alpha
Age	1	1	1
ABC	1	1	1
Differentiation	0.69	0.94	0.92
Cost leadership	0.61	0.86	0.81
Motivation factor	0.73	0.93	0.91
Human factor	0.77	0.93	0.90
Process factor	0.54	0.87	0.83
Physical structure factor	0.64	0.88	0.81
Customer value factor	0.54	0.82	0.71
Error prevention factor	0.76	0.86	0.68
Customer satisfaction	0.74	0.89	0.83
Waste elimination	0.62	0.83	0.71
Process time reduction	0.68	0.86	0.77
Profit Margin	1	1	1
ROCE	1	1	1
Size	1	1	1
Turnover per employee	1	1	1

As can be seen from Table 6-1, AVE for all constructs in the model is higher than the suggested value of 0.50 which supports the convergent validity of those constructs. To examine the discriminant validity of constructs following the Fornell-Larcker criterion, the correlation matrix between constructs is constructed as presented in Table 6-2. As can be noticed from Table 6-2, the square root of AVE of each construct is higher than its correlation with any other construct in the model which clearly supports the discriminant validity of the constructs.

To double check the discriminant validity using the cross loadings method, Table 6-3 has been constructed. Exploring the results in Table 6-3 reveals that all indicators have significantly higher loadings with their respected constructs compared to their loadings with other constructs in the model. In other words, no serious sign of cross loadings which further supports the discriminant validity of the constructs employed in this study.

Table 6-2: The correlation matrix of constructs and square root of AVE

Construct	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1 Age	**1.00**																
2 ABC	-0.10	**1.00**															
3 Differentiation	0.12	0.27	**0.83***														
4 Cost leadership	0.10	-0.26	0.12	**0.78**													
5 Motivation factor	-0.18	-0.13	0.07	0.27	**0.85**												
6 Human factor	-0.10	-0.04	0.27	0.05	0.19	**0.88**											
7 Process factor	-0.10	0.20	0.28	0.26	0.14	0.27	**0.73**										
8 Physical structure factor	-0.15	0.21	0.14	0.22	0.21	0.18	0.46	**0.80**									
9 Customer value factor	-0.03	0.20	0.31	0.17	0.20	0.24	0.46	0.49	**0.74**								
10 Error prevention factor	-0.17	0.01	0.06	-0.03	0.12	0.16	0.18	0.32	0.22	**0.87**							
11 Customer satisfaction	0.00	0.06	0.23	0.31	0.20	0.08	0.28	0.30	0.38	0.08	**0.86**						
12 Waste elimination	0.12	-0.11	0.22	0.36	0.21	0.08	0.12	0.12	0.07	0.13	0.48	**0.79**					
13 Process time reduction	0.08	0.10	0.14	0.30	0.27	0.02	0.30	0.33	0.36	0.26	0.46	0.41	**0.83**				
14 Profit Margin	-0.09	0.06	0.20	-0.03	0.34	0.17	0.18	0.24	0.15	0.04	0.01	0.02	0.14	**1.00**			
15 ROCE	-0.19	-0.15	0.04	0.09	0.21	0.31	0.13	0.05	0.11	0.04	0.11	0.00	-0.03	0.44	**1.00**		
16 Size	0.33	-0.13	-0.14	0.10	-0.12	-0.04	-0.07	0.07	0.09	-0.08	0.00	-0.01	0.06	-0.13	0.02	**1.00**	
17 Turnover per employee	-0.07	0.10	0.05	0.08	0.14	0.07	-0.05	0.06	0.10	0.00	0.03	0.06	0.03	-0.08	-0.13	-0.23	**1.00**

* Values in the diagonal represent the square root of AVE for each construct.

Having the measurement model passed the reliability and validity tests of its constructs, the structural model now can be estimated and the hypotheses of this study be tested accordingly (Hair et al., 2011).

6.3 Structural model

Having ensured that the constructs included in the model of this study are valid and reliable, the analysis can proceed to estimate and evaluate the structural model representing the hypotheses developed in chapter 3. For this, all constructs presented in Table 6-4 should be included in the structural model. Compared to the measurement model, the structural model has a product term of each of the four technical factors of lean service with each of its two social factors. These are important for testing the synergy proposed in H3a and H3b (see Table 3-4).

Table 6-3: Correlation matrix of constructs and indicators

Indicators	1	2	3	4	5	6	7	8	9	10	11
Differ1	**0.72**	0.19	0.29	0.27	-0.04	0.10	0.13	0.12	0.20	0.25	0.17
Differ2	**0.88**	0.01	0.28	0.21	0.08	0.28	0.06	0.05	0.25	0.21	0.02
Differ3	**0.86**	0.00	0.25	0.31	0.21	0.32	0.13	0.06	0.15	0.16	0.13
Differ4	**0.88**	0.04	0.21	0.32	0.13	0.32	0.04	0.11	0.25	0.18	0.14
Differ5	**0.82**	0.10	0.16	0.17	0.15	0.19	-0.04	0.25	0.20	0.30	0.17
Differ6	**0.80**	0.00	0.10	0.09	0.05	0.25	-0.03	0.08	0.06	0.15	0.06
Differ7	**0.82**	0.11	0.26	0.18	0.15	0.23	0.04	0.08	0.24	0.23	0.17
Reward system	0.01	**0.84**	0.14	0.09	0.14	0.23	-0.02	0.17	0.15	0.13	0.13
Communication system	-0.07	**0.85**	0.05	0.06	0.16	0.12	0.10	0.29	0.14	0.24	0.29
Management support	0.08	**0.89**	0.19	0.17	0.24	0.22	0.13	0.30	0.22	0.17	0.27
Performance measurement system	0.16	**0.82**	0.23	0.09	0.19	0.14	0.26	0.22	0.22	0.18	0.21
Training	0.11	**0.86**	0.20	0.16	0.14	0.12	0.09	0.19	0.16	0.28	0.27
Employee empowerment	0.24	0.20	**0.83**	0.20	0.17	0.17	0.08	0.16	0.10	0.10	0.05
Employee commitment	0.21	0.13	**0.88**	0.29	0.18	0.24	0.09	0.04	0.10	0.09	0.01
Employee involvement	0.32	0.15	**0.90**	0.25	0.17	0.30	0.18	0.04	0.02	0.10	0.00
Leadership	0.19	0.20	**0.90**	0.21	0.14	0.12	0.19	0.00	0.03	0.08	0.02
Automation	0.19	0.13	0.23	**0.75**	0.25	0.25	-0.01	0.28	0.29	0.30	0.29
Just in Time	0.06	0.10	0.16	**0.74**	0.42	0.30	0.12	0.13	0.23	0.10	0.30
Pull system	0.33	0.05	0.17	**0.74**	0.32	0.35	0.28	0.24	0.09	0.08	0.14
Quick set up time	0.28	0.10	0.27	**0.70**	0.34	0.44	0.27	0.24	0.21	0.02	0.11
Small lots	0.16	0.00	0.14	**0.73**	0.41	0.36	0.03	0.12	0.23	0.11	0.24
Work load balancing	0.29	0.23	0.23	**0.72**	0.33	0.39	0.19	0.12	0.09	-0.08	0.15
5Ss	0.11	0.15	0.14	0.25	**0.75**	0.34	0.23	0.19	0.24	-0.05	0.18
Group technology	0.19	0.13	0.17	0.44	**0.85**	0.45	0.25	0.11	0.21	0.11	0.23
Improving facility layout	0.08	0.21	0.19	0.39	**0.88**	0.35	0.32	0.22	0.29	0.12	0.31
Visualisation	0.06	0.17	0.08	0.38	**0.72**	0.44	0.23	0.19	0.19	0.13	0.34
Kaizen blitz	0.34	0.06	0.18	0.46	0.38	**0.76**	0.15	0.03	0.30	-0.09	0.29
Policy deployment/Hoshin Kanri	0.21	0.19	0.19	0.30	0.36	**0.80**	0.17	0.10	0.24	0.07	0.31
Quality function deployment	0.21	0.28	0.30	0.36	0.40	**0.77**	0.29	0.23	0.34	0.15	0.27
Value stream mapping	0.12	0.04	0.01	0.18	0.31	**0.58**	0.00	0.16	0.15	0.05	0.20
Root cause analysis	0.08	0.17	0.21	0.12	0.27	0.23	**0.88**	0.01	0.11	0.13	0.21
Total preventive maintenance	0.02	0.05	0.06	0.18	0.29	0.14	**0.86**	-0.07	0.03	0.06	0.24
Leader1	-0.03	0.14	-0.02	0.11	0.02	-0.01	-0.07	**0.59**	0.11	0.13	0.13
Leader2	0.06	0.22	-0.02	0.16	0.05	-0.06	0.03	**0.77**	0.24	0.33	0.23
Leader3	0.15	0.26	0.03	0.30	0.27	0.19	0.02	**0.88**	0.27	0.42	0.28
Leader4	0.10	0.21	0.12	0.19	0.22	0.26	-0.09	**0.86**	0.32	0.24	0.26
Customer satisfaction	0.15	0.16	-0.09	0.14	0.16	0.14	0.04	0.30	**0.80**	0.47	0.30
Employees satisfaction and their performance	0.24	0.17	0.11	0.29	0.26	0.32	0.08	0.20	**0.88**	0.43	0.41
Employees understanding of the process	0.19	0.19	0.11	0.27	0.32	0.44	0.07	0.32	**0.87**	0.50	0.44
Productivity	0.22	0.15	0.10	0.16	0.14	0.07	0.10	0.38	0.47	**0.80**	0.40
Reduction in costs	0.14	0.15	0.11	0.05	0.11	0.06	-0.01	0.23	0.38	**0.72**	0.15
Identification and elimination of waste	0.15	0.19	0.01	0.05	0.05	0.04	0.17	0.25	0.38	**0.77**	0.36
Freeing staff time	0.14	0.30	-0.02	0.16	0.15	0.19	0.15	0.30	0.48	0.43	**0.80**
Lead time and cycle time	0.10	0.14	0.04	0.35	0.36	0.40	0.25	0.21	0.31	0.21	**0.82**
Number of human errors	0.12	0.27	0.01	0.20	0.27	0.27	0.22	0.25	0.41	0.39	**0.85**

(1) Differentiation, (2) Motivation factor, (3) Human factor, (4) Process factor, (5) Physical structure factor, (6) Customer value factor, (7) Error prevention factor, (8) Cost leadership, (9) Customer satisfaction, (10) Waste elimination, (11) Process time reduction

Table 6-4: Constructs included in the structural model with respective reasons for their inclusion

Constructs	Reason
Process factor	H1a-H1b, H7, H8, H11
Physical structure factor	H1a-H1b, H7, H8, H11
Customer value factor	H1a-H1b, H7, H8, H11
Error prevention factor	H1a-H1b, H7, H8, H11
Motivation factor	H2a-H2b
Human factor	H2a-H2b
Motivation factor * Process factor	H3a-H3b
Human factor * Process factor	H3a-H3b
Motivation factor * Physical structure factor	H3a-H3b
Human factor * Physical structure factor	H3a-H3b
Motivation factor * Customer value factor	H3a-H3b
Human factor * Customer value factor	H3a-H3b
Motivation factor * Error prevention factor	H3a-H3b
Human factor * Error prevention factor	H3a-H3b
Age	H4a-H4b
ABC	H5a-H5b, H9, H10, H11
Size	H6a-H6b
Differentiation	H7, H9
Cost leadership	H8, H10
Lag profit margin	To control for previous performance effect
Lag ROCE	To control for previous performance effect
Lag turnover/employee	To control for previous performance effect
Performance constructs	
Customer satisfaction	H1a-H6b
Waste elimination	H1a-H6b
Process time reduction	H1a-H6b
Industry-adjusted Profit margin	H1a-H6b
Industry-adjusted ROCE	H1a-H6b
Industry-adjusted Turnover/employee	H1a-H6b

The hypotheses developed in Chapter 3 and summarised in Table 3-4 will be tested using PLS-SEM and the Smartpls package in three stages as explained below.

6.3.1 Stages for hypotheses testing using PLS-SEM

In the first stage, the structural model will be estimated with all variables in Table 6-4 being included except the interaction terms necessary for H3a and H3b. This stage is important for testing the main effect of the technical and social lean service factors (i.e. H1a-H2b). As explained by Hair et al. (2013), a model that has an independent variable X, an independent variable Z and an interaction term X*Z cannot be used to estimate the main effect of X and Z on a dependent variable Y. The logic behind this argument is that

when the interaction term (X*Z) is included, the coefficients of X and Z represent their conditional rather than main effect. That is, the coefficient of X indicates the effect of X on Y when Z is zero. Similarly, the coefficient of Z indicates the effect of Z on Y when X is zero (Hair et al., 2013).

In the second stage, eight interaction terms (four technical factors * two social factors, printed in bold in Table 6-4) are created using the feature available in Smartpls for testing H3a and H3b. The Smartpls package creates an interaction latent variable term (e.g. Motivation factor * Process factor) by building product terms using the indicators of the latent independent variables (i.e. Motivation factor and Process factor). These product terms serve as indicators of the interaction term (i.e. Motivation factor * Process factor) in the structural model (Henseler and Chin, 2010). To reduce the level of multicollinearity usually resulting from the inclusion of interaction terms, Smartpls allows for standardising the indicators of the latent independent variables used for creating the product terms serving as indicators of the eight interaction terms (Henseler and Chin, 2010). However, due to one unique feature of PLS-SEM, the coefficient of the 8 interaction terms cannot be interpreted without adjustment (Henseler and Chin, 2010).

For an appropriate and valid interaction analysis, an interaction term (X*Z) is created after standardising both X and Z. Although X and Z enter the analysis in their standardised form, the interaction term (X*Z) should not be standardised (Henseler and Chin, 2010). However, as Henseler and Chin (2010) highlight, PLS calculates path coefficients from standardised latent variable scores. That is, for the structural model, PLS will standardise all latent variables including the interaction terms. This renders the resulting interaction term path coefficients invalid for interpretation without adjustment. For making these coefficients interpretable, Henseler and Chin (2010) suggest modifying the standard deviation of the interaction term's latent variable score before calculating the structural model with the interaction term. This can be done by multiplying the latent variable scores of the interaction term by the weighted average of the standard deviations of the product indicators using the respective loadings as weights (Henseler and Chin, 2010).

Having adjusted the latent variable scores of the eight interaction terms included in the model, the third and final stage for testing H3a and H3b will begin by estimating the structural model with all variables presented in Table 6-4 are included with the adjusted scores of the interaction terms. It is the results of this third round estimation that will be used to examine the interaction effect suggested by H3a and H3b.

6.3.2 Structural model specification and evaluation

The structural model of this study will be tested using Smartpls 2.0. This version performs a PLS analysis with the following settings: the Weighting Scheme is the "Path Weighting Scheme", Data Metric is "Mean 0, Var1", Maximum Iterations are "300", Abort criterion is "1.0E-5" and Initial Weights are "1".

To evaluate the structural model, as indicated in subsection 4.11.3.2, R^2 and path coefficients are the primary indications (Hair et al., 2011). The significance of path coefficients will be obtained through bootstrapping technique. Hair et al. (2011) point out that the larger the number of samples used during the bootstrapping process, the more robust the findings will be. Therefore, instead of relying on the default number of 200 for bootstrapping in Smartpls 2.0, the bootstrapping process will be applied on 500 samples with the number of cases is equal to the sample size of this study which is "99". Another important criterion for assessing the structural model is its predictive capability (Hair et al., 2011). The predictive capability of the model is usually evaluated by the Stone-Geisser Q^2 value (Geisser, 1974; Stone, 1974), which assumes that the model must be able to predict each endogenous latent construct's indicator (Hair et al., 2011). This Q^2 value is calculated using the blindfolding technique which omits part of the data systematically and uses the resulting estimates to predict the omitted part of the data (Hair et al., 2011). Two forms of Q^2 are usually produced by Smartpls the cross-validated communality and the cross-validated redundancy. However, Hair et al. (2011) recommend using the latter rather than the former as it uses the PLS-SEM estimates of both the structural and measurement models for data prediction. A Q^2 value of larger than zero implies that the exogenous constructs have predictive relevance for the endogenous constructs included in the model. Table 6-5 presents the two forms of Q^2 .

Table 6-5: Cross validated Communality and Redundancy

Construct	Cv-communality	Cv-redundancy
Age	1.0000	
Differentiation	0.6869	
Lag profit margin	1.0000	
Lag ROCE	1.0000	
Lag turnover/employee	1.0000	
Cost leadership	0.6151	
Motivation factor	0.7285	
Human factor	0.7693	
Size	1.0000	
ABC	1.0000	0.1628
Process factor	0.5423	0.0925
Physical structure factor	0.6440	0.0817
Customer value factor	0.5450	0.0745
Error prevention factor	0.7603	0.0020
Customer satisfaction	0.7300	0.3301
Waste elimination	0.6286	0.2231
Process time reduction	0.6792	0.3030
Profit margin	0.9926	0.6030
ROCE	0.9967	0.5947
Turnover/employee	0.9962	0.7953

As can be seen, all values in Table 6-5 are larger than zero indicating a satisfactory level of predictive relevance of the model.

6.4 Hypotheses testing

In this section the research hypotheses will be tested and reported. For this purpose, the hypotheses are classified into two groups. The first group includes hypotheses focusing the relationship between lean service bundles, contextual variables and firm performance. The second group includes those hypotheses that focus on the impact of business strategy and ABC on the lean service bundles. The results are reported in Tables 6-6 and 6-7.

Table 6-6: Lean bundles, contextual variables and firm performance-results from PLS-SEM

	Endogenous variables										
	ABC	Process factor	Physical structure factor	Customer value factor	Error prevention factor	Customer satisfaction	Waste elimination	Process time reduction	PM	ROCE	TE
	Standardised coefficient (β)										
Differentiation	0.31 (3.89)***	0.18 (1.83)*	0.03 (0.27)	0.23 (2.42)**	0.07 (0.65)						
Cost leadership	-0.3 (3.29)***	0.3 (2.82)***	0.29 (2.54)**	0.19 (1.59)	-0.04 (0.33)						
ABC		0.23 (2.21)**	0.28 (3)***	0.19 (1.9)*	-0.02 (0.12)	-0.03 (0.33)	-0.09 (0.92)	0.06 (0.57)	0.05 (0.48)	0 (0.01)	0.09(1.36)
Motivation factor						0.12 (1.1)	0.19 (1.52)	0.24 (2.23)**	0.2 (2.32)**	0.04 (0.46)	0.01(0.12)
Human factor						-0.06 (0.54)	0.01 (0.12)	0.14 (1.28)	0.14 (1.49)	0.28 (3.42)***	0.01(0.14)
Process factor						0.11 (0.9)	0.09 (0.62)	0.15 (1.14)	0.002 (0.01)	0.14 (1.58)	0.03(0.46)
Physical structure factor						0.14 (1.16)	0.08 (0.58)	0.09 (0.9)	0.06 (0.46)	-0.11 (1)	-0.05(0.81)
Customer value factor						0.27 (1.98)**	-0.04 (0.28)	0.19 (1.54)	0.06 (0.57)	0.02 (0.19)	-0.01(0.16)
Error prevention factor						0.05 (0.44)	0.11 (0.85)	0.18 (1.9)*	-0.1 (0.9)	0.01 (0.06)	0.03(0.4)
Age						0.05 (0.52)	0.2 (1.67)*	0.17 (1.53)	-0.05 (0.53)	-0.11 (1.34)	0.09(1.44)
Size						-0.04 (0.39)	-0.05 (0.57)	0.04 (0.4)	-0.09 (1.04)	0.13 (1.75)*	
Lag profit margin									0.54 (4.89)***		
Lag ROCE										0.62 (6.45)***	
Lag turnover/employee											0.89 (14.5)***
R^2	0.162	0.174	0.128	0.143	0.005	0.192	0.105	0.275	0.432	0.522	0.771

* $p \leq 0.10$, ** $p \leq 0.05$, *** $p \leq 0.01$
t value in brackets

Table 6-7: Lean bundles interaction and firm performance- results from PLS-SEM

	Endogenous variables										
	ABC	Process factor	Physical structure factor	Customer value factor	Error prevention factor	Customer satisfaction	Waste elimination	Process time reduction	PM	ROCE	TE
	Standardised coefficient (β)										
Differentiation	0.31 (3.83)***	0.18 (1.84)*	0.03 (0.26)	0.23 (2.4)**	0.07 (0.58)						
Cost leadership	-0.3 (3.09)***	0.3 (2.75)***	0.29 (2.68)***	0.19 (1.64)	-0.04 (0.34)						
ABC		0.23 (2.07)**	0.28 (2.79)***	0.19 (2)**	-0.02 (0.12)	-0.01 (0.08)	-0.04 (0.43)	0.01 (0.07)	0.03 (0.34)	-0.01 (0.08)	0.09 (1.27)
Motivation factor						0.23 (2.16)**	0.25 (2.17)**	0.27 (2.6)***	0.2 (2.1)**	0.03 (0.32)	0.03 (0.58)
Human factor						0.05 (0.44)	0.01 (0.13)	0.1 (1.02)	0.04 (0.46)	0.26 (2.85)***	0.01 (0.19)
Process factor						0.01 (0.11)	0.05 (0.46)	0.06 (0.55)	0.01 (0.06)	0.14 (1.47)	-0.01 (0.13)
Physical structure factor						0.33 (2.79)***	0.16 (1.36)	0.2 (1.8)*	0.01 (0.09)	-0.11 (1.15)	-0.01 (0.09)
Customer value factor						0.05 (0.38)	-0.14 (0.88)	0.06 (0.51)	0.13 (1.24)	0.03 (0.23)	-0.05 (0.58)
Error prevention factor						0.1 (1.02)	0.01 (0.08)	0.05 (0.5)	-0.08 (0.84)	-0.01 (0.17)	0.01 (0.1)
Age						0.08 (0.83)	0.22 (1.96)**	0.17 (1.61)	-0.03 (0.31)	-0.12 (1.27)	0.08 (1.3)
Size						0.06 (0.5)	-0.03 (0.33)	0.06 (0.58)	-0.14 (1.41)	0.06 (0.71)	
Lag profit margin									0.42 (4.04)***		
Lag ROCE										0.59 (6.94)***	
Lag turnover/employee											0.85 (10.56)***
Motivation factor * Process factor						0.25 (2.79)***	0.14 (1.26)	0.14 (1.05)	0.18 (1.71)*	0.18 (2.29)**	-0.08 (1.18)
Human factor * Process factor						-0.06 (0.56)	0.22 (2.3)**	0.18 (1.7)*	0.18 (1.71)*	0.13 (1.33)	-0.04 (0.5)
Motivation factor * Physical structure factor						0.03 (0.26)	0.23 (2.1)**	0.2 (1.83)*	0.15 (1.5)	0.14 (1.54)	0.03 (0.53)
Human factor * Physical structure factor						-0.03	0.1	-0.07 (0.64)	0.26	-0.01	0.09

						(0.19)	(0.88)			(2.15)**	(0.07)	(1.11)
Motivation factor * Customer value factor						0.25	0.19			0.14	0.18	-0.04
						(2.59)***	(1.52)	0.05	(0.39)	(1.64)	(2.26)**	(0.58)
Human factor * Customer value factor						0.12	0.1			0.05	-0.07	-0.04
						(0.88)	(0.77)	0.11	(0.99)	(0.44)	(0.61)	(0.55)
Motivation factor * Error prevention factor						0.27	0.27			-0.04	-0.05	0.09
						(2.44)**	(2.39)**	0.2	(1.69)*	(0.32)	(0.71)	(0.94)
Human factor * Error prevention factor						-0.06	0.15			0.11	0.03	-0.05
						(0.55)	(1.39)	-0.01	(0.07)	(0.98)	(0.34)	(0.62)
R^2	0.162	0.174	0.128	0.143	0.005	0.44	0.375	0.459		0.593	0.591	0.789

* $p \leq 0.10$, ** $p \leq 0.05$, *** $p \leq 0.01$
t-statistic in brackets

6.4.1 Lean bundles, contextual variables and firm performance

This study expects that both the social and technical bundles of lean service have an independent positive impact on both operational and financial performance. Further, it is expected in this research that the technical and social bundles of lean service will interact to improve firm performance beyond that improvement achieved by each set of bundles separately. In addition, three contextual variables (i.e. firm size, firm age and ABC) are assumed to have a relationship with firm operational and financial performance. This subsection presents the results of testing for the expected associations between lean bundles, their interaction, contextual variables and firm operational and financial performance.

6.4.1.1 The main effect of lean technical bundles on firm performance

The first two hypotheses in this research study (H1a and H1b) predict a direct positive relation between the four technical bundles of lean service (i.e. process factor, physical structure factor, customer value factor and error prevention factor) and firm operational and financial performance. The results reported in Table 6-6 indicate that only two factors are positively associated with only operational performance. Specifically, the customer value factor is found to have a positive relationship with customer satisfaction ($\beta = 0.27$, $p < 0.05$). In addition, the error prevention factor is positively related to process time reduction ($\beta = 0.18$, $p < 0.10$). This provides partial support for H1a. However, none of the four technical lean bundles is found to be related to the three financial indicators used in this study which does not support H1b.

6.4.1.2 The main effect of lean social bundles on firm performance

As stated in H2a and H2b, the two social bundles of lean service are anticipated to have a direct positive relation with firm operational and financial performance. Table 6-6 reveals a direct positive association between the motivation factor and process time reduction. The two social bundles are found to have a direct positive relationship with financial performance. Specifically, while the motivation factor has a direct positive association with profit margin ($\beta = 0.20$, $p < 0.05$), the human factor is directly and positively related

to ROCE ($\beta = 0.28$, $p < 0.01$). Collectively, these findings bear support for H2b but only partial support for H2a.

6.4.1.3 The synergy between the social and technical bundles of lean service

The social and technical bundles of lean service are expected to collaborate in improving firm performance over and above the improvement achieved from each set separately as indicated by H3a and H3b. Inspecting the results reported in Table 6-7 lends support to this notion. It is found that different social and technical bundles positively interact to improve different dimensions of firm operational and financial performance. The results in Table 6-7 demonstrate that while the process factor positively interacts with the motivation factor to improve customer satisfaction ($\beta = 0.25$, $p < 0.01$), profit margin ($\beta = 0.18$, $p < 0.10$) and ROCE ($\beta = 0.18$, $p < 0.05$), it also positively interacts with the human factor to improve waste elimination ($\beta = 0.22$, $p < 0.05$), process time reduction ($\beta = 0.18$, $p < 0.10$) and profit margin ($\beta = 0.18$, $p < 0.10$). Further, the physical structure factor collaborates with the motivation factor to enhance waste elimination ($\beta = 0.23$, $p < 0.05$) and process time reduction ($\beta = 0.20$, $p < 0.10$). The physical structure factor also interacts with the human factor to improve profit margin ($\beta = 0.26$, $p < 0.05$). The customer value factor seems to be less effective as it only interacts with motivation factor to improve customer satisfaction ($\beta = 0.25$, $p < 0.01$) and ROCE ($\beta = 0.18$, $p < 0.05$). Finally, the error prevention factor is shown to merely interact with the motivation factor to improve all operational performance factors, namely customer satisfaction ($\beta = 0.27$, $p < 0.05$), process time ($\beta = 0.20$, $p < 0.10$) and waste elimination ($\beta = 0.27$, $p < 0.05$). These findings collectively validate H3a and H3b stated in this research.

6.4.1.4 Firm age and performance

The effect that firm age has on firm performance has not been clear given the contrasting theoretical and empirical evidence presented in subsection 3.5.2.1. Therefore, H4a and H4b have been stated in the non-directional form. However, the results in Table 6-6 implies that firm age has a positive relation with operational performance represented by waste elimination factor ($\beta = 0.20$, $p < 0.10$). No evidence of relationship between firm

age and financial performance is detected. Consequently, H4a is supported while H4b is not supported.

6.4.1.5 ABC and performance

The use of ABC is expected to directly improve the operational and financial performance of firms as expected in H5a and H5b. however, the results reported in both Table 6-6 and Table 6-7 do not support neither of these hypotheses. ABC is not significantly related with any of the operational and financial performance factors. Therefore, H5a and H5b are rejected.

6.4.1.6 Firm size and performance

Like the effect of firm age on performance, the effect of firm size has not been clear given the contrasting theoretical and empirical evidence presented in subsection 3.5.2.3. Therefore, H6a and H6b have been stated in the non-directional form. However, the results in Table 6-6 indicate a positive relation between firm size and financial performance represented by ROCE ($\beta = 0.13$, $p < 0.10$). No significant association between firm size and operational performance is detected. In consequence, H6a is rejected and H6b is supported.

6.4.2 Lean technical bundles, ABC and business strategy

The second set of hypotheses concerns the impact of the use of ABC and business strategy adopted on the technical bundles of lean service. Therefore, this subsection will present the results of testing the last five hypotheses in this study which are H7-H11.

6.4.2.1 Differentiation strategy and lean technical bundles

As the literature review has revealed, it is expected that adopting the differentiation strategy will have a direct and positive impact on the implementation of lean technical bundles (H7). Inspection of the results reported in Table 6-6 highlights a direct positive impact of adopting the differentiation strategy on process factor ($\beta = 0.18$, $p < 0.10$) and customer value factor ($\beta = 0.23$, $p < 0.05$). As a result, H7 is proved by this empirical result.

6.4.2.2 Cost leadership strategy and lean technical bundles

H8 predicts a direct and positive influence of adopting a cost leadership strategy on the implementation of lean technical bundles. The results shown in Table 6-6 demonstrate a strong positive effect of adopting the cost leadership strategy on the implementation of the process factor ($\beta = 0.30$, $p < 0.01$) and physical structure factor ($\beta = 0.29$, $p < 0.05$). This apparently supports H8.

6.4.2.3 Differentiation strategy and ABC

Adoption of the differentiation strategy is expected to be positively association with the implementation of ABC as stated in H9. This hypothesis is strongly supported given the large and significant path coefficient ($\beta = 0.31$, $p < 0.01$) form differentiation strategy to ABC reported in Table 6-6.

6.4.2.4 Cost leadership strategy and ABC

It is assumed in this research that companies adopting the cost leadership will less likely to rely on ABC as can be indicated from H10. This hypothesis is strongly supported. Table 6-6 provides evidence on the negative relation between the adoption of the cost leadership strategy and the use of ABC ($\beta = -0.30$, $p < 0.01$).

6.4.2.5 ABC and the technical bundles of lean service

The last hypothesis in this study anticipates a positive association between the use of ABC and the implementation of the technical bundles of lean service (H11). The results of both Table 6-6 and Table 6-7 are consistent in supporting this hypothesis. The use of ABC is positively associated with three technical factors, namely process factor ($\beta = 0.23$, $p < 0.05$), physical structure factor ($\beta = 0.28$, $p < 0.01$) and customer value factor ($\beta = 0.19$, $p < 0.10$). Table 6-8 summarises the outcome of hypotheses testing. As can be seen from Table 6-8, all but four hypotheses have been supported by the empirical analysis conducted in this study.

Table 6-8: Summary table of hypotheses testing

No.	Hypotheses	Expected results	Empirical results
H1a	There is a direct positive relationship between LTPs and operational performance of service firms.	+	Partial support
H1b	There is a direct positive relationship between LTPs and financial performance of service firms.	+	Rejected
H2a	There is a direct positive relationship between LSPs and operational performance of service firms.	+	Partial support
H2b	There is a direct positive relationship between LSPs and financial performance of service firms.	+	Supported
H3a	There is a synergy between LTPs and LSPs in improving operational performance of service firms.	+	Supported
H3b	There is a synergy between LTPs and LSPs in improving financial performance of service firms.	+	Supported
H4a	There is a direct relationship between firm age and operational performance of service firms.	+/-	Supported (+)
H4b	There is a direct relationship between firm age and financial performance of service firms.	+/-	Rejected
H5a	There is a positive relationship between the use of ABC and operational performance of service firms.	+	Rejected
H5b	There is a positive relationship between the use of ABC and financial performance of service firms.	+	Rejected
H6a	There is a direct relationship between firm size and operational performance of service firms.	+/-	Rejected
H6b	There is a direct relationship between firm size and financial performance of service firms.	+/-	Supported (+)
H7	There is a direct positive relation between differentiation strategy and the implementation of LTPs.	+	Supported
H8	There is a direct positive relation between cost leadership strategy and the implementation of LTPs.	+	Supported
H9	The differentiation strategy is positively related to the adoption of ABC	+	Supported
H10	The cost leadership strategy is negatively related to the adoption of ABC.	-	Supported
H11	There is a positive relation between the use of ABC and the use of LTPs.	+	Supported

6.5 Summary of chapter six

Chapter six focused on developing and assessing the measurement and structural model of this study. First, the measurement model was developed and its constructs were assessed in terms of their reliability and validity. Second, having the measurement model passed the assessment tests, the structural model was estimated taking into account the unique feature of PLS-SEM of using standardised latent variable scores which is found to affect interaction testing. Finally, all hypotheses developed in chapter have been tested and the results were reported.

Chapter 7 : Discussion and implications

7.1 Introduction

In the previous chapter, the research hypotheses were tested and the results were reported. This chapter will discuss these results in more detail which allows for answering the research questions and achieving the aim and objectives of this research study. The discussion of the empirical results reported in the previous chapter will proceed in two stages. First, the set of hypotheses focusing on the relationships between lean bundles, contextual variables and firm performance will be further explored. Second, discussions of the role of ABC and business strategy in the implementation of the technical bundles of lean service will follow.

7.2 Lean service bundles, contextual variables and firm performance

This section presents a detailed discussion of the results achieved in the previous chapter in regard with the hypotheses associated with the impact of lean bundles and contextual variables on firm performance. This implies a specific focus of this section on hypotheses H1a-H6b as presented in Table 3-5 in the summary section of chapter 3.

7.2.1 The direct relationship between LTP factors and firm performance

The empirical results in this study partially support the direct positive impact of LTPs on operational performance (H1a) while they do not support the same impact on financial performance (H1b). The results indicate that the observed positive association between LTPs and operational performance is driven by two lean technical factors, i.e., customer value factor and error prevention factor. The customer value factor is proved effective in improving customer satisfaction while the error prevention factor seems important for improving process time. This finding is not surprising given the higher emphasis placed by the sample firms on these two technical factors as concluded in subsection 5.4.1 and Table 5-6. In addition, having two (out of four) significant LTPs factors conveys that various lean practices play role in improving performance. Hence, service firms focusing

on a limited number of those improvement practices may only realise limited advancement in performance. This conclusion accords with findings reported recently by Kim et al. (2012) and de Leeuw and van den Berg (2011).

Furthermore, two technical factors i.e. process factor and physical structure factor are found to have no association with any of the three operational performance factors. This conclusion should not imply that these factors are not significant elements of lean service and can be simply neglected. Inspecting Table 6-5 reveals that, on average, the sample service firms are at the early stage of implementing LTPs with higher emphasis on the customer value and error prevention factors at the account of the process and physical structure factors. If the sample service firms are following the five principles of lean service introduced by Womack and Jones (1996) in order (see section 2.3), they should first implement those practices that help understand the value from customer perspective. As Table 5-6 shows service firms have focused more on the customer value factor which includes practices such as VSM, quality function deployment and policy deployment. Consulting the glossary sheet in Appendix 3 for a definition of those practices can highlight the critical role of these practices in understanding the value from the customer point of view and linking this value to a firm strategy. In consequence, the results in this study indicate that the sample firms are on the correct track of their LTPs implementation by focusing first on customer value identification which then will be followed by improving processes and firm structure in light of this value (Shah and Ward, 2007, 2003; Womack and Jones, 1996). Despite that, the lack of association between the two technical factors and operational performance concurs with previous research. For example, Sakakibara et al. (1997) and Bonavia and Marin (2006) conclude that LTPs do not have any direct association with improvement at the operational level.

Further, it has been realised that none of the four technical factors of lean service has a direct positive impact on financial performance as expected in H1b. This finding goes along with the finding of the few previous similar studies (e.g. Fullerton and Wempe, 2009; González-Benito, 2005; Patterson et al., 2004). Fullerton and Wempe (2009) examine the direct positive impact of three technical practices on return on sales using

data from 121 manufacturing firms and have not detected the anticipated positive impact. In a similar vein, González-Benito (2005) investigates the direct impact of technical practices on return on assets using data from 186 manufacturing firms. However, the results of González-Benito's (2005) study demonstrate that the technical practices alone are not capable of improving profitability. Similar findings have been documented by Patterson et al. (2004) who also have not been able to capture the direct impact of lean technical practices on the of sales per employee and profit.

In contrast to the above findings demonstrating a non-existence of direct influence of technical practices on financial performance, Kaynak (2003) reports empirical evidence supporting the capability of LTPs in directly improving the operational and financial performance of both manufacturing and service firms. Similarly, Alsamdi et al. (2012) reveal a direct positive association between the technical side of lean service and the operational and financial performance of adopters. Agarwal et al. (2013) use data from 152 manufacturing firms to test the assumed positive impact of lean practices on both operational and financial indicators. The results prove that while the lean index has a direct positive influence on sales, profit and profit margin, it has no effect on return on equity and negative effect on sales growth. However, it should be noted that the documented positive impact of LTPs on financial performance in the first two studies has been obtained based on subjective data from respondents rather than secondary data like the one used in this research.

The lack of association between the technical factors and financial performance can also be attributed to the time lag needed for the effect of an improvement practice to be reflected in financial statements (Shafer and Moeller, 2012; Birdi et al., 2008; Mohrman et al., 1995). As the sample service firms in this study are found to be at early stage of their LTPs implementation, it is possible that the effect of these practices has not accumulated to a level that can be seen in the financial statements of those firms. Some researchers have suggested a time lag of three to six years for the effect of an improvement practice to materialise (Shafer and Moeller, 2012; Birdi et al., 2008; Powell, 1995). As a result, future

research is encouraged to adopt a longitudinal research methodology to supplement the current literature with more insights on this aspect.

To conclude, collectively, the results of testing H1a and H1b can imply that at least some of the technical practices of lean service are capable of generating benefits to service firms that outweigh the cost of their implementation.

7.2.2 The direct relationship between LSP factors and firm performance

In line with the theoretical argument leading to H2a and H2b, the empirical results of this study support a direct positive association between operational and financial performance factors on the one hand, and LSP factors on the other hand. Specifically, the motivation factor of the social side of lean service has a strong positive relation with process time reduction and profit margin. The human factor is found to have a direct positive association with ROCE.

Unlike the influence of LTPs, the influence of LSPs goes beyond improving operational performance to enhance financial performance, namely profit margin and ROCE as the results of Table 6-6 demonstrate. This confirms the findings of previous research which highlights the superiority of the social practices over the technical practices (e.g. Talib et al., 2013; Samson and Terziovski, 1999; Sakakibara et al., 1997; Powell, 1995). While Dabhilkar and Åhlström (2013) and Pont et al. (2008) have not been able to capture the direct positive influence of LSPs on the performance of adopters, the majority of researchers have disagreed with such findings. For example, Cua et al. (2001) employ data from 163 manufacturing firms and report evidence implying that the social practices are positively related to operational performance. Shah and Ward (2003) conduct a survey study of 1757 manufacturing plants to study the effect of lean system represented by four bundles, namely JIT, TQM, TPM and HRM, on the operational performance. Their findings confirm the direct positive influence of each bundle on operational performance of adopters. Birdi et al. (2008) conclude that while LTPs can be transplanted easily, the knowledge created by LSPs to companies cannot and so their effect will be superior to the impact of LTPs.

7.2.3 The synergistic effect of LSPs and LTPs on firm performance

The synergy expected between the technical and social factors of lean service has been detected in the data of this research study; H3a and H3b have been accepted. This implies that each side of lean service does play an indirect role in improving firm performance through enhancing the performance outcome of the other side. Consequently, the theoretical argument developed in sub-section 3.5.3.1 in connection with the validity of the STS mechanism has proved true in this study.

Although none of the technical factors has a direct positive relation with financial performance (subsection 7.2.1), three technical factors (i.e. process factor, physical structure factor and customer value factor) interact with the two social factors to improve profit margin and ROCE. In addition, the process factor and physical structure factor which have not influenced the operational performance alone also interact with the two social factors to enhance all operational performance factors (i.e. customer satisfaction, waste elimination and process time reduction). These findings emphasise the importance of implementing the two sides of lean service together. This is so because the simultaneous implementation of both sides will result in an improvement in both operational and financial performance greater than the sum of their independent improvements.

The results of this study in term of the synergy hypotheses accord with the findings of De Menezes et al. (2010), Das and Jayaram (2007), González-Benito (2005), and Flynn et al. (1995). Using data collected on 42 US plants, Flynn et al. (1995) forward evidence which proves a positive interaction between the social and technical factors in improving tow operational indicators, namely cycle time and quality performance. González-Benito (2005) also confirms, using data from 186 manufacturing firms, the positive interaction between social and technical factors in improving financial performance represented by return on assets. More recently, Das and Jayaram (2007) adopt the socio-technical perspective to examine the synergy between four lean technical practices (i.e. kanban, group technology, JIT supply, TPM) and three HRM practices (i.e. cross-trained

employees, operator teams, decentralised decision-making). Based on data from 322 manufacturing firms, the authors demonstrate the expected synergy between the two sets of practices on operational performance.

In their current form, the results of testing H1 (a, b), H2 (a, b) and H3 (a, b) have significant implications for service managements. Service managers can rely on practices from each side of lean service (LTPs and LSPs) to improve operational and financial performance. However, the best utilisation of their resources can be achieved by investing in both sets of practices simultaneously. That is, if a service firm has limited resources to implement a few practices from lean service, the results suggest that the firm chooses practices from LSPs and LTPs that are likely to collaborate and yield higher performance improvement. For example, Table 6-7 indicates that unlike the human factor, the motivation factor interacts with all technical factors to improve firm performance. Therefore, with limited resource, investing in this factor along with one or more of the technical factors seems more promising than investing first in the human factor of the social side.

7.2.4 Firm age and firm performance

H4a and H4b have expected a direct relationship between firm age and the performance of service firms. The results of Tables 6-6 provide support for a positive association between firm age and the waste elimination factor. This finding validates the argument that older firms have better knowledge and experience which enable them to run their operations more efficiently than less experienced firms (Coad et al., 2013; Lundvall and Battese, 2000; Glancey, 1998). However, it is not necessary that such companies will enjoy higher financial performance as firm age has not had a positive relation with financial performance which supports the findings of previous studies (e.g. Wagner et al., 2012).

7.2.5 ABC and firm performance

H5a and H5b have anticipated that companies who adopted ABC have a better operational and financial performance than those who adopted TAS. However, neither of these hypotheses has been supported. This indicates that neither of these two accounting

systems is superior to the other in terms of improving firm performance. Similar conclusion has been reached by some researchers (e.g. Sheu and Pan, 2009; Cagwin and Bouwman, 2002; Mishra and Vaysman, 2001). Sheu and Pan (2009) and Mishra and Vaysman (2001) report that both ABC and TAS can be effective but under different circumstance. ABC will be more effective under high uncertainty levels while TAS will be more effective under low uncertainty levels. Consequently, if firms adopt the appropriate system based on their conditions, no difference in their performance may be detected.

Another possibility can be the recent argument by Banker et al. (2008), who suggest that ABC will not have a direct effect on firm performance. Rather it will improve other capabilities such as the implementation of lean practices which in turn improve performance. Using data from a large sample of manufacturing firms, Banker et al. (2008) have empirically confirmed this possibility. It seems that the results of this research study lend itself to this perspective. As has been demonstrated in subsection 6.4.2.5, adopting ABC is found to support the implementation of LTPs which in turn are proved to improve at least the operational performance (H1a has been supported).

7.2.6 Firm size and firm performance

Although firm size, represented by the number of employees, is proved to have no relation with operational performance, its positive association with financial performance (i.e. ROCE) is evident. This finding implies that although larger firms do not necessarily enjoy better operational performance, they do at financial level. The lack of association between firm size and operational performance found in this study concurs with earlier evidence reported by González-Benito (2005) who also has not been able to capture such association using data from 186 firms on four operational indicators, namely cost, quality, flexibility and reliability. Moreover, the positive association between firm size and financial performance confirms the notion that larger firms are likely to have more financial resources than small firms (Jayaram et al., 2010). It also goes in line with the findings of Wagner et al. (2012) who have used empirical data from 259 manufacturing firms and proved a positive influence of firm size on financial performance.

7.3 Lean service, ABC and business strategy

This section presents a detailed discussion of the results achieved in the previous chapter in regard to the hypotheses associated with the role of ABC and business strategy in the implementation of LTPs. This implies a specific focus of this section on hypotheses H6-H11 as presented in Table 3-5 in the summary section of chapter 3.

7.3.1 LTPs and Business strategy

The cost leadership and differentiation strategies have been anticipated to have a direct positive impact on the implementation of LTPs (H7 and H8). Both hypotheses have been supported as presented in subsections 6.4.2.3 and 6.4.2.4. However, firms adopting the differentiation strategy are found to focus on the customer value factor and process factor (see Table 6-6). On the other hand, firms adopting the cost leadership strategy have higher emphasis on the process factor and physical structure factor. The difference in focus between these two strategies provides empirical validation to Porter's (1980) notion that differentiators and cost leaders have different priorities.

Differentiators compete through product/service innovation and customisation where understanding the value from customer perspective is critical (Kumar and Telang, 2011; Kennedy and Widener, 2008; Gosselin, 1997). As a result, they have strongly implemented the customer value factor which includes practices important for understanding the value from customer point of view. In contrast, cost leaders compete on the price basis and emphasise process efficiency and cost reduction to enable them compete on the price basis (Ward et al., 2007; Frey and Gordon, 1999; Gosselin, 1997). Therefore, they have devoted their effort to implement the process factor and physical structure factor which include practices focusing on waste elimination at both process and structure levels. Interestingly, by implementing the process factor, differentiators seem to keep an eye on the efficiency of their processes even though they can usually ask for a price premium for their innovative and customised products/services (Qi et al., 2011).

Recognising the emphasis on different sets of lean practices by each strategy can offer one explanation to the mixed results found in the few empirical studies which have examined the strategy-lean association (e.g. Qi et al., 2011; Ward et al.; 2007; Baines and Langfield-Smith, 2003; Chenhall and Langfield-Smith, 1998). The findings propose that detecting a significant relation between each type of strategy and lean practices depends on the lean practices included in the study. For instance, representing lean service by practices included in the customer value factor will support the fit between differentiation strategy and lean found by Baines and Langfield-Smith (2003) and Chenhall and Langfield-Smith (1998). If lean service is represented by practices contained in the physical structure factor, the finding is expected to advocate the match between cost leadership strategy and lean found by Qi et al. (2011). The preceding finding implies that researchers should avoid a restricted representation of lean service by a few practices when studying the strategy-lean association.

7.3.2 Business strategy and ABC

H9 and H10 state a positive association between the differentiation strategy and ABC and a negative association between the cost leadership strategy and ABC, respectively. The results of Table 6-6 have confirmed both hypotheses. These results empirically confirm the notion which indicates that given the differences in priorities and environments in which differentiators and cost leaders operate, differentiators will more likely prefer ABC which generates more accurate and detailed financial and non-financial information and helps in understanding value adding activities necessary to enhance products/services differentiation (Khataie et al., 2011; Cagwin and Bouwman, 2002; Chenhall and Langfield-Smith, 1998). Similar conclusion has been reported in this stream of literature. For instance, Baines and Langfield-Smith (2003) use data from 140 manufacturing firms and forward evidence suggesting that adopting differentiation strategy will lead to increased use of advanced MASs including ABC. In a similar vein, Gosselin (1997) uses data from 161 manufacturing firms and find the adoption of differentiation strategy to be associated with implementation of ABC. In addition, Frey and Gordon (1999) and Chenhall and Langfield-Smith (1998) demonstrate through empirical evidence that ABC benefits differentiators more that cost leaders.

7.3.3 LTPs and ABC

As has been expected by H11, the adoption of ABC has been association with implementation of LTPs. This result has validated the significant direct role of ABC in influencing the implementation level of LTPs. More specifically, This advocates the notion that as ABC improves the visibility of what truly drives cost and consumes resources at activity level, it helps expose areas for improvements by identifying non-value adding activities which encourages the implementation of lean service practices to eliminate them (Khataie and Bulgak, 2013; Chiarini, 2012; Li et al., 2012; Maiga and Jacobs, 2008; Clarke and Mullins, 2001). In addition, when taken together the positive ABC-lean association (H11) and lean-performance relation (H1a) found in this study bring to light a new perspective into the ABC-performance literature (e.g. Sheu and Pan, 2009; Cagwin and Bouwman, 2002; Kennedy and Affleck-Graves, 2001; Mishra and Vaysman, 2001). This new perspective suggests that ABC is capable of contributing to firm performance indirectly through helping companies develop other organizational capabilities (e.g. lean service) which, in turn, can improve performance. In consequence, these findings imply that by implementing ABC, firms can kill two birds with one stone. First, they enjoy better understanding of how and where their resources are consumed which is important for informed decision making. Second, they become in a better position to improve their processes and performance through implementing lean service practices.

The important role of ABC in the lean context found in the current study emphasises earlier evidence in the literature. For instance, Al-Omiri and Drury (2007) in a survey study of 176 UK manufacturing and service firms highlight a positive relationship between the implementation of lean system and the level of cost system sophistication. In addition, Innes and Mitchell (1995) survey the largest UK companies and find them to depend on the measures generated from ABC to support other improvement initiatives such as continuous improvement, TQM and JIT. Adam (1996) argues that when ABC is used in conjunction with other process improvement systems such as quality and lean system, companies enjoy a higher level of benefits. Khataie and Bulgak (2013) use a

system dynamics modelling tool and reveal the importance of ABC in achieving the aim of lean system. Moreover, Banker et al. (2008) report empirical evidence indicating that companies adopting ABC are more likely to adopt lean practices in their operations.

7.3.4 ABC, business strategy and LTPs

When taken together the results of testing H7-H11 offer another significant insight into the relationship among ABC, business strategy and LTPs. In addition to the direct relation between business strategy and LTPs (H7 and H8), there is also an indirect relation acting through the accounting variable (ABC) as H9, H10 and H11 have been supported. The support found for H9 indicates that adopting differentiation strategy is positively associated with implementation of ABC which overcomes TAS in uncertain environments and when more customized products/services are produced (Khataie et al., 2011; Sheu and Pan, 2009; Gosselin, 1997; Cooper and Kaplan, 1992). Being supported, H9 and H11 highlight the indirect positive association between differentiation strategy and lean service through the intervening variable ABC. However, given that H7 (direct relation between differentiation and lean service) is supported; the variable ABC only partially mediates the differentiation-lean association.

In contrast to differentiators, cost leaders are found to rely more on TAS given the support found for H10 which proposes a negative relation between cost leadership strategy and the dummy variable ABC constructed as 1 for ABC and 0 for TAS. Relying on TAS by cost leaders is not surprising given their tendency to avoid investing in innovations and producing a relatively limited range of standardized products/services (Chenhall, 2003; Lamminmaki and Drury, 2001; Gosselin, 1997). However, being supported, H10 and H11 lead to the conclusion that cost leadership strategy has an indirect negative relation with lean service which contradicts its direct positive relation (H8). In other words, the accounting variable (ABC) in the model suppresses the relationship between cost leadership strategy and lean service leading to a case of inconsistent mediation (Taylor et al., 2008; MacKinnon et al., 2000). Inconsistent mediation occurs when the direct and indirect effects have opposite signs (Taylor et al., 2008; MacKinnon et al., 2000). Consequently, the total effect of cost leadership strategy on lean service will depend on

the magnitude of each effect (i.e. direct and indirect). When the magnitudes of the direct and indirect effects are close to each other or identical, the total effect will be zero or close to zero. This can be one reason behind the lack of association between the cost leadership strategy and lean practices found by studies which did not account for the role of ABC in that relation. Therefore, the implication of this finding is that researchers should include the effect of the accounting system used by companies to better understand the relationship between business strategy and lean practices. In addition, while TAS may provide less distorted cost information for cost leaders operating in a stable environment and producing a relatively limited set of standardized products, it does not help in developing other organizational capabilities (i.e. lean service) which have a direct positive impact on performance (Li et al., 2012). The two case studies reported by Cooper and Maskell (2008) and Datar et al. (1991) clearly demonstrate the detrimental effect of TAS on the implementation of lean practices which supports the above conclusion.

7.4. Summary of chapter seven

This chapter presented a detailed discussion of the hypotheses testing results reported in chapter 6. In discussing the results of this research study, there has been an attempt to position the results achieved for each of the research hypotheses within the relevant extant literature so that differences have been highlighted and implications have been deduced.

The findings of this research indicated that at least some LTPs can improve operational performance of service companies. LSPs were found to have a direct positive relationship with both operational and financial performance of service firms. More importantly, there was a positive interaction between LTPs and LSPs which improved firm performance over and above the improvement that could be achieved from each separately. Moreover, activity-based costing system was revealed to be critical in overcoming the limitations of the traditional accounting system (TAS) and consequently encouraging the implementation of lean technical practices. This was a significant finding as it highlighted the role of ABC in improving firm performance indirectly through other organisational capabilities (i.e. lean practices) which, in turn, influenced performance. Finally, In respect of business strategy, both differentiation and cost leadership strategies had a direct

positive association with lean service. However, while the differentiation strategy also had an indirect positive association with lean service through ABC, the cost leadership strategy had an indirect negative relationship with lean service due to its negative relation with ABC.

Chapter 8 : Conclusions

8.1 Introduction

This study aims to uncover the full potential of lean service in improving firm performance and the role of two contextual variables (i.e. ABC, business strategy) in the adoption of lean service. To address this aim, the current study makes use of two well known theories (i.e. STS and CT) to develop a theoretical model and a set of research hypotheses. The model views lean service as a socio-technical system with two sides: technical side and social side. The mechanism of the STS is then relied on to expand the traditional lean-performance model focusing mainly on the direct and additive effect of lean bundles by highlighting the possible synergy between the two sides of lean service. By doing so, this study probes deeper in the mechanism through which lean service is expected to influence firm performance. Consequently, the model assumes each side of lean service to play two roles in influencing firm performance: a direct role and an indirect role through enhancing the impact of the other side.

Moreover, adopting the CT sets the foundation for underlining the potential effect of two contextual variables (i.e. ABC, business strategy) on the adoption level of the technical side of lean service usually neglected in the current literature. In addition, the model developed in this study extends the focus of the few studies which examined only the additive impact of ABC and business strategy on lean practices. By highlighting the relationships among these three variables, the model emphasises the need to examine the possibility of the indirect effect, acting through the other variables, of each variable on lean practices along with their direct effect.

To test the theoretical model a positivist approach is adopted, and a cross-sectional survey methodology is employed in the UK service context. The UK is an appropriate context for the current study given the established service nature of its economy. The data are collected using multiple methods including questionnaire instrument and archive database.

The most appropriate statistical techniques are adopted for data analysis and hypotheses testing including factor analysis and PLS-SEM.

The second section of this chapter will summarise the research findings of the data analysis and the hypotheses testing process. In the third section, the research questions will be revisited in an attempt to provide answers to these questions given the findings of this research study. The main conclusions of this study will be provided in the fourth section. The fifth section is devoted to highlight the main contributions of this study. Finally, the last section of this chapter will report the limitations of this study and provide directions for future research.

8.2 Summary of research findings

Testing the direct and synergistic impact of the two sides of lean service on firm performance while controlling for the effect of ABC, industry, past performance, firm size and firm age indicates the following:

i. LTPs are found to have a direct positive association with operational performance but not with financial performance indicators.
ii. Adopting LSPs are proved to have a direct positive relationship with operational and financial performance indicators. This relationship is stronger than that between LTPs and firm performance.
iii. The effect of the expected collaboration (synergy) between the two sides of lean service is empirically supported by the data collected in this study.
iv. In terms of the impact of the contextual variables on firm performance, the use of advanced MAS (i.e. ABC) is proved to have no direct impact on operational and financial performance. Firm size is found to have a positive relation with financial performance but not with operational performance. Firm age is shown to have a positive influence on firm operational performance rather than financial performance.

In relation to the impact of ABC and business strategy on the technical side of lean service, the results support the following conclusions:

i. The use of ABC has a direct positive relation with the level of LTPs adoption.
ii. The cost leadership strategy is shown to have a direct positive association with LTPs. However, its negative indirect association with LTPs acting through ABC (intervening variable) has reduced the magnitude of its direct positive relation with LTPs.
iii. The differentiation strategy is found to have positive direct and indirect effect acting through ABC on the implementation of LTPs.

As has been reported above, a number of relationships as proposed by the theoretical model are supported in this study. Moreover, the results also provide support to the argument highlighting the need to focus on not only the operational performance but also the financial performance given that some variables (e.g. LSPs) in the model have a relationship with both. In addition, although the implementation of ABC is found to have no direct relation with firm performance, its indirect association with performance is evident through its effect on lean practices which are, in turn, related to firm performance. In light of the research findings reported above, the research questions can now be revisited in an attempt to answer those questions as presented in the next section.

8.3 Revisiting the research questions

This research study sought to answer mainly two research questions as stated in the first chapter. These two questions are:

1. Do lean practices have an additive (direct) and/or non-additive (indirect) impact on operational and/or financial performance of service firms?
2. Does each of the following contextual variables: ABC and business strategy affect lean service practices? And if so, is the effect direct, indirect or both?

8.3.1 The first research question

The first research question constructively questions the traditional lean-performance model focusing mainly on the additive impact of lean practices on mainly firm operational

performance. The model of the current study suggests expanding the traditional model by empirically investigating the non-additive (synergy) impact of lean practices on both operational and financial performance as only very limited information is available to date in this respect.

To answer the first research question, lean service is viewed as a socio-technical system where each of its two sides is expected to directly influence firm performance and indirectly through the expected collaboration between them. PLS-SEM analysis is used to test the corresponding hypotheses. The results suggest a direct positive impact of the two sides of lean service on firm operational performance, although a stronger impact of the social side is evident. In addition, while the effect of the social side extends to the financial performance, the impact of the technical side does not. More importantly, the non-additive effect (synergy) of each side of lean service is statistically supported in this study. Therefore, the simultaneous implementation of the technical and social sides of lean service is expected to result in an improvement in firm performance greater than the sum of the independent improvements attained from each side separately.

In the current form, the findings of this study support the presence of a direct and additive impact of the two sides of lean service on both operational and financial performance as well as synergistic impact resulting from the interaction between the two sides.

8.3.2 The second research question

The second research question addresses the nature of the likely impact of ABC and business strategy on the technical side of lean service. The results suggest a direct positive impact of ABC and business strategy (differentiation and cost leadership) on the implementation of LTPs. However, while the differentiation strategy also had a positive indirect impact on LTPs acting through ABC, the cost leadership strategy is found to have a negative indirect effect on LTPs acting through ABC. In other words, while ABC is found to partially mediate the differentiation-LTPs association, it suppresses the cost leadership-LTPs association leading to a case of inconsistent mediation.

In conclusion and as a response to the second research question, ABC has a direct positive impact on LTPs, while cost leadership strategy and differentiation strategy have both direct and indirect influence on LTPs acting through ABC.

8.4 Research Contributions

This study aims at probing the mechanism of lean service in improving firm performance and investigating the role of ABC and business strategy in the adoption of lean service. To achieve this aim and associated objectives:

i. A theoretical model has been developed by integrating two well known theories, namely STS and CT,
ii. The model has been empirically examined using data collected from UK service companies.

Consequently, the contributions of this study can be realised at different levels, namely theoretical, methodological and empirical levels.

At the theoretical level, this study develops a conceptual framework which crosses different streams of literatures mainly, lean system literature, management accounting literature with focus on ABC, business strategy literature and human resources management literature. Unlike previous studies, by integrating the perspective of STS and CT, the model (i) highlights not only the direct effect of each of the lean service sides on firm performance but also the potential synergy between the two sides, (ii) brings to light the direct impact of ABC and business strategy on LTPs and the intervening role of ABC due to which the business strategy is assumed to have also an indirect influence on LTPs, and (iii) offers an alternative view on how ABC can improve firm performance by enhancing other organisational capabilities which are expected to improve performance .

At the methodological level, unlike previous studies, this study includes a large number of lean service practices and contextual variables to report more precisely on the lean-performance association. In addition, the inclusion of the financial performance dimension -measured by secondary data- in the model in addition to the operational performance is critical to understand the full capability of lean service in improving firm performance.

Finally, employing powerful statistical techniques like factor analysis and PLS-SEM provides more credibility to the results reported in this study.

At the empirical level, this study is conducted in the UK service sector. As such, this study is one of the very few studies that have reported on lean service and examined how the adoption of ABC and specific business strategy can affect its implementation using empirical survey data from another context than manufacturing.

Finally, the findings of the current research have significant implications for both practice and academia. First, the interaction between the two sides of lean service detected in this study should encourage service firms to avoid focusing on the practices of only one side. A better outcome can be expected from implementing practices from both sides. Second, service firms should also be aware of the effect of their accounting system on the implementation of lean service practices. In contrast to the TAS, ABC helps service firms distinguish between value adding and non-value adding activities which may motivate and justify the need for lean service practices to eliminate the waste associated with the non-value adding activities. In addition, researchers are encouraged to take into consideration the role of the accounting system when examining the strategy-lean association. By doing so the current study has offered a better understanding of the lack of relationship between the cost leadership strategy and lean practices found in the existing literature.

8.5 Limitations and Directions for Future Research

Like all other research studies, a number of limitations of this study can be highlighted which can be addressed in future research. These limitations can be classified into three groups, namely theoretical, methodological and empirical limitations.

At the theoretical level, given the complexity of the model developed in this study, only the synergy between the two sides of lean service is conceptualised and empirically tested. Therefore, no attempt has been made to theorise the possible interaction between any of the contextual variables and both or either of the two sides of lean service. Similarly, only two contextual variables (i.e. ABC and business strategy) are examined in terms of their

effect on LTPs. Consequently, other contextual variables such as unionisation, service process type and firm age can be the focus of future research to investigate their impact on lean service.

At the methodological level, the cross-sectional nature of this research prevents definitive statements about causality between dependent variables (DVs) and independent variables (IVs) involved in this research. Future research with longitudinal nature would advance the findings of this study and provides unique information on the sustainability of the impact of lean service on firm performance over time. Further, given the size of the sample obtained in this research study, obtaining a larger sample would allow for more robust results to be obtained. In addition, another limitation arises from using subjective measures and single informant to collect data on both DVs and IVs. This method of measurement is argued to introduce the possibility of higher measurement error and inflated association between criterion and predictor variables. Despite that, subjective measures whether single-item or multiple-item have been widely used in operations management literature (Fullerton et al., 2013; Shah and Ward, 2007, 2003; Fullerton et al., 2003; Cua et al., 2001).

At the empirical level, this study is limited to medium and large companies only. Therefore, the results may not be generalisable to small companies. In addition, the study is also limited to the UK service sector. Consequently, future research may replicate this study in other service contexts than the UK. It should also be noted that several practices of lean service were dropped as they had not been reported by at least five studies. Future research may focus on these practices to examine their effectiveness and relation with other contextual variables.

Finally, as shown in Table (4-6), a relatively large number of service firms (22% of non-respondents) indicated irrelevancy of the questionnaire to their firms. This result points to the high reluctance of service managers to experiment with lean service practices despite the increasing level of literature encouraging them to do so. Therefore, valuable future work can improve our knowledge on reasons behind this reluctance of service managers to

adopt lean service practices. Further, it has been out of the scope of this study to examine whether there is a specific sequence in the implementation of LTPs and LSPs that leads to the improved performance. Little work has been done in the literature that tries to establish best models for best outcome of lean system. Future attempts focusing on this point can allow for critical theoretical and practical implications to be realised.

References

Abdelaziz, E.A., Saidur, R. and Mekhilef, S. (2011). A review on energy saving strategies in industrial sector. *Renewable and Sustainable Energy Reviews*, 15 (1), 150–168

Abdel-Kader, M. and Luther, R. (2008). The impact of firm characteristics on management accounting practices: A UK-based empirical analysis. *The British Accounting Review*, 40 (1), 2-27

Abdi, F., Shavarini, S. K. and Hoseini, S. M. S. (2006). Glean Lean: How to use lean approach in service industries? *Journal of Services Research*, 6 (special issue), 191-206

Abu Mansor, N.N., Tayles, M. and Pike, R. (2012). Information Usefulness and Usage in Business Decision-Making: An Activity-Based Costing (ABC) Perspective. *International Journal of Management*, 29 (1), 19-32

Adams, M. (1996). Activity-based costing (ABC) and the life insurance industry. *The Service Industries Journal*, 16 (4), 511-526

Agarwal, R., Green, R., Brown, P.J., Tan, H. and Randhawa, K. (2013). Determinants of quality management practices: An empirical study of New Zealand manufacturing firms. *International Journal of Production Economics*, 142 (1), 130–145

Ahlstrom, P. (1998). Sequences in the implementation of lean production. European Management Journal, 16 (3), 327-334

Åhlström, P. (2004). Lean service operations: Translating lean production principles to service operations. *Int. J. Services Technology and Management*, 5 (5-6), 545-564

Ahluwalia, R. S., Srinivasan, A. and Irani, S. A. (2004). Evidence of lean. *Industrial Engineer*, 36 (12), 35-40

Ahmad, S., Schroeder, R.G. and Sinha, K.K. (2003). The role of infrastructure practices in

the effectiveness of JIT practices implications for plant competitiveness. *Journal of Engineering and Technology Management*, 20, 161-191

Alagaraja, M. (2010). Lean Thinking as applied to the adult education environment. *Int. J. Human Resources Development and Management*, 10 (1), 51-62

Allway, M. and Corbett, S. (2002). Shifting to lean service: Stealing a page from manufacturers' playbooks. *Journal of Organizational Excellence*, 21 (2), 45-54

Al-Omiri, M. and Drury, C. (2007). A survey of factors influencing the choice of product costing systems in UK organizations. *Management Accounting Research*, 18 (4), 399-424

Alsmadi, M., Almani, A. and Jerisat, R. (2012). A comparative analysis of Lean practices and performance in the UK manufacturing and service sector firms. *Total Quality Management and Business Excellence*, 23 (3-4), 381-396

Amoako-Gyampah, K. and Acquaah, M. (2008). Manufacturing strategy, competitive strategy and firm performance: An empirical study in a developing economy environment. *International Journal of Production Economics*, 111 (2), 575–592

Anania, L. (1987). Services: Low Productivity High Cost. *Review of Business*, 9 (1), 21-23

Anderson, S., and Widener, S. (2007). Doing quantitative field research in management accounting. In C. Chapman, A. Hopwood, and M. D. Shields, Handbook of Management Accounting Research, 1. (pp. 319-342). Oxford: Elseiver.

Appelbaum, S.H. (1997). Socio-technical systems theory: an intervention strategy for organizational development. *Management Decision*, 35 (6), 452–463

Apte, U.M. and Goh, CH. (2004). Applying lean manufacturing principles to information intensive services. *Int. J. Services Technology and Management*, 5 (5-6), 1-20

Arbos, L. C. (2002). Design of a rapid response and high efficiency service by lean production principles: Methodology and evaluation of variability of performance.

International Journal of Production Economics, 80 (2), 169-183

Arlbjørn, J. S., and Freytag, P. V. (2013). Evidence of lean: a review of international peer-reviewed journal articles. *European Business Review*, 25 (2), 174-205

Arlbjørn, J. S., Freytag, P. V. and Haas, H. (2011). Service supply chain management: A survey of lean application in the municipal sector. *International Journal of Physical Distribution and Logistics Management*, 41 (3), 277-295

Armstrong, S. and Overton, T. (1977). Estimating Nonresponse Bias in Mail Surveys. *Journal of Marketing Research*, 14 (3), 396-402

Askarany, D., Yazdifar, H. and Askary, S. (2010). Supply chain management, activity-based costing and organisational factors. *International Journal of Production Economics*, 127 (2), 238–248

Atkinson, P. (2004). Creating and Implementing Lean Strategies. *Management Services*, 48 (2), 18-21

Auzair, S.M. and Langfield-Smith, K. (2005). The effect of service process type, business strategy and life cycle stage on bureaucratic MCS in service organizations. *Management Accounting Research*, 16 (4), 399–421

Baggaley, B. (2006). Using strategic perofrmance measurements to accelerate lean performance. *Cost Management*, 20 (1), 36-44

Baines, A. and Langfield-Smith, K. (2003). Antecedents to management accounting change: a structural equation approach. *Accounting, Organizations and Society*, 28 (7-8), 675–698

Ball, D.R. and Maleyeff, J. (2003). Lean management of environmental consulting. *Journal of Management in Engineering*, 19 (1), 17-24

Banker, R.D., Bardhan, I.R., & Chen, T.Y. (2008). The role of manufacturing practices in mediating the impact of activity-based costing on plant performance. *Accounting,*

Organizations and Society, 33 (1), 1-19

Baxter, G. and Sommerville, I. (2011). Socio-technical systems: From design methods to systems engineering. *Interacting with Computers*, 23 (1), 4-17

Bayo-Moriones, A., Bello-Pintado, A. and Merino-Dı´az-de-Cerio, J. (2008). The role of organizational context and infrastructure practices in JIT implementation. *International Journal of Operations and Production Management*, 28 (11), 1042-1066

Ben-Tovim, D. I., Bassham, J. I., Bolch, D., Martin, M. A., Dougherty, M. and Szwarc, M. (2007). Lean thinking across a hospital: redesigning care at the Flinders Medical Centre. *Australian Health Review*, 31 (1), 10-15

Bhasin, S. (2008). Lean and performance measurement. *Journal of Manufacturing Technology Management*, 19 (5), 670-684

Bhasin, S. (2012). Performance of Lean in large organisations. *Journal of Manufacturing Systems*, 31 (3), 349– 357

Bhasin, S. and Burcher, B. (2006). Lean viewed as a philosophy. *Journal of Manufacturing Technology Management*, 17 (1), 56-72

Bhatia, N. and Drew, J. (2007). Applying Lean production to the Public Sector. *The McKinsey Quarterly*, June, 1-5

Birdi, K., Clegg, C., Patterson, M., Robinson, A., Stride, C.B., Wall, T.D. and Wood, S.J. (2008). The impact of human resource and operational management practices on company productivity: A longitudinal study. *Personnel Psychology*, 61 (3), 467-501

Bodek, N. (2007). The ninth waste—Saying no. Available at: http://www.industryweek.com/articles/the_ninth_waste_--_saying_no_15106.aspx

Bonavia, T. and Marin, J.A. (2006). An empirical study of lean production in the ceramic tile industry in Spain. *International Journal of Operations and Production*

Management, 26 (5), 505-531

Bonavia, T. and Marin-Garcia, J.A. (2011). Integrating human resource management into lean production and their impact on organizational performance. *International Journal of Manpower*, 32 (8), 923-938

Bortolotti, T. and Romano, P. (2010). Enabling lean management adoption in the pure service sector: when to implement automation and information systems?. In: Proceedings of the 17th International Annual EurOMA Conference, Portugal, June, 2010), 1-10

Bortolotti, T. and Romano, P. (2012). Lean first, then automate: a framework for process improvement in pure service companies. A case study. *Production Planning and Control: The Management of Operations*, 23 (7), 513-522

Bowen, D. E. and Youngdahl, W. E. (1998). Lean" service in defense of a production-line approach. *International Journal of Service Industry Management*, 9 (3), 207-225

Brewton, J. (2009). The lean office: Develop lean administrative procedures. *Cost management*, 23 (2), 40-47

Brignall, S. (1997). A contingent rationale for cost system design in services. *Management Accounting Research*, 8 (3), 325-346

Brignall, T.J. Fitzgerald, L. Johnston, R. and Silvestro, R. (1991). Product costing in service organizations. *Management Accounting Research*, 2 (4), 227-248

Bruggeman, W. and Stede, W.V. (1993). Fitting Management Control Systems to Competitive Advantage. *British Journal of Management*, 4 (3), 205-218

Bryman, A., and Bell, E. (2007). Business Research Methods. New York: Oxford University Press.

Burgess, N. and Radnor, Z. (2010). Lean Paradox: can lean influence healthcare?. In: Proceedings of the 17th International Annual EurOMA Conference, Portugal, June,

2010), 1-10

Burgess, N., Radnor, Z. and Davies, R. (2009). Taxonomy of Lean in Healthcare: A Framework for Evaluating Activity and Impact. In: Proceedings of the 16th International Annual EurOMA Conference, Gothenburg, Sweden, June (not provided), 1-10

Bushell, S., Mobley, J. and Shelest, B. (2002). Discovering lean thinking at progressive healthcare. *Journal for Quality and Participation*, 25 (2), 20-25

Cagwin, D. and Bouwman, M.J. (2002). The association between activity-based costing and improvement in financial performance. *Management Accounting Research,* 13 (1), 1-39

Camacho-Miñano, M., Moyano-Fuentes, J. and Sacristán-Díaz, M. (2013). What can we learn from the evolution of research on lean management assessment? *International Journal of Production Research,* 51 (4), 1098–1116

Capon, N., Farley, J.U. and Hoenig, S. (1990). Determinants of Financial Performance: A Meta-Analysis. *Management Science*, 36 (10), 1143-1159

Cappelli, P. and Neumark, D. (2001). Do "High Performance" work practices improve establishment-level outcomes? *Industrial and Labor Relations Review*, 54 (4), 737-775

Carenys, J. and Sales, X. (2008). Costing the Banking Services: A Management Accounting Approach. Journal of Money, Investment and Banking, (6), 35-53

Carnes, K. and Hedin, S. (2005). Accounting for Lean Manufacturing: Another Missed Opportunity? *Management Accounting Quarterly*, 7 (1), 28-35

Carter, B., Danford, A., Howcroft, D., Richardson, H., Smith, A. and Taylor, P. (2011). All they lack is a chain' lean and the new performance management in the British civil service. *New Technology, Work and Employment*, 26 (2), 83-97

Challis, D., Samson, D. and Lawson, B. (2002). Integrated manufacturing, employee and

business performance: Australian and New Zealand evidence. *International Journal of Production Research*, 40 (8), 1941-1964

Chaneski, WS. (2005). Stories from the Lean Office. *Modern Machine Shop*, 78 (7), 44-46

Chase, R. B. and Apte, U. M. (2007). A history of research in service operations: What's the big idea? *Journal of Operations Management*, 25 (2), 375-386

Chenhall, R.H. (2003). Management control systems design within its organizational context: findings from contingency-based research and directions for the future. *Accounting, Organizations and Society*, 28 (2-3), 127-168

Chenhall, R.H. and Langfield-Smith, K. (1998). The relationship between strategic priorities, management techniques and management accounting: an empirical investigation using a systems approach. *Accounting, Organizations and Society*, 23 (3), 243-264

Chenhall, R.H. and Moers, F. (2007). The Issue of Endogeneity within Theory-Based, Quantitative Management Accounting Research. *European Accounting Review*, 16 (1), 173-196

Chiarini, A. (2012). Lean production: mistakes and limitations of accounting systems inside the SME sector. *Journal of Manufacturing Technology Management*, 23 (5), 681-700

Chin, W. W. (1998). The Partial Least Squares approach to Structural Equation Modeling. In G. A. Marcoulides, Modern Methods for business research (pp. 295-336). New Jersey: Lawerence Erlbaum Associates.

Chong, V.K. (1996). Management accounting systems, task uncertainty and managerial performance: A research note. *Accounting, Organizations and Society*, 21 (5), 415-421

Chong, V.K. and Chong, K.M. (1997). Strategic Choices, Environmental Uncertainty and SBU Performance: A Note on the Intervening Role of Management Accounting

Systems. *Accounting and Business Research*, 27 (4), 268-276

Christie, A.A., Joye, M.P. and Watts, R.L. (2003). Decentralization of the firm: theory and evidence. *Journal of Corporate Finance*, 9 (1), 3-36

Christopher, M. (2000). The agile supply chain competing in volatile markets. *Industrial Marketing Management*, 29 (1), 37-44

Clarke, P. and Mullins, T. (2001). Activity based costing in the non-manufacturing sector in Ireland: A preliminary investigation. *Irish Journal of Management*, 22 (2), 1-18

Coad, A., Segarra, A. and Teruel, M. (2013). Like milk or wine: Does firm performance improve with age? *Structural Change and Economic Dynamics*, 24, 173– 189

Collis, J., and Hussey, R. (2009). Business Research: A Practical Guide for Undergraduate and Postgraduate Students. Basingstoke: Palgrave Macmillan.

Comm, C. L and Mathaisel, D. F. X. (2000). A paradigm for benchmarking lean initiatives for quality improvement. *Benchmarking: An International Journal*, 7 (2), 118-127

Comm, C. L and Mathaisel, D. F. X. (2005(a)). A case study in applying lean sustainability concepts to universities. *International Journal of Sustainability in Higher Education*, 6 (2), 134-146

Comm, C. L and Mathaisel, D. F. X. (2005(b)). An exploratory study of best lean sustainability practices in higher education. *Quality Assurance in Education*, 13 (3), 227-240

Comm, C. L. (1999). Marketing Lean Initiatives in Service Industries. *Journal of Professional Service Marketing*, 18 (2), 59-64

Cooper, R. and Kablan, R. (1992). Activity-Based Systems: Measuring the Costs of Resource Usage. *Accounting Horizons*, 6 (3), 2-13

Cooper, R. and Kaplan, R.S. (1988). Measure costs right: make the right decisions.

Harvard Business Review, 66 (5), 96-103

Cooper, R. G. and Mohabeersingh, C. (2008(a)). Lean thinking for medical practices. *Journal of Pre-Clinical and Clinical Research*, 2 (1), 88-89

Cooper, R. G. and Mohabeersingh, C. (2008(b)). Lean thinking in a healthcare system–innovative roles. *Journal of Pre-Clinical and Clinical Research*, 2 (2), 110-117

Cooper,R.and Maskell, B. (2008). How to Manage Through Worse-Before-Better. *MIT Sloan management review* , 49 (4), 58-65

Cortina, J. (1993). What is coefficient alpha? An examination of theory and methods. *Journal of Applied Psychology*, 78 (1),98-104

Craighead, C.W., Hult, G.T.M. and Ketchen Jr, D.J. (2009). The effects of innovation–cost strategy, knowledge, and action in the supply chain on firm performance. *Journal of Operations Management*, 27 (5), 405-421

Cua, K.O., McKone, K.E. and Schroeder, R.G. (2001). Relationships between implementation of TQM, JIT, and TPM and manufacturing performance. *Journal of Operations Management*, 19 (6), 675–694

Cuatrecasas, L. (2004). A lean management implementation method in service operations. *Int. J. Services Technology and Management*, 5 (5-6), 532-544

Cusumano, M. A. (1994). The Limits of "Lean". *Sloan Management Review*, 35 (4), 27-38

Dabhilkar, M. and Åhlström, P. (2013). Converging Production Models: The STS Versus Lean Production Debate Revisited. *International Journal of Operations and Production Management*, 33 (8), 1019-1039

Dahlgaard, J.J. and Dahlgaard-Park, S.M. (2006). Lean production, six sigma quality, TQM and company culture. *The TQM Magazine*, 18 (3), 263-281

Dankbaar, B. (1997). Lean production: denial, confirmation or extension of sociotechnical

systems design. *Human Relations*, 50 (5), 567-583

Das, A. and Jayaram, J. (2007). Socio-technical perspective on manufacturing system synergies. *International Journal of Production Research*, 45 (1), 169-205

Datar, S., Kekre, S., Mukhopadaya, M. and Svaan, E. (1991). Overloaded Overheads: Activity-Based Cost Analysis of Material Handling in Cell Manufacturing. *Journal of Operations Management*, 10 (1), 119-137

Davidson, A.R. and Stern, L.W. (2004). A quality self-assessment model. *Managerial Auditing Journal*, 19 (7), 859-868

De Leeuw, S. and van den Berg, J.P. (2011). Improving operational performance by influencing shopfloor behavior via performance management practices. *Journal of Operations Management*, 29 (3), 224-235

De Menezes, L.M. and Wood, S. (2006). The reality of flexible work systems in Britain. *The International Journal of Human Resource Management*, 17 (1), 106-138

De Menezes, L.M., Wood, S. and Gelade, G. (2010). The integration of human resource and operation management practices and its link with performance: A longitudinal latent class study. *Journal of Operations Management*, 28 (6), 455-471

Dearden, J. (1978). Cost accounting comes to service industries. *Harvard Business Review*, 56 (5), 132-140

Delaney, J.T. and Huselid, M.A. (1996). The impact of human resource management practices on perceptions of organizational performance. *Academy of Management Journal*, 39 (4), 949-969

Dickson, E. W., Anguelov, Z., Vetterick, D., Eller, A. and Singh. S. (2009). Use of Lean in the Emergency Department: A Case Series of 4 Hospitals. *Annals of Emergency Medicine*, 54 (4), 504-510

Dillman, D. A. (2007). Mail and Internet Surveys: The Tailored Design Method, second

edition. Hoboken, New Jersey: John Wiley and Sons, Inc.

Doman, M.S. (2011). A new lean paradigm in higher education: a case study. *Quality Assurance in Education*, 19 (3), 248-262

Drazin, R. and Van de Ven, A.H. (1985). Alternative forms of fit in contingency theory. *Administrative Science Quarterly*, 30 (4), 514-539

Drury, C. and Tayles, M. (2005). Explicating the design of overhead absorption procedures in UK organizations. *The British Accounting Review*, 37 (1), 47–84

Ehrlich, B. H. (2006). Service with a smile: lean solutions extend beyond the factory floor. *Industrial Engineer*, 38 (8), 40-44

Ellram, L.M., Tate, W.L. and Billington, C. (2004). Understanding and Managing the Services Supply Chain. *Journal of Supply Chain Management*, 40 (4), 17-32

Emery, F.E. and Trist, E.L. (1965). The Causal Texture of Organizational Environments. *Human relations*, 18, 21-32

Emiliani, M. L. (2004). Improving business school courses by applying lean principles and practices. *Quality Assurance in Education*, 12 (4), 175-187

Endsley, S., Magill, M. K. and Godfrey, M. M. (2006). Creating a lean practice. *Family Practice Management*, 13 (4), 34-38

Esain, A., Williams, S. and Massey, L. (2008). Combining Planned and Emergent Change in a Healthcare Lean Transformation. *Public Money and Management*, 28 (1), 21-26

Fillingham, D. (2007). Can lean save lives? *Leadership in Health Services*, 20 (4), 231-241

Finigan, T. and Humphries, J. (2006). Maintenance gets lean. *Industrial Engineer*, 38 (10), 26-31

Flynn, B.B., Sakakibara, S. and Schroeder, R.G. (1995). Relationship between JIT and

TQM: practices and performance. *The Academy of Management Journal*, 38 (5), 1325-1360

Fornell, C. G., and Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, 18(1), 39-50

Fox, W.M. (1995). Sociotechnical System Principles and Guidelines: Past and Present. *Journal of Applied Behavioral Science*, 31 (1), 91-105

Frazier, P.A., Tix, A.P. and Barron, K.E. (2004). Testing Moderator and Mediator Effects in Counseling Psychology Research. *Journal of Counseling Psychology*, 51 (1), 115-134

Frey, K. and Gordon, L.A. (1999). ABC, strategy and business unit performance. *International Journal of Applied Quality Management*, 2 (1), 1-23

Fullerton, R. R. and McWatters, C. S. (2002). The role of performance measures and incentive systems in relation to the degree of JIT implementation. *Accounting, Organizations and Society*, 27 (8), 711–735

Fullerton, R. R. and Wempe, W. F. (2009). Lean manufacturing, non-financial performance measures, and financial performance. *International Journal of Operations and Production Management*, 29 (3), 214-240

Fullerton, R. R., McWatters, C. S. and Fawson, C. (2003). An examination of the relationships between JIT and financial performance. *Journal of Operations Management*, 21 (4), 383-404

Fullerton, R.R. and McWatters, C.S. (2004). An empirical examination of cost accounting practices used in advanced manufacturing environments. *Advances in Management Accounting*, 12 (-), 85–113

Fullerton, R.R., Kennedy, F.A. and Widener, S.A. (2013). Management accounting and

control practices in a lean manufacturing environment. *Accounting, Organizations and Society*, 38 (1), 50–71

Furlan, A., Vinelli, A. and Dal Pont, G. (2011). Complementarity and lean manufacturing bundles: an empirical analysis. *International Journal of Operations and Production Management*, 31 (8), 835-850

Galende, J. and de la Fuente, J.M. (2003). Internal factors determining a firm's innovative behaviour. *Research Policy*, 32 (5), 715 - 736

Garrett, D.F. and Lee, J. (2010). Lean Construction Submittal Process-A Case Study. *Quality Engineering*, 23 (1), 84-93

Geisser, S. (1974). A Predictive Approach to the Random Effects Model. *Biometrika*, 61 (1), 101–107.

Gerdin, J. (2005). The Impact of departmental interdependencies and management accounting system use on subunit performance. *European Accounting Review*, 14 (2), 297-327

Glancey, K. (1998). Determinants of growth and profitability in small entrepreneurial firms. *International Journal of Entrepreneurial Behaviour & Research*, 4 (1), 18-27

González-Benito, J. (2005). A study of the effect of manufacturing proactivity on business performance. *International Journal of Operations and Production Management*, 25 (3), 222-241

Gorman, M.F., Hoff, J. and Kinion, R. (2009). ASP, The Art and Science of Practice: Tales from the Front: Case Studies Indicate the Potential Pitfalls of Misapplication of Lean Improvement Programs. *Interfaces*, 39 (6), 540-548

Gosselin, M. (1997). The effect of strategy and organizational structure on the adoption and implementation of activity-based costing. *Accounting, Organizations and Society*, 22 (2), 105–122

Grafton, J., Lillis, A.M. and Widener, S.K. (2010). The role of performance measurement and evaluation in building organizational capabilities and performance. *Accounting, Organizations and Society*, 35 (7), 689–706

Grasso, L. (2005). Are ABC and RCA Accounting Systems Compatible with Lean Management? *Management Accounting Quarterly*, 7 (1), 12-27

Guest, D.E., Michie, J., Conway, N. and Sheehan, M. (2003). Human Resource Management and Corporate Performance in the UK. *British Journal of Industrial Relations*, 41 (2), 291–314

Guilding, C., Drury, C. and Tayles, M. (2005). An empirical investigation of the importance of cost-plus pricing. *Managerial Auditing Journal*, 20 (2), 125-137

Gunasekaran, A. and Sarhadi, M. (1998). Implementation of activity-based costing in manufacturing. *International Journal of Production Economics*, 56-57 (20), 231-242

Hagan, P. (2011). Waste not, want not Leading the lean health-care journey at Seattle Children's Hospital. *Global Business and Organizational Excellence*, 30 (3), 25-31

Hair, J.F., Ringle, C.M. and Sarstedt, M . (2011). PLS-SEM: Indeed a silver bullet. *Journal of Marketing Theory and Practice*, 19 (2), 139–151

Hair, J.F., Ringle, C.M. and Sarstedt, M . (2013). Partial least squares structural equation modeling: rigorous applications, better results and higher acceptance. *Long Range Planning*, 46 (1-2), 1–12

Hair, J.F., Sarstedt, M. and Ringle, C.M. (2012). An assessment of the use of partial least squares structural equation modeling in marketing research. *Journal of the Academy of Marketing Science*, 40 (3), 414-433

Hair, Joseph F, William C. Black, Barry J.Babin, and Rolph E. Anderson, (2010). Multivariate Data Analysis. A Global Perspective, 7th edition. New Jersey: Pearson Education,Inc

Hameri, AP. (2010). Production flow analysis-Cases from manufacturing and service industry. *International Journal of Production Economics*, 129 (2), 233-241

Hammad, S.A., Jusoh, R. and Oon, E.Y.N. (2010). Management accounting system for hospitals: a research framework. *Industrial Management and Data Systems*, 110 (5), 762-784

Hannan, M.T. and Freeman, J. (1984). Structural Inertia and Organizational Change. *American Sociological Review*, 49 (2), 149-164

Haque, B. and James-Moore, M. (2004). Applying lean thinking to new product introduction. *Journal of Engineering Design*, 15 (1), 1-31

Harris, L.G. (2001). Market Orientation and Performance: Objective and Subjective Empirical Evidence from UK Companies. *Journal of Management Studies*, 38 (1), 17-43

Hartwell, J. and Roth, G. (2010). Doing more with less at Ariens: a leadership and transformation case study. *Organization Management Journal*, 7 (2), 89-109

Hegde, G.G. and Nagarajan, N.J. (1992). Incentives for overhead cost reduction: Setup time and lot size considerations. *International Journal of Production Economics*, 28 (3), 255-263

Henri, J. -F. (2007). A quantitative assessment of the reporting of structural equation modeling information. *Journal of Accounting Literature*, 76-115.

Henseler, J., and Chin, W. W. (2010). A comparison of approaches for the analysis of interaction effects between latent variables using Partial Least Squares path modeling. *Structural Equation Modeling: A miltidiscipilnary journal*, 17(1), 82-109.

Hillman, A.J. (2005). Politicians on the Board of Directors: Do Connections Affect the Bottom Line? *Journal of Management*, 31 (3), 464-481

Hines, P. and Lethbridge, S. (2008). New Development: Creating a Lean University.

Public Money and Management, 28 (1), 53-56

Hines, P., Holweg, M. and Rich, N. (2004). Learning to evolve: A review of contemporary lean thinking. *International Journal of Operations and Production Management*, 24 (10), 994-1011

Hines, P., Martins, A. L. and Beale, J. (2008). Testing the Boundaries of Lean Thinking: Observations from the Legal Public Sector. *Public Money and Management*, 28 (1), 35-40

Hinterhuber, H. H. (1994). The European Way to Lean Management. *The International Executive*, 36 (3), 275-290

Holden, R. J. (2010). Lean Thinking in Emergency Departments: A Critical Review. *Annals of Emergency Medicine*, 57 (3), 265-278

Holm, M. and Ahlstrom, P. (2010a). Assessing lean service integration. In: Proceedings of the 17th International Annual EurOMA Conference, Portugal, June, 1-10

Holm, M. and Ahlstrom, P. (2010b). Lean Service - a literature review. In: Proceedings of the 17th International Annual EurOMA Conference, Portugal, June, 1-10

Holweg, M. (2007). The genealogy of lean production. *Journal of Operations Management*, 25 (2), 420-437

Höök, M. and Stehn, L. (2008). Lean principles in industrialized housing production: the need for a cultural change. *Lean Construction Journal*, 20-33

Huber, V.L. and Brown, K.A. (1991). Human resource issues in cellular manufacturing: A sociotechnical analysis. *Journal of Operations Management*, 10 (1), 138-159

Huselid, M.A. (1995). The impact of human resource management practices on turnover, productivity, and corporate financial performance. *Academy of Management Journal*, 38 (3), 635-672

Hyer, N.L. and Wemmerlöv, U. (2002). The office that lean built. *Industrial Management*, 44 (5), 36-43

Inman, R.A., Sale, R.S., Green Jr, K.W. and Whitten, D. (2011). Agile manufacturing: Relation to JIT, operational performance and firm performance. *Journal of Operations Management*, 29 (4), 343–355

Innes, J. and Mitchell, F. (1995). A survey of activity-based costing in the U.K.'s largest companies. *Management Accounting Research*, 6 (2), 137-153

Ittner, C. D. (1999). Activity-based costing concepts for quality improvement. *European Management Journal*, 17 (5), 492-500

Ittner, C. D., and Larcker, D. F. (2001). Assessing empirical research in managerial accounting: A value-based management perspective. *Journal of Accounting and Economics*, 32, 349-410.

Ittner, C.D., Lanen, W.N. and Larcker, D.F. (2002). The Association Between Activity-Based Costing and Manufacturing Performance. *Journal of Accounting Research*, 40 (3), 711-726

Jaaron, A. and Backhouse, C.J. (2011). A methodology for the implementation of lean thinking in manufacturing support services. *Int. J. Services and Operations Management*, 9 (4), 389-410

Jain, R. and Lyons, A.C. (2009). The implementation of lean manufacturing in the UK food and drink industry. *Int. J. Services and Operations Management*, 5 (4), 548-573

Jayaram, J., Ahire, S.L. and Dreyfus, P. (2010). Contingency relationships of firm size, TQM duration, unionization, and industry context on TQM implementation—A focus on total effects. *Journal of Operations Management*, 28 (4), 345–356

Jimmerson, C., Weber, D. and Sobek, D. K. (2005). Reducing Waste and Errors: Piloting Lean Principles at IHC. *Joint Commission Journal on Quality and Patient Safety*, 31

(5), 249-257

Jones, C., Medlen, N., Merlo, C., Robertson, M. and Shepherdson, J. (1999). The lean enterprise. *BT Technology Journal*, 17 (4), 15-22

Joosten, T., Bongers, I. and Jansses, R. (2009). Application of lean thinking to health care: Issues and observations. *International Journal for Quality in Health Care*, 21 (5), 341-347

Joshi, M.P., Kathuria, R. and Porth, S.J. (2003). Alignment of strategic priorities and performance: an integration of operations and strategic management perspectives. *Journal of Operations Management*, 21 (3), 353–369

Julien, D.M. and Tjahjono, B. (2009). Lean thinking implementation at a safari park. *Business Process Management Journal*, 15 (3), 321-335

Kallunki, JP. and Silvola, H. (2008). The effect of organizational life cycle stage on the use of activity-based costing. *Management Accounting Research*, 19 (1), 62–79

Kaplan, G.S. and Patterson, S.H. (2008). Seeking perfection in Healthcare: A Case Study in Adopting Toyota Production System Methods. *Healthcare Executive*, 23 (3), 17-20

Karlsson, C. and Ahlstrom, P. (1996). Assessing changes towards lean production. *International Journal of Operations and Production Management*, 16 (2), 24-41

Karmarkar, U. (2004). Will you survive the services revolution? *Harvard Business Review*, 82 (6), 100-107

Kaynak, H. (2003). The relationship between total quality management practices and their effects on firm performance. *Journal of Operations Management*, 21 (4), 405-435

Keen, M. (2011). Office skills. *Management Services*, 55 (1), 20-22

Kennedy, F., Owens-Jackson, L., Burney, L. and Schoon, M. (2007). How do your

measurements stack up to lean? *Strategic Finance*, 88 (11), 33-41

Kennedy, F.A. and Widener, S.K. (2008). A control framework: insights from evidence on lean accounting. *Management Accounting Research*, 19 (4), 301-323

Kennedy, T. and Affleck-Graves, J. (2001). The impact of activity-based costing techniques on firm performance. *Journal of Management Accounting Research*, 13, 19-45

Kepes, S., Banks, G.C., McDaniel, M. and Whetzel, D.L. (2012). Publication Bias in the Organizational Sciences. *Organizational Research Methods*, 15 (4), 624-662

Khataie, A.H. and Bulgak, A.A. (2013). A cost of quality decision support model for lean manufacturing: activity-based costing application. *International Journal of Quality & Reliability Management*, 30 (7), 751-764

Khataie, A.H., Bulgak, A.A and Segovia, J.J. (2011). Activity-Based Costing and Management applied in a hybrid Decision Support System for order management. *Decision Support Systems*, 52 (1), 142–156

Kim, C. S., Spahlinger, D. A., Kin, J. M. and Billi, J. A. (2006). Lean Health Care: What Can Hospitals Learn from a World-Class Automaker? *Journal of Hospital Medicine*, 1 (3), 191-199

Kim, D.U., Kumar, V. and Kumar, U. (2012). Relationship between quality management practices and innovation. *Journal of Operations Management*, 30 (4), 295-315

King, D. L., Ben-Tovim, D. I. and Bassham, J. (2006). Redesigning emergency department patient flows: Application of Lean Thinking to health care. *Emergency Medicine Australasia*, 18 (4), 391-397

Kock, S. (1995). Implementation considerations for activity-based cost systems in service firms: The unavoidable challenge. *Management Decision*, 33 (6), 57-63

Kosuge, R., Modig, N. and Ahlstrom, P. (2010). Standardization in lean service: Exploring

the contradiction. In: Proceedings of the 17th International Annual EurOMA Conference, Portugal, June, 2010), 1-10

Krafcik, J. F. (1988). Triumph of the lean production system. *Sloan Management Review*, 30 (1), 41-52

Kress, N.J. (2008). Lean Thinking in Libraries: A Case Study on Improving Shelving Turnaround. *Journal of Access Services*, 5 (1-2), 159-172

Kroes, J.R. and Ghosh, S. (2010). Outsourcing congruence with competitive priorities: Impact on supply chain and firm performance. *Journal of Operations Management*, 28 (2), 124–143

Kull, T.J., Ellis, S.C. and Narasimhan, R. (2013). Reducing Behavioral Constraints to Supplier Integration: A Socio-Technical Systems Perspective. *Journal of Supply Chain Management*, 49 (1),64-86

Kumar, A. and Telang, R. (2011). Product Customization and Customer Service Costs: An Empirical Analysis. *Manufacturing and Service Operations Management*, 13 (3), 347-360

Kuriger, G.W., Wan, H.D., Mirehei, M., Tamma, S. and Chen, F.F. (2010). A Web-Based Lean Simulation Game for Office Operations: Training the Other Side of a Lean Enterprise. *Simulation and Gaming*, 41 (4), 487-510

LaGanga, L.R. (2011). Lean service operations: Reflections and new directions for capacity expansion in outpatient clinics. *Journal of Operations Management*, 29 (5), 422-433

Lamminmaki, D. and Drury, C. (2001). A comparison of New Zealand and British product-costing practices. *The International Journal of Accounting*, 36 (3), 329–347

Langfield-Smith, K. (1997). Management control systems and strategy: A critical review. *Accounting, Organizations and Society*, 22 (2), 207-232

Larcker, D.F. and Rusticus, T.O. (2007). Endogeneity and Empirical Accounting Research. *European Accounting Review*, 16 (1), 207-215

Larson, P.D. and Kerr, S.G. (2007). Integration of Process Management Tools to Support TQM Implementation: ISO 9000 and Activity-based Costing. *Total Quality Management and Business Excellence*, 18 (1), 201-207

Lasa, I.S., Castro, R. and Laburu, C.O. (2009). Extent of the use of Lean concepts proposed for a value stream mapping application. *Production Planning and Control*, 20 (1), 82-98

Lazarus, I. R. and Andell, J. (2006). Providers, payers and it suppliers learn it pays to get "Lean". *Managed Healthcare Executive*, 16 (2), 34-36

Lee, L., Petter, S., Fayard, D. and Robinson, S. (2011). On the use of partial least squares path modeling in accounting research. *International Journal of Accounting Information Systems*, 12 (4), 305-328

Lee, S. M., Olson, D. L., Lee, S. H., Hwang, T. and Shin, M. S. (2008). Entrepreneurial applications of the lean approach to service industries. *The Service Industries Journal*, 28 (7), 973-987

Lei, D., Hitt, M.M. and Goldhar, J.D. (1996). Advanced Manufacturing Technology: Organizational Design and Strategic Flexibility. *Organization Studies*, 17 (3), 501-523

Lewis, M.A. (2000). Lean production and sustainable competitive advantage. *International Journal of Operations and Production Management*, 20 (8), 959-978

Li, X., Sawhney, R., Arendt, E.J. and Ramasamy, K. (2012). A comparative analysis of management accounting systems' impact on lean implementation. *International Journal of Technology Management*, 57 (1-3), 33-48

Liker, J. K. and Morgan, J. M. (2006). The Toyota Way in Services: The Case of Lean Product Development. *Academy of Management Perspectives*, 20 (2), 5-20

Lodge, A. and Bamford, D. (2008). New Development: Using Lean Techniques to Reduce Radiology Waiting Times. *Public Money and Management*, 28 (1), 49-52

Lowry, J.F. (1990). Management Accounting and Service Industries: An Exploratory Account of Historical and Current Economic Contexts. *ABACUS*, 26 (2), 159-184

Luft, J. and Shields, M. (2003). Mapping management accounting graphics and guidelines for theory-consistent empirical research. *Accounting, Organizations and Society*, 28 (2-3), 169–249

Lundvall, K. and Battese, G.E. (2000). Firm size, age and efficiency: Evidence from Kenyan manufacturing firms. *The Journal of Development Studies*, 36 (3), 146-163

Machuca, J. A. D., Gonza´lez-Zamora, M. d. M. and Aguilar-Escobar, V. G. (2007). Service operations management research. *Journal of Operations Management*, 25 (3), 585-603

MacKinnon, D.P., Krull, J.L. and Lockwood, C.M. (2000). Equivalence of the mediation, confounding and suppression effect. *Prevention Science*, 1 (4), 173-181

Maguad, BA. (2007). Lean Strategies for Education: Overcoming the Waste Factor. *Project Innovation*, 128 (2), 248-255

Maiga, A.S. and Jacobs, F.A. (2008). Extent of ABC Use and Its Consequences. *Contemporary Accounting Research*, 25 (2), 533-566

Malladi, S., Dominic, P.D.D. and Kamil, A. (2010). Lean principles in IT services: a case study on implementation and best practices. *Int. J. Business Information Systems*, 8 (3), 1-22

Malmbrandt, M., & Åhlström, P. (2013). An Instrument for Assessing Lean Service Adoption. *International Journal of Operations and Production Management*, 33 (9), 1131-1165

Manos, A., Sattler, M. and Alukal, G. (2006). Make Healthcare Lean. *Quality Progress*, 39

(7), 24-30

Manz, C.C. and Stewart, G.L. (1997). Attaining Flexible Stability by Integrating Total Quality Management and Socio-Technical Systems Theory. *Organization Science*, 8 (1), 59-70

Martinson, O.B. (2002). A look at cost accounting in the service industry and the federal government. *The Journal of Government Financial Management*, 51 (1), 18-25

Maskell, B.H. (2006). Solving the standard cost problem. *Cost Management*, 20 (1), 27-35

Maskell, B.H. and Kennedy, F.A. (2007). Why do we need lean accounting and how does it work? *Journal of Corporate Accounting and Finance*, 18 (3), 59-73

McQuade, D. (2008). New Development: Leading Lean Action to Transform Housing Services. *Public Money and Management*, 28 (1), 57-60

Meade, D. J., Kumar, S. and White, B. (2010). Analysing the impact of the implementation of lean manufacturing strategies on profitability. *Journal of the Operational Research Society*, 61 (5), 858-871

Mefford, R. N. (1993). Improving service quality: Learning from manufacturing. *International Journal of Production Economics*, 30-31, July, 399-413

Meier, H. S. and Forrester, P. L. (2002). A model for evaluating the degree of leanness of manufacturing firms. *Integrated Manufacturing Systems*, 13 (2), 104-109

Mia, L. and Clarke, B. (1999). Market competition, management accounting systems and business unit performance. *Management Accounting Research*, 10 (2), 137-1 58

Middleton, P., Flaxel, A. and Cookson, A. (2005). Lean Software Management Case Study: Timberline Inc.. *Lecture Notes in Computer Science*, 3556, 1-9

Miles, R. E., Snow, C.C., Meyer, A.D. and Coleman, H.J. (1978). Organizational strategy,

structure, and process. *Academy of Management Review*, 3 (3), 546-562

Miller, D. (1981). Toward a new contingency approach: The search for organisational gestals. *Journal of Management Studies*, 18(1), 1–26

Mirehei, S.M., Kuriger, G., Wan. H.D. And Chen, F.F. (2011). Enhancing lean training for the office environment through simulation and gaming. *Int. J. Learning and Intellectual Capital*, 8 (2), 206-221

Mishra, B. and Vaysman, I. (2001). Cost-System Choice and Incentives-Traditional vs. Activity-Based Costing. *Journal of Accounting Research*, 39 (3), 619-641

Moayed, F.A. and Shell, R.L. (2009). Comparison and evaluation of maintenance operations in lean versus non-lean production systems. *Journal of Quality in Maintenance Engineering*, 15 (3), 285-296

Mohrman, S.A., Tenkasi, R.V., Lawler, E.E. and Ledford, G.E. (1995). Total quality management: practice and outcomes in the largest US firms. *Employee Relations*, 17 (3), 26-41

Montabon, F. (2005). Using kaizen events for back office processes: the recruitment of frontline supervisor co-ops. *Total Quality Management and Business Excellence*, 16 (10), 1139–1147

Nelson-Peterson, D.L. and Leppa, C.J. (2007). Creating an environment for caring using lean principles of the Virginia mason production system. *The journal of nursing administration*, 37 (6), 287-294

Nie, W. and Kellogg, D. L. (1999). How professors of operations management view service operations? *Production and Operations Management*, 8 (3), 339-355

Nielsen, A. P. and Edwards, k. (2010). Implementing lean in healthcare: Barriers and opportunities. In: Proceedings of the 17th International Annual EurOMA Conference, Portugal, June, 2010), 1-10

Nunnally, J. (1978). Psychometric Theory, second ed. McGraw-Hill, New York.

Ohno, T. (1988). Toyota Production System: Beyond Large-Scale Production. Portland, OR: Productivity Press.

Oliver, N., Delbridge, R., Jones, D. and Lowe, J. (1994). World Class Manufacturing: Further Evidence in the Lean Production Debate. *British Journal of Management*, 5 (1), 53-63

Papadopoulos, T. and Merali, Y. (2008). Stakeholder Network Dynamics and Emergent Trajectories of Lean Implementation Projects: A Study in the UK National Health Service. *Public Money and Management*, 28 (1), 41-48

Patterson, M.G., West, M.A. and Wall, T.D. (2004). Integrated manufacturing, empowerment and company performance. *Journal of Organizational Behavior*, 25 (5), 641-665

Pavlatos, O. (2010). The impact of firm characteristics on ABC systems: a Greek-based empirical analysis. *Studies in Managerial and Financial Accounting*, 20, 501–527

Pavnaskar, S.J., Gershenson, J.K. and Jambekar, A.B. (2003). Classification scheme for lean manufacturing tools. *International Journal of Production Research*, 41 (13), 3075-3090

Pedersen, ERG. and Huniche, M. (2011). Negotiating lean: The fluidity and solidity of new management technologies in the Danish public sector. *International Journal of Productivity and performance management*, 60 (6), 550-566

Pejsa, P. and Eng, R. (2011). Lean strategy deployment delivers customer satisfaction at GE Healthcare. *Global Business and Organizational Excellence*, 30 (5), 45-55

Peng, D.X. and Lai, F. (2012). Using partial least squares in operations management research: A practical guideline and summary of past research. *Journal of Operations Management*, 30 (6), 467-480

Petersen, K. and Wohlin, C. (2010). Software process improvement through the Lean Measurement (SPI-LEAM) method. *The Journal of Systems and Software*, 83 (7), 1275–1287

Pettersen, J. (2009). Defining lean production: some conceptual and practical issues. *The TQM Journal*, 21 (2), 127-142

Piercy, N. and Rich, N. (2009(a)). High quality and low cost: the lean service center. *European Journal of Marketing*, 43 (11), 1477-1497

Piercy, N. and Rich, N. (2009(b)). Lean transformation in the pure service environment: the case of the call service centre. *International Journal of Operations and Production Management*, 29 (1), 54-76

Pizzini, M.J. (2006). The relation between cost-system design, managers' evaluations of the relevance and usefulness of cost data, and financial performance: an empirical study of US hospitals. *Accounting, Organizations and Society*, 31 (2), 179–210

Podsakoff, P.M., Mackenzie, S.B., Lee, J.Y., & Podsakoff, N.P. (2003). Common method biases in behavioral research: a critical review of the literature and recommended remedies. *Journal of Applied Psychology*, 88 (5), 879–903

Poksinska, B. (2010). The Current State of Lean Implementation in Health Care: Literature Review. *Quality Management in Health Care*, 19 (4), 319-329

Pont, G.D., Furlan, A. and Vinelli, A. (2008). Interrelationships among lean bundles and their effects on operational performance. *Operations Management Research*, 1 (2), 150-158

Porter, M. (1980). Competitive Strategy, Free Press. New York. NY.

Powell, T.C. (1995). Total Quality Management as Competitive Advantage: A Review and Empirical Study. *Strategic Management Journal*, 16 (1), 15-37

Qi, Y., Zhao, X. and Sheu, C. (2011). The Impact of Competitive Strategy and Supply

Chain Strategy on Business Performance: The Role of Environmental Uncertainty. *Decision Sciences*, 42 (2), 371-389

Qudrat-Ullah, H., Seong, B.S. and Mills, B.L. (2012). Improving high variable-low volume operations: an exploration into the lean product development. *International Journal of Technology Management*, 57 (1-23), 49-70

Radnor, Z. (2010). Transferring lean into government. *Journal of Manufacturing Technology Management*, 21 (3), 411-428

Radnor, Z. and Boaden, R. (2008). Lean in Public Services – Panacea or Paradox? *Public Money and Management*, 28 (1), 3-7

Radnor, Z. and Walley, P. (2008). Learning to Walk Before We Try to Run: Adapting Lean for the Public Sector. *Public Money and Management*, 28 (1), 13-20

Rahman, S., Laosirihongthong, T. and Sohal, A.S. (2010). Impact of lean strategy on operational performance: A study of Thai manufacturing companies. *Journal of Manufacturing Technology Management*, 21 (7), 839-852

Rajiv, S. (2009). The skinny on lean logistics. *Industrial Engineer*, 41 (10), 20-20

Rashidirad, M., Soltani, E. and Syed, J. (2013). Strategic Alignment Between Competitive Strategy and Dynamic Capability: Conceptual Framework and Hypothesis Development. *Strategic Change*, 22 (3-4), 213-224

Reinertsen, D. (2005). Let it flow. *Industrial Engineer*, 37 (6), 40-45

Reinertsen, D. and Shaeffer, L. (2005). Making R&D lean. *Research Technology Management*, 48 (4), 51-57

Rexhausen, D., Pibernik, R. and Kaiser, G. (2012). Customer-facing supply chain practices—The impact of demand and distribution management on supply chain success. *Journal of Operations Management*, 30 (4), 269–281

Robinson, A. G. and Schroeder, D. M. (2009). The Role of Front-Line Ideas in Lean Performance Improvement. *The Quality Management Journal*, 16 (4), 27-40

Ruiz-de-Arbulo-Lopez, P., Fortuny-Santos, J. and Cuatrecasas-Arbo´s, L. (2013). Lean manufacturing: costing the value stream. *Industrial Management and Data Systems*, 113 (5), 647-668

Saidur. R., Atabani, A.E. and Mekhilef, S. (2011). A review on electrical and thermal energy for industries. *Renewable and Sustainable Energy Reviews*, 15 (4), 2073–2086

Sakakibara, S., Flynn, B.B., Schroeder, R.G. and Morris, W.T. (1997). The Impact of Just-In-Time Manufacturing and Its Infrastructure on Manufacturing Performance. *Management Science*, 43 (9), 1246-1257

Sampson, S.E. and Froehle, C. M. (2006). Foundations and Implications of a Proposed Unified Services Theory. *Production and Operations Management*, 15 (2),329–343

Samson, D. and Terziovski, M. (1999). The relationship between total quality management practices and operational performance. *Journal of Operations Management*, 17 (4), 393-409

Sasser, W.E. (1976). Match supply and demand in service industries. *Harvard Business Review*, 54 (6), 133-140

Saunders, M., Lewis, P., and Thornhill, A. (2009). Research Methods for Business Students. London: FT Prentice Hall.

Scherrer-Rathje, M., Boyle, T.A. and Deflorin, P. (2009). Lean, take two! Reflections from the second attempt at lean implementation. *Business Horizons*, 52 (1), 79-88

Schlissel, M.R. and Chasin, J. (1991). Pricing of services: an interdisciplinary review. *The Service Industries Journal*, 11 (3), 271-286

Schmenner, R.W. (1986). How Can Service Businesses Survive and Prosper? *Sloan*

Management Review, 27 (3), 32

Schonberger, R. J. (2008). Lean performance management (metrics do not add up). *Cost Management*, 22 (1), 5-10

Schoute, M. (2011). The relationship between product diversity, usage of advanced manufacturing technologies and activity-based costing adoption. *The British Accounting Review*, 43 (2), 120–134

Scott, W.M. and Walton, D.A. (2010). Maximizing Case Efficiency: Lessons Learned From Lean-A Process Management Philosophy Utilized In Automotive Manufacturing. *FDCC Quarterly*, Fall, 1-16

Searcy, D.L. (2009(b)). Using cost management and lean tools to improve AMG's rental operations. *Cost Management*, 23 (6), 24-33

Shafer, S.M. and Moeller, S.B. (2012). The effects of Six Sigma on corporate performance: An empirical investigation. *Journal of Operations Management*, 30 (7-8), 521-532

Shah, R. and Goldstein, S.M. (2006). Use of structural equation modeling in operations management research: Looking back and forward. *Journal of Operations Management*, 24(2), 148-169

Shah, R. and Ward, P. T. (2003). Lean manufacturing: context, practice bundles, and performance. *Journal of Operations Management*, 21 (2), 129-149

Shah, R. and Ward, P. T. (2007). Defining and developing measures of lean production. *Journal of Operations Management*, 25 (4), 785-805

Shahrukh, I. (2011). Choosing what works: high-mix, low-volume small manufacturers must supplement the right tools with other strategies. *Industrial Engineer*, 43 (8), 42-47

Sharma, S., Durand, R.M. and Gur-Arie, O. (1981). Identification and Analysis of

Moderator Variables. *Journal of Marketing Research*, 18 (3), 291-300

Sheu, H.J. and Pan, CY. (2009). Cost-system choice in a multidimensional knowledge space: traditional versus activity-based costing. *International Journal of Technology Management*, 48 (3), 358-388

Shields, J., and Shields, M. (1998). Antecedents of participative budgeting. *Accounting, Organizations and Society*, 23, 49-76.

Shields, M. D. (1995). An empirical analysis of firms' implementation experiences with activity-based costing. *Journal of Management Accounting Research*, 7 (Fall), 1-28

Shields, M.D; Deng, F.G., Kato, Y. (2000). The design and effects of control systems: tests of direct- and indirect effects models. *Accounting, Organizations and Society*, 25(2), 185-202

Smith, D., and Langfield-Smith, K. (2004). Structural equation modeling in management accounting research: Critical analysis and opportunities. *Journal of Accounting Literature*, 23, 49-86.

Soltani, E., Barnes, B., Syed, J. and Liao, Y. (2012). Does management's approach impede service quality? *Production Planning & Control: The Management of Operations*, 23 (7), 523-540

Soltani, E., Liao, Y., Singh, A. and Wang, W. (2010). Managing service quality: The managers' orientations and their consequences – case study evidence of current practice. *Total Quality Management & Business Excellence*, 21(6), 673-685

South, J.B. (1993). A modified standard cost-accounting system can generate valid product costs. *Production and Inventory Management Journal*, 34 (2), 28-31

Souza, L. B. (2009). Trends and approaches in lean healthcare. *Leadership in Health Services*, 22 (2), 121-139

Spedding, T.A. and Sun, G.Q. (1999). Application of discrete event simulation to the

activity based costing of manufacturing systems. *International Journal of Production Economics*, 58 (3), 289–301

Sprigg, C. A. and Jackson, P. R. (2006). Call Centers as Lean Service Environments: Job-Related Strain and the Mediating Role of Work Design. *Journal of Occupational Health Psychology*, 11 (2), 197-212

Staats, B.R. and Upton, D.M. (2011). Lean knowledge work. *Harvard Business Review*, 89 (10), 100-110

Staats, B.R., Brunner, D.J. and Upton, D.M. (2011). Lean principles, learning, and knowledge work: Evidence from software services provider. *Journal of Operations Management*, 29 (5), 376-390

Stone, M. (1974). Cross-Validatory Choice and Assessment of Statistical Predictions. *Journal of the Royal Statistical Society*, 36 (2), 111–147.

Stuebs, M. and Sun, L. (2010). Business Reputation and Labor Efficiency, Productivity, and Cost. *Journal of Business Ethics*, 96 (2), 265-283

Suarez-Barraza, M. F., Smith, T. and Dahlgaard-Park, S. M. (2009). Lean-kaizen public service: an empirical approach in Spanish local governments. *The TQM Journal*, 21 (2), 143-167

Suarez-Barraza, M.F. and Ramis-Pujol, J. (2010). Implementation of Lean-Kaizen in the human resource service process: A case study in a Mexican public service organisation. *Journal of Manufacturing Technology Management*, 21 (3), 388-410

Suárez-Barraza, M.F., Smith, T. and Dahlgaard-Park, S.M. (2012). Lean Service: A literature analysis and classification. *Total Quality Management and Business Excellence*, 23 (3-4), 359-380

Swank, C. K. (2003). The Lean Service Machine. *Harvard Business Review*, 81 (10), 123-129

Swink, M. and Jacobs, B.W. (2012). Six Sigma adoption: Operating performance impacts and contextual drivers of success. *Journal of Operations Management*, 30 (6), 437-453

Tabachnick, B.G., & Fidell, L.S. (2007), Using Multivariate Statistics (5th ed.). New York: Allyn and Bacon.

Talib, F., Rahman, Z. and Qureshi, M.N. (2013). An empirical investigation of relationship between total quality management practices and quality performance in Indian service companies. *International Journal of Quality and Reliability Management*, 30 (3), 280-318

Tatikonda, L. (2007). Applying Lean Principles to Design, Teach, and Assess Courses. *Management Accounting Quarterly*, 8 (3), 27-38

Taylor, A. and Taylor, M. (2009). Operations management research: contemporary themes, trends and potential future directions. *International Journal of Operations and Production Management*, 29 (12), 1316-1340

Taylor, A.B., MacKinnon, D.P. and Tein, J. (2008). Tests of the three-path mediated effect. *Organizational Research Methods*, 11 (2), 241-269

Temme, D., Henning, K., and Hildebrandt, L. (2010). A comparison of current PLS path modeling software: Features, ease-of-Use, and performance. In V. E. Vinzi, W.

Tiplady, B. (2010). Running a lean office. *British Journal of Administrative Management*, fall (72), 22-23

Tischler, L. (2006). Bringing Lean to the Office. *Quality Progress*, 39 (7), 32-38

Tonya, V. (2004). Spreading The Good Word. *Industry Week*, 253 (2), 59-60

Toomey, J.W. (1994). Adjusting cost management systems to lean manufacturing environments. *Production and Inventory Management Journal*, 35 (3), 82-85

Towne, J. (2006). Going 'lean' streamlines processes, empowers staff and enhances care.

Hospitals and Health Networks, 80 (10), 34-35

Trist, E.L. (1981), The evolution of socio-technical systems: a conceptual framework and action research program. (Occasional paper No. 2), Ontario Quality of Working Life Centre, Ontario.

Trist, E.L. and Bamforth, K.W. (1951). Some Social and Psychological Consequences of the Longwall Method. *Human relations*, 4, 3-38

Tsai, W. and Lai, C. (2007). Outsourcing or capacity expansions: Application of activity-based costing model on joint products decisions. *Computers and Operations Research*, 34 (12), 3666–3681

Turesky, E.F. and Connell, P. (2010). Off the rails: understanding the derailment of a lean manufacturing initiative. *Organization Management Journal*, 7 (2), 110-132

Turney, P.B.B. and Anderson, B. (1989). Accounting For Continuous Improvement. MIT *Sloan Management Review*, 30 (2), 37-47

Van Biema, M. and Greenwald, B. (1997). Managing our way to higher service-sector productivity. *Harvard Business Review*, 75 (4), 87-95

Venkatraman, N. (1989). The concept of fit in strategy research: Toward verbal and statistical correspondence. *Academy of Management Review*, 14 (3), 423-444

Villarreal, B., Garcia, D. and Rosas, I. (2009). Eliminating Transportation Waste in Food Distribution: A Case Study. *Transportation Journal*, 48 (4), 72-77

Vlachos, I. and Bogdanovic, A. (2013). Lean thinking in the European hotel industry. *Tourism Management*, 36 (June), 354-363

Voss, C., Tsikriktsis, N. and Frohlich, M. (2002). Case research in operations management. *International Journal of Operations & Production Management*, 22 (2), 195-219

Voss, C.A. (2005). Paradigms of manufacturing strategy re-visited. *International Journal*

of Operations and Production Management, 25 (12), 1223-1227

Wagner, S.M., Grosse-Ruyken, P.T. and Erhun, F. (2012). The link between supply chain fit and financial performance of the firm. *Journal of Operations Management*, 30 (4), 340-353

Ward, P.T. and Duray, R. (2000). Manufacturing strategy in context: environment, competitive strategy and manufacturing strategy. *Journal of Operations Management*, 18 (2), 123–138

Ward, P.T., Bickford, D.J. and Leong, G.K. (1996). Configurations of Manufacturing Strategy, Business Strategy, Environment and Structure. *Journal of Management*, 22 (4), 597-626

Ward, P.T., McCreery, J.K. and Anand, G. (2007). Business strategies and manufacturing decisions: An empirical examination of linkages. *International Journal of Operations and Production Management*, 27 (9), 951-973

Wayne, C. (2005). Company Applies Lean Techniques in The Office. *Modern Machine Shop*, 78 (7), 44-46

Wenchao Song, W., Tan, K.H. and Baranek, A. (2009). Effective toolbox for lean service implementation. *International Journal of Services and Standards*, 5 (1), 1-16

Windrum, P. and Tomlinson, M. (1999). Knowledge-intensive Services and International Competitiveness: A Four Country Comparison. *Technology Analysis and Strategic Management*, 11 (3), 391-408

Womack, J. P. and Jones, D. T. (1994). From Lean Production to the Lean Enterprise. *Harvard Business Review*, 72, 93-103

Womack, J. P. and Jones, D. T. (1996). Beyond Toyota: How to Root Out Waste and Pursue Perfection. *Harvard Business Review*, 74 (5), 140-158

Womack, James P., Daniel T. Jones, and Daniel Roos, The Machine that Changed the

World: Based on the Massachusetts Institute of Technology 5-Million-Dollar 5-Year Study on the Future of the Automobile. Macmillan (1990).

Worley, J.M. and Doolen, T.L. (2006). The role of communication and management support in a lean manufacturing implementation. *Management Decision*, 44 (2), 228-245

Wu, L.C. and Wu, L.H. (2010). Service Engineering: An Interdisciplinary Framework. *Journal of Computer Information Systems*, December (1), 14-23

Yasin, M.M., Small, M.H. and Wafa, M.A. (2003). Organizational modifications to support JIT implementation in manufacturing and service operations. *Omega*, 31 (3),213-226

Yasuda, T. (2005). Firm Growth, Size, Age and behavior in Japanese manufacturing. *Small Business Economics*, 24 (1), 1-15

Yavas, U. and Yasin, M.M. (2001). Enhancing organizational performance in banks: A systematic approach. *Journal of Services Marketing*, 15 (6), 444 - 453

Yu-Lee, R.T. (2011). Proper Lean Accounting: Eliminating waste isn't enough; you have to reduce inputs to save money. *Industrial Engineer*, 43 (10), 39-43

Zaman, K., Khan, M.M. and Ahmad, M. (2013). Factors affecting commercial energy consumption in Pakistan: Progress in energy. *Renewable and Sustainable Energy Reviews*, 19, 107–135

Zhang, D., Linderman, K. and Schroeder, R.G. (2012). The moderating role of contextual factors on quality management practices. *Journal of Operations Management*, 30 (1-2), 12–23

Zu, X. (2009). Infrastructure and core quality management practices: how do they affect quality? *International Journal of Quality and Reliability Management*, 26 (2), 129-149

Appendix (1): The questionnaire

Section I. Best Practices and Performance

1. Indicate the extent to which your firm has implemented the following practices: (***tick one option***) (**Check the glossary sheet for a definition of each expression if needed**)

Practices	No imlementation	Considering	Beginning	Partially	Substantially	Fully
	1	**2**	**3**	**4**	**5**	**6**
1- 5Ss	☐	☐	☐	☐	☐	☐
2- Automation	☐	☐	☐	☐	☐	☐
3- Continuous improvement	☐	☐	☐	☐	☐	☐
4- Group technology	☐	☐	☐	☐	☐	☐
5- Improving facility layout	☐	☐	☐	☐	☐	☐
6- Just in Time	☐	☐	☐	☐	☐	☐
7- Kaizen blitz	☐	☐	☐	☐	☐	☐
8- Kanban	☐	☐	☐	☐	☐	☐
9- Mistakes proofing/Poka-Yoke	☐	☐	☐	☐	☐	☐
10- Policy deployment/Hoshin Kanri	☐	☐	☐	☐	☐	☐
11- Process redesign	☐	☐	☐	☐	☐	☐
12- Pull system	☐	☐	☐	☐	☐	☐
13- Quality function deployment	☐	☐	☐	☐	☐	☐
14- Quick set up time	☐	☐	☐	☐	☐	☐
15- Root cause analysis	☐	☐	☐	☐	☐	☐
16- Single piece flow	☐	☐	☐	☐	☐	☐
17- Small lots	☐	☐	☐	☐	☐	☐
18- Standardisation	☐	☐	☐	☐	☐	☐
19- Takt time	☐	☐	☐	☐	☐	☐
20- Total preventive maintenance	☐	☐	☐	☐	☐	☐
21- Value stream mapping	☐	☐	☐	☐	☐	☐
22- Visualisation	☐	☐	☐	☐	☐	☐
23- Work load balancing	☐	☐	☐	☐	☐	☐

2. How much effort, in terms of monetary, human and other resources, did your firm extend on each of the activities listed below as a direct consequence of implementing the practices reported in ***question (1)***? (***tick one option***)

Activities	No effort					Highest level of effort
	1	**2**	**3**	**4**	**5**	**6**
1- An appropriate rewarding system	☐	☐	☐	☐	☐	☐
2- Effective Communication System	☐	☐	☐	☐	☐	☐
3- Employee empowerment	☐	☐	☐	☐	☐	☐
4- Employee commitment	☐	☐	☐	☐	☐	☐
5- Employee involvement	☐	☐	☐	☐	☐	☐
6- Having multifunctional employees	☐	☐	☐	☐	☐	☐
7- Leadership	☐	☐	☐	☐	☐	☐
8- Obtaining management support	☐	☐	☐	☐	☐	☐
9- Performance measurement system	☐	☐	☐	☐	☐	☐
10- Training	☐	☐	☐	☐	☐	☐

3. Indicate your level of agreement with achieving each of the listed benefits by your firm as a direct consequence of the implementation of the practices reported in ***question (1)***: (***tick one option***)

Benefits	Strongly disagree					Strongly agree
	1	**2**	**3**	**4**	**5**	**6**
1- Freeing staff time	☐	☐	☐	☐	☐	☐
2- Identification and elimination of waste	☐	☐	☐	☐	☐	☐
3- Improvement in capacity	☐	☐	☐	☐	☐	☐
4- Improvement in customer perception of product/service quality	☐	☐	☐	☐	☐	☐
5- Improvement in customer satisfaction	☐	☐	☐	☐	☐	☐
6- Improvement in employees satisfaction and their performance	☐	☐	☐	☐	☐	☐
7- Improvement in employees understanding of the process	☐	☐	☐	☐	☐	☐

8- Improvement in operational efficiency	☐	☐	☐	☐	☐	☐
9- Improvement in productivity	☐	☐	☐	☐	☐	☐
10- Reduction in costs	☐	☐	☐	☐	☐	☐
11- Reduction in inventory	☐	☐	☐	☐	☐	☐
12- Reduction in lead time and cycle time	☐	☐	☐	☐	☐	☐
13- Reduction in the number of human errors	☐	☐	☐	☐	☐	☐

4. Has your firm formally implemented lean system? Yes _____ No _____

   If your answer is ***YES***, indicate year initiated _____

Section II. Business strategy and product costing

5. Please indicate the level of your firm's emphasis on the following activities: (***tick one option***)

Activities	No emphasis					Highest level of emphasis
	1	**2**	**3**	**4**	**5**	**6**
1- Achieving lower cost of services than competitors	☐	☐	☐	☐	☐	☐
2- Making service/procedures more cost efficient	☐	☐	☐	☐	☐	☐
3- Providing high quality services	☐	☐	☐	☐	☐	☐
4- Customising services to customers need	☐	☐	☐	☐	☐	☐
5- Providing after-sale services and support	☐	☐	☐	☐	☐	☐
6- Introducing new services/procedures quickly	☐	☐	☐	☐	☐	☐
7- Improving the cost required for coordination of various services	☐	☐	☐	☐	☐	☐
8- Improving the utilisation of available equipment, services and facilities	☐	☐	☐	☐	☐	☐

9- Providing services that are distinct from that of competitors	☐	☐	☐	☐	☐	☐
10- Offering a broader range of services than the competitors	☐	☐	☐	☐	☐	☐
11- Improving the time it takes to provide services to customers	☐	☐	☐	☐	☐	☐

6. Indicate by circling the costing system that is in use at your firm:

(1) Variable costing
(2) full absorption costing
(3) Activity-based costing
(4) Others

Section III. Demographics and Firm Characteristics

7. Approximately what is the percentage of foreign revenues to total revenues in this firm? (***circle one option***)

(1)	(2)	(3)	(4)	(5)
0%	1-25%	26-50%	51-75%	76-100%

8. Approximately what percent of employees at this firm is represented by a union(s)? (***circle one option***)

(1)	(2)	(3)	(4)	(5)
None	1–25%	26–50%	51–75%	76–100%

9. What is your job title? _____

10. How many years of experience do you have in managerial level? _____ In management at your firm? _____

Thank you for your time and assistance in completing this survey.

If you would like a copy of the results from this study, please check the box on the right. ☐

E-mail address to receive a copy of the results: _____

Appendix (2): Introductory letter

Dear (*participant name*),

I am a doctoral student at Brunel University London whose PhD thesis focuses on the possible impact of lean practices on the performance of UK service firms. This research is highly important given the significant interest in lean concept among practitioners and academics and the noticeable lack of research reporting on the effect of lean practices on the performance of service sector. Therefore, you are kindly invited to voluntarily participate in this research, funded by myself, by answering the enclosed questionnaire that will almost take 15-20 minutes of your time.

It is very important to note that your answers will be strictly confidential as approved by the Ethics Committee of Brunel Business School. The aim of my research will be best achieved by reporting information at an aggregate level (i.e. industry level), therefore the information you provide will not be revealed at company level by any means. In addition to helping me completing my PhD programme, your participation is highly important to improve the very limited knowledge available on service firms' experience with lean system and therefore all participants are promised a copy of my results if they are interested so that you can benchmark your practices against your industry.

This research seeks participation of randomly selected service firms operating in the UK including your company, and you were specifically chosen due to being a member of your company current director board believed to hold required knowledge to answer the questionnaire. However, please feel free to share this questionnaire with other knowledgeable persons in your company for providing the most accurate answers to the questions.

The questionnaire includes questions mainly focusing on your company's experience with implementing specific operations and management practices in its own operations. Therefore, if you are going to participate in my research and that is my wish, please answer the questions from the perspective of your current company ignoring any information related to subsidiaries owned by your firm.

If you have any query related to your participation, please do not hesitate to contact me at wael.hadid@brunel.ac.uk and I will be happy to discuss about it.

Thank you very much for your help and cooperation.

Wael Hadid

PhD researcher

Brunel University

London.

Appendix (3): Glossary sheet

Practices	Definition	Reference
5Ss	Sort—sort out what is wanted in an area and what items can be disposed of, reduced or moved, Set in order—place items to be retrieved closest to the area for frequency of use and determine volume of use. Make visible so abnormalities are apparent, Shine—make sure all items are in the best working condition and remain so, Standardise—standardise work routines as well as equipment and material usage, Sustain—ensure standards set are followed and improved.	Esain et al. (2008)
Automation	It is the replacement of manual labour by advanced equipments.	Bortolotti and Romano (2010)
Continuous improvement	A philosophy which promotes organisational change based on an ongoing pattern of planning, execution and evaluation of results related to all operations of an organisation for the purpose of forever improvement.	Emiliani (2004)
Group technology	Work processes are designed to form work cells which are located close to each other with the object of cutting down on unneeded transport and waiting times.	Suarez-Barraza et al. (2009)
Changing the facility layout	A layout designed according to optimum operational sequence or flow	Suarez-Barraza et al. (2009)
Just in Time	It is the delivery of what is needed to where they are needed, in the quantity needed, at the time they are requested.	Alagaraja (2010)
Kaizen blitz	Short-term process improvement projects that concern a specific area to improve.	Suarez-Barraza et al. (2009)
Kanban	It is an information system that indicates when a subsequent activity within a connected series of activities can start.	Manos et al. (2006)
Mistakes proofing/Poka-Yoke	It is a process that helps eliminate the chance for mistakes.	Manos et al. (2006)
Policy deployment/Hoshin Kanri	A process used to connect corporate strategy to key objectives and resources, including daily activities across functions.	Emiliani (2004)

Process redesign	To redesign content, scope, flow and structure of tasks and subtasks within an organisation to enhance operational and customer-related performance outcomes such as cost, productivity, quality, service, satisfaction and speed.	Yavas and Yasin (2001)
Pull system	To produce and deliver products/services at the request or pull of the customer or user.	Manos et al. (2006)
Quality function deployment	Using a cross-functional team approach to reach consensus about final product/service specifications, in accordance with customer requirements.	Alagaraja (2010)
Quick set up time	It is the ability to re setup an area for providing a different product/service quickly.	Maguad (2007)
Root cause analysis	Methods used to determine the root cause of a problem and identify countermeasures to avoid repeat occurrences. Key tools are "5 Whys" (asking why five or more times until the root cause of the problem is discovered) and fishbone or cause-and effect diagram.	Emiliani (2004)
Single piece flow	To pass the work to the next station right after finishing it without making any batches.	Mirehei et al. (2011)
Small lots	To process transactions/information in the smaller batch possible and passed it along to the next step.	Arbos (2002)
Standardisation	It is an agreed-upon set of work procedures that establish the best and most reliable methods and sequences for each process and each worker.	Kosuge et al. (2010)
Takt time	The rate of customer demand. Used to establish a direct link between marketplace demand and workplace activities.	Emiliani (2004)
Total preventive maintenance	A program used to ensure that equipment is in good operating condition and available for use when needed.	Mirehei et al. (2011)
Value stream mapping	A visual picture of material and information flows from supplier to customer: current-state map determines current conditions of flow; future-state map shows opportunities for improvement at some future point.	Alagaraja (2010)
Visualisation	Signs and other forms of visual information used to simplify the workplace and make it easy to recognise abnormalities.	Emiliani (2004)
Work load balancing	It is the allocation of tasks in a balanced amount between employees so that none will be over or under loaded with tasks.	Mirehei et al. (2011)