Exploring the relationships between operational practices and financial performance for UK manufacturing companies

S.Mohammad Nabavieh

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Abstract

Since the late 1980s many business performance measurement (BPM) frameworks have been developed. These frameworks suggest users to choose their own measures or define different aspects of a company's operational practice to be measured to improve competitiveness and give an early indication of its future financial performance. However using a framework does not help identifying which operational practices have a direct positive impact on which financial performance indicators. Thus a key challenge for company managers is to find which of their operational practices directly lead to an improvement in which of their financial performance measures. Many studies have examined the impact of different operational practices on financial results in different countries. The findings of those studies are thus context-specific (country, legal, market) and often have limitations in the study methodology. The goal of this study was to develop a BPM framework for UK manufacturing companies based on a positive relationship that the recommended key operational practices have on measures of their financial performance.

Initially twenty hypotheses based on the findings from forty earlier studies were formulated. The applicability of these relationships to UK manufacturing companies was tested on a sample of seventy-nine UK manufacturing companies. The sample companies had participated in the Institute of Mechanical Engineers (IMechE)'s manufacturing-excellence (MX) Awards between 2006 and 2011 and consists of thirty-one SMEs and forty-eight large firms. To test the hypotheses, the performance scores for the sample in ninety of their operational practices were analysed against eighteen financial ratios, collected from two financial databases (FAME and Amadeus). A longitudinal study compared financial data for five financial years; the year of application for the award and one financial year before and three years after the IMechE assessment. Thus the time delay between having a strong operational practices and realisation of financial benefits could be investigated. In addition if the impact of operational practices on the financial results is persistent over time could be judged. The company data in the ninety operational practices was used as explanatory variables against improvements in each of the eighteen financial outcome variables. To analyse the relationships between these variables, the dataset of the study was split into two parts. The data from companies that have participated in the MX Awards between 2006 and 2010 were used as estimation sample for statistical predictions. Then the data from companies that have participated in the MX Awards in 2011 were used for validation.

Initially the Fisher's exact test was used to find the correlated pair of operational practices and financial ratios. For each of the identified correlated pairs, the exact logistic regression analysis was used to find the dependence of the financial ratios on their correlated operational practices. As a result of these analyses, eleven relationships for SMEs and forty-nine relationships for large companies were identified. These relationships were used to develop BPM frameworks for UK SMEs and another for large UK companies. The framework linked specific operational practices to specific financial measures. To further refine the findings, three supporting studies were used to find potential causal explanations for relationships or lack of relationships identified between the operational practices and financial results in the derived BPM framework. Approach one was based on reviewing earlier studies for causal relationships they had noted. In approach two, key researchers from earlier studies were contacted for their opinion about the findings of this study. In approach three, the BPM relationships identified were discussed with ten manufacturing academics/business consultants in two focus groups sessions and two individual interviews to explore the possible causal reasons behind the relationships identified. This process resulted in the removal of lack of relationships in eight categories of operational practices from the BPM frameworks, as there were insufficient possible explanations to support them.

The adopted methodology addressed the key research questions of the study by providing BMP frameworks for large businesses and SMEs in the UK. This study has three main limitations. First, compared to some of the earlier studies, the sample size is smaller and the operational measures used were driven by the needs of the IMechE's MX-Awards. This can reduce the generalisability of the findings. Secondly, because of this dataset the impact of each of the operational practices was separately analysed. This has two problems including 'Confounding-bias' and 'Multiple comparisons' which could have influence the identified relationships. Eight categories of operational practices did not have any direct positive impact on financial performance. The data analysis conducted only looked for positive impact, exploring the dataset for negative impact may have revealed more useful information. Thus there is a need for future studies to verify the representativeness of the IMechE dataset and to look for negative correlations.

Declaration

I declare, that the work contained in this dissertation is my own, and has not been submitted in any previous application for a degree or award. I acknowledge that anywhere in this thesis that, ideas, figures, tables from other sources have been used, appropriate referencing has been used.

Signed: *S.Mohammad Nabavieh*

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1. Introduction

In his lecture on 'Electrical Units of Measurement' on 3rd May 1883, William Thomson Baron Kelvin (Lord Kelvin), the well-known physicist, said the following on the importance of measurement:

> I often say that when you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind: it may be the beginning of knowledge, but you have scarcely, in your thoughts, advanced to the stage of science, whatever the matter may be (Kelvin, 1883, p1-2).

The same is applicable to the measurement of business performance. It is only through measurement that managers can identify and quantify problems in their business and take corrective actions to improve them. Until the 1980s, most companies tended to focus on financial measures such as return on investment or return on equity to evaluate their performance (Taticchi et al., 2012). However, in the late 1980s and early 1990s, authors such as Kaplan & Norton (1992) criticised financial measures for being backward looking and for encouraging short-termism (Neely et al., 2000). These criticisms led to developing of multidimensional performance measurement frameworks such as the following:

1. Performance Measurement Matrix (Keegan et al., 1989),
2. Results and Determinants Framework (Fitzgerald et al., 1991),
3. Balanced Scorecard (BSC) (Kaplan & Norton, 1992),
4. Integrated Performance Measurement Framework (Medori & Steeple, 2000) and
5. Performance Prism (Neely et al., 2002).

These frameworks suggest measuring operational practices to give an early signal of future financial performance (Bourne et al., 2000). Therefore, they tried to overcome the drawbacks of financial performance measures that can only suggest what has been achieved in the past. However, Neely & Austin (2004) argue that the widespread interest in these frameworks resulted in companies becoming obsessed with measurement. Therefore, the problem of performance measurement is shifted from measuring the wrong things (only financial measures) in the 1980s to measuring too many things in 2000s (Neely & Austin, 2004).

William Bruce Cameron in his book, *Informal Sociology: A casual introduction to sociological thinking*, states the following:

> It would be nice if all of the data which sociologists require could be enumerated because then we could run them through IBM machines and draw charts as the economists do. **However, not everything that can be counted counts, and not everything that counts can be counted** (Cameron, 1963, p13).

Ittner & Larcker's (2003) study, based on interviewing managers of sixty manufacturing and service companies and survey responses from 297 senior executives, points out a similar problem related to companies' performance measurements. Most of the companies in their study fail to realise the benefits of measuring their operational practices, because they fail to measure the right operational practices that can improve their financial performance. As Ittner & Larcker (2003) stated:

> […] using such a framework by itself won't help identify which performance areas— and which drivers—make the greatest contribution to the company's financial outcomes (Ittner & Larcker, 2003, p2).

Thus a key challenge for companies is still to find which of their operational practices directly lead to an improvement in their financial performance (Ittner & Larcker, 2003; Neely et al., 2002). This study tries to identify key operational practices and the associated measures of UK manufacturing companies that have a positive impact on their financial performance. Many studies have examined the impact of operational practices on financial results. However, of the seventy-two studies that are reviewed in this research, only one study incorporated UK manufacturing companies in their sample. The studies that have been conducted in other countries state that their findings are only useful for those countries. For example, Duh et al. (2012) study the impact of total quality management (TQM) practices on the financial performance of 209 firms in Taiwan. As a suggestion for future research, they recommend that only further studies in other countries can comment on the generalisability of their findings in other countries. In this study, the impact of operational practices in UK manufacturing companies on their financial performance is analysed. From this analysis, the impact of specific operational practices on specific financial measures is drawn.

This introductory chapter gives the underlying basis of the thesis, provides necessary background information and explains the reasons for starting the study. It starts by defining performance measurement and its historical background in order to contextualise the study within the relevant literature (section 1.1). Then in section 1.2 the reasons to start this study are explained. This consists of the author's personal motivation and the knowledge gaps in the literature that this study seeks to address. Based on those motivations, the research questions of the study and a set of objectives to address the research questions are defined in section 1.3. Then in section 1.4, an introduction to the selected research approach to answer the research questions is explained. Finally, section 1.5 provides an outline of the thesis.

1.1. Context of the study

This section provides definitions for key terms in the performance measurement field of study and explores the historical context and the current status of the field.

1.1.1. Definition of performance measurement

There is a general agreement on the definitions of performance measurement in the literature. Many studies, such as McDougall et al. (2002), Moullin (2007), Nudurupati et al. (2010), Striteska & Spickova (2012), quote the following definition by Neely et al. (1995):

> The process of quantifying [the efficiency and effectiveness of past] actions, where measurement is the process of quantification and [past] action leads to [current] performance (Neely et al., 1995, p1)

In the same article, Neely et al. (1995) also defines a performance measure as: A metric used to quantify the efficiency and/or effectiveness of an action (Neely et al., 1995, p80).

Max Moullin criticises Neely et al.'s (1995) definition in two of his publications (i.e. Moullin (2003) and Moullin (2007)). He points out that Neely's definition does not exactly point out what managers should quantify or why, and recommends the following definition:

> Performance measurement is evaluating how well organisations are managed and the value they deliver for customers and other stakeholders (Moullin, 2003, p3).

Striteska & Spickova (2012), support Moullin's definition because it highlights the value that an organisation delivers to its customers. However, Neely et al. (1995) have also pointed out the need to meet customers' needs by explaining the terms effectiveness and efficiency.

> Effectiveness refers to the extent to which **customer** requirements are met, while efficiency is a measure of how economically the firm's resources are utilized when providing a given level of **customer** satisfaction (Neely et al., 1995, p1)

Neely et al. (2002) further improved this definition by replacing the word customer by stakeholder:

> Effectiveness refers to the extent to which **stakeholder** requirements are met, while efficiency is a measure of how economically the firm's resources are utilized when providing a given level of **stakeholder** satisfaction (Neely et al., 2002, p xii)

This is because according to Neely et al. (2002), it is no longer enough for companies to only concentrate on the needs of their customers and shareholders. To be able to survive and succeed in the long term, they need to also consider the needs of other stakeholders, such as employees, suppliers, regulators and communities (Neely et al., 2002).

By comparing these definitions, the necessary purpose of performance measurement that is agreed by most authors is to measure how well and cost-effectively an organisation has met the needs of its stakeholders. However, unlike the term performance measurement, there is no consensus on defining performance measurement systems in the literature. Some authors such as Bititci et al. (1997) only stress the use of performance measurement systems to support business management in their definition:

> The performance measurement system is the information system which is at the heart of the performance management process and it is of critical importance to the effective and efficient functioning of the performance management system (Bititci et al., 1997, p 533).

Others, such as Neely et al. (2002), define it by the steps needed to conduct performance measurement:

> A performance measurement system enables informed decisions to be made and actions to be taken because it quantifies the efficiency and effectiveness of past actions through the acquisition, collation, sorting, analysis and interpretation of appropriate data (Neely et al., 2002, p xiii)

The study by Franco-Santos et al. (2007), based on reviewing of more than 300 documents (including journal articles, book chapters, conference papers and working papers), identified seventeen different definitions of business performance measurement (BPM) systems. By analysing those definitions, they claim there are only two necessary features, one role and three essential processes for BPM systems.

- The necessary features of BPM systems are:
    - Having a set of performance measures
    - Having a supporting infrastructure to collect and analyse the data from measures.

- The necessary role of BPM systems is to measure performance.

- Finally, the three necessary processes of a BPM system are:
    - Designing and selecting measures,
    - Collecting data and
    - Sharing the result of measurement (Franco-Santos et al., 2007).

Although there is a general agreement that all BPM systems should include a set of performance measures, there is no agreement on the types or characteristics of those measures (Franco-Santos et al., 2007). This study tries to find the impact of companies' operational practices on their financial performance to help simplify the definition of effective performance measures in evaluating companies' performance. The next section explains the origins of performance measurement and how it is evolved since early twentieth century.

1.1.2. The origins of performance measurement

1.1.2.1. Early twentieth century

The origins of performance measurement can be traced back to the early twentieth century. One of the founders of operational practice measurement was Fredrick Taylor. His theory of scientific management was developed in the first decade of the twentieth century (Radnor & Barnes, 2007).The foundation of scientific management is based on the following features:

- Science, not rule of thumb
- Harmony, not disagreement
- Cooperation, not individualism
- Maximum output, in place of restricted output,
- Develop each man to his greatest efficiency and prosperity (Taylor, 1911).

Therefore, the emphasis of scientific management was based more on measuring performance of individual workers. For measuring the company's overall performance, managers were likely to rely on financial measures (Radnor & Barnes, 2007).

The Du Pont cousins are recognised as being the founder of financial performance measurement (Neely et al., 2000). These cousins developed the 'The Pyramid of financial ratios for calculation of return on investment (ROI)' in the Du Pont Company in the early 1920s.These are still widely used for the financial performance measurement of companies (Yadav et al., 2013).

In the years immediately after the Second World War, driven by the human relations movements, the scientific management approach was criticised for its concentration on the resulting performance of an individual (Radnor & Barnes, 2007). The critics argued that the social aspect of the work was at least as important as the technical. Therefore, the emphasis of the performance measurement was shifted from the performance of individuals to that of teams (Radnor & Barnes, 2007). However, in this period the main focus of manufacturing operations was on sales rather than customers i.e. selling a small range of products to relatively undemanding customers (Neely & Austin, 2004). Therefore, the emphasis of performance measurement in that period was still on financial metrics (Nudurupati et al., 2010).

1.1.2.2. Early 1980s

In the 1980s, Japanese techniques and practices, such as total quality management (TQM), Just-in-time (JIT), gained wider acceptance throughout the world (Nudurupati et al., 2010). Thus the emphasis of manufacturing operations was shifted from 'conformance to specification' towards customer satisfaction (Neely, 2007). Hayes & Abernathy (1980) argued that Japanese economic success was due to their pursuit of both operational efficiency and effectiveness (Nudurupati et al., 2010; Neely & Austin, 2004; Radnor & Barnes, 2007).

Because of the shift towards customer satisfaction, new dimensions of performance effectiveness, such as product specification, quality, volume and delivery, came into the picture (Slack, 1983; Nudurupati et al., 2010). Concurrently, authors such as Johnson & Kaplan (1987) highlighted the drawbacks of financial-based performance measurement systems and argued for change (Bourne et al., 2000).

1.1.2.3. Late 1980s and early 1990s

To overcome some limitations of the financial performance measures, since the late 1980s and early 1990s, various frameworks were developed that incorporated a balanced set of operational and financial measures (Bourne et al., 2000). The Performance Pyramid model (Cross & Lynch, 1988) was the first model that linked a company's strategy to its operational practices. This was followed by the Performance Measurement Matrix (Keegan et al., 1989) that introduced a mixture of financial and non-financial measures to evaluate companies' performance (Taticchi, et al, 2010).

The most well-known model in this period is the balanced scorecard (BSC) (Kaplan & Norton, 1992), which integrates four facets of business performance (i.e. Customer, Internal Business, Innovation & Learning and Financial perspectives). This model was developed to address some of the weaknesses of traditional management accounting and control (Johanson et al., 2006). However, despite its strength in integrating four facets of business performance, one of the weaknesses of this model is that it neglects some important stakeholder perspectives – i.e. employees and suppliers (Neely, 2004).

1.1.2.4. Early 2000s and current status of the field

Since 1992, in which the first generation of the balanced scorecard was developed, Kaplan & Norton have made a few changes and additions to the framework. For example, in 1996, a four-step process was proposed for developing the balanced scorecard in an organisation (Kaplan & Norton, 1996). Also Kaplan & Norton (2000) introduce the idea of strategy map to enable an organisation to describe its objectives and targets and measures to assess its performance.

Besides the changes that were made to the balanced scorecard by its original developers, other authors have also suggested some recommendations to overcome the limitations of this approach. For example, Chytas et al. (2011) propose a method called proactive balanced scorecard methodology to support design, implementation and use of the balanced scorecard. Similarly, Valmohammadi & Servati (2011) suggest an approach to selecting performance measures to be used in the balanced scorecard by using statistical methods.

One of the most well-known frameworks developed in the 2000s to overcome the limitations of the balanced scorecard and other similar frameworks is the Performance Prism (Neely et al., 2002). Neely et al. (2002) claimed to develop the Performance Prism, based on the strengths of the earlier frameworks, by addressing their limitations. The Performance Prism consists of five interconnected facets of performance including: Stakeholder Satisfaction, Stakeholder Contribution, Strategies, Processes, and Capabilities, to meet the needs of the five key business stakeholders including: Shareholders, Customers, Employees, Suppliers and Regulators (Neely et al., 2002).

Most of the frameworks developed since 1980s have been concerned with the development of performance measurement systems and answer the question of how to design such systems (Nudurupati, 2010). Companies still need to select their own set of measures to complement these frameworks. However, there is evidence in the literature that companies have difficulty in doing so. For example, Neely et al. (2002) report the findings of a survey which studies managers' difficulties in choosing suitable performance measures. Of the respondents, 56% had difficulty in selecting leading (performance drivers) and lagging (outcomes) measures and 37% had difficulty in finding key value drivers for their business. Supported by Ittner & Larcker (2003) and Neely et al. (2002), one of the key challenges for companies is still selecting the right set of performance measures to help in improving performance.

Overall, performance measurement can be traced back to the scientific management theory of Fredrick Taylor (Radnor & Barnes, 2007). The main emphasis of scientific management was on the performance of an individual employee and for measuring company-wide performance, and only financial measures were used (Radnor & Barnes, 2007). Gradually, and by the wider acceptance of the quality practices such as TQM and JIT, the scope of performance measurement was widened to include other facets of performance, such as product specification, quality and delivery (Nudurupati et al., 2010). In the late 1980s, the financial performance measures were criticised for their short-termism (Johnson & Kaplan 1987; Bourne et al., 2000). As a result, since then, many performance measurement frameworks based on a combination of operational and financial measures have been developed (Bourne et al., 2000).

Although these frameworks help companies to design their performance measurement systems (Nudurupati, 2010), companies still need to select their own set of measures to complement these frameworks. This study tries to find the relationship between companies' operational practices and financial performance. This can simplify a company's effort in defining the performance measures to evaluate their performance against its strategic goals. The next section explains the motivation to starting this study.

1.2. Motivations for the study

This section explains the main reasons for conducting this research, including both the author's personal motivation and the knowledge gaps in the existing literature that this study will try to address.

1.2.1. Personal motivation

In the first year of his PhD, the author worked mainly as a software developer on a project called 'MX Start'. This project was a collaboration between Warwick Manufacturing Group (WMG), the Manufacturing Advisory Service (MAS) and the Institution of Mechanical Engineers (IMechE). The aim of project was to:

> Support manufacturing companies start their journey towards manufacturing excellence through identifying key improvement areas, disseminating best practice and providing facilitative feedback to guide them to start making improvements (McDougall, 2011, p123).

It had been noted that companies which entered the annual IMechE National Manufacturing Excellence awards cited the value of the feedback provided by teams of award assessors as a key benefit from the programme. The goal was to make this benefit accessible to a much greater number of companies without the cost of sending a team of expert assessors to visit the business. This was to be achieved through two means:

1. Developing a method by which companies could easily start the journey to manufacturing excellence by gaining feedback on the current actions against benchmark best practice by a self-help website (MX Start).
2. Encourage companies that scored well on MX Start to enter the IMechE National Manufacturing Excellence Awards.

The final product of that project was a web-based self-assessment tool which provides a basis for guiding manufacturing companies to improve their performance in eight interrelated business practices as showed in Figure **1-1**.

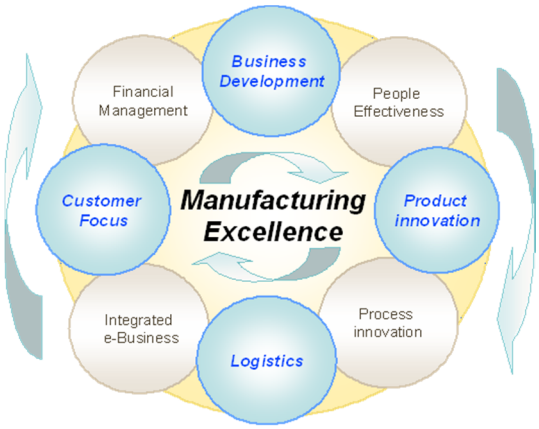


Figure 1-1 A pictorial representation of Manufacturing Excellence (Garside, 2009)

The author's contribution to that project was to complete a software tool (an assessment module) to produce radar diagrams and feedback reports to enable companies to compare their performance against best practice. The tool has proven to be effective in helping companies to compare their performance against best practices and identify the areas of improvement (McDougall, 2011). However, business consultants such as Dr Graham Broome, Dr Peter Summerfield and Dr John Garside through their comments about the website point out that, business managers usually have a more essential question: Senior managers were still looking for which particular operational practices can directly help them to improve specific financial measures. The next section discusses the limitations of the existing literature in answering this question.

1.2.2. Knowledge gaps in the existing literature

Many research studies claim that an essential feature to developing an effective performance measurement system is to find causal relationships between a company's operational practices and financial performance (Kaplan & Norton, 2000; Ittner & Larcker, 2003; Ittner, 2008). Such relationships are claimed to:

1. Help in communicating the strategic intent of an organisation (Kaplan & Norton, 2000),
2. Provide a basis for selecting suitable performance measures and improved financial result (Ittner & Larcker, 2003)
3. Improve performance evaluation (Ittner, 2008).

However, this is not universally accepted; Ratner et al. (2009) argues that a company's operational practice and financial results are not always mutually inclusive. So companies with strong operational performance might financially struggle or the other way round.

Kaplan & Norton (1992) give an example of an electronic company that during a three-year period improved their operational performance, including the reduction of their defect rate and an improvement to their on-time delivery rate. However, during the same period, the company's financial results did not improve and its stock price dropped to one-third of its original price. Kaplan & Norton (1992) argue that the company's failure to expand its marketing, together with its slowness in introducing new products, could be the potential reasons preventing it from realising the benefits of its operational successes. This inconsistency between improved operational and financial performance only leads to the frustration of senior executives (Kaplan & Norton, 1992). The aim of this study is to contribute to addressing this ambiguity in the literature and provide guidelines that companies in the UK can use in practice. There are many studies that have examined the relationship between operational practice and financial performance. The following summarises the main limitations in the existing literature on the relationship between operational practices and financial performance that this study seeks to address:

1.2.2.1. Limited operational practices and financial measures

Most of the earlier studies only examine the relationship between a limited number of operational practices and financial performance measures. For example, Dubey et al. (2014) examine the impact of the following four operational competencies:

1- Manufacturing
2- Marketing
3- Logistics
4- Procurement

on Indian companies' financial performance, including: 'days of payable outstanding' and 'profitability'. They conclude that those variables explain 45.7% of the total variance of companies' financial performance and the remaining variance is from other variables which are not considered in their study. Similarly, Abusa & Gibson (2013) examine the relationships between the extent of implementation of the following six elements of total quality management (TQM) and financial performance of Libyan firms, including: sales growth and profit growth.

1- Top management commitment
2- Customer focus
3- Supplier quality management
4- People management
5- Continuous improvement
6- Process management.

This study also found that most variance in the companies' financial performance was not explained by their selected TQM elements. Therefore, there is a need for further studies to expand the number of variables that are considered in these studies to identify other influential variables that are not considered in them. In addition, Duarte et al. (2011) test the impact of the following operational practices on Brazilian companies' revenue growth and profitability.

1- Adoption of quality practices
2- Usage of Just-in-time practices
3- Usage of ISO standards.

This study did not find a positive relationship between their selected operational practices and firms' financial performance. Duarte et al. (2011) suggest that exploring a limited set of practices was one of the limitations of their study. Therefore, the study suggests using a broader set of measures to explore the relationship between companies' operational practices and financial performance (Duarte et al., 2011). Besides that, Duarte et al. (2011) also state that:

> The impact on performance may be dependent on the development of more complex capability and not simply the result of practice adoption (Duarte et al., 2011, p407).

Therefore, apart from studying the financial relationships for a broader set of operational practices, there is the need to study the companies' abilities in performing those practices, rather than only the adoption of those practices. This is a key point. It is not enough for a company to say, for example, that they have implemented TQM. We must look to the 'quality' of the implementation before looking at the correlation with financial performance.

1.2.2.2. Using perceptual data as a basis of analysis

The majority of the existing studies use a survey, usually of senior managers to collect managerial perceptions about their operational practices and financial performance. This data collection method has two main limitations:

First, the perceptual data might not reflect the real-firm performance (Teeratansirikool et al., 2013; Klingenberg et al., 2013; Saunila et al., 2014). To overcome this limitation, Nilsson et al. (2001) suggest using archival data to complement the findings based on perceptual data. In their study, Nilsson et al. (2001) first used perceptual data from 482 Swedish companies to find the impact of their employee management and customer satisfaction on improving their financial performance. Then they confirmed their findings with more objective archival financial data (profit margin and return on capital employed).

The use of archival data in a research study can overcome some of the limitation associated with using perceptual data, such as those related to managerial biases and non-respondent biases (Boyd et al., 1993). However, there are also three major concerns associated with archival data.

1- Data from a heterogeneous group of firms may affect the accuracy and generalisability of the findings.
2- In an era of continuous improvement, the findings might be based on outdated data, and organisations are more likely to pay attention to the findings based on more recent data.
3- The lack of consistency between any archival data used and the purpose of the study could result in false conclusions (Boyd et al., 1993).

To overcome these limitations, Venkatraman & Ramanujam (1986) and Duarte et al. (2011) suggest using primary data to certify the findings.

The second limitation associated with using surveys for data collection is using a single respondent for collecting data about both operational practices and financial variables. This can lead to finding false covariance between variables independent of their real relationship (Podsakoff et al., 2003). Authors such as Sila (2007), Li et al. (2010), and Sadikoglu & Zehir (2010) have acknowledged this limitation and suggest using multiple respondents for data collection.

For example, Sila (2007) uses a single respondent's responses to find the impact of total quality management (TQM) practices on 286 American firms' financial performance and argued that this might have led to false conclusions. Some studies tried to overcome this limitation, by using multiple respondents. For example, Dubey & Gunasekaran (2015) examine the impact of TQM practices on the financial performance of 132 Indian firms. They split their survey into two parts and asked individuals in the firms' quality and finance departments to complete their related parts. Therefore, it is desirable to use different sources for collecting the data on the companies' operational practices and financial performance to help find a real rather than perceptual relationship between these variables.

1.2.2.3. Contradictory findings of the studies

Some of the findings of the earlier studies are contradictory and thus context-specific, so no general conclusions for UK manufacturing companies can be drawn from them.

For example, both Lakhal et al. (2006) and Abusa & Gibson (2013) examined the relationship between companies' quality practices and their financial performance and reported contradictory findings. The study by Lakhal et al. (2006), based on ninety-two Tunisian firms, claims that customers' involvement in product development has a positive impact on the firms' sales growth and return on investment. However, Abusa & Gibson's research (2013), based on fifty-six Libyan firms, infer that customers' involvement does not have any impact on the firms' sales and profit growth.

Similarly, Valmohammadi's study (2011), based on fifty-three Iranian firms, infer that identification of customer needs and expectations has a positive impact on the firms' profitability and sales growth. However, the research by Han et al. (2007), based on 441 American firms, did not find any relationship between the identification of customers' input and the firms' revenue and return on investment. So the logical conclusion from most of the research in this domain is the national characteristics (probably through legal and competition factor) significantly affect the findings. Therefore, there is a need to examine the relationship between operational practices and financial performance for UK manufacturing companies to contribute to the literature.

In this research, seventy-two studies that have considered the relationship between companies' operational practices and financial performance were reviewed. These studies were obtained from six major electronic databases (ProQuest – ABI/Inform, EBSCO – Business Source Premier, Elsevier (Science Direct), Emerald, Wiley Online Library and Google scholars) using the following steps:

1. First, the papers that had a combination of the following terms in their titles, abstracts and keywords were identified: 'Financial performance', 'operational practices', 'TQM', 'Lean', and 'Just-in-time'. The reason to include these terms was to increase the chance of finding all relevant publications that have studied the impact of operational practices on financial results. Eighty-three publications were identified.
2. Then, from the collected papers, only those that have studied the impact of operational practices on financial results were selected (seventy-two studies).
3. Of the selected papers, the following group of papers were excluded (thirty-two studies):
    a. Studies that only explore the impact of a company's extent of use of performance measurement systems such as balanced score card.
    b. Studies that used a proxy such as winning a quality award as a proxy for its successful implementation operational practices.
4. This procedure whittled it down to forty studies that have directly investigated the impact of companies' operational practices on their financial results.

Of the studies that are reviewed in this thesis, only one study incorporates UK manufacturing companies in their sample. Liu & Barrar (2009) study the effect of strategy-technology integration on financial performance of 355 UK manufacturing companies. Therefore, there is limited research in the context of UK manufacturing companies and the context-specific findings of the earlier studies make their applicability to the UK context problematic.

1.2.2.4. Difference between SMEs and large firms

In the earlier studies, the difference between SMEs and large companies in the way that their operational practices influence their financial performance is not examined.

Some of the earlier studies such as Lie et al. (2010) and Crisostomo et al. (2011) consider the firms' 'size' as a control variable in their study. The purpose of using a control variable is to reduce the impact of influential variables other than those under investigation (Bross, 1998). This results in a purer conclusion about the relationship between predictor and respond variables. Therefore, the company's size has been considered influential on the relationship between their operational practices and financial performance. However, the difference between SMEs and large companies is not explored in the earlier studies.

Overall, the earlier research that explores the relationship between companies' operational practices and financial performance has four key limitations and there is no common agreement on the relationships between individual operational and financial measures. The four main limitations in the earlier studies that this research tries to address have been discussed in points 1.2.2.1 to 1.2.2.4 above and are summarised in section 1.3. Thus to explore these issues further, the next section defines the research questions and the main objectives of this study.

1.3. The purpose and data sources of the study

The earlier studies on the relationship between companies' operational practices and financial performance have flaws in the process and there is no common agreement on the relationships between individual operational practices and financial measures. The following are the four key limitations in the earlier studies that this study seeks to address:

1. Only the relationship between a limited number of operational practices and financial performance measures is studied.
2. Previous studies are mainly based on managerial opinions (surveys) about both operational practices and financial performance in the studies.
3. Their findings are mixed and context-specific and thus no general conclusions for UK manufacturing companies can be drawn from them.
4. Difference between SMEs and large companies on the way in which their operational practices influence their financial performance is not studied.

1.3.1. Research questions

Based on the limitations of the earlier studies, the research questions of this study are set as follows:

1- What operational practices in the UK manufacturing companies have a positive impact on their financial performance?

2- What is the difference between SMEs and large companies in the way that their operational practices influence their financial performance?

1.3.2. Objectives

To address these questions, the main objective of this study is to develop a BPM framework for UK manufacturing SMEs and large companies that links their operational practices to their financial performance.

To achieve this aim, the following sub-objectives are set.

1. To identify the most commonly recommended measures used to evaluate a company's operational practices and financial performance from the existing studies in the literature.
2. To develop a theoretical model based on the findings of the earlier studies on the relationship between companies' operational practices and financial performance.
3. To adjust the theoretical model based on the results from a statistical analysis of data from UK manufacturing companies.
4. To validate the model in the context of the UK manufacturing companies.

One of the limitations of the earlier studies (section 1.2.2) was using a survey for data collection. This has the following two limitations:

1- The managerial opinions might not reflect the real performance of companies (Teeratansirikool et al., 2013).
2- Using a single respondent for collecting data about both operational practices and financial variables can lead to finding a false covariance between them independent of their real relationship (Podsakoff et al., 2003).

To overcome this limitation in this study, two independent sources of data are used. The following subsection describes the data sources of the study.

1.3.3. The operational and financial data sources

Because of the author's involvement in the MX Start project, he had access to the Manufacturing Excellence (MX) awards archival data of companies' operational practices. The MX Awards are an annual competition organised by the IMechE to highlight the best manufacturing companies in the UK. It needs the entrants to complete a questionnaire on various facets of their operational practices (Tsinopoulos & McDougall, 2011). Then, a group of experienced assessors from the IMechE check the companies' self-assessment report and score them using their common scoring guideline and rank them based on their performance. For the shortlisted companies, a group of experts from the IMechE, MAS, WMG and other partner organisations visit the companies to certify the scores from the previous stage. Finally, the winner companies in each category of the awards are selected. Regardless of winning an award or not, the IMechE will send a report to all companies who have applied for the award to suggest the areas in which they can improve (Garside & Tsinopoulos, 2004).

The IMechE's scores for the shortlisted companies that had entered the MX Awards between 2006 and 2011 are used in this study. These scores assess a company's abilities in their operational practices. The financial data of these companies covers up to four years after their participation in the awards, and was collected from two financial databases (FAME – Financial Analysis Made Easy – and Amadeus). In the following subsections the data sources for operational practices and financial results are discussed.

1.3.3.1. Data Source of Operational Practices

The data collection for the MX Awards was based on work from Dr John Garside drawn from his experience with the Lucas Process Method and discussed in his book *Make-It-Right* (Garside, 1998). In essence, the method argues that in the 1990s, the success of many aerospace and automotive manufacturers was due to removing their uncoordinated departmental arrangements and setting up interrelated business processes in their organisations (Garside, 2009). The value for companies to incorporate a set of interrelated business processes was reflected in the MX Awards self-assessment questionnaire.

The goal of most businesses is to keep a viable operation by generating profit and cash to meet all stakeholders' expectations. Manufacturing companies achieve this through the following four core business processes (Garside, 1998).

1. Identifying customer needs and winning orders
2. Designing products and the processes needed for manufacture
3. Managing manufacturing operations and supply chains (Logistics)
4. Distribution and selling, focusing on providing value to customers

These core processes are supported by six supporting processes that provide the needed infrastructure to run a successful business (**Error! Reference source not found.**).

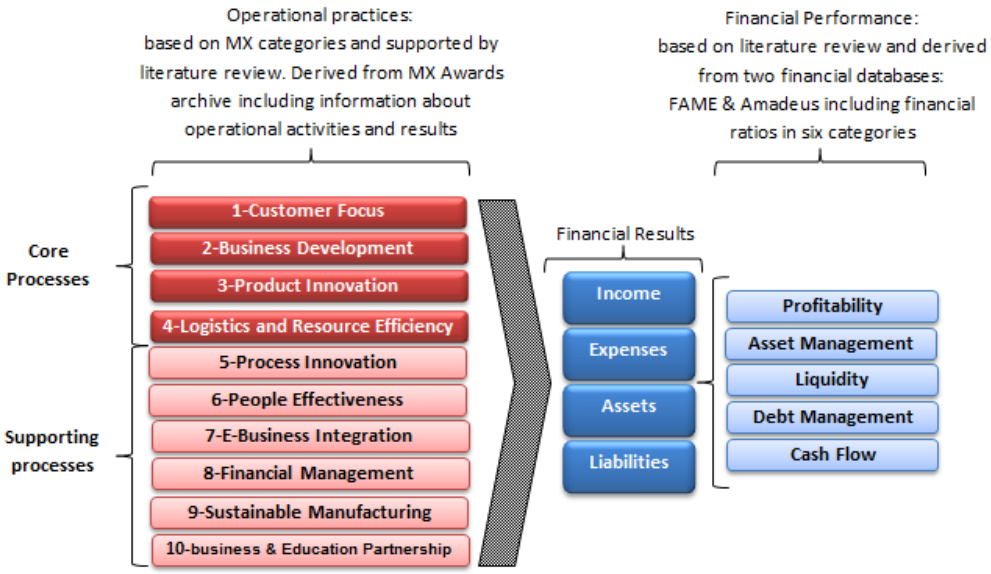


Figure 1-2 Conceptual map of the relationship between operational practices and financial performance

In this study, companies' performance in these ten processes is represented by their operational practices in key processes such as customer relationship, product innovation and employee effectiveness. These are drawn from the MX Awards categories that logically are direct drivers for financial results (see appendix 2 for a list of operational variables used in this study). These operational practices are sometimes referred to as the non-financial elements of performance (Larcker et al., 2003) or intangible assets (Kaplan & Norton, 2000; Larcker, 2008).

1.3.3.2. Data Sources of Financial Performance

From the existing business performance measurement frameworks (section 2.2.4), two dimensions for analysing the financial performance of companies (i.e. competitiveness and financial performance) are identified. Most of the analysed frameworks suggest using sales growth or market share for analysing 'competitiveness'. For analysing 'financial performance', based on reviewing fifteen studies on financial analysis (section 2.2.4), six categories for analysing financial performance of companies are identified. These categories include:

1. Competitiveness
2. Profitability
3. Asset management
4. Liquidity
5. Debt Management
6. Cash flow.

The ratios in each of these categories are calculated from elements of a company's financial results, such as total income and expenses (see appendix 3 for a list of financial variables used in this study). **Error! Reference source not found.** shows a conceptual map of the relationship between these ratios and the variables of operational practices that are studied in this study.

The financial performances of the companies which have taken part in MX Awards were collected from two financial databases. The Financial Analysis Made Easy (FAME) database, which holds the reported financial information of 8 million UK and Irish companies (FAME, 2014), is the main source of financial data in this study. The cash flow data for some of the companies were not available in FAME. This data was available from the Amadeus database, which contains financial information for around 19 million European companies (Amadeus, 2014).

This section described the purpose of the study, and the data sources used by the study to overcome the limitations identified in the earlier research. The next section (1.4) provides an introduction to the research approach taken in this study.

1.4. Research approach

The main objective of this study is to find the operational practices of the UK manufacturing companies' (SMEs and large) that can improve their financial performance. A research design is a research master plan which consists of methods and techniques for collecting and analysing the data needed for a research project (Zikmund et al., 2009).The appropriateness of the research results depends on coherence of the selected methods for conducting that research (Greener, 2008). **Error! Reference source not found.** shows the selected research methods to achieve the objectives of this study and the other potentially suitable research methods that have been considered.

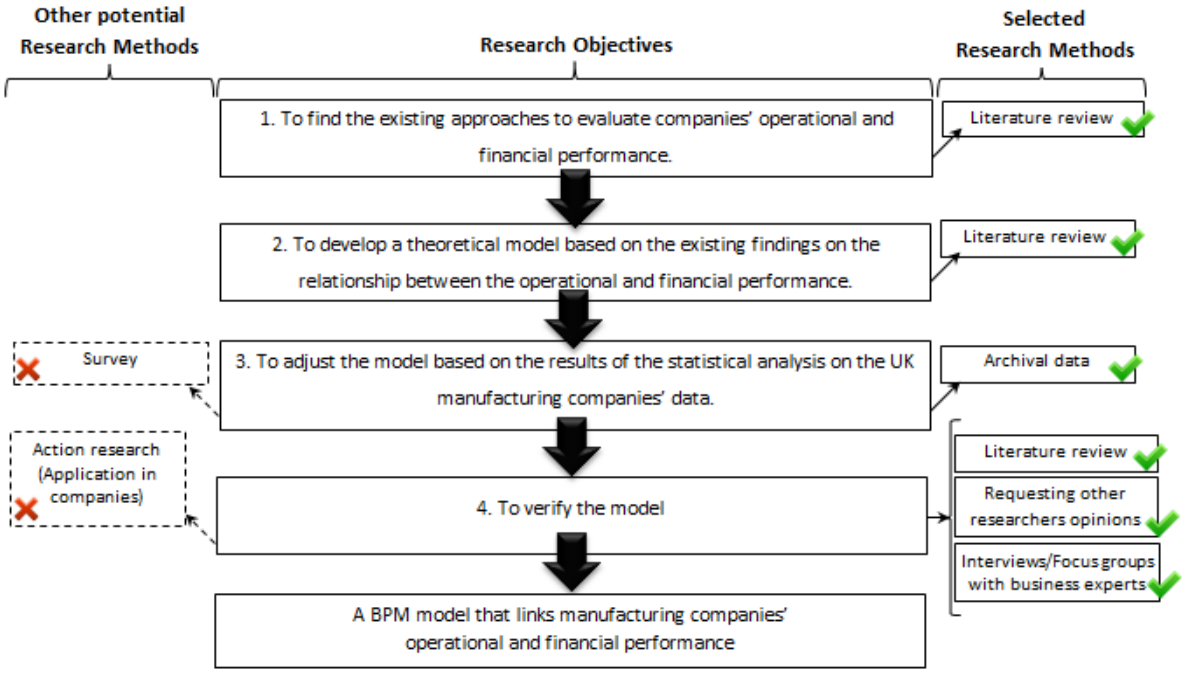


Figure 1-3 Potential and selected research methods of the study

The first two objectives of the study are to identify the existing approaches for evaluating a company's operational practices and its financial performance and the links between them. The first step to carry out any piece of academic research is to perform a literature review (Okoli & Schabram, 2010).

This is to contextualise the research in the existing body of literature and to find gaps in the literature that future studies can fill (Rowley & Slack, 2004; Levy & Ellis, 2006). Therefore, to address the first two objectives of this study a literature review was conducted and its findings are provided in chapter 2. These highlight the limitations in earlier studies and a theoretical model showing the expected link between companies' operational practices and financial performance based on the findings from the earlier studies.

Since there was clear variation caused by national differences, the model developed in chapter 2 is adjusted to the context of UK manufacturing companies. Most of the reviewed studies used a survey to collect managerial opinions about their operational practices and financial performance. However, using surveys was criticised by authors such as Teeratansirikool et al., 2013; Klingenberg et al., 2013 and Saunila et al., 2014 for not reflecting the real-firm performance. Also, using surveys is subject to different types of common method biases (Sila, 2007; Li et al., 2010; Sadikoglu & Zehir, 2010). Some authors suggest that the use of archival data overcomes some of those limitations (Nilsson et al., 2001; Valmohammadi, 2011). There was an opportunity in this research to use MX Awards archival data to verify some of the findings of the earlier studies based on perceptual data. However, to overcome the limitations of using archival data (Boyd et al., 1993), primary data was also used to confirm the findings (Venkatraman & Ramanujam, 1986; Duarte et al., 2011).

Finally, to address the last objective (i.e. to verify the developed model), three different approaches were used. First, based on the suggestions of the previous studies, some potential explanations for the findings of this study were explored and identified. Then, findings of the study were also checked by the other researchers that their findings were contradicted to the findings in this study. Finally, the findings of the study were also discussed with ten academics and business consultants in two focus groups and two individual interviews to validate the proposed model of the study. An alternative method to certify the model would be to apply the model in a company to verify its usability and effectiveness (Neely et al., 2000). This, however, could only support a limited set of circumstances (i.e. a particular company of a particular size in a particular market). Therefore, this alternative was not used in this study, but could be applied in the future.

In this section, a summary of the research approach taken in the study was explained, and an outline of the thesis is provided in the following section (1.5).

1.5. An overview of the thesis

The remaining chapters of this thesis are organised as follows:

The second chapter discusses the findings from the literature review. It starts by providing how frameworks for business performance measurement have evolved and describes their suggested dimensions in evaluating the performance of a company. This is followed by an analysis of studies on the relationship between operational practices and financial performance. To conclude the second chapter, a conceptual framework that links companies' operational practices and financial performance based on the findings of the earlier studies is developed.

The third chapter explains the selected research approach of the study. It provides a comparison between the research methods that can potentially be used in this study and their related limitations.

The fourth chapter provides the result of statistical data analysis on the UK manufacturing companies' data. The result of the analysis is used to adjust the conceptual model developed in chapter two based on the results of the statistical analysis in chapter three.

The fifth chapter further discusses the findings of the statistical analysis, based on the potential justification from the literature and the discussion with ten academics and business consultants. Chapter five concludes by presenting the proposed frameworks of the study after certifying by experts' opinion.

Chapter six explains the achievements of this study against the research question and the contributions of the study. Finally, in this chapter the limitations of the study and suggestions for future research are suggested.

2. Business Performance Evaluation

2.1. Introduction

In the previous chapter, the motivation to start this study and the objectives of this research were explained. This chapter aims to address the first and second objectives of the project, as follows:

1. To identify the most commonly recommended measures used to evaluate a company's operational practices and financial performance from the existing approaches in the literature.
2. To develop a theoretical model based on the findings of the earlier studies on the relationship between companies' operational practices and financial performance.

The chapter consists of three main sections and figure 2-1 shows a summary of the topics that are covered in those sections. In the first part of the chapter, fifteen of the most prominent business performance measurement (BPM) frameworks in the literature are reviewed in order to address the first objective of the study (section 2.2). The detailed results of reviewing these frameworks (including their suggested measures, the relationships between those measures and the strength and weaknesses of the frameworks) are provided in appendix 1. In this chapter, the criteria for selecting those frameworks will be given. Then, based on the review of these frameworks, two patterns in the developments of the reviewed frameworks are identified and discussed in section 2.2.2.

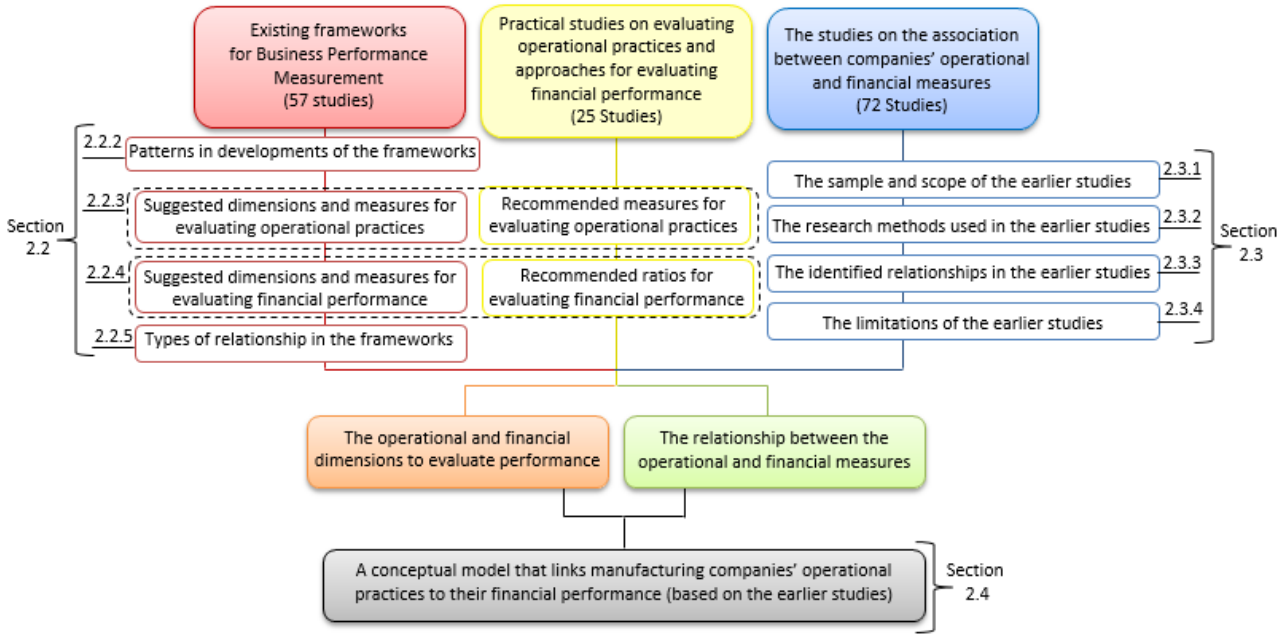


Figure 2-1 topics covered in the literature review

The most commonly recommended operational dimensions in the reviewed frameworks are discussed in subsections 2.2.3. In addition, in this subsection ten empirical studies which evaluate the operational practices of companies are also reviewed to corroborate the identified dimensions from the frameworks and to see how they are used in practice. Subsection 2.2.4 discusses the commonly recommended dimensions in the reviewed frameworks for evaluating the financial performance of companies. Also in this subsection, fifteen studies that examine financial analyses are reviewed to find the most commonly recommended financial ratios in evaluating a company's financial performance. Finally, in subsection 2.2.5, the types of relationships between the dimensions of the reviewed frameworks are discussed. Most of the reviewed frameworks suggest that there is a relationship between their operational and financial dimensions. However, the specific measures in those dimensions are not given in the reviewed frameworks.

To address the second objective of the study (i.e. to develop a theoretical model), the relationships between individual operational practices and financial measures in those dimensions needs to be identified. Therefore, section 2.3 shows the result of reviewing forty of the earlier studies on the relationship between the companies' operational practices and financial performance measures. These studies are identified from analysing a larger group of seventy-two studies; however, the selected forty studies are the most relevant ones to the subject of this study.

Based on the review of these forty studies, the sample and scope of the earlier studies, and their chosen research methods, their findings and limitations are extracted and are presented in subsections 2.3.1 to 2.3.4 respectively. The identified relationships between individual operational practices and financial measures in the earlier studies are used to develop twenty hypotheses in subsection 2.3.3. Finally, section 2.4 ends this chapter by providing a conceptual framework based on the expected relationship between companies' operational practices and financial measures from the earlier studies

2.2. Insights from reviewing existing BPM frameworks

As discussed in the previous chapter, the main objective of this study is to develop a BPM framework that links companies' operational practices to their financial performance. This is to help companies define measures for their performance measurement system which will enable them to evaluate their performance.

According to Rouse & Putterill (2003), business performance measurement (BPM) frameworks help in modelling a BPM system by clarifying boundaries and dimensions of performance and providing general suggestions about the relationships between those dimensions. Therefore, BPM frameworks are a good choice for deciding on the dimensions that should be considered in evaluating the performance of a company. However, there are also two types of frameworks in the literature, including Procedural and Structural frameworks (Folan & Browne, 2005).

Procedural frameworks provide a set of guidelines for developing a performance measurement system in a company (Folan & Browne, 2005). An example of these frameworks is the 'Performance Criteria System' developed by Globerson (1985). This framework suggests a procedure for developing a Performance criteria system in a company based on the following stages:

- Choosing and weighting the preferred set of Performance Criteria
- Measuring the chosen Performance Criteria
- Assigning standards to the Performance Criteria
- Designing a feedback loop to respond to discrepancies between standards and actual performance.

These frameworks do not suggest any specific measure of performance and they offer companies a choice of measures. The other types of frameworks are structural frameworks that give the specific dimensions for performance evaluation (Folan & Browne, 2005). Therefore, the existing structural BPM frameworks in the literature were selected as being suitable for addressing the main objective of the study. In the next section the method of selecting the frameworks from the literature are justified.

2.2.1. Criteria for choosing the frameworks

The BPM frameworks considered in this study are selected from ten recent reviews of the BPM frameworks in the literature. Table 2-1 highlights the prominence of the frameworks by showing the number of times they have been analysed in recent literature reviews. The first twelve frameworks (i.e. from the Du Pont model up to the Performance Prism model (Neely & Adams, 2000)) are generic models that can be applied in any company regardless of their size. The last three frameworks (i.e. the Organizational performance measurement (OPM) system (Chennell et al. (2000), framework for Computer Integrated Manufacturing (CIM) in SMEs (Marri et al., 2000), and the Dynamic Integrated Performance Measurement System (DIPMS) (Laitinen (2002)), are often classified as the frameworks designed for SMEs by studies such as Garengo et al., (2005), Taticchi et al., (2010) and Jamil & Mohamed, (2011).

However, Chennell et al. (2000) and Laitinen (2002) claim that their frameworks can be applied in both large companies and SMEs. Therefore, of the fifteen reviewed frameworks, only the 'Framework for Performance measurement of CIM in SMEs' (Marri et al., 2000) is designed only for SMEs.

Table 2-1 Reviewed frameworks identified by the recent literature reviews

#	Name of the model/framework	Author(s)/Date	Rouse & Putterill (2003)	Folan & Browne (2005)	Garengo et al. (2005)	Hon (2005)	Pun & White (2005)	Taticchi et al. (2010)	Jamil & Mohamed (2011)	Nudurupati et al. (2011)	Taticchi et al. (2012)	Yadav & Sagar (2013)
1	Du Pont Pyramid of Financial Ratios	Du Pont Company (early 1920); referenced in Chandler (1977)	✓									✓
2	Tableau de Bord	French Engineers (1932); referenced in Bessire & Baker (2005)										✓
3	The Strategic Measurement Analysis and Reporting Technique (SMART)	Cross & Lynch (1988)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
4	Performance Measurement Matrix (PMM)	Keegan et al. (1989)	✓		✓	✓		✓	✓	✓	✓	
5	The framework for WCM performance measures	Maskell (1989)				✓		✓			✓	
6	The Results and Determinants Framework	Fitzgerald et al. (1991)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
7	Performance Measurement Framework for linking the shop floor to the top floor	Beischel & Smith (1991)	✓									
8	The Balanced Scorecard (BSC)	Kaplan & Norton (1992)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

#	Name of the model/framework	Author(s)/ Date	Rouse & Putterill (2003)	Folan & Browne (2005)	Garengo et al. (2005)	Hon (2005)	Pun & White (2005)	Taticchi et al. (2010)	Jamil & Mohamed (2011)	Nudurupati et al. (2011)	Taticchi et al. (2012)	Yadav & Sagar (2013)
9	Macro Process Model (MPM) of an organisation	Brown (1996)		✓								
10	Kanji's Business excellence model and business scorecard	Kanji (1998)					✓	✓			✓	
11	The Integrated Performance Measurement Framework (IPMF)	Medori & Steeple (2000)				✓	✓	✓			✓	✓
12	Performance Prism	Neely & Adams (2000)	✓	✓	✓	✓		✓	✓	✓	✓	✓
13	Organizational performance measurement (OPM) system	Chennell et al. (2000)			✓			✓	✓			
14	Framework for Performance measurement of Computer Integrated Manufacturing (CIM) in SMEs	Marri et al. (2000)						✓				
15	Dynamic Integrated Performance Measurement System (DIPMS)	Laitinen (2002)			✓			✓	✓			

The strength and weaknesses of these frameworks, their suggested operational and financial dimensions, and the proposed relationships between the dimensions, are summarised in appendix 1. In the following four subsections, insights from reviewing of these frameworks are provided. First, section 2.2.2 discusses the two main patterns in developing the reviewed frameworks in the literature. Sections 2.2.3 and 2.2.4 compare the suggested operational and financial measures of the frameworks. This is to gather the required dimensions of operational practices and financial performance that should be considered for evaluating the performance of a company. The suggested relationships between those dimensions in the reviewed frameworks are then discussed in section 2.2.5.

2.2.2. Patterns in developments of the frameworks

In the previous section, fifteen business performance frameworks from ten recent literature reviews were identified. By reviewing the strength and weaknesses of these frameworks, the following two patterns in the framework development can be identified and are explained in the following subsections:

1- Shift from strategy implementation to stakeholder satisfaction
2- Shift from measuring individual elements to measuring processes

2.2.2.1. Shift from strategy implementation to stakeholder satisfaction

Up until the 1980s, most companies used financial measures, such as Return on Investment (ROI) or Return on Equity (ROE), to evaluate their performance (Taticchi et al., 2010). The Du Pont Pyramid of Financial Ratios is one of the earliest frameworks developed for financial performance measurement in the early 1920s (Yadav & Sagar, 2013). The strength of this model is that it provides a sophisticated approach which is still extensively used for analysing financial performance (Rouse & Putterill, 2003; Yadav & Sagar, 2013).

However, these financial measures were criticised for not being linked to a company's strategy (Garengo et al., 2005). The models developed after the 1980s tried to address this limitation by linking the process of performance measurement to a company's strategy. For example, Cross & Lynch (1988) introduced the SMART approach which is based on a four-level pyramid of objectives and measures. This approach 'ensures an effective link between strategies and operations' (Cross & Lynch, 1988).The strengths of the framework are as follows:

- Linking strategy to operations (Rouse & Putterill, 2003; Pun & White, 2005; Taticchi et al., 2010; Jamil & Mohammad, 2011; Taticchi et al., 2012)
- Using external and internal measures of performance (Taticchi et al., 2010; Taticchi et al., 2012)
- Modelling the company as an integrated structure (Taticchi et al., 2010); Taticchi et al., 2012)
- Connecting the business process view with the hierarchical view of business performance measurement (Yadav & Sagar, 2013).

However, one of the limitations of the framework is that it does not propose any specific measures or mechanisms to develop measures (Pun & White, 2005; Yadav & Sagar, 2013). Similarly, the creators of the Balanced Scorecard, in their original paper, claim that:

> The scorecard puts strategy and vision, not control, at the center. It establishes goals but assumes that people will adopt whatever behaviors and take whatever actions are necessary to arrive at those goals. The measures are designed to pull people toward the overall vision (Kaplan & Norton, 1992, p79).

Therefore, the emphasis of these models was on linking performance measures with strategy. However, in the more recent performance measurement frameworks, the emphasis is shifted towards the requirements and satisfaction of the stakeholders. For example, the developers of the 'Performance Prism' state that:

> One of the great fallacies of performance measurement is that measures should be derived from strategy. [….However] the first and fundamental perspective on performance is the stakeholder perspective (Neely & Adams, 2000, p4).

Neely et al. (2000) argue that one of the main strengths that distinguishes the 'Performance Prism' from the earlier frameworks is that it starts from identifying the needs of the following five stakeholders.

1- Investors
2- Customers & Intermediaries
3- Employees
4- Suppliers
5- Regulators & Communities.

The authors of other more recent frameworks, such as Brown (1996), Kanji (1998) and Chennell et al. (2000), have also considered the importance of stakeholders in their frameworks. Brown's (1996) suggested framework (i.e. 'The Macro Process Model of an Organization') also identifies some of the main stakeholders in the 'Performance Prism', including:

1- Suppliers,
2- Customers
3- Employees

Rouse & Putterill (2003) argue that Brown's framework ignores certain stakeholders and would be better described as a micro process model. However, it has considered some of the main stakeholders that appear in the other existing frameworks such as the Performance Prism.

Kanji's (1998) Business Excellence Model also emphasises stakeholders' satisfaction. It is claimed that pleasing stakeholders helps create revenue and a satisfactory return for the investor. Increased revenue helps fund investment in both process and in learning. This, in turn, helps people to satisfy the demands of the stakeholders and create business excellence (Kanji, 1998). However, as argued by Yadav & Sagar (2013), this framework mainly focuses on external stakeholders and internal stakeholders, such as employees, are not considered.

The Organizational performance measurement (OPM) framework suggested by Chennell et al. (2000) also recommends that the success of a company is measured by the value it provides to the following five key stakeholders, including:

1- Community (Industry and local group)
2- Business including owners and shareholders
3- Customers
4- People (employees)
5- Strategic Partners (suppliers).

Therefore, this framework also highlights the importance of satisfying the stakeholders. However, the drawback of this framework is that it has left the choice of measures to organisations. Therefore, the performance measures and the relationships between them are not stated in this framework.

Overall, based on the reviews of the existing frameworks in the literature, the emphasis of performance measurement in the more recent frameworks is shifted from strategy implementation to stakeholder satisfaction. In the next subsection, the second shift in the development of the performance measurement frameworks is discussed.

2.2.2.2. Shift from measuring individual elements to measurement of processes

The second pattern in developing the performance measurement frameworks is the inclusion of business processes in achieving corporate goals, as found in the more recent frameworks. A business process is defined as a set of activities to achieve a certain business goal (Han et al., 2009).

Some of the earlier frameworks only propose individual elements of performance, such as quality, time, flexibility and cost in their frameworks. However, they have either not suggested any relationship between those measures, or they suggest that companies find links between the performance measures at different levels of their management hierarchy. Therefore, in these frameworks it is not clear how companies can achieve their business objectives. For example, Maskell's (1989) framework (i.e. Performance Measures for world Class Manufacturing) only suggests five categories of operational measures used by world-class manufacturing firms including:

1- Quality
2- Delivery
3- Production Process Time
4- Flexibility
5- Costs.

However, in this framework, the relationships between these categories are not provided. Similarly, Beischel & Smith's (1991) framework offers five categories for performance measurement, including:

1- Quality
2- Customer service
3- Resource management
4- Flexibility
5- Cost.

This framework urges companies to find and link performance measures at different levels of management, such as Corporate, Plant Manager, Department Manager, and Process Drivers. However, it does not offer any recommendations with regard to the links between their suggested categories of performance. However, this pattern (i.e. individual elements of performance only) does not appear in all of the earlier frameworks. Cross & Lynch's (1988) framework (i.e. The Performance Pyramid) suggests two categories of financial measures, including:

1- Long-term market measures
2- Short-term financial measures

These financial measures depend on six categories of operational performance, including:

1- Customer satisfaction
2- Flexibility
3- Productivity
4- Quality
5- Delivery
6- Process time.

This framework states that there is a causal relationship between its categories of performance. For example, financial measures depend on flexibility and productivity. In turn, flexibility measures depend on delivery and process time, and productivity measures depend on process time and cost.

The shift to propose a process for performance measurement to help companies achieve their objectives is more recognisable in the more recent frameworks. For example, in the first generation of the Balanced Scorecard Kaplan & Norton (1996) identifies four categories for measuring the performance of a company including:

1- Learning and growth perspective
2- Internal process perspective
3- Customer perspective
4- Financial perspective.

However, in the first generation of the Balanced Scorecard framework, the causal link between the identified categories of the framework was not clear. However, Kaplan & Norton (2000) introduce the idea of a strategy map to enable an organisation to describe its objectives and targets and the measures used in assessing its performance. The strategy map is a visual illustration of an organisation's strategy. It provides cause-and-effect links between the measures at four perspectives of the Balanced Scorecard to show how an organisation is expected to reach its desired outcomes. The suggested link starts from the 'Learning and growth' perspective that is expected to elicit improvement in the 'Internal process' perspective. The 'Internal process' perspective, in turn, is expected to improve the 'Customer' perspective. Finally, the improvement in the 'Customer' perspective is expected to improve the 'financial' perspective.

However, Norreklit (2003) criticises the suggested relationship in the Balanced Scorecard and argues that the suggested relationships in this framework are not causal, but logical. In particular, the assumed causal relationship between customer satisfaction and profitability on the Balanced Scorecard is criticised as problematic because:

> Profitability depends on the revenues and costs attributable to having satisfied or loyal customers. This has to be based on financial calculus, i.e. on a logical relationship and not a causal one (Norreklit, 2003, p617).

Kaplan (2012) briefly responds to some of Norreklit criticisms by stating:

> I found it curious that they describe the [Balanced Scorecard] (BSC) as a "myth." when it has been successfully implemented by thousands of for-profit, non-profit and public sector enterprises […]. Perhaps, Norreklit et al. believe that the BSC may be fine in practice but it does not work in theory (Kaplan, 2012, p542).

Other examples of frameworks that propose a process for performance measurement to help companies achieve their objectives are Brown's (1996) Macro Process Model of an organisation (MPM) and Neely & Adams's (2000) Performance Prism. Brown's (1996) MPM framework offers six categories of measures for evaluating the performance of a company including:

1- Product/Service quality
2- Supplier performance
3- Customer satisfaction
4- Process and operational performance
5- Employee satisfaction
6- Financial performance.

In this framework, employee satisfaction and supplier performance categories influence the performance of a company in process and operational measures. These, in turn, will influence the quality of a company's product or services. The quality of the product or services eventually improves customer satisfaction and financial performance. Similar to the MPM framework, Neely & Adams's (2000) Performance Prism offers five categories of performance, including:

1- Stakeholders' satisfaction
2- Strategies
3- Processes
4- Capabilities
5- Stakeholder contribution.

It also highlights the importance of considering the needs of stakeholders, as well as shareholders, in identifying performance measurement and identifies five stakeholders:

1- Investors
2- Customers & Intermediaries
3- Employees
4- Suppliers
5- Regulators & Communities.

It is claimed that for many companies, shareholders will remain the most important stakeholders; however, it will not be possible to create value for shareholders without creating value for other stakeholders (Kennerley & Neely, 2002). The process of performance measurement in this framework starts by identifying the stakeholders' expectations of a company and the company's expectations of those stakeholders. The identified needs from the first two steps will lead to companies developing strategies to meet those needs. Afterwards, it is essential to find the necessary processes to perform corporate strategies and the necessary capabilities to perform the processes (Neely et al, 2002). Although this model is comprehensive in term of evaluating business performance, it does not explain the relationship between the measures in different categories. It is assumed that a company's strategies, processes, capabilities, and stakeholders' contributions are all determinates of the stakeholder satisfaction perspective (Kennerley & Neely, 2002). However, the relationship between the measures to meet the needs of different stakeholders and the overall financial performance of the company (i.e. the shareholders' expectations in this model) are not named.

Overall, in most of the recent frameworks, the emphasis of the frameworks is shifted from measuring individual elements of performance towards the measurement of processes to achieve business objectives. However, there are some exceptions in some of the recent models. For example, Medori & Steeple's (2000) 'Integrated Performance Measurement framework' only identifies the required performance measures of a company and not the relationships between those measures.

This section describes the two patterns in developing performance measurement frameworks that are reviewed in this study and highlights some of the strengths and weaknesses of some of these frameworks. However, the complete strengths and weaknesses of all of the identified frameworks are provided in appendix 1. The next two sections (2.2.3 and 2.2.4) compare the suggested operational and financial measures of the identified frameworks to gather the necessary dimensions that should be considered for evaluating the performance of a company.

2.2.3. The suggested operational dimensions in the existing frameworks

Each of the reviewed frameworks has proposed a unique set of operational dimensions for evaluating the operational practices of the companies. However, the Performance Prism framework (Neely et al., 2002) and the MPM framework (Brown, 1996) provide the most comprehensive list. The other frameworks also provide similar dimensions. However, each has ignored some aspects of operational dimensions. For example, the 'SMART' framework (Cross & Lynch, 1988) considers Customer, Internal business and Product/Service dimensions. This framework has overlooked Employees and Suppliers dimensions. Maskell (1989) designed the 'framework for WCM performance measures' which is based on world-class manufacturing performance measures. This framework only considers the internal business, products and supplier dimensions. Therefore, two of the most common, i.e. the customer and the employee, are neglected in this framework.

The identified operational dimensions from the reviewed frameworks, plus sample measures for each dimension, are shown in **Table 2-2**. Overall, based on the reviewed frameworks, the following five commonly suggested dimensions for evaluating operational practices of the companies can be identified as:

1. Customer (suggested by nine frameworks)
2. Employee (suggested by nine frameworks)
3. Internal Process (suggested by twelve frameworks)
4. Product/Service (suggested by eleven frameworks)
5. Supplier (suggested by six frameworks).

To confirm whether the identified dimensions from the reviewed frameworks are used in practice, ten practical studies are also reviewed in this subsection. These studies report the operational measures that are being used by manufacturing companies to evaluate their operational practices.

Table 2-2 The operational dimensions of the reviewed frameworks

Operational Dimensions	Sample measures derived from the reviewed models	Du Pont Pyramid (Du Pont Company, early 1920s; referenced in Chandler, 1977)	Tableau de Bord (French Engineers, 1932; referenced in Bessire & Baker, 2005)	The SMART Framework (Cross & Lynch, 1988)	The PMM (Keegan et al., 1989)	The PM for WCM framework (Maskell, 1989)	The R & D Framework (Fitzgerald et al., 1991)	The Framework for linking SF to TF (Beischel & Smith, 1991)	The BSC (Kaplan & Norton, 1992)	The MPM (Brown, 1996)	Kanji's Business Excellence Model (Kanji, 1998)	The IPMF (Medori & Steeple, 2000)	The PP framework (Neely & Adams, 2000)	The OPM system (Chennell et al., 2000)	The Framework for CIM in SMEs (Marri et al., 2000)	The DIPMS (Laitinen, 2002)
Customer	1-Customer satisfaction 2-Customer complaints 3- On-time and complete delivery 4-Customers' referral rate	---	---	✓	✓	---	---	✓	✓	✓	✓	---	✓	✓	---	✓
Employee	1- Employee performance improvement 2-Employee satisfaction level 3-Motivation of employees 4-Relevance/Quality of training courses	---	---	---	✓	---	✓	✓	✓	✓	✓	---	✓	✓	---	✓
Internal process	1- Customers' expectations 2-Level of demand forecast accuracy 3-Level of specification changes 4-Maintenance of equipment 5-Introducing new products 6-Process excellence	---	---	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	---	✓	✓
Product/Service	1-Continual improvements to the existing products and processes 2-Number of new products per year 3-Improvement in new Product Introduction 4-Service Image 5-Quality, Flexibility Innovativeness	---	---	✓	✓	✓	✓	✓	✓	✓	---	✓	✓	---	✓	✓
Supplier	1-Partner satisfaction level 2-Average spend per supplier trend 3-Vendor delivery performance 4-Average supplier retention 5-Improvement in supplier quality	---	---	---	✓	✓	---	---	---	✓	---	✓	✓	✓	---	---

The reviewed practical studies can be classified into two groups: the first examines the applicability of an established framework (i.e. the Balanced Scorecard (Kaplan & Norton, 1992)) in practice. Therefore, in this group of studies the same dimensions that are proposed by the framework are used in practice. For example, Craig & Moores (2005) conducted an action research project in which the authors evaluated and implementation the Balanced Scorecard (BSC) in one small family business in Australia. The authors extended the theory by including 'Familiness' measures to the existing dimensions to enable family-owned firms to adopt it. Similarly, Fernandes et.al (2006) reported the lessons from the implementation of the Balanced Scorecard (BSC) in a UK-based manufacturing SME. The study proposed and confirmed a systematic method for implementing the BSC in SMEs which can be used as a guideline for similar implementations.

The second group of practical studies reported the performance measures used by manufacturing companies in different contexts. Therefore, this group reported a mixture of performance measures regardless of whether they belonged to a particular framework or not. For example, Abdel-Maksoud et al. (2005) reported the measurement practices in 313 large UK manufacturing firms. The study collected and classified operational performance measures used by UK manufacturers. It also considered the impact of competitive environments and the adoption of TQM on the companies' choice of operational measures. According to this study, the operational measures being used by UK manufacturing companies can be classified into five groups: Customer satisfaction, Human resource, Product quality, Efficiency & Utilisation and On-time delivery. However, most of the companies incorporated in this study were customer-focused; therefore, the Customer satisfaction and On-time delivery measures were the most important categories. This is followed by the Efficiency & Utilisation and the Product quality categories. The 'Human resource' category was considered the least important.

Nilsson & Kald (2002) explored the development of business performance measurement systems in Nordic companies (209 manufacturing and service companies in Denmark, Finland, Sweden and Norway). This study shows the main financial and non-financial measures used by these firms. According to this study, the financial performance is still considered the most important dimension of a company's performance. This is followed by externally and internally focused measures, such as customer satisfaction and product quality. However, measures that focused on development such as employee satisfaction were not important for Nordic firms.

As shown in Table 2-33, for each of the identified dimensions a number of measures could be identified from the reviewed practical studies. Therefore, the reviewed practical studies verified that the identified dimensions from the frameworks are also used in practice by manufacturing companies.

Table 2-3 Operational measures derived from the reviewed practical studies

Operational Dimensions	Non-financial measures derived from the reviewed Practical studies	(Nilsson & Kald, 2002)	(Gosselin, 2005)	(Craig & Moores, 2005)	(Lau & Sholihin, 2005)	(Abdel-Maksoud et al., 2005)	(Fernandes et. al, 2006)	(Cardinaels & Veen-Dirks, 2010)	(Dossi & Patelli, 2010)	(Coram et al., 2011)	(Lau, 2011)
Customer	1- Number of customer complaints				✓	✓					
	2-Number of customer returns			✓		✓	✓	✓	✓	✓	
	3-Attracting new customers		✓		✓				✓		
	4-Number of warranty claims				✓	✓					
	5-On-time delivery to customer (%)	✓			✓	✓	✓	✓			
	6-Customer satisfaction	✓		✓	✓			✓	✓	✓	
Employee	1-Employee retention rate					✓			✓	✓	✓
	2-Absenteeism (%)					✓					
	3-Employee lateness (%)					✓					
	4-Employee satisfaction	✓				✓		✓	✓		✓
	5-Suggestions per employee							✓		✓	
	6-Proportion of overtime worked					✓					
	7-Employee capabilities and skills (Training, Development courses)	✓		✓	✓			✓	✓	✓	✓
	8-Promoting innovation			✓					✓		✓
	9-Improving corporate climate and Promoting corporate citizenship			✓					✓		
Internal business	1-Schedule adherence (On-time production)					✓					
	2-Productivity (Manufacturing efficiency)	✓	✓	✓	✓	✓	✓		✓		
	3-Manufacturing lead time										
	4-Capacity utilisation (hrs. worked/budgeted hrs.)					✓					
	5-Percentage of machine up time		✓								
	6-Usage of technology to improve business procedure	✓		✓							✓
	7-Process improvement and re-engineering						✓				
	8-Production quality (Scrap, Defect, Rework)		✓		✓	✓	✓	✓		✓	
	9-Environmental profile	✓									
Product/Service	1-Number of new products		✓		✓			✓			
	2-New product introduction	✓									
	3-Perceived quality (Performance, Features, Reliability, Durability)	✓							✓		
	4-Time to market new products		✓		✓		✓		✓		
	5-Organisational reputation			✓			✓				
Supplier	1-Work closely with suppliers to improve mutual processes								✓		
	2-Suppliers involvement in product development										
	3-Suppliers quality measurement										
	4-Supplier involvement in solving quality/technical problems							✓		✓	

2.2.4. Suggested financial dimensions in the existing frameworks

From the analysed frameworks, two main dimensions for evaluating the financial performance of companies (i.e. Competitiveness and Financial performance) can be identified. **Table 2-4** shows a sample of the recommended financial measures suggested by the analysed frameworks under these two dimensions. The frameworks that have proposed 'competitiveness', recommend using either the 'relative market share' or the 'sales growth' or both as measures of the companies' competitiveness.

Table 2-4 The financial dimensions of the reviewed frameworks

Financial Dimensions	**Sample measures derived from the reviewed frameworks**	Du Pont Pyramid (Du Pont Company, early 1920s; referenced in Chandler, 1977)	Tableau de Bord (French Engineers, 1932; referenced in Bessire & Baker, 2005)	The SMART Framework (Cross & Lynch, 1988)	The PMM (Keegan et al., 1989)	The PM for WCM framework (Maskell, 1989)	The R & D Framework (Fitzgerald et al., 1991)	The Framework for linking SF to TF (Beischel & Smith, (1991)	The BSC (Kaplan & Norton, 1992)	The MPM (Brown, 1996)	Kanji's Business excellence model (Kanji, 1998)	The IPMF (Medori & Steeple, 2000)	The PP framework (Neely & Adams, 2000)	The OPM system (Chennell et al., 2000)	The Framework for CIM in SMEs (Marri et al., 2000)	The DIPMS (Laitinen, 2002)
Competitiveness	1-Relative market share 2-Sales growth	---	---	✓	✓	---	✓	---	✓	---	---	---	✓	---	---	✓
Financial performance	1-Liquidity ratios 2-Solvency ratios 3-Market ratios 4-Profitability ratios 5-Cash flow ratios 6-Asset management 7-Inventory management	✓	---	✓	✓	✓	✓	---	✓	✓	✓	---	✓	✓	---	✓

Except for one framework, in all of the analysed frameworks some ratios for analysing financial performance are suggested. These ratios are mainly for measuring profitability, but in a few of the frameworks other dimensions of financial performance, such as liquidity and cash flow ratios, are proposed. However, for each of the suggested categories of financial performance (i.e. profitability, liquidity, etc.), many financial ratios can be applied. To find the most commonly recommended financial ratios, fifteen financial analysis approaches are also reviewed.

Table 2-5 shows the result of comparing fifteen recent studies on financial analysis. This shows five commonly recommended ratios in each of the categories of financial performance. The general definitions for each category of ratios are as provided below.

Table 2-5 Financial ratios derived from the reviewed financial analysis approaches

Financial performance dimensions	Financial ratios derived from the reviewed financial analysis approaches	(Helfert, 2001)	(Brealey et al., 2001)	(Friedlob & Schleifer, 2003)	(Walsh, 2003)	(Narayanan & Nanda, 2004)	(Moyer et al., 2006)	(Bragg, 2007)	(Bull, 2008)	(Barrow, 2008)	(Priester & Wang, 2010)	(Ehrhardt & Brigham, 2011)	(Gibson, 2011)	(Needles & Marian, 2011)	(Higgins, 2012)	(Horngren et.al., 2012)
Profitability	1-Return on equity	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓
	2-Return on capital employed	✓				✓									✓	
	3-Return on total assets	✓			✓	✓			✓		✓	✓	✓	✓	✓	✓
	4-Margin on sales	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
	5-Gross profit margin	✓					✓	✓		✓	✓	✓	✓		✓	✓
Asset management	1-Asset turnover	✓	✓		✓		✓		✓		✓	✓	✓	✓		✓
	2-Days in inventory		✓		✓					✓			✓	✓		✓
	3-Inventory turnover	✓	✓				✓				✓	✓	✓	✓	✓	✓
	4-Sales to working capital ratio							✓								
	5-Sales per average employee	✓														
Liquidity	1-Accounts receivable days	✓	✓		✓		✓			✓		✓	✓	✓	✓	✓
	2-Accounts payable days	✓	✓											✓	✓	
	3-Current ratio	✓	✓	✓	✓		✓			✓	✓	✓	✓	✓	✓	✓
	4-Quick ratio	✓	✓	✓	✓		✓				✓	✓	✓	✓	✓	✓
	5-Cash Ratio		✓	✓									✓			
Debt Management	1-Interest cover	✓	✓		✓		✓					✓	✓	✓	✓	✓
	2-Debt to assets	✓	✓		✓		✓				✓	✓	✓		✓	✓
	3-Debt-to-equity ratio	✓	✓				✓		✓	✓	✓	✓	✓	✓	✓	✓
	4-Long-term debt ratio		✓													
	5-Cash coverage ratio		✓									✓				
Cash flow	1-Operating cash flows															✓
	2-Cash flow/Total debt			✓				✓					✓			
	3-Cash flow yield			✓				✓						✓		
	4-Cash flows to sales							✓						✓		
	5-Cash flows to assets							✓						✓		

Profitability: these ratios concentrate on companies' earnings and possibly measure the most important part of business finance (Walsh, 2003). The ratios in this group measure how effectively a company is making profit on its shareholders' fund or return on its assets (Moyer et al., 2006).

Asset management: these ratios measure corporates' productivity (Priester & Wang, 2010). The ratios in this group measure how effectively a company manager has employed the company's assets to create revenues (Helfert, 2001).

Liquidity: these ratios control a company's ability to fulfil its short-term liabilities (Friedlob & Schleifer, 2003). The ratios in this group examine the relationship between a firm's current assets and current liabilities to control if a firm has enough cash to pay its duties as they come due (Moyer et al., 2006).

Debt Management: these ratios measure the degree to which a firm finances its assets with any fixed-charged financing (Moyer et al., 2006). The ratios in this group show early signs of firms' financial difficulty and examine the companies' long-term survival (Needles & Marian, 2011).

Cash flow: these ratios explain the changes that have taken place in a firm's cash balances (Gibson, 2011). The ratios in this group can reflect the cash inflow and outflow from a company and a positive result of these ratios could ensure the companies' survival (Bragg, 2007; Moyer et al., 2006).

Some of the identified ratios have a different name or slightly different formulas in various sources. To clarify the ambiguities of these, **Error! Reference source not found.** presents descriptions and formulas of the identified ratios.

Table 2-6 The descriptions and formulas of the selected ratios

Dimensions	Ratio	Description	Formula
Profitability	1-Return on equity	Company owners' earnings from investment in their business. (Needles & Marian, 2011)	Net income/Average owner's equity
	2-Return on capital employed	A company's ability to earn profit from all funds employed in the company including shareholders' funds and long-term loan. (Walsh, 2003)	Earnings Before Interests & Tax (EBIT)/Capital employed (Total assets-current liabilities)
	3-Return on total assets	A company's success in utilising its assets to earn profit. (Horngren et.al, 2012)	Net income + Interest expense/Average total assets
	4-Margin on sales	A company's operating income from every £1.00 of sales. (Horngren et.al, 2012)	Operating income/Sales
	5-Gross profit margin	A Company's efficiency in earning profit after subtracting the cost of goods sold. (Horngren et.al, 2012)	(Gross profit / Net sales revenue) x 100
Asset management	1-Asset turnover	A company's efficiency in utilising its total assets to generate sales. (Horngren et.al, 2012)	Net sales/Average total assets
	2-Days in inventory	The average number of days that a company held the inventory. (Horngren et.al, 2012)	365 days/ Inventory turnover ratio
	3-Inventory turnover	A Company Promptness in selling its inventories. (Ehrhardt & Brigham, 2011)	Sales/Inventories
	4-Sales to working capital ratio	The amount of cash required by a company to keep a certain level of sales. (Bragg, 2007)	Net sales/ (Accounts receivable + Inventory – Accounts payable)
	5-Sales per average employee	Human resource effectiveness in generating sales. (Helfert, 2001)	Deliveries completed, costs of employment, training and development
Liquidity	1-Accounts receivable days	The number of days it takes for a company to collect the average level of receivables in terms of average daily sales. (Helfert, 2001)	Accounts receivable/Average sales per day
	2-Accounts payable days	The number of days it takes for a company to pay the average level of payables in terms of average daily sales. (Helfert, 2001)	Accounts payable/Average sales per day
	3-Current ratio	The ability of a company to pay its current liabilities from its current assets. (Horngren et.al, 2012)	Total current assets/Total current liabilities
	4-Quick ratio	The ability of a company to pay its current liabilities only from cash, investment securities, and net receivables. (Friedlob & Schleifer, 2003)	Total quick assets/Total current liabilities
	5-Cash Ratio	The ability of a company to pay its current liabilities only from cash & short-term investments. (Friedlob & Schleifer, 2003)	Cash + Short-term investments/Current Liabilities

Dimensions	Ratio	Description	Formula
Debt Management	1-Interest cover	The number of times a company's earnings before interest and tax can pay interest expenses. (Horngren et.al, 2012)	EBIT/Interest expense
	2-Debt to assets	The fraction of a company's assets that has been financed with debt. (Horngren et.al, 2012)	Total liabilities/Total assets
	3-Debt-to-equity ratio	The proportion of a company's assets that has been financed with debt in relation to the company's assets financed with equity. (Horngren et.al, 2012)	Total liabilities/Total equity
	4-Long-term debt ratio	The fraction of a company's long-term capital that is financed with debt. (Brealey et al., 2001)	long-term debt/ long-term debt + equity (total capitalization)
	5-Cash coverage ratio	The number of times a company's operational cash flow can pay interest expenses. (Brealey et al., 2001)	EBIT + depreciation/Interest payments
Cash flow	1-Operating cash flows	The amount of cash generated from operating activities. (Horngren et.al, 2012)	Net Income + Depreciation + Gains (Losses) on Assets + Changes in the Current assets and the Current liabilities
	2-Cash flow/Total debt	The amount of operating cash flow to pay back debt payment commitment. (Bragg, 2007)	Operating Cash flow/Total debt
	3-Cash flow yield	The company's ability to generate operating cash flow in relation to net income. (Needles & Marian, 2011)	Operating Cash flow/Net income
	4-Cash flows to sales	The ability of a company's sales to generate operating cash. (Needles & Marian, 2011)	Operating Cash flow/Net sales
	5-Cash flows to assets	The amount of cash generating from a company's operating activities in proportion to its total assets. (Bragg, 2007)	Operating Cash flow/Total assets

2.2.5. Relationships between the dimensions in the existing frameworks

In the previous two sections, the suggested operational and financial dimensions of the reviewed frameworks were discussed. In this section, the types of relationships between the measures of performance in the selected frameworks are explained. **Table 2-7 Types of relationship between the dimensions of performance**shows a summary of the relationships between the measures in the analysed frameworks.

Table 2-7 Types of relationship between the dimensions of performance

#	Frameworks (Author(s)/ Date)	Relationship between the measures
1	Du Pont Pyramid (Du Pont Company, early 1920s; referenced in Chandler, 1977)	Relationship between financial ratios
2	Tableau de Bord (French Engineers, 1932; referenced in Bessire & Baker, 2005)	It doesn't assume any relationship between areas of measurement
3	The Strategic measurement analysis and reporting technique (SMART). (Cross & Lynch, 1988)	Operational practices to financial results
4	Performance Measurement Matrix (Keegan et al., 1989)	Hierarchical relationship between the measures
5	The framework for WCM performance measures (Maskell, 1989)	Network of dimensions
6	The Results and Determinants Framework (Fitzgerald et al., 1991)	Operational practices to financial results
7	Performance Measurement Framework for linking the shop floor to the top floor. (Beischel & Smith, 1991)	Hierarchical relationship between the measures
8	The Balanced Scorecard (Kaplan & Norton, 1992)	Operational practices to financial results
9	Macro Process Model of an organisation (Brown, 1996)	Operational practices to financial results
10	Kanji's Business Excellence Model and Business Scorecard (Kanji, 1998)	Operational practices to financial results
11	The Integrated Performance Measurement Framework (Medori & Steeple, 2000)	Network of dimensions
12	Performance Prism (Neely & Adams, 2000)	Operational practices to financial results
13	Organizational performance measurement system (Chennell et al., 2000)	Hierarchical relationship between the measures
14	Framework for Performance measurement of CIM in SMEs (Marri et al., 2000)	Network of dimensions
15	Dynamic integrated performance measurement system (Laitinen, 2002)	Operational practices to financial results
= Hierarchical relationship between the measures = Operational practices to financial results = Network of dimensions		

Overall, based the types of relationships, they can be classified into the following three types:

Type 1- Relationship between operational practices and financial results

Most of the frameworks suggest a causal relationship between the operational practices of a company and its financial performance. The most distinct example of these frameworks is the results and determinants framework (Fitzgerald et al., 1991). It offers four categories for evaluating the operational performance of a company, including:

1- Quality of service
2- Flexibility
3- Resource utilisation
4- Innovation.

These operational measures are assumed to influence the performance of a company in two categories of financial performance, including:

1- Competitiveness
2- Financial performance.

Type 2-Hierarchical relationship between management levels

Three of the reviewed frameworks suggest a hierarchical relationship between performance measurements at different management levels of a company. For example, the Performance Measurement Matrix (Keegan et al., 1989) suggests six strands of performance measurement at each corporate management levels, including:

1- Company
2- Group
3- Division
4- Business units
5- Plants
6- Cells.

As we move down in the hierarchy, performance measures will get more specific and will cover a shorter planning horizon.

Type 3- Unstructured relationship between a network of dimensions

Three of the reviewed frameworks only suggest some categories of performance that should be used for performance measurement. However, these frameworks do not assume any relationship between their suggested categories of performance. An example of these frameworks is the framework for WCM performance measures (Maskell, 1989). Maskell (1989) proposes that the criteria comprise four categories of operational performance, including:

1- Quality
2- Delivery
3- Production Process Time
4- Flexibility and one category of financial measure i.e. Costs.

However, this framework does not suggest any relationship between these measures. The other two frameworks cannot be classified into any of the identified types of frameworks. The Du Pont framework only considers financial ratios in calculating a company's return on investment. Therefore, it does not propose any operational measure. Tableau de Bord also left the choice of operational and financial measures to the company management. Therefore, this framework does not suggest any relationship between these measures of performance.

Considering the three identified types of relationship, the first type (i.e. relationship between operational practices and financial results) is closest to the purpose of this research. However, the reviewed frameworks do not name exact operational practices and financial measures. To find the expected impact of companies' operational practices on their financial performance, forty studies that have analysed this relationship will now be reviewed.

2.3. Impact of operational practices on financial performance

In the previous section, the suggested dimensions of operational practices and financial performance of the existing performance measurement frameworks were discussed. The identified dimensions show the criteria that should be used for evaluating the performance of a company. However, the relationships between the specific measures were not provided in the reviewed frameworks. Therefore, based on the existing frameworks, it is not clear which operational practices are expected to improve which dimension of a company's financial performance.

In this section, forty practical studies that have analysed the relationship between companies' operational practices and financial performance are reviewed. These studies are selected from a larger group of seventy-two studies that have considered the relationship between companies' operational practices and financial performance. These studies were collected from six major databases (ProQuest – ABI/Inform, EBSCO- Business Source Premier, Elsevier (Science Direct), Emerald, Wiley Online Library and Google scholars) using the following steps:

1. First, the papers that had a combination of the following terms in their titles, abstracts and keywords were identified: 'Financial performance', 'Operational practices', 'TQM', 'Lean', 'Just-in-time'. The reason to include these terms was to increase the chance of finding all relevant publications that have studied the impact of operational practices on financial results. This search yielded eighty-three publications.

2. From the collected papers, only those that had examined the impact of operational practices on financial results were selected (seventy-two studies).

3. From these selected papers, those that had only explored the impact of a company's extent of use of performance measurement systems or had used a proxy for successful implementation of operational practices were excluded (thirty-two studies).

4. This was whittled down to forty studies that had directly examined the impact of companies' operational practices on their financial results. The sample and scope, research methods, findings and limitations of these studies are reviewed in this section. **Table 2-8** shows a summary of the purposes and the findings of the analysed studies in this literature review. In the next subsection (2.4.1), the sample and scope of the reviewed studies are discussed.

Table 2-8 Summary of the reviewed studies

#	Author(s)/Date	Purpose of the study	Study Findings
1	Ittner & Larcker (1998)	Find the relationship between customer satisfaction measures and future accounting performance	✓
2	Callen et al. (2000)	Analyse the relative performance of Just-in-time (JIT) and non-JIT plants operating in two distinct manufacturing industries: electronic components and auto-parts.	✓
3	Fullerton & McWatters (2001)	Understand the benefits that firms have gained through JIT adoption, and whether a more comprehensive implementation is worthwhile.	✓
4	Nilsson et al. (2001)	Find the relationship between internal quality practices, including employee management, process orientation, and customer orientation and business financial results.	✓
5	Fullerton et al. (2003)	Find the relationship between JIT practices such as Reduced set-up times, Total productive maintenance and Firm profitability.	●
6	Kaynak (2003)	Find the relationships between the direct and indirect effects of TQM practices on various performance levels, including 1-Financial & Market, 2-Quality Performance, 3-Inventory Management Performance.	✓
7	Rosenzweig et al. (2003)	Find the relationship between supply chain integration and business performance and the mediating role of the manufacturing-based competitive capabilities	●
8	Yasin et al. (2004)	Find the relationships between quality improvement efforts targeted at customer satisfaction, employee's satisfaction and process efficiency and companies' financial performance measures.	✓
9	Hertenstein et al. (2005)	Find the relationship between companies' quality of the design programme; quality of design; Importance placed on the firm's design programme and company financial performance	✓
10	Kannan & Tan (2005)	Find the relationship between Just-in-time practices (11 items), supply chain management practices (18 items), and quality management practices (18 items) and firms' financial performance (5 items).	✓
11	Zhang (2005)	Find the relationship between the companies IS support for product flexibility and cross-functional coordination and their financial results.	●
12	Jin (2006)	To empirically investigate the moderating effects of firm size on the relationship between the level of IT adoption and three performance levels, operational, financial and strategic	✗
13	Lakhal et al. (2006)	Study the relationships between ISO 9000 certification, TQM practices, and organisational performance.	✓
14	Banker & Mashruwala (2007)	Investigate whether the non-financial measures are lead indicators of financial performance and, more importantly, whether these relationships are moderated by competition faced by retail outlets.	✓
15	Han et al. (2007)	Explain and predict the relationships between and among ISO 9000 certification, TQM practices, organisational competitiveness, customer satisfaction, and business performance.	✓
16	Sila (2007)	Find the relationship between the combined effects of seven TQM practices on four measures of organisational performance, as well as the impacts of these performance measures on each other.	✓
17	Huang et al. (2008)	Find the association between six operational business activities and companies' competitiveness, long-term financial performance and process efficiency	✓
18	Jayaram et al. (2008)	Hypothesize that relationship building positively affects both aspects of lean strategy, which in turn positively influences firm performance.	●
19	Ngo et al. (2008)	To assess the impact of strategic human resource management (SHRM) and human resource practices on firm performance and the employee relations climate.	✓
20	Fullerton & Wempe (2009)	Find the relationship between lean manufacturing practices and use of non-financial manufacturing performance measures and firms' profitability (Return on Sales)	●

✓ = Found Association ● = Association partially found ✗ = Association not found

#	Author(s)/Date	Purpose of the study	Study Findings
21	Kumar et al. (2009)	To investigate the impact of total quality management (TQM) implementation on different dimensions of company performance.	✓
22	Lee et al. (2009)	Examines the effects of information technology (IT) knowledge and media selection on operational performance, measured by balanced scorecard, in small firms.	✓
23	Liu & Barrar (2009)	To test the positive effect of strategy-technology integration on performance, in comparison with the impact of other types of strategies.	✓
24	Fotopoulos & Psomas (2010)	To determine the relationships between the total quality management (TQM) factors and organisational performance.	●
25	Li et al. (2010)	Finds the relationship between companies' product innovation practices and their financial performance. It also explores the moderating effect of strategic flexibility (composed of resource flexibility and coordination flexibility) on this relationship.	●
26	Crisostomo et al. (2011)	Finds the relationship between corporate social responsibility segments, including: relationship with employees, external social action and environmental action and their financial performance including Return on assets and Return on equity.	✗
27	Durate et al. (2011)	Tests the relationship between selected operational practices (quality management, Just-in- time, ISO certification and services outsourcing) and financial performance outcomes of profitability and growth.	✗
28	Valmohammadi (2011)	To examine the effects of seven TQM criteria, namely: leadership, process management, supplier, customer focus, employee management, communication and quality information system (QIS) and tools and techniques on the organizational performance of Iranian manufacturing SMEs.	✓
29	Yang et al. (2011)	Explores relationships between lean manufacturing practices, environmental management (e.g., environmental management practices and environmental performance) and business performance outcomes (e.g., market and financial performance).	●
30	Agus & Hajinoor (2012)	To obtain a better understanding of the extent to which lean production permeates manufacturing companies in Malaysia by drawing on supply chain management (SCM) managers' or production managers' perception of lean production practices and level of performances in the industry.	✓
31	Duh et al. (2012)	To investigate the determinants and performance effects of total quality management (TQM) practices.	●
32	Hofer et al. (2012)	To empirically investigate the relationship between lean production implementation and financial performance.	●
33	Lee & Roh (2012)	Finds the relationship between the corporate reputation, including Overall reputation score; Quality of product/services; Social responsibility; Innovativeness and their financial performance, including: ROA; ROE; Tobin's Q; Sales growth.	●
34	Tarigan & Widjaja (2012)	A study on non-financial performance relationship with a financial performance. The framework used is the Balanced Scorecard.	●
35	Abusa & Gibson (2013)	To examine the extent of total quality management (TQM) implementation in Libyan manufacturing companies (LMCs), and its impact on organisational performance (OP).	●
36	Dubey et al. (2014)	To explore the dimensions of Indian manufacturing firms' competencies and to study the impact of these competencies on firm performance.	●
37	Lakhal (2014)	Studies the relationships between ISO 9000 certification, TQM practices, and organisational performance.	✓
38	Wang et al. (2014)	To investigate the impact of knowledge sharing (KS) on firm performance and the mediating role of intellectual capital (IC).	✓
39	Dubey & Gunasekaran (2015)	To study soft total quality management practices and their impacts on firm performance.	✓
40	Lee & Lee (2015)	To understand the integrated relationship between organisational learning and TQM as two sources of sustainable competitive advantage. It proposes several hypotheses related to the relationship among organisational learning, TQM and business performance.	✓

✓ = Found Association ● = Association partially found ✗ = Association not found

2.3.1. Sample and scope

This section explains the similarities and differences of the samples and scope of the reviewed studies. The differences in the following characteristics of the sample of the earlier studies can partially explain the difference in their findings.

2.3.1.1. Size of the sample

There is a significant difference between the sizes of the samples in the reviewed studies. As shown in table 2-9, Lee & Lee's (2015) study is based on nine firms and the Durate et al. (2011) study is based on 1200 firms. Overall, fifteen of the analysed studies incorporated fewer than 100 companies in their samples and twelve studies more than 300 companies. The remainder of the studies used a sample of between 100 and 300 companies. Since most of the statistical analysis methods are sensitive to sample size, as Lakhal et al. (2006) have argued, using a larger sample size will give more reliable results and increase the generalisability of the findings.

2.3.1.2. Countries

Three of the reviewed studies are based on a mixture of different countries. For example, the studies by Rosenzweig et al. (2003) and Yang et al. (2011) are based on thirty-five and twenty-two different countries respectively. However, as shown in table 2-9, most of the reviewed studies are based on US companies (fourteen studies). The others are based on fifteen different countries. Some of these studies, such as Abusa & Gibson (2013) and Wang et al. (2014), argue that their findings are only applicable to the countries where their studies were conducted. Therefore, it is not clear if the relationship between operational practices and financial results are context-specific or, as identified by Rosenzweig et al. (2003) and Yang et al. (2011), there are similarities between different countries. Comparative studies using data from different countries can clarify this ambiguity.

2.3.1.3. Size of the companies incorporated in the sample

Most of the studies have incorporated a mixture of SMEs and large companies in their sample (twenty-five studies). As shown in table 2-9, three studies were only based on SMEs, one study is only based on medium-sized companies (i.e. Dubey et al., 2014) and one only based on large firms (i.e. Zhang, 2005). The other studies have not stated the size of the companies incorporated in their samples. However, although most of the reviewed studies use a mixture of SMEs and large companies, they suggest one set of findings for all companies regardless of their size. However, as argued by Jin (2006) and Dubey & Gunasekaran (2015), the size of the firms is influential in the relationship between operational practices and financial results. Therefore, there is the need to study the difference between SMEs and large companies in the way their operational practices affect their financial performance.

2.3.1.4. Industry sector of companies incorporated in the sample

As shown in table 2-9 most of the studies are either only based on the manufacturing companies or a mixture of manufacturing and service companies. However, there are two studies based solely on the financial service sector, one based on retailer and one based on a service industry. The other studies have not stated the industry sectors of their samples. Some of these studies, such as Fotopoulos & Psomas (2010) and Valmohammadi (2011), claim that their findings are only applicable to the industry sectors that they have employed in their samples. Therefore, there is a need to study how companies that work in different industry sectors vary in the way their operational practices affect their financial performance.

Table 2-9 Sample and scope of the reviewed studies

#	Author(s)/Date	Size of the sample	Country	Size of the companies incorporated in the sample	Industry sector of companies incorporated in the sample
1	Ittner & Larcker (1998)	1 service provider (73 branches)	USA	Not specified	Financial service
2	Callen et al. (2000)	100 firms	Canada	Medium & large	Manufacturing
3	Fullerton & McWatters (2001)	95 firms	USA	SMEs & large	Manufacturing
4	Nilsson et al. (2001)	482 firms	Sweden	Medium & large	Manufacturing & Service
5	Fullerton et al. (2003)	253 firms	USA	Not specified	Manufacturing
6	Kaynak (2003)	382 firms	USA	SMEs & large	Manufacturing & Service
7	Rosenzweig et al. (2003)	238 firms	Mixture of 35 countries	SMEs & large	Manufacturing
8	Yasin et al. (2004)	68 firms	Portugal	SMEs & large	Manufacturing
9	Hertenstein et al. (2005)	68 firms	USA	Not specified	Manufacturing
10	Kannan & Tan (2005)	565 firms	Mixture of countries	SMEs & large	Not specified
11	Zhang (2005)	153 firms	USA	Only large	Manufacturing & Service
12	Jin (2006)	113 firms	USA	SMEs & large	Manufacturing
13	Lakhal et al. (2006)	92 firms	Tunisia	Medium & large	Manufacturing
14	Banker & Mashruwala (2007)	1 retailer (800 stores)	USA	Not specified	Retailer
15	Han et al. (2007)	441 firms	USA	Not specified	Manufacturing
16	Sila (2007)	286 firms	USA	SMEs & large	Manufacturing & Service
17	Huang et al. (2008)	83 firms	Taiwan	Medium & large	Manufacturing
18	Jayaram et al. (2008)	57 firms	USA	Not specified	Manufacturing
19	Ngo et al. (2008)	600 firms	China	SMEs & large	Manufacturing
20	Fullerton & Wempe (2009)	121 firms	USA	SMEs & large	Manufacturing
21	Kumar et al. (2009)	14 firms	Canada	Medium & large	Manufacturing
22	Lee et al. (2009)	698 firms	Korea	Only Small firms	Manufacturing & Service
23	Liu & Barrar (2009)	355 firms	UK	SMEs & large	Manufacturing
24	Fotopoulos & Psomas (2010)	370 firms	Greece	Mainly SMEs (84 %)	Manufacturing & Service
25	Li et al (2010)	607 firms	China	SMEs & large	Not specified
26	Crisostomo et al. (2011)	78 firms	Brazil	Not specified	Manufacturing & Service
27	Durate et al. (2011)	1200 firms	Brazil	Medium & large	Manufacturing
28	Valmohammadi (2011)	53 firms	Iran	Only SMEs	Manufacturing
29	Yang et al. (2011)	309 firms	Mixture of 22 countries	SMEs & large	Manufacturing
30	Agus & Hajinoor (2012)	200 firms	Malaysia	SMEs & large	Manufacturing

#	Author(s)/Date	Size of the sample	Country	Size of the companies incorporated in the sample	Industry sector of companies incorporated in the sample
31	Duh et al. (2012)	209 firms	Taiwan	SMEs & large	Manufacturing
32	Hofer et al. (2012)	229 firms	USA	SMEs & large	Manufacturing
33	Lee & Roh (2012)	230 firms	USA	SMEs & large	Manufacturing & Service
34	Tarigan & Widjaja (2012)	55 restaurants and cafés	Indonesia	Not specified	Service Industry
35	Abusa & Gibson (2013)	56 firms	Libya	SMEs & large	Manufacturing
36	Dubey et al. (2014)	100 firms	India	Only medium-sized firms	Manufacturing
37	Lakhal (2014)	176 firms	Tunisia	Not specified	Manufacturing & Service
38	Wang et al. (2014)	228 firms	China	SMEs & large	Not specified
39	Dubey & Gunasekaran (2015)	132 firms	India	SMEs & large	Manufacturing & Service
40	Lee & Lee (2015)	9 firms	Taiwan	Not specified	Financial (Insurance)

In the next section, the time horizons, the methods of selecting variables and data collection, and data analysis methods employed in the earlier studies are discussed.

2.3.2. Research methods

This section discusses the similarities and differences between the reviewed studies on the research methods that they have employed in their studies.

2.3.2.1. Time horizons of the studies

The reviewed studies used two main types of time horizons – cross-sectional and longitudinal. The purpose of the cross-sectional studies is to study a topic in a one particular instance (Saunders, et al., 2009). By contrast, longitudinal studies check the continuity or discontinuity of the results of an experiment over time (Zikmund, et al., 2009). As shown in table 2-10, thirty-four of the analysed studies used cross-sectional data, and the remaining six studies used longitudinal data. The timeframe of the longitudinal analysis varies between two years in the Crisostomo et al. (2011) study and seven years in the Hertenstein et al. (2005) study. Many of the studies that have used cross-sectional data, such as Lakhal (2014) or Wang et al. (2014), claim that these data are not suitable for finding causal relationships. Therefore, for future studies it is recommended to use longitudinal data to find the impact of operational practices over a longer timeframe.

2.3.2.2. Method of selecting variables

Most of the analysed studies identified their examined operational and financial measures by reviewing the earlier literature (thirty-four studies), as shown in table 2-10. However, one study used the standard criteria used by the major quality awards such the EFQM for their analysis (i.e. Nilsson et al., 2001). Two studies (i.e. Ittner & Larcker, 1998 and Banker & Mashruwala, 2007) used the operational and financial measures of the companies that they have incorporated in their studies. Using similar variables that have been used in the earlier studies can verify if similar relationships between operational practices and financial performance exist in different environments or not.

2.3.2.3. Data Collection Method(s)

Surveys are used as the one sole method of data collection in most of the analysed studies (twenty-six studies), as shown in table 2-10. Using one method of data collection can cause common method bias or common method variance which refers to collecting both predictor and response variables from one data source. This makes it difficult to conclude if the findings of the study reveal the real relationships between the examined variables or it is because of the method of data collection. However, to reduce this impact, in the other studies a combination of research methods is employed. For example, Hofer et al. (2012) use a survey for collecting operational data and collect their financial data from the 'Compustat' financial database.

2.3.2.4. Data analysis Method(s)

Correlation and the regression analysis methods are the most common data analysis methods in the reviewed studies (twenty-one studies), as shown in table 2-10. However, to test dependence of the financial variables on operational variables in some studies, other analysis methods were also used, for example, the Structural Equation Model in the Kaynak (2003) study and the Path Analysis in the Huang et.al. (2008) study. Using similar data analysis methods in future studies can help with the comparison of their findings with those of the earlier studies. This is because the use of similar methods reduces the impact that the potential difference in the analysis methods can have on identified relationships.

In this section and in the previous section, an outline of the reviewed studies on their samples, scopes and their research methods were discussed. The next section uses the identified relationships in the reviewed studies to develop a conceptual framework that links the companies' operational practices to their financial performance.

Table 2-10 Research methods of the reviewed studies

#	Author(s)/Date	Time horizon	Method of selecting variables	Data collection method(s)	Data analysis method(s)
1	Ittner & Larcker (1998)	Longitudinal (4 quarters)	The bank's customer satisfaction measures	The firm provided customer satisfaction and accounting data.	Regression analysis
2	Callen et al. (2000)	Cross-sectional	Literature review	Survey	Regression analysis
3	Fullerton & McWatters (2001)	Cross-sectional	Literature review	**Operational data:** Survey **Financial data:** Compustat database	ANOVA
4	Nilsson et al. (2001)	Cross-sectional	The EFQM Excellence model guideline	Survey	1-Factor Analysis 2-Regression Analysis
5	Fullerton et al. (2003)	Longitudinal analysis (2 years prior and 3 years after JIT adoption.	Literature review	**Operational data:** Survey **Financial data:** Compustat database	Regression Analysis
6	Kaynak (2003)	Cross-sectional	Literature review	Survey	1-Correlational Analysis 2-Structural equation model (SEM)
7	Rosenzweig et al. (2003)	Cross-sectional	Literature review	Survey	Regression analysis
8	Yasin et al. (2004)	Cross-sectional	Literature review	Survey	1-Factor analysis, 2-Cluster analysis 3-Analysis of variance
9	Hertenstein et al. (2005)	Longitudinal (7 years)	Expert's opinion	**Only Financial data:** Compustat database	T-Statistics test
10	Kannan & Tan (2005)	Cross-sectional	Literature review	Survey	1- Factor analysis 2-Correlation analysis
11	Zhang (2005)	Cross-sectional	Literature review	**Operational data:** Survey **Financial data:** Compustat database	Regression analysis
12	Jin (2006)	Cross-sectional	Literature review	Survey	Regression Analysis
13	Lakhal et al. (2006)	Cross-sectional	Literature review	Survey	1-Factor Analysis 2-Path Analysis
14	Banker & Mashruwala (2007)	Cross-sectional	The firm's financial and operational data sources	**Operational data:** An external agency **Financial data:** Company accounting data	1-Correlation Analysis 2-Regression Analysis 3-Structural Equation Modelling
15	Han et al. (2007)	Cross-sectional	Literature review	Survey	Structural Equation modelling
16	Sila (2007)	Cross-sectional	Literature review	Survey	1-Factor analysis 2-Discriminant analysis, 3-path analyses
17	Huang et al. (2008)	Longitudinal (the timeframe is not mentioned)	Literature review	Survey	1-Exp factor analysis 2-Correlation Analysis, 3-Path analysis
18	Jayaram et al. (2008)	Cross-sectional	Expert's opinion	Survey	The structural path model
19	Ngo et al. (2008)	Cross-sectional	Literature review	Survey	Regression Analysis
20	Fullerton & Wempe (2009)	Cross-sectional	Literature review	**Operational data:** Survey **Financial data:** Compustat database	1-Structural equation models 2-Regressions analysis

#	Author(s)/ Date	Type of data analysis	Method of selecting variables	Data Collection Method(s)	Data analysis Method(s)
21	Kumar et al. (2009)	Cross-sectional	The MBNQA criteria	Interviews, mail/telephone survey	1-Mean difference 2-Student t-test
22	Lee et al. (2009)	Cross-sectional	Literature review	Survey	1-Factor Analysis 2-Path Analysis
23	Liu & Barrar (2009)	Cross-sectional	Literature review	Survey	1-Factor Analysis 2-Regression Analysis
24	Fotopoulos & Psomas (2010)	Cross-sectional	Literature review	Survey	1-Factor Analysis 2-Structural Equation Modelling
25	Li et al. (2010)	Cross-sectional	Literature review	Interviews	Regression analysis
26	Crisostomo et al. (2011)	Longitudinal (2 years)	Literature review	**Only Financial data:** Ibase **Control variables:** Economa ´tica database	Regression analysis
27	Durate et al. (2011)	Cross-sectional	Literature review	**Operational and financial data:** Secondary database called PAEP (São Paulo State Economic Activity Survey)	Regression analysis
28	Valmohammadi (2011)	Cross-sectional	Literature review	Survey	1-Factor Analysis 2-Regression Analysis
29	Yang et al. (2011)	Cross-sectional	Literature review	Survey	Structural equation modelling
30	Agus & Hajinoor (2012)	Cross-sectional	Literature review	Survey	1- Correlation analysis 2-Structural equation modelling
31	Duh et al. (2012)	Cross-sectional	Literature review	**Operational data:** Survey **Financial data:** Archival data	Structural equation modelling
32	Hofer et al. (2012)	Cross-sectional	Literature review	**Operational data:** Survey **Financial data:** Compustat database	1-Factor Analysis 2-Regression Analysis
33	Lee & Roh (2012)	Longitudinal (5 years)	Literature review	**Operational data: Fortune's Companies08.** **Financial data:** Compustat database	1-Correlation analysis 2-Regression analysis
34	Tarigan & Widjaja (2012)	Cross-sectional	Literature review	Survey	Regression Analysis
35	Abusa & Gibson (2013)	Cross-sectional	Literature review + Expert's opinion	Survey	1-T-test of ; 2-Correlation analysis; 3-Stepwise regressing analysis
36	Dubey et al. (2014)	Cross-sectional	Literature review + Expert's opinion	Survey	1-Factor Analysis 2-Regression Analysis
37	Lakhal (2014)	Cross-sectional	Literature review	Survey	1-Factor Analysis 2-Path Analysis
38	Wang et al. (2014)	Cross-sectional	Literature review	Survey	Structural equation modelling
39	Dubey & Gunasekaran (2015)	Cross-sectional	Literature review	Survey	1-Factor Analysis 2-Regression Analysis
40	Lee & Lee (2015)	Cross-sectional	Literature review	Survey	1-Factor Analysis 2-Structural Equation Modelling

2.3.3. Findings

This section explains the identified relationships in the earlier studies that are reviewed in this research. In section 2.3.1, five dimensions of operational practices and two dimensions of financial performance were identified. In the following subsections, the identified relationships in the earlier studies are presented under each of the categories of operational dimensions. For each dimension, the identified relationships between the measures of the category and financial measures in the two categories of financial dimension are explained. The identified relationships in the reviewed studies are used to develop twenty hypotheses to be tested in this study.

2.3.3.1. Customers

Based on reviewing the earlier studies, the following three groups of operational practices related to the 'Customers' dimension, are identified. The identified relationships in the earlier studies are used to develop three hypotheses that are explained in the following subsections.

1- Customer satisfaction
2- Customer focus
3- Delivery reliability.

2.3.3.1.1. Customer satisfaction

Most of the earlier studies that consider practices related to customer satisfaction found that these practices have a direct positive impact on a company's competitiveness or profitability (table 2-11).

Table 2-11 Studies that have investigated practices related to customer satisfaction

Customers related practices	**Authors/Date**	**Financial perspectives**	
		Competitiveness: • Increased market share • Sales growth	**Profitability:** • Return on investment • Return on capital employed • Return on total assets
H1. Practices related to customer satisfaction such as: • Increased customer satisfaction • Decreased customer complaints • Customer Retention Rate • Personalised service • Value for the money spent	Fotopoulos & Psomas (2010)	✓	✓
	Han et al. (2007)	✓	✓
	Nilsson et al. (2001)	---	✓
	Yasin et al. (2004)	---	✓
	Ittner & Larcker (1998)	✓	✓
	Sila (2007)	✓	✓
	Tarigan & Widjaja (2012)	---	×

✓= Direct positive impact on financial performance ×= No direct positive impact on financial performance

Only Tarigan & Widjaja (2012) found no positive impact of these practices on the firms' financial performance. They claim that it could be because the restaurants and cafés in their study were still building product quality in order to satisfy their customers (Tarigan & Widjaja (2012). Therefore, a longer timeframe may be needed before the result of those practices could be realised. Based on most of the earlier studies it can be expected that:

H_1: Practices related to customer satisfaction have a direct positive impact on companies' competitiveness or profitability (figure 2-2).

Figure 2-2 Expected impact of practices related to customers satisfaction

2.3.3.1.2. Customer focus

In six of the reviewed studies, practices related to customer focus had a direct and positive impact on the firms' competitiveness or profitability (table 2-12). However, there are also three studies that claim these practices can only indirectly influence a company's financial performance.

Table 2-12 Studies that have investigated practices related to customer focus

Customers related practices	**Authors/Date**	**Financial perspectives**	
		Competitiveness: • Increased market share • Sales growth	**Profitability:** • Return on investment • Return on capital employed • Return on total assets
H2. Practices related to customer focus such as: • Identification of customer needs and expectations. • Customer integration in product development process. • Assessment of customer needs and expectations. • Customers are encouraged to submit proposals and complaints • Overall reputation score	Lakhal et al. (2006)	✓	✓
	Valmohammadi (2011)	✓	✓
	Lakhal (2014)	✓	✓
	Lee & Roh (2012)	✓	✓
	Banker & Mashruwala (2007)	✓	✓
	Lee et al. (2009)	✓	✓
	Fotopoulos & Psomas (2010)	×	×
	Abusa & Gibson (2013)	×	×
	Han et al. (2007)	×	×
✓= Direct positive impact on financial performance ×= No direct positive impact on financial performance			

For example, Abusa & Gibson (2013) find that these practices have no direct impact on a company's financial performance. However, they help to increase the percentage of exports growth in the companies in their sample. Therefore, while they haven't found a direct impact of these practices on the financial performance, it can be expected that increased exports could eventually lead to increased sales and profitability. Similarly, Fotopoulos & Psomas (2010) found that companies' improved customer focus can lead to an improved process management. That, in turn, leads to quality improvement which has a direct impact on the firms' profitability and competitiveness. Therefore, based on most of the reviewed studies, it can be expected that:

H_2: Practices related to customer focus have a direct positive impact on companies' competitiveness or profitability (figure 2-3).

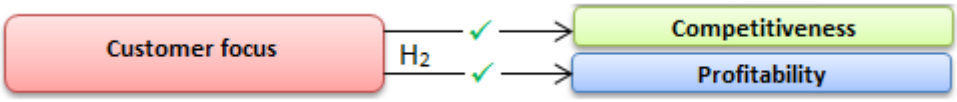


Figure 2-3 Expected impact of practices related to customer focus

2.3.3.1.3. Delivery reliability

There are two studies that considered practices to improve companies' delivery reliability (table 2-13). Both of these studies claim that these practices have direct positive impact on the firms' competitiveness or profitability.

Table 2-13 Studies that have examined practices related to delivery reliability

Customers related practices	**Authors/Date**	**Financial perspectives**	
		Competitiveness: • Increased market share • Sales growth	**Profitability:** • Return on investment • Return on capital employed • Return on total assets
H3. Practices related to delivery reliability such as: • Delivery speed • Reliability of delivery times (on time) • On-time delivery • Promptly handle customer complaints	Han et al. (2007)	✓	✓
	Rosenzweig et al. (2003)	✓	✓
✓= Direct positive impact on financial performance ×= No direct positive impact on financial performance			

Therefore, it can be expected that:

H_3: Practices related to delivery reliability have a direct positive impact on companies' competitiveness or profitability (figure 2-4).

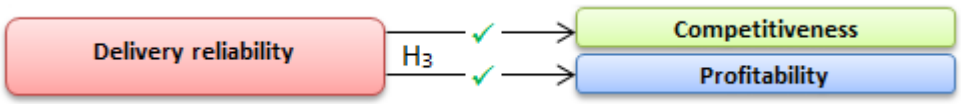


Figure 2-4 Expected impact of practices related to delivery reliability

2.3.3.2. Employees

Based on reviewing the earlier studies, the following four groups of operational practices related to employees' dimension are identified. The identified relationships in the earlier studies are used to develop four hypotheses that are explained in the following subsections.

1- Employees' effectiveness and satisfaction
2- Employees' involvement in business activities
3- Employees' recruitment, reward & retention
4- Employees' training.

2.3.3.2.1. Employees' effectiveness and satisfaction

Six out of nine of the reviewed studies claim that practices related to employees' effectiveness and satisfaction have a direct positive impact on a company's competitiveness or profitability (table 2-14). However, three studies also found no direct impact of these practices on companies' financial performance.

Table 2-14 Studies that have examined practices related to employees' effectiveness

Employees related practices	**Authors/Date**	**Financial perspectives**	
		Competitiveness: • Increased market share • Sales growth	**Profitability:** • Return on investment • Return on capital employed • Return on total assets
H4. Practices related to employees' effectiveness and satisfaction such as: • Transparency of mission and vision. • Providing participative environment for employees. • The competence of the employees is maintained and developed in a systematic way. • Empowerment of staff for continuous improvement. • Employee satisfaction is analysed and the results are the target of continuous improvement.	Valmohammadi (2011)	✓	✓
	Banker & Mashruwala (2007)	✓	✓
	Tarigan & Widjaja (2012)	✓	✓
	Nilsson et al. (2001)	---	✓
	Kumar et al. (2009)	---	✓
	Dubey & Gunasekaran (2015)	---	✓
	Sila (2007)	×	×
	Fotopoulos & Psomas (2010)	×	×
	Abusa & Gibson (2013)	×	×
✓= Direct positive impact on financial performance ×= No direct positive impact on financial performance			

For example, Abusa & Gibson (2013) found that these practices have a positive impact on employees' morale. However, they have no direct impact on firms' financial performance. Similarly, Fotopoulos & Psomas (2010) found that these practices only have a direct impact on firm's customer satisfaction which, in turn, has a direct impact on their financial performance. Therefore, based on most of the reviewed studies, it can be expected that:

> H_4: Practices related to employees' effectiveness and satisfaction have a direct positive impact on companies' competitiveness or profitability (figure 2-5).

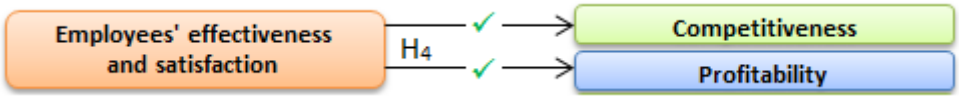


Figure 2-5 Expected impact of practices related to employees' effectiveness

2.3.3.2.2. Employees' involvement in business activities

Three of the reviewed studies find that practices related to employee's involvement in business activities have a direct positive impact on a firm's financial performance (table 2-15). However, two studies claim that these practices have indirect impact on firms' financial performance.

Table 2-15 Studies that have investigated practices related to employees' involvement

Employees related practices	**Authors/Date**	**Financial perspectives**	
		Competitiveness: • Increased market share • Sales growth	**Profitability:** • Return on investment • Return On Capital Employed • Return on total assets
H5. Practices related to employee's involvement in business activities such as: • Employees are responsible for the tasks they perform, and inspect their own work. • Number of employee suggestions • Employees working in teams, having open access to management and corrective action program striving for continuous improvement. • Actively participate in meetings & workshops • Employees take part in designing quality improvement activities	Lakhal (2014)	✓	✓
	Lee & Lee (2015)	✓	---
	Dubey & Gunasekaran (2015)	✓	---
	Fotopoulos & Psomas (2010)	×	×
	Lakhal et al. (2006)	×	×
✓= Direct positive impact on financial performance × = No direct positive impact on financial performance			

Lakhal et al. (2006) find that these practices improve financial performance via Information analysis and communication practices. For example, these practices can improve how companies collect and analyse information to improve its key processes, products and services, which, in turn, has a positive impact on their financial performance. Similarly, Fotopoulos & Psomas (2010) find that these practices improve financial performance via improved process management and product quality improvement. Thus it takes a longer time until the impact of these practices can be realised. Therefore, based on most of the reviewed studies, it can be expected that:

H_5: Practices related to employees' involvement in business activities have a direct positive impact on companies' competitiveness or profitability (figure 2-6).

Figure 2-6 Expected impact of practices related to employees' involvement

2.3.3.2.3. Employees' recruitment, reward & retention

Two studies have considered impact of practices related to employees' recruitment, reward and retention on companies' financial performance and found a positive impact (table 2-16).

Table 2-16 Studies that have investigated practices related to employees' recruitment

Employees related practices	**Authors/Date**	**Financial perspectives**	
		Competitiveness: • Increased market share • Sales growth	**Profitability:** • Return on investment • Return on capital employed • Return on total assets
H6. Practices related to employees' recruitment, reward and retention such as: •Rigorous staff selection process •Employees hold suitable work experience for accomplishing their job successfully in our company. •Our performance appraisals emphasise outcomes. •Remuneration package to promote employee retention. •Employees are creative in the company.	Ngo et al. (2008)	✓	✓
	Wang et al. (2014)	✓	✓
✓= Direct positive impact on financial performance	×= No direct positive impact on financial performance		

Therefore, it can be expected that:

H_6: Practices related to employees' recruitment, reward & retention have a direct positive impact on companies' competitiveness or profitability (figure 2-7).

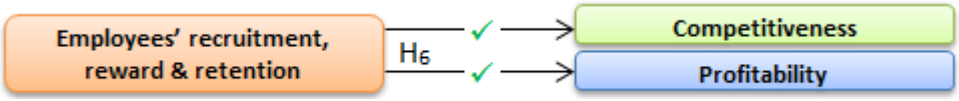


Figure 2-7 Expected impact of practices related to employees' recruitment

2.3.3.2.4. Employee training

Four of the reviewed studies have analysed the impact of practices related to employee training on the firms' financial performance (table 2-17).

Table 2-17 Studies that have investigated practices related to employees' training

Employees related practices	Authors/Date	Financial perspectives	
		Competitiveness: • Increased market share • Sales growth	**Profitability:** • Return on investment • Return on capital employed • Return on total assets
H7. Practices related to employees' training such as: • Employee training • Management training • Employee training in quality management and control • Empowerment of shop operators to correct quality problems • The company practices employee satisfaction with training received.	Lakhal (2014)	✓	✓
	Kannan & Tan (2005)	✓	×
	Lakhal et al. (2006)	×	×
	Han et al. (2007)	×	×
✓= Direct positive impact on financial performance ×= No direct positive impact on financial performance			

However, three of these studies (i.e. Lakhal, 2014; Kannan & Tan, 2005; Han et al. (2007) included these practices as a part of a bundle of TQM practices. Therefore, the impact of other TQM practices might have influenced their identified relationships. Lakhal et al. (2006) have only considered the impact of these practices on financial performance and found that they are not significantly linked. Therefore, it can be expected that:

H_7: Practices related to employees' training have no direct positive impact on companies' competitiveness or profitability (figure 2-8).

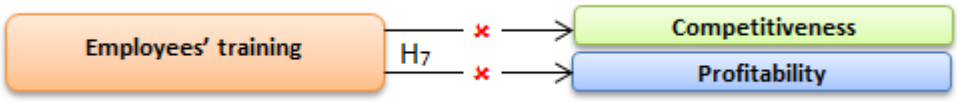


Figure 2-8 Expected impact of practices related to employees' training

2.3.3.3. Internal Processes

From reviewing the earlier studies, the following nine groups of operational practices related to internal processes' dimension are identified.

1. Process management
2. Process performance improvement
3. Waste reduction
4. Manufacturing simplicity and reducing set-up time
5. Preventive maintenance
6. Marketing
7. Usage of Information Systems (IS) for internal activities
8. Usage of IS for relationship with external partners
9. Corporate social responsibility practices.

The identified relationships in the earlier studies are used to develop nine hypotheses that are explained in below.

2.3.3.3.1. Process management:

Of the six studies that have considered the impact of practices related to process management on firms' financial performance, four studies found that they have direct positive impact (table 2-18). The other two studies found that they have indirect impact.

Table 2-18 Studies that have investigated practices related to process management

Internal processes related practices	**Authors/Date**	**Financial perspectives**	
		Competitiveness: • Increased market share • Sales growth	**Profitability:** • Return on investment • Return on capital employed • Return on total assets
H8. Practices related to process management such as: • The organisation has a process management method. • There is clarity and transparency of procedures and work instructions of processes and operations. • There is systematic recording and evaluation of critical process performance • There is a little bureaucracy (formal hierarchy, procedures and detailed rules) in the organisation. • Determination of areas and points for improvement	Lakhal et al. (2006)	✓	✓
	Valmohammadi (2011)	✓	✓
	Lakhal (2014)	✓	✓
	Fotopoulos & Psomas (2010)	×	×
	Abusa & Gibson (2013)	×	×
✓= Direct positive impact on financial performance		×= No direct positive impact on financial performance	

Fotopoulos & Psomas (2010) found that these practices have a direct positive impact on product quality improvement practices which, in turn, has a positive impact on firms' financial performance. Similarly, Abusa & Gibson (2013) found that these practices have a direct impact on companies' customer satisfaction and overall competitive position, which can expect to consecutively improve financial performance. Therefore, based on most of the reviewed studies, it can be expected that:

H_8: Practices related to process management have a direct positive impact on their competitiveness or profitability (figure 2-9).

Figure 2-9 Expected impact of practices related to process management

2.3.3.3.2. Process performance improvement

Of the eight studies that considered the impact practices related to process performance improvement on firms' financial performance, three studies have not found a direct positive impact of these practices on firms' financial performance (table 2-19).

Table 2-19 Studies that have investigated practices related to process improvement

Studies that have considered practices in Internal process perspective			
Internal processes related practices	**Authors/Date**	**Financial perspectives**	
		Competitiveness: • Increased market share • Sales growth	**Profitability:** • Return on investment • Return on capital employed • Return on total assets
H9. Practices related to process performance improvement such as: • Continuous efforts are made to improve quality at all levels • Management provides the necessary resources to carry out activities efficiently • Quality system in the company is improved continuously • Involvement in establishing and communicating the organisation's vision, goals, plans, and values for its quality programme • Clear set of work instructions	Lee et al. (2009)	✓	✓
	Wang et al. (2014)	✓	✓
	Abusa & Gibson (2013)	✓	✓
	Lakhal (2014)	✓	✓
	Huang et.al (2008)	✓	---
	Lakhal et al. (2006)	×	×
	Han et al. (2007)	×	×
	Duh et al. (2012)	---	×
✓= Direct positive impact on financial performance ×= No direct positive impact on financial performance			

However, one of those studies (Lakhal et al., 2006) claims that these practices have positive impact on product quality, which can be expected to consecutively improve firms' financial performance. Therefore, based on most of the reviewed studies, it can be expected that:

H_9: Practices related to process performance improvement have a direct positive impact on companies' competitiveness or profitability (figure 2-10).

Figure 2-10 Expected impact of practices related to process improvement

2.3.3.3.3. Waste reduction

Three of the reviewed studies, have considered the impact of practices related to waste reduction and found that they have a positive impact on companies' financial performance (table 2-20).

Table 2-20 Studies that have investigated practices related to waste reduction

Internal processes related practices	**Authors/Date**	**Financial perspectives**	
		Competitiveness: • Increased market share • Sales growth	**Profitability:** • Return on investment • Return on capital employed • Return on total assets
H10. Practices related to waste reduction such as: •Reduction of product defects •Reduction of product rework rate •Reduction of non-conformances •Capacity utilisation •Reduction of warranty compensations	Fotopoulos & Psomas (2010)	✓	✓
	Duh et al. (2012)	---	✓
	Han et al. (2007)	✓	✓
✓= Direct positive impact on financial performance ×= No direct positive impact on financial performance			

Therefore, it can be expected that:

H_{10}: Practices related to waste reduction have a direct positive impact on companies' competitiveness or profitability (figure 2-11).

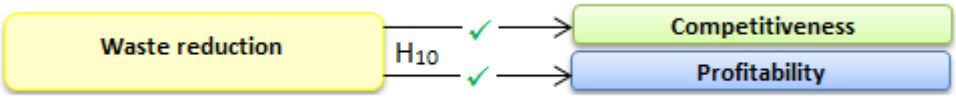


Figure 2-11 Expected impact of practices related to waste reduction

2.3.3.3.4. Manufacturing simplicity and reducing setup time

Of the ten studies that have considered the impact of practices related to manufacturing simplicity and reducing set-up time on firms' financial performance, six studies found a direct positive impact on companies' competitiveness or profitability (table 2-21).

Table 2-21 Studies that have investigated practices related to manufacturing simplicity

Internal processes related practices	**Authors/Date**	**Financial perspectives**	
		Competitiveness: • Increased market share • Sales growth	**Profitability:** • Return on investment • Return on capital employed • Return on total assets
H11. Practices related to manufacturing simplicity and reducing set-up time such as: •Reducing lot size •Cellular manufacturing (equipment's redesign) •Daily schedule adherence •Inventory transportation and management system •Manufacture broad product mix within same facilities •Uses special tools to shorten set-up time •Trains employees to reduce set-up time	Fullerton & Wempe (2009)	---	✓
	Dubey et al. (2014)	---	✓
	Callen et al. (2000)	---	✓
	Matsui (2007)	---	✓
	Hofer et al. (2012)	---	✓
	Agus & Hajinoor (2012)	✓	✓
	Kannan & Tan (2005)	×	×
	Jayaram et al. (2008)	---	×
	Rosenzweig et al. (2003)	×	×
	Durate et al. (2011)	×	×
✓= Direct positive impact on financial performance ×= No direct positive impact on financial performance			

Dubey et al. (2014) found that these practices have a positive impact on firms' liquidity as well. However, four studies found that they have no direct impact on financial performance. From these four studies, Kannan & Tan (2005) and Durate et al. (2011) considered these practices as a bundle of TQM and JIT practices respectively. Therefore, the impact of other practices in those bundles of TQM or JIT practices might have influenced the relationship between manufacturing simplicity and financial performance. Also Rosenzweig et al. (2003) found that these practices have no direct impact on firms' financial performance. However, they found that these practices have a positive impact on companies' customer satisfaction which, in turn, can expect to improve their financial performance too. Overall, based on most of the reviewed studies, it can be expected that:

> H_{11}: Practices related to manufacturing simplicity and reducing set-up time have a direct positive impact on companies' competitiveness or profitability (figure 2-12).

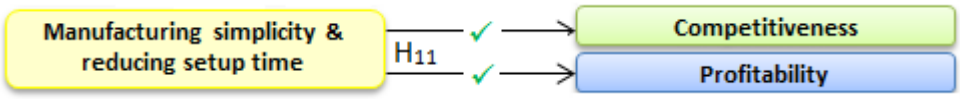


Figure 2-12 Expected impact of practices related to manufacturing simplicity

2.3.3.3.5. Preventive maintenance

Four of the five studies that have analysed the impact of practices related to preventive maintenance on firms' financial performance found that they have a direct positive impact on their competitiveness or profitability (table 2-22).

Table 2-22 Studies that have investigated practices related to preventive maintenance

Internal processes related practices	**Authors/Date**	**Financial perspectives**	
		Competitiveness: • Increased market share • Sales growth	**Profitability:** • Return on investment • Return on capital employed • Return on total assets
H12. Practices related to preventive maintenance such as: • Total preventive maintenance practices • Productive maintenance • Undertaking programmes for the improvement of equipment productivity • Multi-function employees	Dubey et al. (2014)	---	✓
	Fullerton et al. (2003)	---	✓
	Fullerton & McWatters (2001)	---	✓
	Yang et al. (2011)	✓	✓
	Durate et al. (2011)	×	×
✓= Direct positive impact on financial performance ×= No direct positive impact on financial performance			

In addition, Dubey et al. (2014) found they have positive impact on a firm's liquidity, and Fullerton et al. (2003) found they also have positive impact on cash flow ratios. Only Durate et al. (2011) found no positive relationship between these practices and companies' financial performance. However, Durate et al. (2011) considered the impact of these practices as a part of a bundle of practices a firm uses to improve quality, such as use of mini plants or statistical process control. Therefore, the other practices might have influenced the relationship between these practices and financial performance. Therefore, based on most of the reviewed studies, it can be expected that:

H_{12}: Practices related to preventive maintenance have a direct positive impact on companies' competitiveness or profitability (figure 2-13).

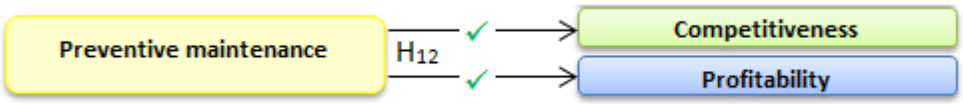


Figure 2-13 Expected impact of practices related to preventive maintenance

2.3.3.3.6. Marketing

Of the reviewed studies, only Dubey et al. (2014) have analysed the impact of marketing practices on firms' financial performance. They found that they have a positive impact on companies' profitability and liquidity measures (table 2-23).

Table 2-23 Studies that have investigated practices related to marketing

Internal processes related practices	**Authors/Date**	**Financial perspectives**	
		Competitiveness: • Increased market share • Sales growth	**Profitability:** • Return on investment • Return on capital employed • Return on total assets
H13. Marketing practices including: • Benchmarking practice impact on company performance • Effective sales promotion • Marketing research	Dubey et al. (2014)	---	✓
✓= Direct positive impact on financial performance ×= No direct positive impact on financial performance			

Therefore, it can be expected that:

H_{13}: Practices related to marketing have a direct positive impact on companies' profitability (figure 2-14).

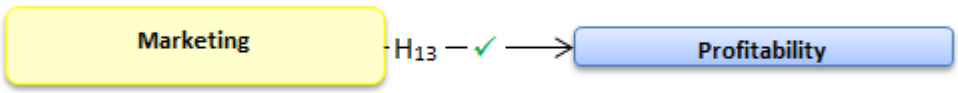


Figure 2-14 Expected impact of practices related to marketing

2.3.3.3.7. Usage of IS for internal process integration

Six of the reviewed studies have considered the impact of practices related to usage of information systems (IS) for internal integration. All of these studies have found that these practices have a positive impact on firms' financial performance (table 2-24).

Table 2-24 Studies that have investigated practices related to usage of IS for internal activities

Internal processes related practices	**Authors/Date**	**Financial perspectives**	
		Competitiveness: • Increased market share • Sales growth	**Profitability:** • Return on investment • Return on capital employed • Return on total assets
H14. Practices related to usage of information systems for internal integration such as: • Collection, analysis and use of data and quality information. • Important information is presented and transmitted to employees • Information System support for product flexibility • Harnesses information to improve key processes, products and services. • Formal information is shared in the form of regular newsletter and hand outs	Lakhal et al. (2006)	✓	✓
	Valmohammadi (2011)	✓	✓
	Lakhal (2014)	✓	✓
	Zhang (2005)	✓	✓
	Dubey & Gunasekaran (2015)	---	✓
✓= Direct positive impact on financial performance ×= No direct positive impact on financial performance			

Therefore, based on most of the reviewed studies, it can be expected that:

H_{14}: Practices related to usage of IS for internal integration have a direct positive impact on companies' competitiveness or profitability (figure 2-15).

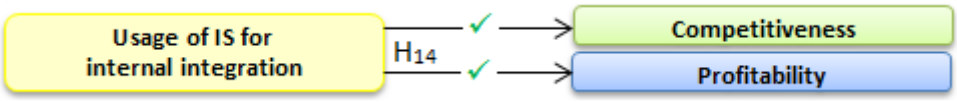


Figure 2-15 Expected impact of practices related to usage of IS for internal integration

2.3.3.3.8. Usage of IS for relationship with external partners

Of the five studies that have analysed the relationship between practices related to usage of information systems for external partnership and financial performance, three studies found that they have direct positive impact (table 2-25).

Table 2-25 Studies that have investigated practices related to usage of IS for external partnership

Internal processes related practices	**Authors/Date**	**Financial perspectives**	
		Competitiveness: • Increased market share • Sales growth	**Profitability:** • Return on investment • Return on capital employed • Return on total assets
H15. Practices related to usage of Information Systems for external partnership such as: • Coordinating activities with those of customers, suppliers or distributors • Discovering and solving problems through intimate communication and effective collaboration. • Maintaining appropriate interactions with stakeholders • Effective coordination with customers, suppliers or distributors • Customers and partners give suggestions and feedback and take the responsibility of managing the system	Dubey & Gunasekaran (2015)	---	✓
	Liu & Barrar (2009)	---	✓
	Wang et al. (2014)	✓	✓
	Zhang (2005)	×	×
	Jin (2006)	×	×
✓= Direct positive impact on financial performance × = No direct positive impact on financial performance			

The other two studies (i.e. Zhang, 2005; Jin, 2006) claim that it might take a longer time (between three and five years) before the impact of these practices can be realised. Therefore, it can be expected that:

H_{15}: Practices related to usage of IS for external partnership have a direct positive impact on companies' competitiveness or profitability (figure 2-16).

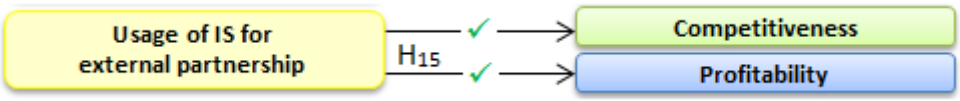


Figure 2-16 Expected impact of practices related to usage of IS for partnership

2.3.3.3.9. Corporate social responsibility practices

Four of the reviewed studies have considered the impact of practices related to corporate social responsibility. Three of these studies found no relationship between these practices and the firms' financial performance (table 2-26).

Table 2-26 Studies that have investigated practices related to corporate social responsibility

Internal processes related practices	**Authors/Date**	**Financial perspectives**	
		Competitiveness: • Increased market share • Sales growth	**Profitability:** • Return on investment • Return on capital employed • Return on total assets
H16. Corporate social responsibility practices including practices such as: • Programmes to improve environmental performance of processes and products • Relationship with employees • Health and security risks are prevented and reduced • Active involvement in social issues	Lee & Roh (2012)	✓	×
	Yang et al. (2011)	×	×
	Crisostomo et al. (2011)	---	×
	Fotopoulos & Psomas (2010)	×	×
✓= Direct positive impact on financial performance ×= No direct positive impact on financial performance			

Therefore, based on most of the reviewed studies, it can be expected that:

H_{16}: Practices related to corporate social responsibility have no direct positive impact on companies' competitiveness or profitability (figure 2-17).

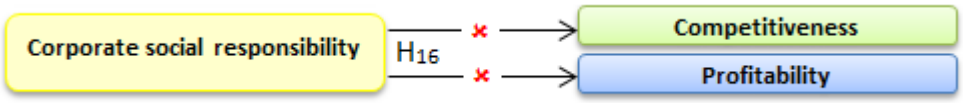


Figure 2-17 Expected impact of practices related to corporate social responsibility

2.3.3.4. Product/Service

From reviewing of the earlier studies, the following two groups of operational practices related to products dimension are identified:

1. Product quality improvement
2. Product Innovation

The identified relationships in the earlier studies are used to develop two hypotheses that are explained in below.

2.3.3.4.1. Product quality improvement

Eleven studies have analysed the impact of practices related to product quality improvement on companies' financial performance. Eight of those studies found that they have direct positive impact (table 2-27).

Table 2-27 Studies that have investigated practices related to product quality improvement

Product/Service related practices	**Authors/Date**	**Financial perspectives**	
		Competitiveness: • Increased market share • Sales growth	**Profitability:** • Return on investment • Return on capital employed • Return on total assets
H17. Practices related to product quality improvement such as: • Product quality improvement practices • Conformance to design specification • Product durability, reliability • Using objective data as the basis for quality improvement • Encouragement for continuous improvement of all products, services and processes	Hertenstein et al, (2005)	✓	✓
	Jayaram et al. (2008)	---	✓
	Han et al. (2007)	✓	✓
	Fullerton & McWatters (2001)	---	✓
	Agus & Hajinoor (2012)	✓	✓
	Rosenzweig et al. (2003)	✓	×
	Kaynak (2003)	✓	✓
	Sila (2007)	✓	✓
	Lee & Roh (2012)	✓	✓
	Abusa & Gibson (2013)	×	×
	Fullerton et al. (2003)	---	×
✓= Direct positive impact on financial performance ×= No direct positive impact on financial performance			

Rosenzweig et al. (2003) found that they have a positive influence on firms' competitiveness, but not on their profitability. Two studies (i.e. Abusa & Gibson, 2013 and Fullerton et al., 2003) found that they have no positive impact on firms' financial performance. However, in these studies, these practices are considered in a bundle of TQM and JIT practices respectively. Therefore, it is not clear if the lack of relationship is because of these practices or other practices in the bundle. Therefore, based on most of the reviewed studies, it can be expected that:

H_{17}: Practices related to product quality improvement have a direct positive impact on companies' competitiveness or profitability (figure 2-18).

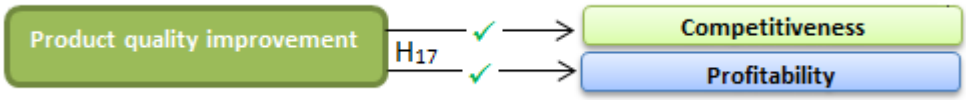


Figure 2-18 Expected impact of practices related to product quality improvement

2.3.3.4.2. Product Innovation

Two of the four studies that have analysed the relationship between practices related to product innovation and financial performance (i.e. Li et al., 2010 and Han et al., 2007) found that they have a positive impact on firms' competitiveness or profitability (table 2-28).

Table 2-28 Studies that have investigated practices related to product innovation

Product/Service related measures	**Authors/Date**	**Financial perspectives**	
		Competitiveness: • Increased market share • Sales growth	**Profitability:** • Return on investment • Return on capital employed • Return on total assets
H18. Practices related to product innovation such as: • Increasing the variety of product/service • Technical innovation • Improving the quality of products and services • Enhancing the manufacture technology of new products. • Extending the market coverage of product/service;	Li et al. (2010)	✓	✓
	Han et al. (2007)	✓	✓
	Dubey et al. (2014)	---	✓
	Lee & Roh (2012)	×	×
✓= Direct positive impact on financial performance ×= No direct positive impact on financial performance			

Dubey et al. (2014) also found that they have a positive impact on firms' profitability and liquidity measures. However, Lee & Roh (2012) unexpectedly found that these practices have no impact on firms' financial performance and argue that these practices do not consistently influence performance. Therefore, based on most of the reviewed studies, it can be expected that:

H_{18}: Practices related to product innovation have a direct positive impact on companies' competitiveness or profitability (figure 2-19).

Figure 2-19 Expected impact of practices related to product innovation

2.3.3.5. Suppliers

Based on reviewing the earlier studies, the following two groups of operational practices related to supplier's dimension are identified.

1- Building relationship with suppliers
2- Supplier selection

The identified relationships in the earlier studies are used to develop two hypotheses that are explained in below.

2.3.3.5.1. Building relationship with suppliers

Of the six studies that have considered the impact of practices related to building relationship with suppliers, only Valmohammadi (2011) and Rosenzweig et al. (2003) found that they have direct positive impact on firms' financial performance (table 2-29).

Table 2-29 Studies that have investigated practices related to building relationship with suppliers

Suppliers related practices	**Authors/Date**	**Financial perspectives**	
		Competitiveness: • Increased market share • Sales growth	**Profitability:** • Return on investment • Return on capital employed • Return on total assets
H19. Building relationship with suppliers including practices such as: • Integrating closely with raw material suppliers • Providing feedback to suppliers on the performance of products and processes. • Fulfilment of needs and expectation of suppliers. • Suppliers located in close proximity • Establishing long-term relationship with suppliers	Valmohammadi (2011)	✓	✓
	Rosenzweig et al. (2003)	×	✓
	Jayaram et al. (2008)	---	×
	Han et al. (2007)	×	×
	Abusa & Gibson (2013)	×	×
	Hofer et al. (2012)	---	×
✓= Direct positive impact on financial performance ×= No direct positive impact on financial performance			

However, most of the studies did not find a direct positive impact of these practices on firms' competitiveness or profitability. Therefore, it can be expected that:

H_{19}: Practices related to building relationship with suppliers have no positive impact on companies' competitiveness or profitability (figure 2-20).

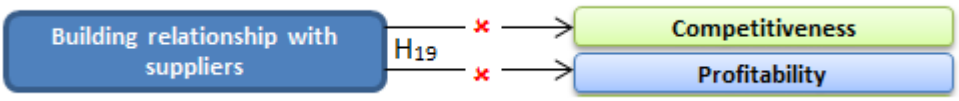


Figure 2-20 Expected impact of practices related to building relationship with suppliers

2.3.3.5.2. Supplier selection

Only two studies have analysed the impact of practices related to supplier selection on firms' financial performance (table 2-30). Huang et.al (2008) find a weak correlation between firms' 'supplier evaluation and selection' and competitiveness.

Table 2-30 Studies that have investigated practices related to supplier selection

Suppliers related practices	**Authors/Date**	**Financial perspectives**	
		Competitiveness: • Increased market share • Sales growth	**Profitability:** • Return on investment • Return on capital employed • Return on total assets
H20. Supplier selection practices including practices such as: • Selecting suppliers striving to eliminate waste • Considering process capability in supplier selection • Supplier evaluation and selection • Considering commitment to quality in supplier selection • Reducing supplier base	Huang et al. (2008)	✓	---
	Kannan & Tan (2005)	×	×
✓= Direct positive impact on financial performance ×= No direct positive impact on financial performance			

Kannan & Tan (2005) argue that 'supplier selection' is only correlated with companies' product quality and customer service and has no direct impact on their competitiveness or profitability. Therefore, it can be expected that:

> H_{20}: Practices related to supplier selection have no direct positive impact on companies' competitiveness or profitability (figure 2-21).

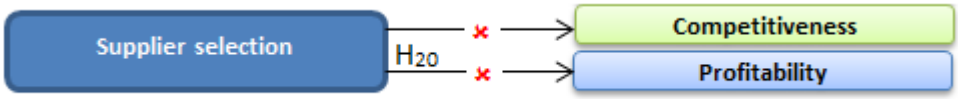


Figure 2-21 Expected impact of practices related to supplier selection

2.3.4. Limitations

In the last section, the findings of the earlier studies are used to develop twenty hypotheses to be tested in this study in the context of the UK manufacturing companies. This section classifies and explains the identified limitations of the reviewed studies. Tables 2-31 to 2-33 show the identified limitation of the earlier studies under the following three classifications:

1- Limitations related to study types
2- Limitations related to study samples
3- Limitations related to research methods.

In the following, each of these limitations and examples in each category are explained.

2.3.4.1. Limitations related to study types

Some of the earlier studies such as Teeratansirikool et al. (2013) only consider the extent of use of performance measurement systems (first row in table 2-31). In these studies, the results of measurement are neglected. Similarly, some studies use a proxy, such as winning a quality award, for assuming that certain operational practices are implemented in a company (second row in table 2-31). However, in these studies the results of performing those practices are neglected.

Table 2-31 Limitations of the reviewed studies related to study types

#	Limitations	Studies stated the limitation
1	Only considered the extent of use of the performance measurement systems and not the results of their usage.	Hoque & James (2000), Braam & Nijssen (2004), Crabtree & DeBusk (2008), Joiner et al. (2009), Teeratansirikool et al. (2013)
2	Comparing the award winners as a proxy for TQM implementation	Hansson & Eriksson (2003), Klingenberg et al. (2013)
3	The selected indicators might not completely indicate actual company practices. (Other potential determinants were not considered.)	Ittner & Larcker (1998), Fullerton & McWatters (2001), Fullerton et al. (2003), Zhang (2005), Hertenstein et al. (2005), Jin (2006), Lakhal et al. (2006), Banker & Mashruwala (2007), Durate et al. (2011), Yang et al. (2011), Agus & Hajinoor (2012), Lee & Roh (2012), Dubey et al. (2014), Wang et al. (2014)

Also, fourteen studies argue that selected indicators in their studies might not fully reflect the real performance of the companies in their samples (third row in table 2-31). These studies claim that other potential variables that are not considered in their studies, such as organisational cultures or other contextual variables (Wang et al., 2014), might have influenced their findings.

2.3.4.2. Limitations related to study samples

Limitations of the reviewed studies related to study samples are shown in table 2-32. For example, Lakhal et al. (2006) suggest that their sample, which consists of ninety-two Tunisian companies, is small. However, as explained in section 2.4.1, there are many other studies based on smaller sample sizes that have found statistically significant findings. For example, Valmohammadi (2011), which is based on fifty-three Iranian firms or Lee & Lee (2015) based on nine Taiwanese firms.

Table 2-32 Limitations of the reviewed studies related to study samples

#	Limitations	Studies stated the limitation
1	Small sample size	Lakhal et al. (2006)
2	Did not employ a random sample which limits the generalisability of conclusions.	Fullerton & McWatters (2001), Fullerton & Wempe (2009)
3	The findings are dependent on a particular circumstance (i.e. time dependent or artefact of a particular data set)	Ittner & Larcker (1998), Durate et al. (2011), Hofer et al. (2012)
4	The sample was dominated by a particular type of company (i.e. particular size or market leaders)	Rosenzweig et al. (2003), Jayaram et al. (2008), Fullerton & Wempe (2009),
5	The findings are limited to a particular industry i.e. the manufacturing companies, or the financial services only	Ittner & Larcker (1998), Rosenzweig et al. (2003), Fullerton et al. (2003), Jin (2006), Lakhal et al. (2006), Han et al. (2007), Kumar et al. (2009), Fotopoulos & Psomas (2010), Valmohammadi (2011), Agus & Hajinoor (2012), Abusa & Gibson (2013)
6	The findings are limited to a country's market competition, regulatory constraints and other economical context	Nilsson et al. (2001), Fullerton et al. (2003), Lakhal et al. (2006), Han et al. (2007), Ngo et al. (2008), Kumar et al. (2009), Lee et al. (2009), Fotopoulos & Psomas (2010), Li et al. (2010), Crisostomo et al. (2011), Valmohammadi (2011), Agus & Hajinoor (2012), Duh et al. (2012), Lee & Roh (2012), Abusa & Gibson (2013), Wang et al. (2014)

Two studies (i.e. Fullerton & McWatters, 2001 and Fullerton & Wempe, 2009) claim that their samples were not randomly selected. These studies use a portion of the samples from their earlier studies. Similarly, some studies, such as Durate et al. (2011), argue that their findings might be dependent on a particular circumstances or particular datasets. Other sample-related limitations are that study samples were dominated by a particular companies (Rosenzweig et al., 2003), or a particular industry (Abusa & Gibson, 2013) or a particular country (Wang et al., 2014). This limits the generalisability of their findings.

2.3.4.3. Limitations related to research methods

One of the most commonly stated limitations in the past studies is the problem of the subjective data (table 2-33). For example, Fotopoulos & Psomas (2010) and Dubey & Gunasekaran (2015) argue that their findings are based on subjective data and therefore, might not reflect the real performance of the companies in their samples.

Table 2-33 Limitations of the reviewed studies related to research methods

#	Limitations	Studies stated the limitation
1	Subjective data: based on self-reported company measures	Nilsson et al. (2001), Fullerton & McWatters (2001), Fullerton et al. (2003), Kaynak (2003), Lakhal et al. (2006), Sila (2007), Jayaram et al. (2008), Fullerton & Wempe (2009), Fotopoulos & Psomas (2010), Agus & Hajinoor (2012), Lakhal (2014), Wang et al. (2014), Dubey & Gunasekaran (2015)
2	Use of a secondary database created for a purpose other than that of the research at hand.	Durate et al. (2011)
3	Common method variance (CMV) & Common method bias – the usage of a single method to collect all data.	Nilsson et al. (2001), Kaynak (2003), Han et al. (2007), Sila, (2007), Ngo et al. (2008), Li et al (2010),
4	Usage of cross-sectional data, which is not suitable for causality analysis	Rosenzweig et al. (2003), Kaynak (2003), Yasin et al. (2004), Kannan & Tan (2005), Jin (2006), Lakhal et al. (2006), Banker & Mashruwala (2007), Sila, (2007), Ngo et al. (2008), Li et al (2010), Durate et al. (2011), Yang et al. (2011), Agus & Hajinoor (2012), Duh et al. (2012), Hofer et al. (2012), Abusa & Gibson (2013), Lakhal (2014), Wang et al. (2014), Dubey & Gunasekaran (2015)
5	Statistical analysis or design limitations (i.e. missing data or not meeting the assumptions of the analysis methods).	Clarke et al. (2011), Dubey et al. (2014), Lakhal (2014)

Another common problem is the usage of cross-sectional data in studies such as Wang et al. (2014) and Dubey & Gunasekaran (2015).This limits the ability to study causal relationships, since both predictors and response variables are collected simultaneously. Other limitations related to research methods include: use of a secondary database (Durate et al., 2011), Common Method Variance (CMV) (Li et al., 2010) and limitations related to the usage of statistical analysis methods (Clarke et al., 2011).

2.4. Conclusion

In appendix 1 of this thesis, fifteen structural business performance measurement frameworks that have emerged in the literature since early 1920s are reviewed. This is to address the first objective of this study to find the existing approaches to evaluate companies' operational practices and financial performance. Appendix 1 summarises the suggested measures, suggested relationships between the measures, and the strengths and the weaknesses of each framework. In section 2.2 of this chapter, the author's understandings of the reviewed frameworks were discussed. To form a comprehensive set of dimensions for performance measurement, five dimensions of operational performance and two dimensions of financial performance are identified. The identified operational dimensions include:

1- Customer
2- Employee
3- Internal process
4- Product/Service
5- Supplier

and the identified financial dimensions includes:

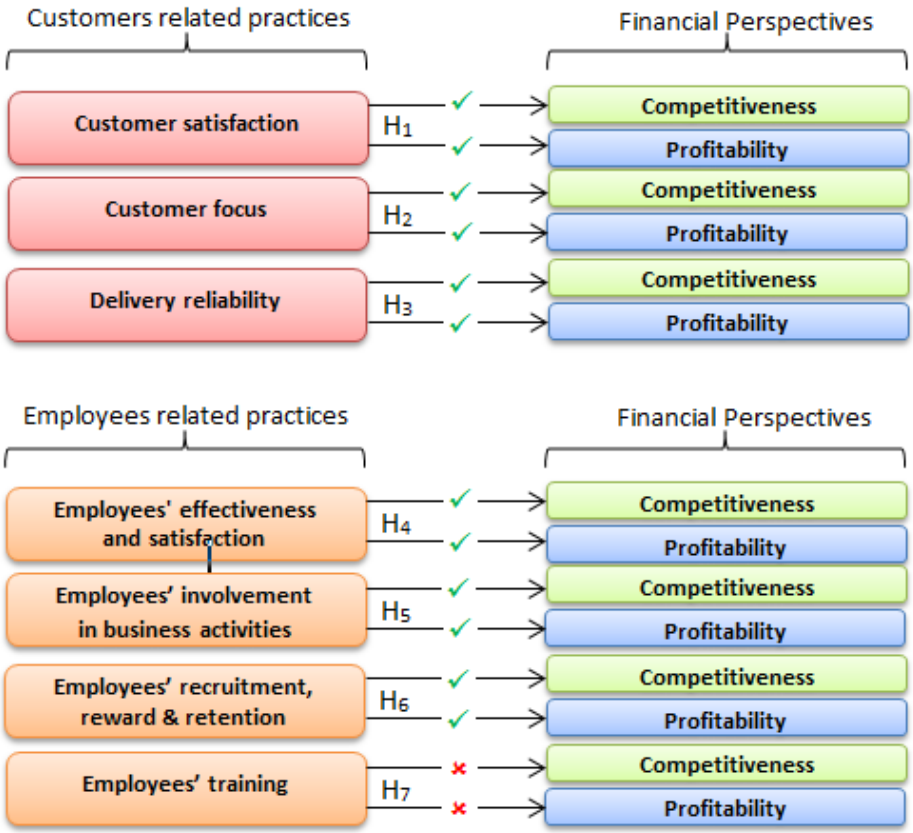
1- Competitiveness
2- Financial performance.

To confirm if the identified operational dimensions are used in practice, ten practical studies were also reviewed in this chapter. The identified operational measures in the practical studies verify the identified dimension in the reviewed frameworks. Also, from reviewing fifteen studies that examine financial analyses, a set of twenty-five ratios in the following five categories were identified that are commonly identified when analysing the financial performance of a company:

1- Profitability
2- Asset management
3- Liquidity
4- Debt management
5- Cash flow ratios.

On the relationships between the measures in the frameworks, three different types of relationships were identified. Three frameworks suggest a hierarchical relationship between performance measurements at different levels of management in a company. Also, three frameworks only propose some categories of measures that should be used for performance measurement, but do not assume any relationship between their suggested categories. However, most of the reviewed frameworks suggest a causal relationship between companies' operational practices and financial performance. This is aligned with the purpose of this study. However, the reviewed frameworks do not suggests specific operational practices that can influence specific dimensions of financial performance. Therefore, to find these relationships, in the last section of this chapter, forty studies that have analysed the relationship between companies' operational practices and financial performance were reviewed.

First, the types of studies and the characteristics of their samples and research methods were reviewed and their similarities and differences were identified. The findings of the studies were classified under the five operational dimensions of performance that are identified from reviewed frameworks in section 2.2. From reviewing the findings of the earlier studies, twenty hypotheses were developed to be tested with the data from the UK manufacturing companies in this study. In the following, the hypotheses of the study are summarised and figure 2-22 shows the conceptual framework of the study based on the findings of the earlier studies (i.e. twenty hypotheses).



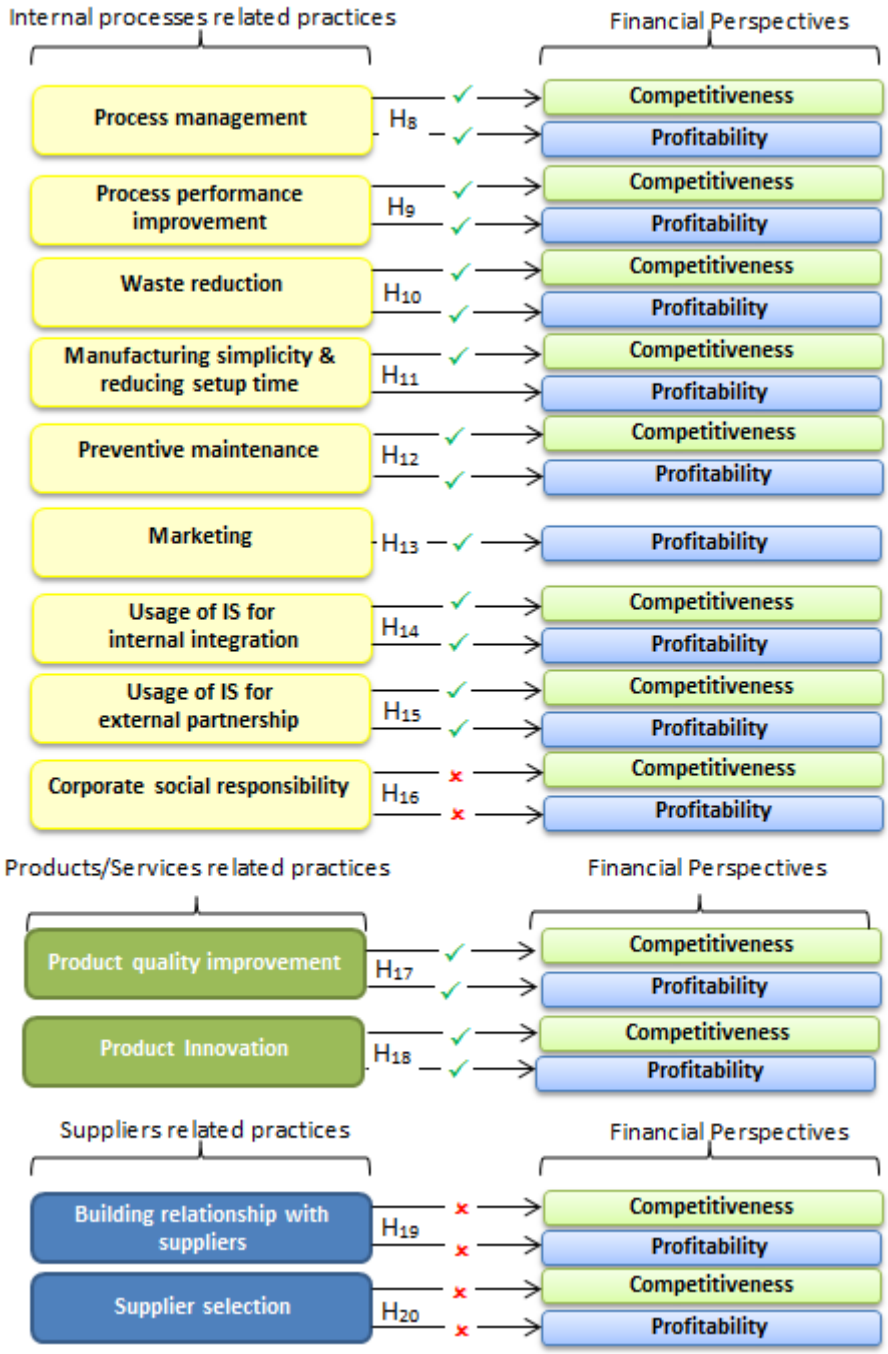


Figure 2-22 Conceptual Framework based on the findings of the earlier studies

- H1: Practices related to customer satisfaction have a direct positive impact on companies' competitiveness or profitability.
- H2: Practices related to customer focus have a direct positive impact on companies' competitiveness or profitability.
- H3: Practices related to delivery reliability have a direct positive impact on companies' competitiveness or profitability.
- H4: Practices related to employees' effectiveness and satisfaction have a direct positive impact on companies' competitiveness or profitability.
- H5: Practices related to employees' involvement in business activities have a direct positive impact on companies' competitiveness or profitability.
- H6: Practices related to employees' recruitment, reward & retention have a direct positive impact on companies' competitiveness or profitability.
- H7: Practices related to employees' training have no direct positive impact on companies' competitiveness or profitability.
- H8: Practices related to process management have a direct positive impact on their competitiveness or profitability.
- H9: Practices related to process performance improvement have a direct positive impact on companies' competitiveness or profitability.
- H10: Practices related to waste reduction have a direct positive impact on companies' competitiveness or profitability.
- H11: Practices related to manufacturing simplicity and reducing set-up time, have a direct positive impact on companies' competitiveness or profitability.
- H12: Practices related to preventive maintenance have a direct positive impact on companies' competitiveness or profitability.
- H13: Practices related to marketing have a direct positive impact on companies' profitability.
- H14: Practices related to usage of IS for internal integration have a direct positive impact on companies' competitiveness or profitability.
- H15: Practices related to usage of IS for external partnership have a direct positive impact on companies' competitiveness or profitability.
- H16: Practices related to corporate social responsibility have no direct positive impact on companies' competitiveness or profitability.
- H17: Practices related to product quality improvement have a direct positive impact on companies' competitiveness or profitability.
- H18: Practices related to product innovation have a direct positive impact on companies' competitiveness or profitability.
- H19: Practices related to building relationships with suppliers have no positive impact on companies' competitiveness or profitability.
- H20: Practices related to supplier selection have no direct positive impact on companies' competitiveness or profitability.

In addition, the reviewed studies had reported fourteen limitations that are classified into the following three categories:

1- Limitations related to study types:

a. Only considered the extent of use of the performance measurement systems and not the results of their usage.
b. Use of a proxy, such as winning a quality award, as a replacement for implementation of operational practices.
c. The selected indicators might not fully reflect company practices. (Other potential determinants were not considered.)

2- Limitations related to study samples:

a. Small sample size
b. The sample was dominated by a particular companies (i.e. particular size or market leaders)
c. Did not employ a random sample which limits the generalisability of conclusions.
d. The findings are dependent on a particular circumstance (i.e. time-dependent or artefact of a particular dataset)
e. The findings are limited to a particular industry i.e. the manufacturing companies, or the financial services only
f. The findings are limited to a country's market competition, regulatory constraints and other economical context.

3- Limitations related to research methods:

a. Using subjective data: based on self-reported company measures
b. Use of a secondary database created for a purpose other than that of the research.
c. Common Method Variance (CMV) & Common method bias – the usage of a single method to collect all data.
d. Usage of cross-sectional data, which is not suitable for causality analysis
e. Statistical analysis or design limitations (i.e. missing data or not meeting the assumptions of the analysis methods.

3. Research Design

3.1. Introduction

In the previous chapter, a conceptual model based on the findings of the earlier studies on the relationship between the companies' operational practices and their financial results was developed. The purpose of this chapter is to explain the research design of the study based on Saunders et al.'s (2009) research onion (figure 3-1). The philosophy and approach for conducting this research is discussed in section 3.2. Based on the purpose of the study, the research strategy, choice of data collection and analysis, and time horizon of the study are explained in section 3.3. Section 3.4 discusses the potential research methods for data collection and analysis and the selected methods for this study. Finally, in section 3.5, the credibility and generalisability of the findings of the study are explained.

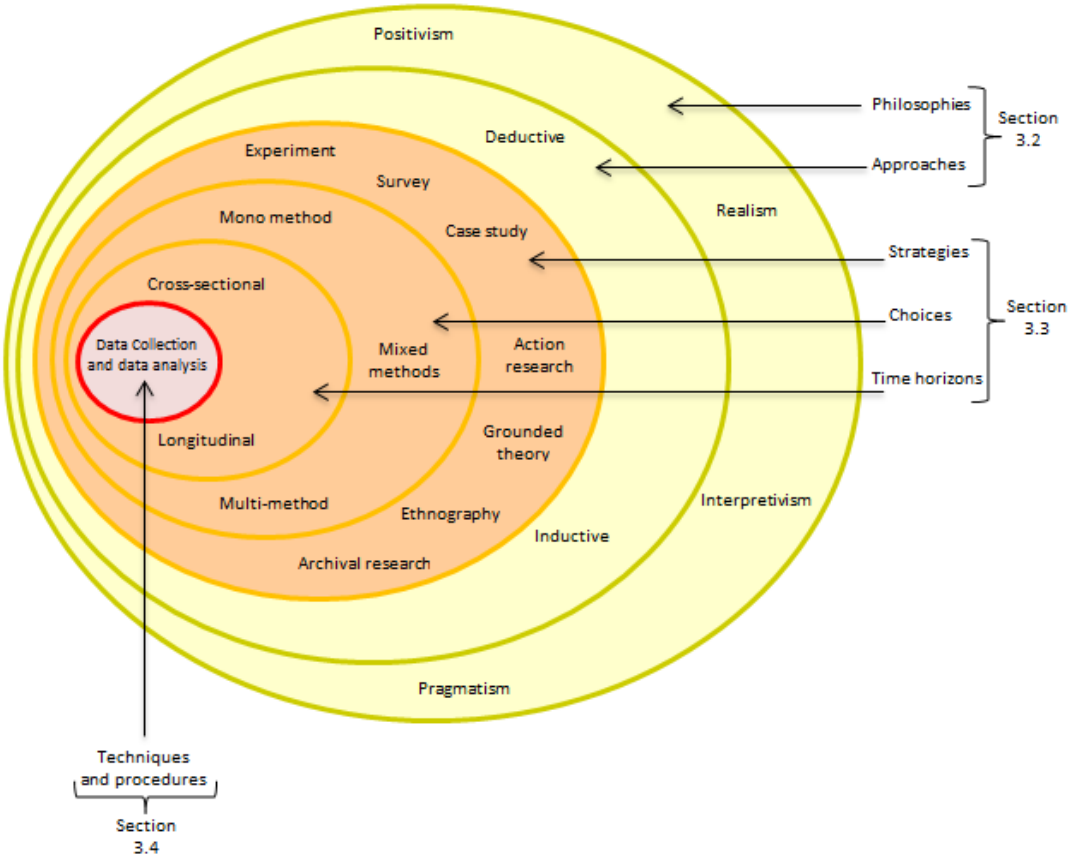


Figure 3-1 the research onion (adapted from Saunders et al., 2009)

3.2. Research philosophy and approach

3.2.1 Research philosophy

Research philosophy describes the way a researcher views the world, the nature of knowledge and development of that knowledge (Saunders et al., 2009). There are three ways of thinking about research philosophy including:

1- Ontology
2- Epistemology
3- Axiology.

Ontology is concerned with the researcher's view about the nature of the reality (Kalof et al., 2008). Epistemology explains the composition of acceptable knowledge in a field of study (Jonker & Pennink, 2010). Axiology explains a research's values as a basis of judgement and the methods of conducting research (Saunders et al., 2009). There are four main research philosophies in business and management research (Saunders et al., 2009), including:

1- Positivism
2- Realism
3- Interpretivism
4- Pragmatism.

The position of Positivism is close to the physical and natural scientist position and is concerned with facts rather than feelings (Jonker & Pennink, 2010). Conversely, Interpretivism involves understanding the differences between humans in their role as social actors (Saunders et al., 2009). Realism is another research philosophy that supports what the senses show us is the truth and that an object's existence is independent of human belief about their existence (Jonker & Pennink, 2010). Finally, Pragmatism's main concern is the research question. Therefore, in Pragmatism a researcher may choose a combination of ontological, epistemological and axiological positions that are not aligned with any of above research philosophies (Saunders et al., 2009). In the following, the position of this research vis-a-vis the three ways of thinking about research philosophy is explained.

A.1.1 Ontology

Ontology is concerned with a researcher's assumptions about the way in which world works and the nature of social entities (Kalof et al., 2008). There are two extreme ontological positions: Objectivism and Subjectivism (Saunders et al., 2009). The objectivism position assumes that social entities exist in reality external to social actors. For example, an Objectivist position would be to assume that management is similar in all organisations. Therefore, the difference between management in organisations is because of different organisational features in which management works. However, Subjectivism assumes that social phenomena are created from the opinions of social actors and their actions that are concerned with their existence. For example, a Subjectivist position would be to assume that the way in which managers think that their jobs should be performed is more important than the objective features of management (Saunders et al., 2009).

Considering these two extreme positions, the Ontological position of this research is closer to Subjectivism. This study tries to find specific operational practices of companies, such as their 'customer focus' practices, that influence their financial performance measures. Therefore, the study is concerned with a person's opinion about how well a company is performing its operational practices. Similarly, it cannot be assumed that, for example, customer focus practices are an entity that is similar in all organisations. Therefore, the ontological position of this research is closer to Subjectivism and so closer to the Interpretivism research philosophy.

A.1.2 Epistemology

Epistemology is concerned with what creates acceptable knowledge in a field of study (Jonker & Pennink, 2010). From the Epistemological position, this study is closer to the Positivism and Realism positions. This is because the study's focus is on finding casual relationships between the operational practices and financial measures, which is aligned with Positivism. It also focuses on studying those relationships for the UK manufacturing companies, so is aligned with Realism which is concerned with studying phenomena within a context. However, the study's focus is not aligned with Interpretivism, which focuses on studying the details of a subject and the reality behind those details. Therefore, it can be argued that the Epistemological position of this study is aligned with Pragmatism which emphases incorporating different positions to help interpret the data.

A.1.3 Axiology

Axiology explains a researcher's value system which is used as a basis for judgement about research and the method of conducting it (Saunders et al., 2009). The main source of data for this study is from two independent archival data sources in which the author has been independent of the data and keeps an objective stance. This position is aligned with Positivism philosophy. However, value plays a large role in the other research philosophies. In the Interpretivism philosophy, the researcher is part of what is being studied and cannot be separated. Similarly, in the Realism philosophy, the researcher is biased by experience, culture or world-view (Saunders et al., 2009). Therefore, from the Axiological position, this research is closer to the Positivism philosophy.

3.2.2 Research approach

There are two main research approaches, including: Deductive and Inductive (figure 3-2). Deductive research involves developing hypotheses from the theory and designing a research strategy to test those hypotheses (Kalof et al., 2008). Conversely, Inductive research involves starting with data analysis and developing a theory based on that data analysis (Kalof et al., 2008). In these descriptions, theory is defined as making causal relationships between two or more variables that may or may not have been tested (Saunders et al., 2009).

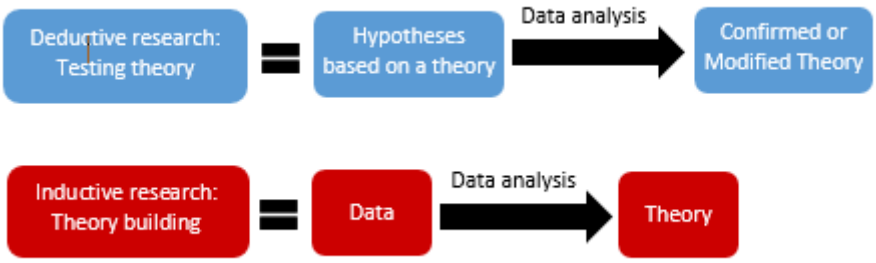


Figure 3-2 Deductive and Inductive research approaches

Considering these two approaches, the research approach of this study is Deductive. This is because the study starts with developing a conceptual model showing the relationships between operational practices and the financial performance of companies that was reported in the earlier studies. Then, the conceptual model is tested using statistical analysis on the data from the UK manufacturing companies. Therefore, this approach is aligned with testing theory and deductive research.

3.3. Research strategy, choice of data collection and analysis and time horizon

In the previous section, the philosophy and the approach of this study is explained. This section describes the selected research strategy, choice of data collection and analysis, and the time horizon of this study. Saunders et al. (2009) highlight three main research purposes that are often used in research methods literature, including:

1- Descriptive
2- Exploratory
3- Explanatory.

Descriptive study is often used to get a clear picture of a phenomenon before starting to collect data about it (Mitchell & Jolley, 2010). Descriptive studies are often followed by an exploratory or an Explanatory study and therefore should be seen as a means to an end (Saunders et al., 2009). Exploratory study is useful to discover the exact nature of a problem and can be conducted by searching the literature, interviewing experts in the subject or by conducting focus group interviews (Mitchell & Jolley, 2010). Explanatory study is useful in studying a subject in order to explain the relationship between variables (Saunders et al., 2009). Since the purpose of this study is to find the relationship between the operational practices and financial performance of the UK manufacturing companies, it is an Explanatory study. Clarifying the purpose of the study can help to select a suitable strategy for the study. This is explained in the following subsection (3.3.1).

3.3.1 Research strategy

There are many types of research strategies that can be used in business and management research. Table 3-1 shows seven of these strategies suggested by Saunders et al. (2009) that are suitable for different research purposes and for answering different types of research questions. This research is an Explanatory research, which aims to explain the causal relationships among the study variables and to answer the following research question: What operational practices in the UK manufacturing companies can improve their financial performance?

Therefore, several alternatives from the highlighted strategies in table 3-1 could potentially be used in this study. However, by comparing some of the potential strategies, archival research was considered as the most suitable strategy for this study. In the following section, the reasons for using archival research and the reasons for not using the other potential strategies are explained.

Table 3-1 Potential research strategies

Research strategies	Purpose of the research	Research questions
Experiment	Exploratory, Explanatory	How? Why?
Survey	Exploratory and Descriptive	Who? What? Where? How much? and how many?
Case study	Explanatory and Exploratory	Why? What? How? (although survey strategy is more concerned with what and how)
Action research	Finding a solution for organisational issues	How?
Grounded theory	Explanatory	What? Why?
Ethnography	Descriptive and Exploratory	Why?
Archival research	Exploratory, Descriptive or Explanatory	Who? What? Where? How much? and how many?

A.1.4 Experiment strategy

Experiment strategy is suitable for Explanatory research; however it is more suitable for answering 'how' and 'why' questions (Bordens & Abbott, 2011), rather than 'what' questions as in this study. Saunders et al. (2009) argues that because of the design needs of this strategy, the selected samples in these studies are non-representative which lead to problems of generalisability.

An example of experiment research is a study conducted by Banker et al. (2004). Using 480 M.B.A students, this study evaluates the influence of strategically linked measures in a Balanced Scorecard on individuals' evaluation of performance of business unit managers. The study showed that when individuals are told about the strategy of a business unit, they rely more on strategically linked measures than non-linked measures (Banker et al., 2004). However, the authors pointed out the three main limitations of their study design which might have influenced their findings:

1- The participants did not have general business experience.
2- They did not have the same incentives as business managers have in real life.
3- The information about business strategy was directly provided to the participants.

The limitations in Banker et al. (2004) study show how similar limitations in the design of experiment strategy might influence their findings. Therefore, the experiment was not a suitable strategy for this study.

A.1.5 Survey

The survey strategy is suitable for answering the 'what' question; however there is a limit to the number of questions in a survey, and therefore the collected data is unlikely to be comprehensive (Kalof et al., 2008). Also, most of the earlier studies that had examined the relationship between companies' operational practice and financial performance used survey strategies to collect their data. Many of those studies such as Wang et al. (2014) and Dubey & Gunasekaran (2015) stated that their findings are based on subjective data, and may not reflect the actual performance of companies. To overcome this limitation, Nilsson et al. (2001) suggest using archival data to complement the findings based on perceptual data.

Similarly, using a single respondent or a single method of data collection for both operational and financial variables can lead to finding a false covariance between the variables (Podsakoff et al., 2003). To overcome this limitation, authors such as Sila (2007) and Li et al. (2010) suggest using multiple respondents (Sila, 2007) or multiple sources (Li et al., 2010) for data collection. Therefore, to avoid repeating the limitations of the earlier studies, a survey strategy was also not selected in this study.

A.1.6 Case study

Case study strategy is suitable for an Explanatory research and is also suitable for answering 'what' questions (Jonker & Pennink, 2010). However, there is a limitation in generalising the findings from a case study to a wider group of companies (Mitchell & Jolley, 2010). For example, Rucci et al. (1998) report findings of a case study research at a US department store (Sears, Roebuck and Company). The company managers decided to make the company 'a compelling place to work, to shop, and to invest'. Over a course of eighteen months, the company collected data on many measures related to their customer satisfaction, employee satisfaction and financial performance. Using the causal pathway modelling method, the company developed a model which connects their employees' satisfaction to customer satisfaction and profitability.

Although the developed model in Rucci et al.'s (1998) study is useful for their company, it cannot be generalised to other companies. The purpose of this study is to find a generic model that can be applied in majority of the UK manufacturing companies. To make a generic conclusion, there is the need to gather a larger number of case studies. Therefore, considering the limitations of time and other resources, it was not feasible to collect a large number of case studies in this research.

A.1.7 Grounded theory

Grounded theory is also an alternative for performing Explanatory research and for answering 'what' questions. However, Sreejesh & Mohapatra (2014) argue that this strategy is associated more with Inductive research. However, a large number of studies in the literature have explored the relationship between operational practices and financial performance. Therefore, Deductive research is more suitable for this study and so using a grounded theory is not relevant to this study.

A.1.8 Archival research

An archival research strategy is selected for this study. Based on Bordens & Abbott's (2011) and Saunders et al.'s (2009) recommendations, the following describe the benefits of using the archival the research strategy for this study:

1- **It is suitable for Explanatory research purposes and for answering 'what' questions:** this study uses an Explanatory research to find causal relationships between operational practices and financial performance in UK manufacturing companies. The research question of the study is: What operational practices in the UK manufacturing companies can improve their financial performance? Therefore, the archival research strategy is fitting for the purpose and the research question of this study.

2- **It is less intrusive method of data collection:** this strategy is a less intrusive method of data collection (Saunders et al., 2009). The companies' information is collected from two independent data sources. Their operational data are collected from the IMechE's archive of the companies who have entered the MX Awards between 2006 and 2011. The companies who have entered the MX Awards had the incentive of winning an award or to find the areas of improvement in their operational practices. Therefore, they were more likely to provide the information, than if they were supposed to provide that information to an academic researcher with no direct benefit for their business. For each of the companies that had entered the MX Awards, their financial data were collected from the financial analysis made easy (FAME) and Amadeus databases. Therefore, the advantage of this method is that collected data is less intrusive than if the information had been collected directly from the companies.

3- **There are savings in time and financial resources:** since the data is already collected, there is less time needed for data collection, which results in great savings in time and financial resources (Saunders et al., 2009). Using archival data to collect companies' operational and financial data was less time-consuming than if it had been collected via a survey. However, the format of the original data needed to be changed before it could be used for statistical analysis.

4- **There is the potential for longitudinal analysis:** archival research strategy allows the company to answer research questions which focus on the past and this provides the researcher with the potential for conducting a longitudinal analysis (Saunders et al., 2009). From the IMechE's archival data, the companies' operational practices were only available for the year in which they had entered the MX Awards. However, the financial ratios of those companies for the year of participation in the awards were collected and compared with their performance in the year before participation and three years after that. Therefore, it was possible to evaluate the impact of the companies' operational practices on their financial performance up to three years after their participation in the MX Awards.

Despite the advantages of using archival data, mentioned above, Saunders et al. (2009) point out the following disadvantages of using this strategy in a research study.

1- **Imprecise information:** the archival documents may not contain the precise information needed to answer the research questions, or the definition of the data may not be suitable for the study (Saunders et al., 2009). However, this problem is not applicable to this study as the data sources of the study contain relevant information that is suitable to answer the research question.

2- **Problem with accessing the data and missing data:** the researcher may be refused access to the data because of confidentiality reasons, or there might be some missing data in the archives (Saunders et al., 2009). In this study, the copyright owners of the IMechE archive gave permission to the author to have access to their database, and the financial information of those companies was collected from publicly available databases (i.e. FAME and Amadeus). Therefore, there was no problem about accessing the data in this study. There was some missing data in the archival data of the study, but this did not affect the analysis as it was possible to reach statistically significant findings with the available data.

3- **No control over data quality and presentation:** there is no control over data quality in archival research and the original purpose of the data may have affected the data presentation (Saunders et al., 2009). As explained in section 3.3.1.2, the quality of the archival data is higher than if collected via a survey. However, presentation of the data was not suitable for analysis in their original format. As explained in section 3.4.2, before the data was analysed, some preliminary steps were needed to prepare the data for analysis.

3.3.2 Choice of data collection and analysis techniques

The methods of data collection and data analysis procedures for conducting research can be classified into quantitative (using numerical data) and qualitative types (using non-numerical data) (Jonker & Pennink, 2010). When a combination of quantitative and qualitative data collection and analysis methods are used in research, it is called a mixed-method approach which can be subdivided into two: mixed-method research and mixed-model research (Saunders et al., 2009). When quantitative data are analysed quantitatively and qualitative data are analysed qualitatively, it is called mixed-method research. Alternatively, when quantitative data is converted into text to be analysed qualitatively or qualitative data are converted into numerical values to be analysed quantitatively, it is called mixed-model research (Saunders et al., 2009).

The main sources of data in this study are archival data. The data about companies' operational data is collected from the IMechE's archival data which is in numerical format. The financial data are also in numerical format and collected from two financial databases (i.e. Fame and Amadeus). The relationships between these variables are analysed using statistical analysis methods. Therefore, both data collection and data analysis methods are quantitative. However, to explain the identified relationships between the variables, the findings of the study were discussed with ten academics or business consultants in two focus groups and two interviews. Using qualitative data to explain the relationships between quantitative variables is one reason for using a mixed-method in a study (Saunders et al., 2009). The data from the focus groups and interviews were analysed qualitatively; therefore, a mixed-method research is applied in this study.

3.3.3 Time horizon

As stated in the previous chapter (section 2.4.2), there are two types of time horizons that can be used in a research study (i.e. Cross-sectional and Longitudinal). In Cross-sectional research a topic is studied in a one particular instance (Bordens & Abbott, 2011). In contrast, in Longitudinal research, the continuity of the results of an experiment over time is tested (Zikmund, et al., 2009).

In this study, the operational practices of the companies were only available for the year in which they had entered the MX Awards. However, the financial ratios of those companies for the year of participation in the awards were collected and compared with their performance in the year before participation and three years after that. Therefore, it was possible to evaluate the impact of the companies' operational practices on their financial performance up to three years after their participation in the MX Awards.

3.4. Data collection and analysis Methods

In the last two sections, the philosophy of this research and the main strategy for conducting this study was outlined. This section explains the methods of data collection and analysis in this study in more detail.

3.4.1 Data collection methods

A.1.9 Data collection for developing the proposed model of the study

To develop the proposed model of the study, two independent archival datasets were used. The companies' operational data was collected from the IMechE's archival data. The financial data of those companies was collected from two financial databases (i.e. FAME and Amadeus). In the following subsection, the methods of data collection for these two archival data are described. Then, the characteristics and scope of the dataset are explained. Finally, the suitability of the selected dataset for answering the research questions of the study is evaluated.

Source of the operational data

The Institute of Mechanical Engineers (IMechE) runs a business-improvement scheme – Manufacturing-Excellence (MX) Awards – that support and promote UK manufacturing companies. Currently the IMechE uses an online tool, whereby companies could receive immediate reports on their business performance (IMechE, 2014). They had a paper-based scheme until 2013 which used to run as follows: first, interested companies filled in a self-appraisal questionnaire in ten areas of performance listed in table 3-2 and sent them to the IMechE to apply for their chosen award (s) (Tsinopoulos & McDougall, 2011). Then, the IMechE's assessment board would review and score the received audits and rank companies based on their performance scores. For the shortlisted companies, a group of experts from the IMechE or WMG would visit the companies to confirm the scores in the last stage. This is to verify that companies' practices are matching with the companies' self-appraisals and to clarify any other questions. Finally, the winning companies in each category of the awards would be selected. Also, regardless of winning an award or not, the IMechE would sent a feedback report to all applicant companies to suggest the areas for improvement (Garside & Tsinopoulos, 2004).

Table 3-2 MX Awards categories and number of questions in each category

Categories (Areas of business performance)	Number of Questions in each category
1.Customer Focus	17
2.Product Innovation	17
3. Manufacturing Process Innovation	15
4. Logistics and Resource Efficiency	26
5.People Effectiveness	27
6. Business Development and Change Management	20
7. Integrated e-business	16
8. Financial Management	20
9. Sustainable Manufacturing	14
10. Partnerships between Business and Education	13
Total	**185**

One hundred and six audits from the 2006 to 2011 IMechE archives formed the basis of analysis in this study. The audits are from seventy-nine unique companies which applied for the awards during the six years. Four companies had applied in five years, three companies in four, thirteen companies in three and seven companies in two years. The purpose of this study was to find the impact of companies' operational performance on their financial results. Therefore, each of the companies' multiple participations in different years, are independently considered.

The author divided the data into two samples for statistical predictions and validation of the resulting estimates. Estimation sample consists of data from 2006 to 2010; Eighty-five companies (thirty SMEs and fifty-five large companies). The data from 2011 consists of twenty-one companies (nine SMEs and thirteen large companies) was withheld for validation.

Sources of the financial data

The main source of financial data was Financial Analysis Made Easy (FAME) which holds financial information for 8 million UK and Irish companies (FAME, 2014). Most of the companies' financial data was available from this source, but for a few missing records and for all Cash flow data, the author used the Amadeus database. Amadeus contains financial information for around 19 million European companies (Amadeus, 2014). Table 3-3 shows the selected financial ratios and their associated formulas. Appendix 3 presents a list of these ratios and clarifies their constituent elements.

Table 3-3 List of selected financial ratios and their formulas

Category	Ratio	Formula
Competitiveness	Turnover growth rate (%) ↑	(Present year turnover - Past year turnover/ Past year turnover) x 100
Corporate Profitability	Return on shareholders' funds (%) ↑	(Profit (Loss) before tax/ shareholders' funds) x 100
	Return on capital employed (%) ↑	(Profit (Loss) before tax/Total assets less current liability) x 100
	Return on total assets (%) ↑	(Profit (Loss) before tax/Total assets) x 100
	Margin on sales (Profit margin) (%) ↑	(Profit (Loss) before tax/Turnover) x 100
	Gross profit margin (%) ↑	(Gross profit/ Turnover) x 100
Asset management ratios	Net assets turnover (x) ↑	(Turnover/Total assets less current liability)
	Stock turnover (x) ↑	(Turnover/Stock & W.I.P.)
Corporate liquidity	Accounts receivable (days) ↓	(Trade debtors/Turnover) x 365
	Accounts payable (days) ↑	(Trade creditors/Turnover) x 365
	Current ratio (x) ↑	(Current assets/ Current liabilities)
	Liquidity ratio (x) ↑	(Current assets - Stock & W.I.P.)/ Current liabilities
Debt Management Ratios	Interest cover (Times-interest-earned) (x) ↑	(Profit (Loss) before interest/ Interest paid)
	Leverage (Gearing) (Debt-to-equity ratio) (%) ↓	((Short term loans & Overdrafts + Long term liabilities/ Shareholders' funds) x 100
Cash flow ratios	Cash flows to sales (%) ↑	(Cash flow/Turnover) x 100
	Cash Flow/Total debt (%) ↑	(Cash flow/Total debt) x 100
	Cash flow yield (%) ↑	(Cash flow/Profit (Loss) for period) x 100
	Cash flow (x) ↑	(Cash flow)
↑ :	The higher this ratio, the better for the business	
↓ :	The Lower this ratio, the better for the business	
% :	Percentage	
X :	Whole number	
days :	Number of days	

Both of the FAME and Amadeus databases are managed by the Bureau van Dijk (BvD) Company, which is a leading publisher of company information and business intelligence (BvD, 2015). BvD either directly collects financial reports from the companies or from the official organisations that are in charge of collecting this information (FAME, 2014). The author extracted financial ratios of companies from these two databases for five consequent financial years; year of application for the awards and one financial year before and three years after that. The differences between ratios in the consecutive years show if their financial performance has improved or worsened.

A.1.10 Scope of the study

Size of the selected companies

In this study, the European Commission's definition for companies' size classification is used. This is because the selected companies were either UK or Irish companies. Therefore, in this study, small and medium-sized companies (SMEs) are companies with less than 250 employees (EC, 2014). Thirty-eight of the companies in the entire sample were SMEs, and sixty-eight of them were large companies. Also there was only one small company (<50 employees), and no micro company (<10 employees) in the sample, so a further break-up was not useful. Table 3-4 shows the percentages of the selected companies based on their sizes in the estimation and hold-out samples.

Table 3-4 Size of the selected companies

Frequency of Companies						
Size	Estimation Sample		Hold-out Sample		Entire Sample	
	Count	Percentage	Count	Percentage	Count	Percentage
SMEs	30	35%	8	38%	38	36%
Large Companies	55	65%	13	62%	68	64%
Total	85	100%	21	100%	106	100%

Industry of the selected companies

The classification of the selected companies based on their industry was chosen for two reasons. First, it was to study the possible influence of the industries' features on the companies' performance. Second, it was to recommend the potential findings to similar companies. The Standard-Industrial-Classification code of each company was available in the two financial sources (FAME and Amadeus). The author used the SIC-Code-Support database to find descriptions of the industry sectors associated with each code (Siccodesupport, 2014). Figures 3-3 and 3-4 show the percentages of the industry-sectors in the selected sample based on their sizes. The sample represents thirty-one SMEs in ten industry-sectors and forty-eight large companies in twenty-one industry sectors. The sample has an uneven distribution of industry sectors. However, before drawing conclusions, the author has considered the potential influence of industry characteristics on the findings. Section 4.5 elaborates on this in more detail.

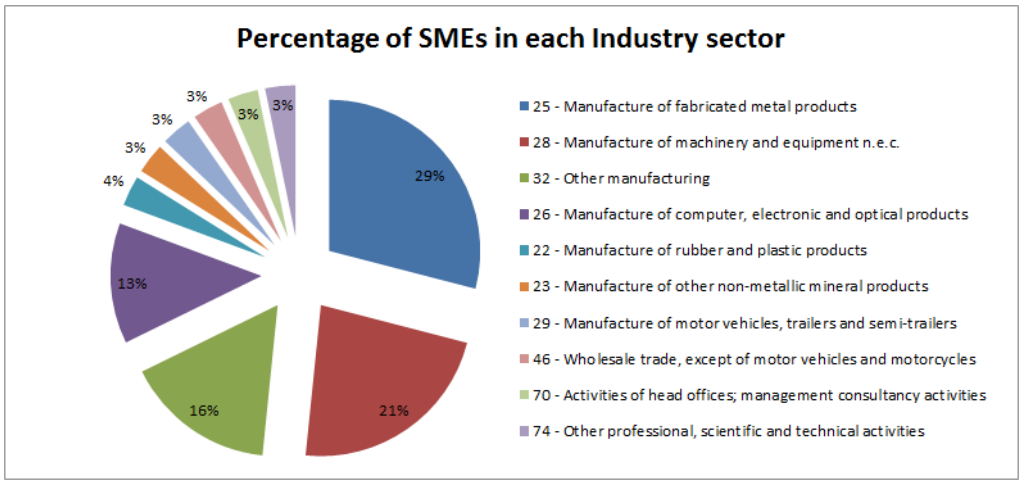


Figure 3-3 Percentage of the SMEs in each Industry section

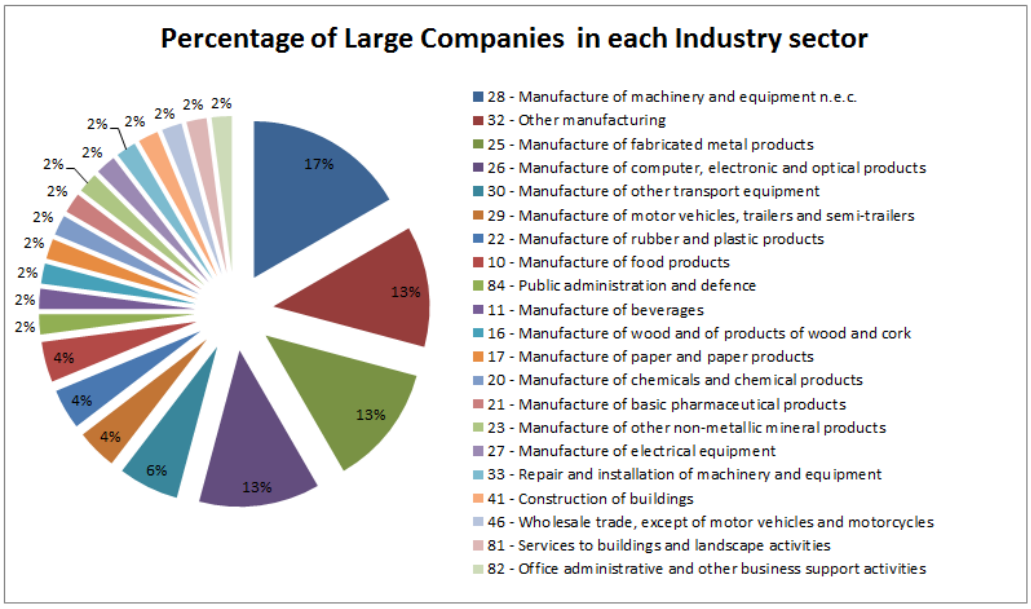


Figure 3-4 Percentage of the large companies in each Industry section

Geographical locations of the selected companies

The geographical location of the selected companies is necessary to recommend the study findings to similar companies. Two financial sources named earlier (section 3.3.2) contain postcodes for each of the selected companies. The author used the Office for National Statistics postcode directory (ONS, 2014) to convert companies' postcodes to their associated regions. Figure 3-5 displays geographical locations of the companies in the sample based on their sizes. The percentages of companies in regions vary, at least one company from each region exist in the sample. Therefore, the selected sample has a wide-ranging geographical coverage.

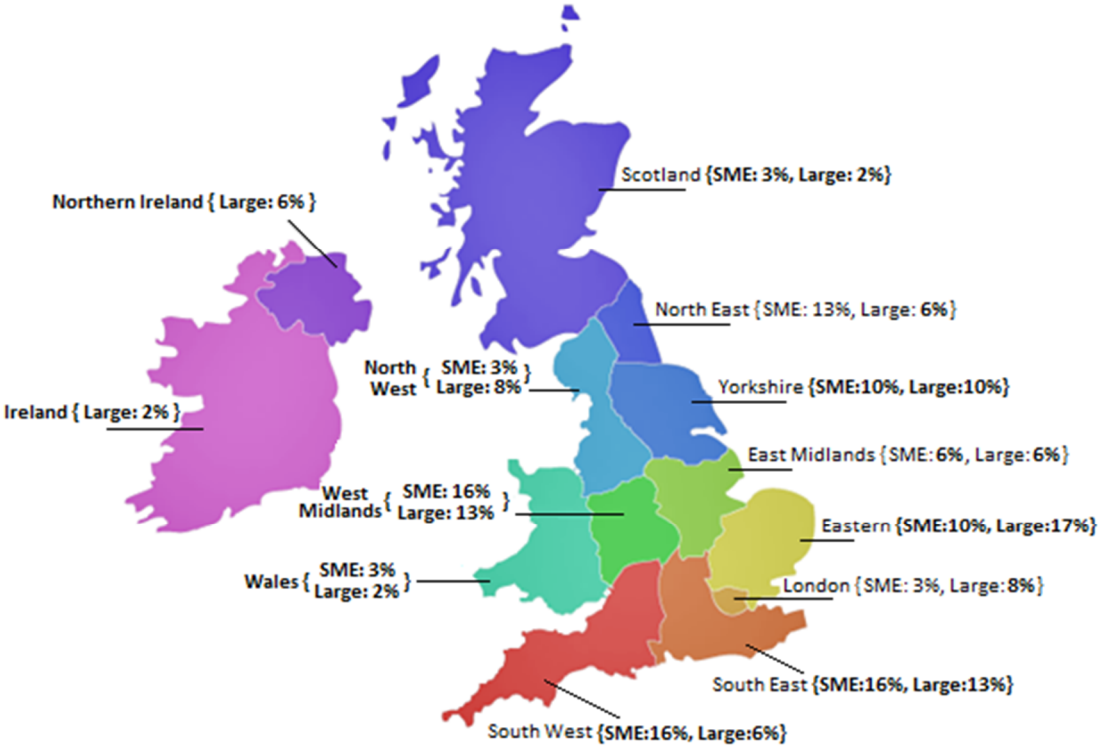


Figure 3-5 Percentage of the companies based on their regions

A.1.11 Evaluation of the datasets before analysis

Saunders et al. (2009) suggest the following three-step criteria to evaluate any archival data before analysis:

1- Overall suitability of the data source
2- Precise suitability of the data source
3- Cost and benefits of the data source in comparison to alternative sources.

In the following subsections, each of above steps will be explained and the suitability of the data sources of the study based on these criteria will be evaluated.

Overall suitability of the data source

Saunders, et al. (2009) argue that in the first stage the dataset needs to be evaluated to ensure that it provides the information that is needed to answer the research question. Also, the dataset needs to be evaluated to ensure it covers the population, time period and the variables that are needed to answer the research question (Saunders, et al., 2009).

This study is an Explanatory research aim to answer two research questions: first, to find what operational practices in the UK manufacturing companies influence improvement of their financial performance? The second question of the study is to find the differences between SMEs and large companies in the way their operational practices influence their financial performance.

The IMechE's archive contains information about UK manufacturing companies (SMEs and Large) in ten areas of their operational practices. The FAME and Amadeus databases contain information about the financial performance of those companies from one year before their application in the MX Awards and up to three years after their application. Therefore, the databases of the study cover the requisite population, time period and the variables in order to answer the research questions of the study and satisfy the overall suitability for this research.

Precise suitability of the data source

In the second stage, the validity and reliability of the data sources and the methods of data collection needs to be evaluated. According to Dochartaigh (2002), this refers to checking the reputation of the sources (Saunders, et al., 2009).

The operational data for this study are collected from the IMechE's MX Awards archival data. The IMechE is a reputable organisation in the UK that runs the Manufacturing Excellence Awards (MX Awards) to identify the UK's excellent manufacturing companies (McDougall, 2011). This awards scheme is comparable to other well-known manufacturing excellence in the world, such as the Deming Prize, Malcolm Baldrige National Quality Award (MBNQA) and the European Foundation for Quality Management (EFQM) (McDougall, 2011).

Similarly, the financial data for this study are collected from two well-known sources of financial data (FAME and Amadeus). The continuous existence of these organisations is dependent on the reliability of their data. Therefore, both sources of operational and financial data of this study are reliable for data collection.

Also according to Saunders, et al. (2009) the data needs to be checked for any measurement bias. The IMechE has made the following five major changes to their awards scheme since 2007:

- Combination of the two smaller categories 4 and 5 into a bigger category 4 (Logistics-and-Resource-Efficiency).
- Making category 10 (Equality) a subsection of category 5 (people-effectiveness).
- Adding a new category (Sustainable-Manufacturing) to the scheme from 2008.
- Combination of the two categories 2 and 3 into one category in 2011.
- Making category 7 (Integrated e-business) a subsection of category 5 in 2011.

The IMechE have also reformed, removed or included some questions in the categories during the six years. But to ensure consistency, the author only used similar questions for each category in the analysis. Appendix 2 presents a list of all questions selected for this study. Table 3-5 shows the changes to the MX Awards categories during the six years between 2006 and 2011.

Table 3-5 Changes to the MX Awards' categories between 2006 and 2010

Changes to the categories of the MX Awards scheme between 2006 and 2011					
2006	**2007**	**2008**	**2009**	**2010**	**2011**
1.Customer Focus	1.Customer Focus	1.Customer Focus	1.Customer Focus	1.Customer Focus	1.Customer Focus
2.Product Innovation	2.Product Innovation	2.Product Innovation	2.Product Innovation	2.Product Innovation	2. Innovation in Products and Processes
3.Process Innovation	3.Process Innovation	3. Process Innovation	3. Process Innovation	3. Process Innovation	
4.Logistics Efficiency 5.Resource Efficiency in Manufacturing	4.Logistics and Resource Efficiency	4. Logistics and Resource Efficiency	4. Logistics and Resource Efficiency	4. Logistics and Resource Efficiency	3. Logistics and Resource Efficiency
6.People Effectiveness	5.People Effectiveness	5.People Effectiveness	5.People Effectiveness	5.People Effectiveness	4.People Effectiveness
7.Business Development & Change Management	7.Business Development & Change Management	7.Business Development & Change Management	7.Business Development & Change Management	7.Business Development & Change Management	5. Business Development & change Management
8.Integrated e-business	7.Integrated e-business	7. Integrated e-business	7. Integrated e-business	7. Integrated e-business	
9.Financial Management	8. Financial Management	8. Financial Management	8. Financial Management	8. Financial Management	6. Financial Management
10.Equality	---	---	---	---	---
---	---	9. Sustainable Manufacturing	9. Sustainable Manufacturing	9. Sustainable Manufacturing	7. Sustainable Manufacturing
11.Partnerships between Business and Education	9. Partnerships between Business and Education	10. Partnerships between Business and Education	10. Partnerships between Business and Education	10. Partnerships between Business and Education	8. Partnerships between Business and Education

However, the financial data from the companies are collected based on constant formulas between 2006 and 2011. Appendix 3 shows the financial ratios used in this study.

Cost and benefits of the data source in comparison to alternative sources

The final stage of evaluating databases involves finding the financial and time expenses of getting the data and the expected benefits for answering the research question (Saunders, et al., 2009). As stated in the introduction chapter (section 1.3.1), because of the author's involvement in the MX Start project, he had access to the Manufacturing Excellence (MX) awards archival data of companies' operational practices. The financial data of the companies are collected from two public databases that are accessible for any researcher interested in companies' financial information. Therefore, there was no cost for data collection in this study.

Comparing with other methods of data collection, for example, if the data had been collected via a survey, it would have been more costly and time-consuming. Also, using a single respondent for collecting data about both operational practices and financial performance of companies can lead to finding false covariance between variables independent of their actual relationship (Podsakoff et al., 2003). Therefore, in this study by collecting data from two different sources which are independent of the companies that their data is used in the study, the chance of finding false covariance between variables independent of their actual relationship is reduced.

A.1.12 Data collection for validating the proposed model of the study

To validate the proposed model of the study, two approaches could be used: The first approach was to apply the proposed model of the study in a company to evaluate its usability and effectiveness. The advantage of this approach was that suggested relationships in the model would be tested in a real world situation. However, the disadvantage of this approach was that the proposed model could only be used in a particular company of a particular size in a particular market. Therefore, the proposed model would only be validated for a limited circumstance. Also, some of the operational practices in the proposed model are expected to impact the financial performance after two or three financial years. Therefore, it would be time-consuming to test the validity of the proposed model in a selected company.

The other potential approach to validating the proposed model would be to discuss the suggested relationships in the model with other researchers who have conducted similar studies, and business experts in the context of the UK manufacturing companies. The advantage of this approach was that relationships in the model could be reviewed by experts from different backgrounds and expertise. However, the disadvantage of this approach was that it cannot substitute validation in a real-life environment. Nevertheless, considering the time limits of the study, the second approach was selected to validate the proposed model of the study.

To verify the suggested relationships in the model, first some potential explanations for the identified relationships, based on the suggestions of the previous studies, were identified. For the findings of the study that contradict the findings of the earlier studies, the authors of the earlier studies were directly contacted (by email) to check their opinion about the findings of this study. Then, to collect other experts' opinions about the findings of the study, the following three potential methods could be used:

1- The Delphi method
2- Interviews
3- Focus groups.

The Delphi method

The Delphi method is a method of data collection in which a questionnaire is designed and sent to a large group of respondents. After receiving the respondents' responses, a new questionnaire based on the summary of the responses is prepared and sent back to the respondents. In this way, the respondents will have at least one opportunity to change their original responses, based on the group responses (Turoff & Linstone, 2002). This is a suitable data collection method when the purpose of a study is to find causal relationships between complex social phenomena (Turoff & Linstone, 2002). The key advantage of this method is that it can be conducted without bringing respondents together (Turoff & Linstone, 2002).

However, the potential respondents in this study were all academics and business consultants who already have busy schedules. So, it could be time-consuming for them to complete two questionnaires in at least two rounds of a Delphi study. As an alternative, it could be easier for them to share their opinions verbally via other methods, such as interviews or focus groups.

Interview

Interviews are often used in business and management research (Adams et al., 2007). They are a suitable method of data collection when the purpose of the study is to gain insight about social issues through understanding the experience of individuals whose lives reflect those issues (Seidman, 2006). One of the key advantages of this approach is that it allows detailed data collection about a specific subject. However, it is time-consuming and its sample size is normally small (Adams et al., 2007).

According to Seidman (2006), there are two criteria for deciding the size of a sample for interviews. The first criterion is sufficiency, which refers to the requisite number of representatives from the target population in the sample. The other criterion is saturation, which refers to increasing the number of participants to the point where the interviewer begins to hear repetitive information. Apart from the two criteria of sufficiency and saturation, other practical limitations, such as time and other resources, also play a role, especially in doctoral research (Seidman, 2006). Since the purpose of this study was to collect experts' opinions about the suitability of the findings of the study for the UK manufacturing companies, this method was deemed suitable. However, the usage of focus groups to follow experts' communication about the findings of the study was also considered.

Focus group

A focus group is an organised group-interview that is planned to collect opinions and knowledge of a selected group of participants about a particular topic (Bader & Rossi, 1998). The ideal number of participants in a focus group is between six to twelve participants (Bloor et al., 2001) with the following two core elements:

1- A trained moderator whose role is to present a set of prepared questions to set the stage.
2- An interview guide whose role is to help eliciting participants' opinion about the selected topic (Puchta & Potter, 2004).

One of the key advantages of using a focus group for data collection is in producing data in a non-judgemental and comfortable situation where participants can have the freedom to interact with each other (Bloor et al., 2001). However, this freedom may also lead the group discussion to veer off to unrelated topics. The moderator is then responsible for bringing back the discussion to the original topic (Puchta & Potter, 2004).

For data collection in this study, using both focus groups and interviews were deemed suitable, although these methods have advantages and disadvantages in comparison with each other. For example, the advantage of conducting an interview is that it allows for more detailed data collection than it is possible when using a focus group (Berg, 2001). This is because in a focus group individual participants might not find enough time to share their opinion. However, the advantage of the focus group is the ability to view the participants' communication about their experiences and opinions (Bader & Rossi, 1998). However, this is not possible in an interview setting.

Originally twelve potential participants were invited to take part in four focus group sessions on four potential dates in June and July 2016. Of the invited participants, eight individuals agree to take part in two different sessions. Another two individuals were not happy to take part on the originally selected dates; however, they agreed to participate in individual interviews. The other two invited potential participants did not reply to the invitations. Therefore, ten participants joined in this study: eight individuals took part in two focus groups (each consisting of four participants) and two individuals were separately interviewed. The University of Warwick's granted approval letter for conducting those focus groups and interviews is provided in appendix 6.

3.4.2 Data analysis methods

In the previous section, the methods of data collection for the data sources of the study were explained. Also, the suitability of the selected data sources for answering the research questions of the study was evaluated. In this section, the potential methods that could be used to analyse the dataset of the study will be described. First, the measurement levels of the variables in the dataset will be explained. Then, based on the measurement levels of the variables, the most suitable data analysis methods from the existing potential methods were selected.

A.1.13 Measurement-levels of the variables in the dataset

To select the suitable statistical analysis methods, the purpose of analysis and the measurement levels of the variables in the dataset under investigation should be considered (Yang, 2010). In general, there are three measurement levels in order of increasing sophistication, as follows:

1. Nominal or Categorical level: the lowest measurement level which defines mutually exclusive categories in a dataset, such as Gender, Postcode.

2. Ordinal or Rank level: as well as defining categories in a dataset, this measurement also ranks them in order, such as customers' opinions on a three-point scale from Unsatisfied to Satisfied.

3. Interval or ratio level: the highest measurement level in which there are equal units of distance between categories in a dataset, such as age, weight (Healey, 2010) (Sheskin, 2004).

In the following subsections, the measurement levels of the operational and financial variables of the study are explained.

Measurement-level of operational variables

Companies' operational performance data was provided in percentage format. IMechE has an assessment guideline for its assessors to evaluate the applicant companies by the same standard. The assessment guideline recommends some ranges for each question to help assessors to give scores in the correct ranges. Then they need to use their own judgement to rank companies within those ranges. Table 3-6 shows an example from this guideline for question 1.1.2.

Table 3-6 Transformation of the scores into relative categories

Questions	Scores	Total Mark	Percentage	Description	Categories
Q 1.1.2 Identifying future customer requirements	0-7	20	0% - 35%	Just talks to customers occasionally.	1
	7-10	20	36% - 50%	Regular dialogue with customers and potential customers to gain feedback on future needs	2
	10-17	20	51% - 85%	A well-structured process with several appropriate techniques.	3
	17-20	20	86% - 100%	Comprehensive process probably quoting at least one example of actions taken as a result of the process.	4

As shown in table 3-6, for example, for question 1.1.2, if companies only occasionally talk to their customers to identify their future need, then their scores should be between 0 and 35%. This score should increase gradually as companies use more sophisticated approaches in identifying their future customer needs. Therefore, the assessors had to use their own judgement to give suitable scores to companies within the given ranges. To reduce the impact of the assessors' judgement, the author used those recommended ranges in the IMechE's assessment guideline to transform companies' scores for each question into four sequential categories; from 1: poorest to 4: best performing companies. Therefore, operational performance data in this study is in ordinal measurement level.

Measurement-level of financial variables

The author used a year-to-year analysis to study companies' financial performance between two financial periods. Horngren, et al. (2012) suggest using Horizontal analysis, which is the study of changes in a variable in two similar periods. This involves finding the difference in a ratio's value between two periods and dividing it by the base year value, which is the first year (Horngren, et al., 2012). However, in some occasions, the financial performance of companies is a negative number and calculating the percentage difference between a positive and a negative number is meaningless. Also when the value for a base year is not available, then percentage difference is not computable (Gibson, 2011). So, instead of percentage difference, the author used a simple difference between the ratios in two periods. Companies' financial ratios were in three different formats: Percentage, Whole numbers and Number of days. Table 3-7 shows ratios of a sample company in four consequent financial years in interval measurement level.

Table 3-7 Ratios of a sample company

Ratios values of a sample company						
Category	**Ratio**	**2005**	**2006**	**2007**	**2008**	**2009**
Competitiveness	Turnover growth rate (%) ↑	0%	5%	10%	7%	-4%
Profitability	Return on shareholders' funds (%) ↑	29%	21%	25%	5%	28%
	Return on capital employed (%) ↑	11%	9%	8%	2%	11%
	Return on total assets (%) ↑	7%	7%	5%	1%	9%
	Margin on sales (Profit margin) (%) ↑	7%	6%	5%	1%	6%
	Gross profit margin (%) ↑	---	---	---	---	---
Asset management	Net assets turnover (x) ↑	1.47	1.43	1.56	1.82	1.72
	Stock turnover (x) ↑	3.19	3.41	3.52	3.51	3.69
liquidity	Accounts receivable (days) ↓	35.51	32.61	34.61	34.30	30.30
	Accounts payable (days) ↑	28.39	21.87	29.14	22.61	20.41
	Current ratio (x) ↑	2.25	2.98	2.47	2.27	3.09
	Liquidity ratio (x) ↑	1.28	1.73	1.42	1.03	1.34
Debt Management	Interest cover (Times-interest-earned) (x) ↑	6.84	6.28	4.30	1.37	5.66
	Leverage (Gearing) (Debt-to-equity ratio) (%) ↓	255%	194%	305%	245%	182%
Cash flow	Cash flows to sales (%) ↑	12%	10%	9%	7%	12%
	Cash Flow/Total debt (%) ↑	8%	8%	6%	6%	11%
	Cash flow yield (%) ↑	212%	229%	224%	785%	207%
	Cash flow (x) ↑	3,031	2,741	2,790	2,095	3,536
↑ :	The higher this ratio, the better for the business					
↓ :	The Lower this ratio, the better for the business					
% :	Percentage					
X :	Whole number					
days :	Number of days					

However, the purpose of the study is to find the operational practices of the companies that have a positive impact on their financial performance. Therefore, similar to the earlier studies that were reviewed in the last chapter (section 2.3), only improvement or deterioration of the financial performance was important (instead of the scale of improvement). Therefore, the author converted the financial performance of the companies to a categorical level with only two possible outcomes. If there was an improvement in ratios compared to the year of participation in the awards, the outcome would be '1' and if the ratio had worsened, the outcome would be '0'. For example, for the sample company in table 3-7, table 3-8 shows the converted ratios into the categorical level. For this company, the year of participation is 2006 and therefore all the ratios of that company in the following years are compared with the performance of the company in 2006. Therefore, the operational variables of the study were in ordinal level and the financial variables were in categorical level.

Table 3-8 Coded ratios for a sample company

Ratios values of a sample company					
Category	**Ratio**	**2006**	**2007**	**2008**	**2009**
Competitiveness	Turnover growth rate (%) ↑	1	1	1	0
Profitability	Return on shareholders' funds (%) ↑	0	1	0	1
	Return on capital employed (%) ↑	0	0	0	1
	Return on total assets (%) ↑	0	0	0	1
	Margin on sales (Profit margin) (%) ↑	0	0	0	1
	Gross profit margin (%) ↑	---	---	---	---
Asset management	Net assets turnover (x) ↑	0	1	1	1
	Stock turnover (x) ↑	1	1	1	1
liquidity	Accounts receivable (days) ↓	1	0	0	1
	Accounts payable (days) ↑	0	1	1	0
	Current ratio (x) ↑	1	0	0	1
	Liquidity ratio (x) ↑	1	0	0	0
Debt Management	Interest cover (Times-interest-earned) (x) ↑	0	0	0	0
	Leverage (Gearing) (Debt-to-equity ratio) (%) ↓	1	0	0	1
Cash flow	Cash flows to sales (%) ↑	0	0	0	1
	Cash Flow/Total debt (%) ↑	0	0	0	1
	Cash flow yield (%) ↑	1	0	1	0
	Cash flow (x) ↑	0	1	0	1

↑ :The higher this ratio, the better for the business

↓ **:**The Lower this ratio, the better for the business

% : Percentage

X : Whole number

days : Number of days

A.1.14 The potential data analysis methods

The potential statistical methods that have been considered for use in this study will now be discussed. Correlation and regression analyses are the two most commonly suggested statistical methods for analysing the relationship between two or more variables. For example, Field (2005), Kirk (2008) and Urdan (2010) have all suggested these two methods for analysing the relationship between variables. Also, as stated in the previous chapter (section 2.3.2.4), these two methods were the most common statistical methods that have been used in the earlier studies which have been reviewed in this study. Therefore, these two methods were selected to be used in this study and in the following subsections the potential approaches for finding the correlation and regression between the variables of this study are explained. Using similar data analysis methods in this study can help compare the findings of this study with that of the earlier studies. This is because by using similar methods the impact that the potential difference in the analysis methods can have on identified relationships will be reduced.

Correlation analysis can be used to explain the degree which two variables are related to each other (Field, 2005) or, as argued by Urdan (2010), it explains the strength of the relationship between two variables. For example, in this study, correlation analysis can be used to explain whether companies with an improved financial performance were also strong in their operational practices. After finding correlated pairs of variables, the regression analysis can be used to find dependence of an outcome variable on one or more predictor variables (Field, 2005). Therefore, regression analysis can explain the nature of the relationship between the variables (Urdan, 2010). In this study, regression analysis can be used to show dependence of the companies' financial performance on their operational practices. The potential approaches of correlation and regression analysis that can be used in this study will be discussed.

In addition, when there is large number of variables in a study, one common method to reduce the number of variables is factor analysis (Urdan, 2010). In this study, there are ninety operational predictor variables (appendix 2) and eighteen financial outcome variables (appendix 3). The purpose of the study is to find the impact of the individual operational variables on individual financial variables. However, factor analysis is also considered in order to find aggregated factors of operational practices, so many operational practices could be simultaneously analysed.

Therefore, the potential approaches for conducting factor analysis are discussed first. This is followed by a discussion of the potential approaches for performing correlation and regression analyses.

Factor Analysis (Principle Component Analysis)

There are two main approaches to factor analysis, namely the Principal Component Analysis (PCA) and the Common Factor Analysis (Malhotra & Birks, 2006). The purpose of the PCA is to keep as much as possible of the variation in a dataset (Jolliffe, 2002). The purpose of the Common Factor Analysis is to find the common variances in a dataset (Malhotra & Birks, 2006). Therefore, when the purpose of the analysis is to find the minimum number of factors that explain the maximum variance in the dataset, the PCA is recommended. Otherwise, when the purpose of the analysis is to find the underlying dimensions in a dataset, then the Common Factor Analysis is suggested (Malhotra & Birks, 2006).

In this study, before starting the analysis, the dimensions of the variables are known (i.e. the group of operational questions from the MX Awards to test each of the twenty hypotheses of the study). Therefore, the PCA is suitable in reducing the dataset to the least number of variables. However, there are two approaches for performing the PCA:

1- Exploratory Factor Analysis (EFA) and
2- Confirmatory Factor Analysis (CFA) (Thompson, 2004).

Both approaches can be employed to find the latent factors that explain the variation or co-variation among a set of variables. Similarly, both of these approaches rely on the same statistical estimation method such as maximum likelihood (Brown, 2006). However, in the EFA, before start the analysis the researchers are not expected to specify the numbers and the dimensions of factors which are needed to be extracted from the dataset (Thompson, 2004). Conversely, to perform the CFA, the researchers are expected to specify those expectations (Brown, 2006). Therefore, the CFA needs a strong theoretical background, which is often gained from past studies or from an EFA procedure in the earlier stages of research (Brown, 2006).

In this study, the operational practices are classified under twenty hypotheses and it is only expected to confirm if the questions under each hypothesis have similar co-variations. Therefore the CFA is a suitable approach for this study.

In addition, the standard format of the PCA is only suitable for variables, which are measured at interval or ratio measurement levels, and it is not suitable for categorical variables (Linting et al., 2007). For categorical variables, the Categorical Principal Component Analysis (CATPCA) has been developed which uses optimal scaling process to transform the category labels of the variables into numerical values, while keeping the maximum variation among them (Linting & Van der Kooij, 2012). Since the predictor variables in this study are categorical, the CATPCA was selected for data reduction in this study.

The purpose of PCA is to find a subset of variables that measure different facets of the same underlying dimension (Field, 2005). Most of the reviewed studies in chapter two (section 2.3.2.4) have used the PCA. This is mainly to reduce the number of their studied variables into smaller sets of variables that represent most of the information in the original variables. An example of using the PCA for data reduction can be found in studies by Saunila et al. (2014) and Hofer et al. (2012). In addition, some studies have used PCA to compare the combined impact of their variables with the impact of the individual variables. For example, Fullerton et al.'s (2003) study found that the aggregated indicator of their studied quality measures had no significant relationship with the firms' profitability. However, some of the individual measures in that study, such as waste-reduction practices, had a positive influence on their profitability.

In this study, PCA was seen to reduce the number of Explanatory variables (operational practices), so many operational practices could be simultaneously analysed. However, as explained in the next chapter (section 4.2.2.3), there were two problems with the result of this analysis. Therefore, the result of the analysis was not used in the correlation and regression analyses.

Correlation Analysis methods

As explained by Urdan (2010), Correlation Analysis can be used to find the strength of the relationship between two variables. Table 3-9 shows the potential correlation analysis methods suggested by Brown (2014) and Bryman & Cramer (2001) based on the variables' measurement levels.

Table 3-9 Choice of correlation analysis methods based on data measurement levels

Combination of variables		Potential correlation analysis methods	
Variable 1	**Variable 2**	**Statistical significance**	**Strength of association**
Interval	Interval	Pearson product-moment correlation (Linear) or Spearman correlation (Non-linear)	Coefficient of determination r2
Ordinal	Interval	Spearman correlation	Kendall's tau-b or Kendall's tau-c
Ordinal	Ordinal	Spearman correlation	Kendall's tau-b or Kendall's tau-c
Nominal	Interval	Analysis of variances	Cramer's V or Phi test
Nominal	Ordinal	Chi-square test for independence/ Fisher's exact test	Cramer's V or Phi test
Nominal	Nominal	Chi-square test for independence/ Fisher's exact test	Cramer's V or Phi test

In the following subsections, the suitability of each of the potential Correlation Analysis methods for the dataset of this study will be explained.

Pearson product-moment correlation:

The Pearson correlation is the most commonly used method of analysing correlation. It measures the strength and direction of relationship between variables (Gravetter & Wallnau, 2013). For applying this method on a dataset, it should meet the following four basic assumptions:

1. Both independent and dependent variables should have continuous values measured on an interval scale.
2. The dataset should represent a random sample of interest population.
3. The relationship between the response item and predictor items should be linear.
4. The dataset should follow a normal distribution (Lehman, et al., 2005).

The predictor variables of this study (Operational questions from MX survey) are ordinal; therefore it fails to meet the first assumption of this method. Thus this correlation analysis method is not suitable for the selected sample.

Spearman correlation:

The Spearman correlation is a special form of the Pearson correlation, suitable for variables at ordinal measurement levels (Urdan, 2010). When a dataset violates assumptions of Pearson correlation, such as a lack of normally spread data, this method is a suitable choice (Field, 2005). Based on these two assumptions, this method is suitable for correlation analysis in this study. However, using this method entails uniformity of the dataset too. Uniformity refers to the simultaneous increase or decrease of the two variables under analysis (Kirk, 2008).

In this study's dataset, improvement in operational performance variables did not always match with improvement in financial variables. Therefore, the dataset failed to meet the Spearman correlation's assumptions. The selected dataset failed to meet the assumptions of both the Pearson and the Spearman correlation analysis methods.

Chi-square test for independence and Fisher's exact test:

Howell (2010) suggests using the Chi-square test for analysing the correlation between ordinal and nominal variables; as in this study. It compares the number of collected cases in each category with the number of expected cases in each category and states if the collected cases are significantly different from expected numbers (Howell, 2010). There are two assumptions for using this method. First, collected records should have no influence on one another (Urdan, 2005); data in this study meet this assumption. Second, using Chi-square is not suitable for samples with fewer than five expected numbers in their categories. For these samples, Fisher's exact test is more suitable (Urdan, 2005). For some variables of the dataset, the expected number was fewer than five; therefore the author used Fisher's exact test instead.

Chi-square and Fisher's exact only test the statistical significance of a relationship and do not measure the strength of it. Cramer's V and Phi tests are two common methods for measuring the strength of the relationship between nominal variables (Morgan, et al., 2004). Morgan et al. (2004) suggest using Phi test for two variables when each has only two categories and Cramer's V for more than two categories. Since operational performance data has more than two categories, therefore Cramer's V was suitable for this study.

Regression Analysis methods

Based on the measurement levels of the variables, either linear or logistic regression analysis methods can be used. Linear regression analysis is for the interval measurement level. Binomial-Logistic-regression is suitable for predicting dichotomous response data-items based on one or more independent predictor items (Kleinbaum & Klein, 2010). Response items in this study, which are financial ratios, are divided into two distinct categories (Improved and Worsened); therefore Logistic-regression fit the dataset. Based on number of predictor items, regression analysis is either simple or multiple types. The multiple regression analysis is for predicting the response items based on more than one predictor. The simple regression analysis is for predicting the response variable, based on only one independent predictor (Marczyk, et al., 2005).

Linear-regression assumes a linear link between dependence and independence items. But there is no such assumption in Logistic-regression (Allison, 1999). Linear-regression predicts the variations of a dependent item for every unit change in the independent items. But logistic-regression estimates the likelihood of happening or not happening of an event in the response item (Allison, 1999). As with the Chi-Square test in the previous subsection, Logistic-regression assumes application on large sample size. Exact-logistic-regression is a variation of Fisher's exact test in regression analysis for small samples (Hosmer & Lemeshow, 2000). Therefore, the author used Exact-logistic-regression for regression analysis of this study.

Overall, in this section, the potential research methods for conducting the statistical analysis of this study are discussed. First the Categorical Principal Component Analysis (CATPCA) is selected to find the aggregated factors of operational practices. This is because the individual operational practices might not have a direct impact on the companies' financial results and need to be combined with other operational practices. Therefore, by using the CATPCA, the author tried to increase the chance of finding the impact of the companies' operational practices on their financial results.

Following the CATPCA, the Fisher's exact test was selected to find the correlated pairs of operational practices and financial results. Finally, for each of the identified correlated pairs of operational and financial variables, the exact logistic regression was selected to find dependence of the companies' financial results on their operational variables.

3.5. Credibility of research findings and generalisability

In the previous section, some of the potential research methods and the selected methods for this study are explained. This section discusses the credibility and generalisability of the findings of the study. The credibility of a research finding depends on the validity and reliability of the selected methods of data collection and analysis in a study (Saunders et al., 2009). Generalisability or external validity refers to the whether the findings of a research are applicable to other research settings (Saunders et al., 2009).

3.5.1 Validity

Testing the validity of research findings includes assessing "whether the findings are about what it appears to be about" (Saunders et al., 2009). Therefore, it was necessary to verify that selected variables of this study are suitable in answering the research question of the study.

The research question of this study is to find what operational practices in the UK manufacturing companies have a positive impact on their financial performance. In chapter two (section 2.3.3), forty studies that have examined a similar research question (i.e. the impact of the companies' operational practices on their financial results) in other countries were reviewed. Based on the selected variables of the earlier studies, twenty hypotheses were developed to address the research question of this study. Therefore, to show the validity of the findings of this research, only the questions from the IMechE's MX survey that were matching with the selected variables of the earlier studies were selected.

For each group of practices (i.e. twenty hypotheses), at least one similar question from the IMechE's MX survey is identified that measure the same variable that was used in the earlier studies. For example, as shown in table 3-10, for testing the hypothesis 1, four questions from the MX survey were identified that are measuring similar practices as the variables in the earlier studies.

Table 3-10 Similarities between the identified practices in the literature and the MX Survey questions

H1: Practices related to customer satisfaction have a direct positive impact on companies' competitiveness or profitability.			
#	**Questions from MX Awards Survey**	**Identified practices from the literature**	**Author(s)/Date**
1	1.3.1 How do you measure customer satisfaction and what are the results?	• Increase customer satisfaction	Fotopoulos & Psomas (2010)
2	1.3.2 What actions have you taken to improve customer satisfaction?		
3	1.1.4 How do you believe your products and/or services add value to your customers?	• Value for the money spent	Sila (2007)
4	6.1.4 What are the significant drivers for change in your business? (Retain key customers, Win new customers, Expand into new markets)	• Customer Retention Rate	Han et al. (2007)

Of the 185 questions of the MX survey, ninety questions were selected that are matching with the practices in the twenty hypotheses of the study. The selected questions (i.e. the operational variables) of the study are presented in appendix 2. The selected questions from the MX survey are consistent with the selected variables of the earlier studies and therefore are valid measures to evaluate companies' operational practices.

Also based on reviewing fifteen financial analysis approaches in chapter two (section 2.2.1.2), twenty-five commonly recommended ratios in five categories of financial performance are identified. Seventeen of those recommended ratios were available in the financial sources of the study (FAME and Amadeus). In addition, for measuring competitiveness, companies' sales growth is selected which is aligned with the recommendations of some of the reviewed frameworks such as the Result & Determinants framework (Fitzgerald et al. (1991). The selected financial ratios (i.e. the financial variables) of the study are presented in appendix 3. The selected financial variables of the study are also consistent with the variables of the earlier studies and are valid measures to evaluate companies' financial result.

Overall, since the variables of the study are consistent with the earlier studies that were examining similar questions; it can be argued that selected variables of this study are suitable in answering the research question of the study.

3.5.2 Reliability

Testing the reliability of a research finding refers to evaluating the extent to which the selected research methods of a study yield consistent results (Saunders et al., 2009). Robson (2002) states that there were four potential threats to research reliability. Two of these threats are concerned with the research participants (1- participants' errors and 2- participants' bias) and two about the observer (1- observers' error and 2- observers' bias) (Robson, 2002).

As explained in section (3.4.1.1) of this chapter, the data about the operational practices of the companies in this study is collected from the IMechE's MX Awards archive. The companies enter this awards scheme in order to be recognised for their manufacturing excellence. Therefore, it is less likely that they provided inaccurate information about their manufacturing practices. In addition as a part of the process to select the best manufacturing companies, the IMechE's assessors had also visited the companies to verify their manufacturing practices. Therefore, there has been a high level of accuracy in collecting the data about the companies' operational practices. In addition, the financial data of the companies is collected from two financial databases (FAME and Amadeus). These databases either directly collects financial reports from the companies or from the official organisations that are in charge of collecting this information (FAME, 2014). The author would have had to use the same method to collect this data.

An alternative method for collecting these data would be to use a survey to collect companies' data about their operational practices and financial results. However, there are three potential problems associated with this method that could reduce the reliability of the collected data:

1- First, as suggested in the study by Dubey & Gunasekaran (2015), there would be a need to split the survey into two parts and ask suitable individuals in the firms to complete their related parts, to ensure the data they provided is accurate. However, it would be difficult to verify if suitable individuals in the companies have completed the survey or not.

2- Second, it would be difficult to verify if the responses provided by the companies are matching with their actual performance. The data in the IMechE's archive is verified against the companies' actual practices, by the IMechE's qualified assessors. It was not possible for the author to verify the companies' responses based on his own knowledge.

3- As suggested by many of the earlier studies, such as Wang et al. (2014), one of the limitations of using survey for data collection is that data would be subjective and based on self-reported managerial opinion. However, the data in the IMechE's archive is reviewed and scored based on the IMechE's assessment guidelines. So although the IMechE's archive is also a perceptual data; this data is based on a common assessment guideline and therefore is consistent for all companies. If the data was collected by a survey, each manager might have their own judgement about their performance which might not be similar to that of the other managers. Therefore, it would be difficult to compare their responses.

Therefore, the possibility of having participants' error and participants' bias would have been higher if the data were collected by a survey in this study. In addition, the IMechE and the two financial databases (FAME and Amadeus) have no bias towards the companies that their data is used in this study. Consequently, the possibility of having observers' bias and observer error is also low in this study.

3.5.3 Generalisability

Generalisability of research findings refers to the extent to which the findings are applicable to other research settings (Saunders et al., 2009). The sample of this study consists of seventy-nine UK manufacturing companies. According to the latest UK business population estimate in October 2015, there are 275,565 manufacturing companies in the UK. Therefore, the sample of the study represents small part of the entire UK manufacturing sector. Also, the external validity of the findings of the study is further reduced by its sampling method. Generally, there are two types of sampling designs:

1- Probability sampling design in which all members of a population have an equal chance of being selected as a subject, such as simple random sampling.
2- Non-probability sampling in which the members of a population do not have equal chance of being selected as a subject, such as convenience sampling and purposive sampling (Sekaran, 2003).

In this study 'Judgement sampling' is used, which is a purposive sampling and is under the category of non-probability sampling design. In judgement sampling, the subjects are selected because they are in the best position to provide the necessary information for a study (Sekaran, 2003). Although the findings based on this sampling are less generalisable than the methods in probability sampling design; they are sometimes the best sampling choice to be used (Sekaran, 2003). In this study, because of the reasons provided in the previous section (3.5.2), using other methods to collect data for the study would be less dependable. Therefore, using the data from the companies in the IMechE's archival data was the best choice.

Overall, though restricted in generalisability, the dataset of this study is still larger than many of the earlier similar studies in other countries. For example, Valmohammadi (2011) use fifty-three Iranian companies to explore the impact of their total quality management (TQM) on their financial performance. Similarly, Abusa & Gibson (2013) use fifty-six Libyan manufacturers to examine the impact of TQM on their financial performance.

Another study with a small sample size is Kumar et al. (2009) which uses fourteen Canadian manufacturing companies to examine the impact of TQM on their financial performance. Kumar et al. (2009) state that result of their study is not generalisable to all Canadian companies. However, it shows what financial benefits can be achieved by successful implementation of TQM programme by Canadian companies (Kumar et al., 2009). Similarly, the findings of this study cannot be generalised to all UK manufacturing companies; however it shows the financial benefits that can be achieved by strong performance in specific operational practices.

3.6. Conclusion

This chapter discusses the research design for conducting this research, based on Saunders et al.'s (2009) recommended research onion. First, in section 3.2, the research philosophy and approach for conducting this research was explained. There are three ways of thinking about research philosophy including: 1-Ontology, 2-Epistemology and 3-Axiology and there are four main research philosophies in business and management research including: 1-Positivism, 2-Realism, 3-Interpretivism and 4-Pragmatism (Saunders et al., 2009). Based on the characteristics of this research, the ontological position of this research is closer to subjectivism and therefore closer to the interpretivism research philosophy. The epistemological position of the study is aligned with pragmatism and the axiological position of this research is closer to the positivism philosophy.

There are two main approaches to performing a research, including: deductive and inductive approaches. This study starts with developing a conceptual model based on the findings of earlier studies and testing the model based on the data from UK manufacturing companies. Therefore, this approach is aligned with testing theory and deductive research.

Based on the purpose of the study, section 3.3 discussed the selected research strategy, choice of data collection and analysis and the time horizon of the study. The purpose of this study is to find the relationship between the operational practices and financial performance of UK manufacturing companies. Explanatory study is useful to studying a situation to explain the relationship between variables (Saunders et al., 2009). Therefore, this study is an Explanatory research and the research question of the study is: What operational practices in UK manufacturing companies can improve their financial performance? After analysing seven potential research strategies and based on the purpose and research question of the study, archival research strategy was considered a suitable strategy for this study.

The data about companies' operational practices is in numerical format and is collected from the IMechE's archival data. The financial data are also in numerical format and collected from two financial databases (i.e. Fame and Amadeus). Using statistical analysis methods, the relationships between these variables are identified. To explain the identified relationships between the variables, the findings of the study were discussed with ten academics or business consultants in two focus groups and two interviews.

Using qualitative data to explain the relationships between quantitative variables is one reason for using a mixed-method in a study (Saunders et al., 2009). The data from the focus groups and interviews are also analysed qualitatively. Therefore, a mixed-method research is applied in this study. In addition this study is longitudinal study in which the impact of the companies' operational practices on their financial performance is analysed up to three years after their participation in the MX Awards.

Section 3.4 discusses the methods of data collection and analysis in this study. The main sources of data collection in this study are two independent archival datasets. The companies' operational information is collected from the IMechE's archival data. The IMechE uses a sophisticated procedure to collect this data. First, interested companies send their self-appraisal questionnaire in ten areas of performance to the IMechE to apply for their chosen award (s) (Tsinopoulos & McDougall, 2011). Then the companies' audits are reviewed and scored by the IMechE's assessment board and the companies are ranked based on their performance scores. Then, a group of experts from the IMechE or WMG visit the shortlisted companies to

confirm that companies' practices are matching with the companies' self-appraisals and to clarify any other questions. Finally, winner companies in each category of the awards are selected. Also, regardless of winning an award or not, the IMechE sends a feedback report to all applicant companies to suggest the areas of improvement (Garside & Tsinopoulos, 2004). The financial data of those companies are collected from two financial databases (i.e. FAME and Amadeus). The data for these databases are either directly collected from the financial reports of the companies or from the official organisations that are in charge of collecting this information (FAME, 2014).

Correlation and regression analyses are the two most commonly recommended statistical methods for analysing the relationship between two or more variables. These two methods were also the most common statistical methods used in the previous studies that analysed the relationship between companies' operational practices and their financial performance. Therefore, these two methods are selected to be used in this study.

The study began by conducting a correlation analysis, which tests the interdependence of the variables. It was used to find the correlated pairs of the companies' operational and financial variables. There were three alternatives available for performing correlation analysis. However, the dataset of the study failed to meet the assumptions of the Pearson and Spearman correlation methods. Pearson correlation assumes that all variables should be measured at a continuous level, but in this study the operational measures were in an ordinal level. Also, Spearman correlation assumes uniformity of the dataset, an assumption that this study failed to meet. Uniformity refers to the simultaneous increase or decrease of the two data items under analysis. However, the dataset of the study meets the assumption of the Chi-square test for independence, and therefore a special form this method (Fisher's exact test), which is suitable for smaller datasets, was used for finding correlations in this study.

Then, for each of the identified correlated pairs in the previous step, regression analysis was used to find dependence of the financial variables on their associated operational variables. Here two methods were also available: 1- Linear regression, which is suitable for continuous measurement level, and 2- Logistic regression, which is suitable for predicting binary data items. Since the financial variable of the study were binary and could only have into two distinct categories (Improved and deteriorated), Logistic-regression fit the dataset. As with correlation analysis, a special form of Logistic-regression – Exact-logistic-regression – was used in this study.

Finally, in section 3.5 of this chapter, the credibility and generalisability of the findings of the study was discussed. The credibility of the study was tested by evaluating the validity of the selected variables of the study to be consistent with the purpose of the study. The validity of the operational variables was tested by finding similarities between the question from the IMechE's MX survey and the operational variables that have been considered in the earlier studies.

Since the operational variables of the study (question from the IMechE's MX survey) are similar to the operational variables of the earlier studies, they are valid measures to evaluate companies' operational practices. Also, the selected financial ratios from the databases of the study are aligned with the recommendations of some of the reviewed frameworks in chapter two. Therefore, the financial variables of the study are also valid measures to evaluate companies' financial result.

The reliability of research findings was also examined by considering Robson's (2002) four potential threats to research reliability including: 1- participants' errors, 2- participants' bias, 3- observers' error and 2- observers' bias. The main sources of data in this study were archival. The data about companies' operational data were collected from the IMechE's archival data and the financial data were collected from two financial databases (i.e. Fame and Amadeus). Considering other options for data collection (e.g. a survey), the possibility of having participant bias and participant error would have been higher. Also, the selected databases have no bias towards the companies whose data is used in this study; therefore, the possibility of having observer's bias and observer error is also low in this study.

With regard to the generalisability of research findings, since the sample of the study represents a small portion of the entire UK manufacturing companies, the findings of this study are not applicable to all UK manufacturing companies. However, the findings of the study can show what financial benefits can be achieved by companies with strong performance in specific operational practices.

The next chapter explains the results of statistical analysis on the UK manufacturing companies' data to support or not support the developed hypotheses outlined in chapter two.

4. Data analysis and findings

4.1. Introduction

In the previous chapter, some of the potentially suitable methods for performing correlation and regression analyses on the dataset of this study were compared. The purpose of this chapter is to apply those methods and to compare the findings of the study with the developed hypotheses in chapter 2. Based on the comparison of the potential analysis methods in chapter 3 (section 3.4.2), the following two statistical techniques were selected to be performed on the sample of this study:

1- The Fisher's exact test to find the potential correlation(s) between the companies' operational measures and their financial ratios
2- The exact logistic regression analysis to find the coefficients of the operational practices to predict improvement in financial results.

This chapter starts by discussing the two potential approaches to conducting the selected techniques on the dataset of the study and provides justification for the selected approach in section 4.2. Then, in section 4.3, the results of the correlation analysis over four years after participation in the IMechE's MX Awards are explained. Section 4.4 explains the results of the regression analysis on each of the identified correlated pairs in section 4.3. Section 4.5 examines the impact of two potentially influential factors on the findings of the study in the previous two sections. Finally, in section 4.6, the identified relationships based on the estimation sample is validated with the data from the validation sample. The comparison between the findings of this study and the developed hypotheses in chapter 2 are explained in section 4.7. Finally, section 4.8 presents the conclusions of the study based on the findings and comparison with the hypotheses.

4.2. Comparison of potential approaches for analysis

Overall, the following two potential approaches could be used to analyse the dataset of this study:

1- Separate analysis of the impact of each individual operational practice on individual financial outcomes.
2- Simultaneous analysis of the impact of many (or all) operational practices on the financial outcomes.

In the following two subsections (sections 4.2.1 and 4.2.2), the advantages and disadvantages of each of the approaches are discussed. Then, based on comparison of the approaches, section 4.2.3 explains the selected approach used in this study.

4.2.1. First approach (separate analysis of each practice)

The first approach would be to consider the impact of each individual operational practice (explanatory variables) on financial outcomes (response variable) individually. To implement this approach, first the Fisher's exact test can be applied to find the correlations between the operational and financial variables. Then, for each of the identified correlated pairs of operational and financial variables, a logistic regression model can be fitted to find dependence of the financial outcome on the operational practices. This approach is suitable in answering the research question of the study, as it makes it possible to find the impact of the individual operational practices on individual financial measures. However, there are two potential problems associated with this approach.

The first problem is 'Confounding Bias'. This is about finding the impact of one explanatory variable on one response variable without considering the impact of other influential variables (Berzuini et al., 2012). Since other factors are connected with the variables in the relationship that we wish to consider alone, the impact of those factors is confounded or intertwined with the identified relationship (Weisberg, 2010).

So, for example, in the case of this study, an operational practice could look like an important driver on its own, but when considered within a group of other practices its effect could be less noticeable. Therefore, as suggested by Weisberg (2010), by controlling for other confounding variables, an unbiased relationship between the intended variables will emerge.

The second problem with the separate analysis of the operational practices is the 'Multiple testing (comparison)' problem. When many tests are performed simultaneously, the probability of a false positive (falsely identifying a practice as a driver) becomes greater than the acceptable rate (Kaltenbach, 2012) (e.g. 5%). Hinton (2014) also suggests that if the overall significance level of many tests is expected to be at 5%, then the significance level of each of the individual tests has to be set at a much lower level. For example, if we perform five tests simultaneously and the significance level of each test is set at 1%, then the overall risk of a false positive becomes 5% (Hinton, 2014).

In this study, there are ninety operational practices as explanatory variables and eighteen financial measures as response variables and we are expecting to find the impact of the operational variables on the financial variables over four years. Therefore, 90*18*4=6,480 tests are needed to be performed. If the significance level of each test is set between 1% and 5% then it is expected to see between 68 (6480*0.01) and 324 (6480*0.05) false positive relationships (falsely identifying a practice as a driver).

One solution to resolve these two problems is to analyse the impact of many practices simultaneously. In this way, since many variables are included in the analysis, the possibility of finding a confounding problem will be reduced. Also, since the number of relationships that need to be examined will be reduced, the possibility of finding 'multiple testing' problems will be reduced. In the next section, three potential approaches that can be used to analysis simultaneously the practices are discussed.

4.2.2. Second approach (simultaneous analysis of all practices)

In the previous section, the advantages and disadvantages of using the first approach for separate analysis of the variables of the study were explained. One method to resolve the problems that are associated with the first method is to analyse many variables or all of them simultaneously. However, there is a rule of thumb in regression analysis that for every ten events in response variables, one explanatory variable can be used in the regression model (van Belle, 2008). Therefore, the numbers of events in response variables determine the number of explanatory variables that can be included in the regression model.

In this study, response variables (i.e. financial measures) are binary, with values of '0' or '1' expressing deterioration or improvement in financial performance. Based on the stated rule of thumb, there is a need to have at least ten 'events', i.e. companies whose performance has improved or deteriorated (whichever is less frequent) per explanatory variable. For example, the first hypothesis of the study is as follows:

> H_1: Practices related to customer satisfaction have a direct positive impact on companies' turnover growth and profitability.

To address this hypothesis, there is a need to fit a logistic regression model to predict turnover growth (improved or deteriorated) using the scores assigned to the four practices related to customer satisfaction (i.e. questions 1.31, 1.32, 1.1.4, 6.1.4 from the MX survey). For example, in the year of participation in the awards, of the eighty-five companies in the sample, the 'Turnover Growth rate' data of seventy companies are available and the rest are missing data. Of those seventy companies, thirty-six companies had shown improvement in their 'Turnover Growth rate' and thirty-four had shown deterioration. Therefore, for predicting 'Turnover Growth rate', we can include up to three variables in a regression model. This sample size is further reduced by considering the missing data in explanatory variables (i.e. operational practices).

This sample size becomes increasingly smaller after excluding the companies whose data about their operational practices are also missing. After excluding the companies with missing data in their operational data, twenty-nine companies will be left, with eleven deteriorations and eighteen improvements in their turnover growth rate. Therefore, based on the rule of thumb of ten events for each explanatory variable, we could only include one explanatory variable in regression models. This leads us back to the first approach that was discussed in the subsection 4.2.1 (i.e. separate analysis of each practice).

However, there are three potential methods that could be used to either reduce the number of missing data or to find aggregated components of explanatory variables. In the following subsections, these three approaches will be discussed.

4.2.2.1. Assuming missing data represents poor performance scores

The first approach that was used to reduce the missing data was to assign a probable value for the missing data. For example, if values were missing because the company refused to answer, then this could be interpreted as having a low performance score such as '0' or '1' for them. This approach could help in reducing the missing data. However, the missing data in this study only reflects the fact that some companies were not interested in entering in a specific award category. Therefore, this approach is not suitable for this dataset as it is not possible to assume that companies had a poor performance from their missing data.

4.2.2.2. Finding average scores of the available related practices

Another approach that was used to reduce the number of missing data was to find an average score for the performance of companies in a group of related practices. For example, the average score for companies in all practices was that related to customer satisfaction (i.e. questions 1.31, 1.32, 1.1.4, 6.1.4 from the MX survey). The advantage of this approach is in reducing the number of missing data. This is because if a company had missing data in a few of those related practices, it is still possible to assign a score to that company by finding an average score over those practices that are not missing. Therefore, it was possible to keep more companies for analysis.

However, even after finding the average scores of the related practices, the total number of possible events (i.e. improvements and deteriorations) in the outcome variables became a number between nine and twenty-six. So again it is only possible to use one predictor variable in the regression model. Therefore, this approach is also not suitable for this dataset.

4.2.2.3. Using principal component analysis for dimension reduction

The final approach used to reduce the number of explanatory variables would be to use the Principal Component Analysis (PCA) to find aggregated components of the explanatory variables. As discussed in section 3.4.2.1, the purpose of PCA is to reduce the dimensions of a dataset to a minimum number that can explain the maximum variance in that dataset (Jolliffe, 2002). Therefore, this approach was potentially useful in reducing the number of variables and the number of relationships that needs to be investigated. The approach to performing PCA as suggested by Smith (2002) is as follows:

To find the principal component between two dimensions X and Y, first as in the following procedure, the covariance matrix of the two dimensions needs to be calculated:

$$C = \begin{bmatrix} cov(X,X) & cov(X,Y) \\ cov(X,Y) & cov(Y,Y) \end{bmatrix}$$

In which, the formula for covariance (X, Y) is:

$$cov\ (X,Y) = \frac{\sum_{i=1}^{n}(X_i - \bar{X})(Y_i - \bar{Y})}{(n-1)}$$

And the covariance (X, X) and (Y, Y) is equal to their variance and can be found from the following formula:

$$var\ (X) = \frac{\sum_{i=1}^{n}(X_i - \bar{X})(X_i - \bar{X})}{(n-1)}$$

After finding the covariance matrix between the two dimensions, the eigenvalues and eigenvectors associated with matrix need to be identified.

For any square matrix A, an eigenvalue is a scalar λ such that:

$$\det(A - \lambda\, \mathrm{I}) = 0$$

In which, A is an n×n matrix and I is the n×n identity matrix (Bruff, 2005). By calculating this equation, two values for λ will be identified. Then, the larger value between the two should be selected and by using the following formula, the eigenvector (a non-zero n×1 matrix X) correspondent to the eigenvalue should be identified:

$$(A - \lambda\, \mathrm{I})\, X = 0$$

In which, 0 is the n×n null matrix (Bruff, 2005).

The eigenvector associated with the largest eigenvalue of the covariance matrix is the principal component between the two variables (Smith, 2002). An eigenvector shows direction of the principal component and the eigenvalue associated with it shows the variance-accounted-for (VAF) or the variance between the two dimensions in that direction (Linting, 2007).

Between the three potential approaches that are considered to reduce the number of variables in the dataset, PCA was the most suitable approach. However, there are two problems associated with the result of the analysis. First, PCA find the principal components based on the variance between the variables; however, it is sometimes difficult to interpret the newly identified components. As stated by Field (2005):

> It is an extremely contentious point whether this assumption is tenable and some believe that the dimensions derived from factor analysis are real only in the statistical sense—and are real-world fictions (Field, 2005, p624).

Therefore, it was difficult to explain the result of the analysis. Also because of missing data in the dataset of the study, even by using PCA, it was not possible to reduce the number of variables that all variables could be included in one regression model. Therefore, it was still not possible to resolve the problem of 'Multiple testing' of the first approach. In the next section, the conclusion of the study to compare the potential approaches to be used in this study is provided.

4.2.3. Conclusion of comparing the potential approaches

In the last two sections (4.2.1 and 4.2.2), the advantages and disadvantages of the two potential approaches that could be used in this study was explained. The first approach was to analyse each of the operational (explanatory) variables of the study separately. The advantage of this approach is that it can specifically answer the research question of the study by finding the impact of individual operational practices on individual financial measures. However, this approach also has two problems. The first is 'confounding bias', which means in identifying the impact of individual practices on financial measures, the potential influence of other variables are not considered. Therefore, an operational practice could look like an important driver on its own, but when considered with other practices its effect could be less noticeable. The second problem with this approach is 'multiple comparisons', which refers to performing many tests simultaneously. As a result, the probability of a false positive (falsely identifying a practice as a driver) becomes greater than the acceptable rate.

To resolve the problems of the first approach, three potential methods to reducing the missing data or to finding the aggregated impact of the practices was examined in the second approach. The first method was to assign a probable value for the missing data (e.g. if missing data means that companies had a poor performance). However, in this study the missing data only shows that companies were not interested in entering a certain award category. Therefore, this approach was not suitable for this study. The second method was to find an average score for the related practices of a company, by only considering the data that are not missing. This method was useful for reducing the number of variables and the relationships that need to be investigated. However, the sample size of the study was small and there were some missing data in the dataset. Therefore, even after reducing the number of variables, the number of events in the response variables was not large enough to consider all variables in a regression model. As a result, this method was also not suitable for this study.

The final method that was considered in the second approach was to use PCA to reduce the dimensions of the dataset. However, the problem with this method was that it was difficult to interpret the result of the analysis and the number of variables was still not small enough to include all of them in a single regression model. Therefore, this method also had the problem of 'multiple comparisons'.

Overall, based on the comparison of the potential approaches mentioned above, the first approach was selected as the most suitable method that could be used in this study. Therefore, in the following two sections (4.3 and 4.4), correlation and regression analyses are separately performed on each pairs of operational practices and financial measures.

To reduce the confounding effect of the other variables that are not included in the analyses, in section 4.5 the impact of the following two potentially influential factors are considered:

1- Year of participation as a proxy for market condition in that year
2- Industry sectors of the companies.

Also in section 4.6, the identified relationships are tested with the data from the validation sample (i.e. the data from companies that have entered 2011 MX Awards). This can reduce the chance of finding false positives (falsely identifying a practice as a driver) associated with 'multiple comparison'.

4.3. Correlation analysis (the Fisher's exact test)

In the last section, the advantages and disadvantages of the potential statistical analysis approaches to be performed in this study was discussed. This section provides the result of performing Fisher's exact test to find the correlated pairs of operational practices and financial ratios. To perform this test, IBM SPSS version 21 was used. For each pairs of operational practices and financial ratios, SPSS produced a frequency table containing the number of cases that falls into each combination of the categories. For example, Table 4-1 shows a frequency table produced by the software. The table's rows show the number of the large companies where their 'return-on-shareholders-fund' had improved or worsened in the first year after participation in the IMechE's MX Awards. The table's columns show four categories of the 'Allocated-resources-to-continuous-improvement' measure from the poorest performing (category 1) to the best performing companies (category 4). Classifying the companies' performances from the poorest to the best performing companies was based on the IMechE assessors' guidelines.

Table 4-1 An example frequency-table

			Allocated resources to continuous improvement activities (Q152)				
			Category_1	Category_2	Category_3	Category_4	Total
First Year Return on Shareholders' Funds	Worsened	Count	2	5	3	1	11
		Expected Frequency	1.2	3.7	1.6	4.5	11
		Percentage	67%	56%	75%	9%	41%
	Improved	Count	1	4	1	10	16
		Expected Frequency	1.8	5.3	2.4	6.5	16
		Percentage	33%	44%	25%	91%	59%
	Total		3	9	4	11	27

In this example, from the eleven companies where their return-on-shareholders-fund had worsened, two companies were in category 1 (the poorest performing companies) and one company was in category 4 (the best performing companies). From the sixteen companies that their return-on-shareholders-fund had improved, ten companies were in category 4 and one company was in category 1.

SPSS uses the following Fisher's exact test formula to calculate the probability of getting this set of observed cases in each category (Freeman & Campbell, 2007; Weisstein, 2014). In this formula R and C are rows and columns totals. The (m) and (n) are the number of rows and columns respectively and (N) is the total number of companies.

$$p = \frac{(R_1!R_2!\ldots R_m!)(C_1!C_2!\ldots C_n!)}{N!\prod_{i,j} a_{ij}!}$$

For the example shown in table 4-1, this probability is 0.0013:

$$p = \frac{(11!\,16!)(3!\,9!\,4!\,11!)}{(27!\,2!\,5!\,3!\,1!\,1!\,4!\,1!\,10!)} = 0.0013$$

Based on the rows and columns' totals, SPSS calculates all probabilities of getting other possible number of cases in each category to get the same totals. For the example shown in table 4-1, the total of all probabilities is 0.025. The statistically significance at 0.01 or 0.05 probability levels means there is respectively less than a 1% or a 5% chance that observed correlation would have occurred by chance (Dewberry, 2004). Therefore, the lower the probability value, the stronger the significance of the correlations. For the example in table 4-1, the correlation between the two variables ('return-on-shareholders-fund' and 'Allocated-resources-to-continuous-improvement') is statistically significant at 0.05 probability level.

To calculate the strength of the correlations, SPSS used the following formula to find the Cramer's V-values. Where: the chi-square $(\chi^2) = \Sigma \frac{(f_o - f_e)^2}{f_e}$ and degree of freedom (df^*) = the lesser number of rows minus one (R-1) or number of columns minus one (C-1). And f_o and f_e are number of observed and expected cases in each category respectively. The Cramer's V-value ranges from 0 to 1 and the larger the value, the stronger the relationship (Healey, 2009).

$$V = \sqrt{\frac{\chi^2}{n(df^*)}}$$

For the example in table 4-1: $\chi^2 = \frac{(2-1.2)^2}{1.2} + \frac{(5-3.7)^2}{3.7} + \frac{(3-1.6)^2}{1.6} + \frac{(1-4.5)^2}{4.5} + \frac{(1-1.8)^2}{1.8} + \frac{(4-5.3)^2}{5.3} + \frac{(1-2.4)^2}{2.4} + \frac{(10-6.5)^2}{6.5} = 8.16$

df* = 1, n= 27 Then, ➔ $V = \sqrt{\frac{8.16}{27(1)}} = 0.55$

Therefore, the Large companies' 'return-on-shareholders-fund' have a medium level correlation (V=0.55) with their 'Allocated-resources-to-continuous-improvement'.

In the following subsections, the result of performing this test for all operational practices and financial ratios of the study over three years after their participation in the IMechE's MX Awards is explained. For each of the identified correlated pairs, the following three key statistics are presented:

1. The P-Value of the Fisher's exact test, which shows the significance of the correlations
2. The Cramer's V values, which shows the strength of the correlations.
3. The total number of companies involved in the analysis, which shows the reliability of the findings.

Appendix 4 shows the detailed summary of the data that is used as the basis of the calculated correlations.

4.3.1. Correlations in the year of participation in the MX Awards

In the original year of participation in the MX Awards, sixty-nine correlated pairs of operational and financial measures were identified. The identified correlations are shown in tables 4-2 to 4-4. Significantly larger number of correlated pairs was identified for Large companies than for SMEs (6 correlations for SMEs vs. sixty-three correlations for Large companies).

The identified correlated pairs for SMEs were between only one operational measure and one financial ratio (table 4-2). The operational measures of the SMEs were mainly correlated with their liquidity and cash flow ratios. There was no significant correlation between their operational measures and profitability, asset management or debt management ratios.

Table 4-2 Results of the Fisher's exact test for SMEs in the original year of participation in the MX Awards

#	Operational Practices	Financial ratios	Fisher's Exact P-value	Cramer's V-value	Total # of companies involved in the analysis
1	Equipment maintenance (Q473)	Cash Flow Yield	0.01 **	0.71	16
2	Project Management techniques to ensure major projects are completed on time (Q652)	Accounts Payable	0.02 *	0.69	15
3	Approach to monitor the effectiveness of your sales process (Q644)	Accounts Receivable	0.03 *	0.70	14
4	Differentiation through Customer Focus (Q181)	Turnover Growth	0.03 *	0.66	14
5	Engagement with the local community (Q545)	Cash Flow Yield	0.05 *	0.68	12
6	Number of working days after the end of the reporting period to prepare management report (Q848)	Accounts Payable	0.05 *	0.82	10
** = significant at 0.01 level * = significant at 0.05 level					

Correlations in table 4-2 are arranged based on their p-values so the most significant correlation (i.e. the lowest p-values) is presented at the top of the table. The correlations with similar significance levels are sorted based on their Cramer's V-value, with the stronger correlations (i.e. higher Cramer's Vs) first. The most significant identified correlation was between the SMEs' 'Equipment maintenance' and their 'cash flow yield'. This shows that companies that were more capable in generating operating cash flow have had better equipment maintenance or vice versa.

For Large companies, eleven operational practices were correlated with more than one financial ratio. These correlations are presented in table 4-3. The following two operational practices had the highest number of correlations with seven financial ratios in the year of participation in the MX Awards:

1- Partnerships with educational establishments and
2- Differentiation through People Effectiveness.

Table 4-3 Most correlated operational practices of Large firms in the original year of participation in the MX Awards

#	Operational Practices	Financial ratios	Fisher's Exact P-value	Cramer's V-value	Total # of companies involved in the analysis
1	Benefits to company from partnerships with educational establishments (Q562)	Gross Profit Margin	0.01 **	0.63	23
		Cash Flows To Sales	0.01 **	0.55	29
		Margin On Sales	0.01 **	0.51	30
		Return On Capital Employed	0.02 *	0.47	31
		Return On Total Assets	0.04 *	0.45	31
		Interest Cover	0.04 *	0.45	26
		Return on Shareholders' Funds	0.04 *	0.43	29
2	Differentiation through People Effectiveness (Q571)	Cash Flows To Sales	0.00 **	0.64	29
		Cash Flow Total Debt	0.00 **	0.62	28
		Margin On Sales	0.01 **	0.51	30
		Free Cash Flow	0.03 *	0.47	29
		Return On Capital Employed	0.02 *	0.46	31
		Interest Cover	0.04 *	0.44	26
		Accounts Payable Days	0.04 *	0.41	29
3	Company's financial and non-financial reward schemes and their reward (Q541)	Turnover Growth	0.00 **	0.59	27
		Return On Capital Employed	0.01 **	0.57	31
		Cash Flows To Sales	0.01 **	0.57	29
		Margin On Sales	0.02 *	0.51	30
4	Differentiation through Customer Focus (Q181)	Return On Capital Employed	0.01 **	0.51	32
		Turnover Growth	0.03 *	0.50	29
		Return on Shareholders' Funds	0.03 *	0.46	30
		Margin On Sales	0.04 *	0.43	31
5	Significant drivers for change in business (Q614)	Margin On Sales	0.03 *	0.63	22
		Return On Total Assets	0.03 *	0.62	23
		Cash Flows To Sales	0.03 *	0.62	22
6	Approach to ensure employees gain experience to take new roles (Q532)	Current Ratio	0.01 **	0.56	31
		Interest Cover	0.04 *	0.53	26
		Cash Flows To Sales	0.04 *	0.45	29
7	Approach to ensure accounting practices support the business drivers (Q847)	Return On Total Assets	0.04 *	0.85	12
		Cash Flows To Sales	0.04 *	0.85	12
8	Benefits of after-sales to customers and company (Q122)	Return On Total Assets	0.02 *	0.57	30
		Margin On Sales	0.04 *	0.53	29
9	Actions taken to reduce all forms of waste (Q471)	Gross Profit Margin	0.02 *	0.60	20
		Return On Total Assets	0.04 *	0.50	27
10	Business drivers and key factors for investing in ICT (Q711)	Margin On Sales	0.01 **	0.69	20
		Cash Flows To Sales	0.03 *	0.62	20
11	Company's collaborate with educational establishments (Q561)	Gross Profit Margin	0.00 **	0.72	23
		Quick Ratio	0.00 **	0.66	31

** = significant at 0.01 level
* = significant at 0.05 level

There were also twenty-five operational practices of large companies that each had correlation with one financial ratio in the year of participation in the MX Awards (table 4-4). Most of the identified correlations of the large companies were between their operational practices and their profitability and liquidity ratios. This shows that in the year of participation at the MX Awards, companies with better operational practices had better profitability and liquidity or the other way round. For example, the most significant correlation was between large companies' actions to reduce the need for regular overtime and their gross profit margin. This could potentially show that companies with lower overtime work have had a better efficiency in earning profit. Alternatively, this can also show that large companies with a better profit margin had less need for regular overtime work.

Table 4-4 Results of the Fisher's exact test for Large firms in the original year of participation in the MX Awards

#	Operational Practices	Financial ratios	Fisher's Exact P-value	Cramer's V-value	Total # of companies involved in the analysis
1	Actions taken to reduce the need for regular overtime (Q544)	Gross Profit Margin	0.00 **	0.76	23
2	Managing impact on customers when finishing production of a product (Q171)	Asset Turnover	0.00 **	0.70	19
3	Business planning process to new products for particular markets (Q622)	Margin On Sales	0.02 *	0.62	22
4	Initiatives to achieve continuous improvement (Q151)	Return On Total Assets	0.02 *	0.58	28
5	Approach to ensure people obtain required formal qualifications and training (Q534)	Quick Ratio	0.02 *	0.50	31
6	Formal business planning process and people involved (Q611)	Cash Flows To Sales	0.03 *	0.62	22
7	Key factors affecting financial performance over the past three years (Q831)	Inventory Turnover	0.03 *	0.60	21
8	Overview of Financial ratios (Q821)	Leverage	0.03 *	0.60	18
9	Coordination between intrl. & extrl. aspects of supply-chain activities (Q411)	Leverage	0.03 *	0.56	25
10	Information on health, safety, environmental issues provided to workforce (Q462)	Quick Ratio	0.03 *	0.54	27
11	Actions to improve customer satisfaction (Q132)	Cash Flows To Sales	0.03 *	0.51	29
12	Approach to collating master production schedule for managing operations (Q451)	Gross Profit Margin	0.04 *	0.56	20
13	Factors influencing the layout of production facilities (Q441)	Quick Ratio	0.04 *	0.53	27
14	Approach to launch new products into manufacturing (Q321)	Quick Ratio	0.04 *	0.52	33
15	What percentage of working time is overtime? (Q543)	Cash Flow Total Debt	0.05 *	0.57	20
16	Approach for keep specification and document control for products (Q232)	Inventory Turnover	0.01 **	0.48	29
17	Percentage of the workforce subject to skills audits (Q537)	Quick Ratio	0.02 *	0.47	31
18	Customer satisfaction measurement and results (Q131)	Return On Capital Employed	0.03 *	0.46	32
19	Approach to ensure employees gain the necessary experience to take new roles (Q532)	Accounts Receivable Days	0.03 *	0.50	28

#	Operational Practices	Financial ratios	Fisher's Exact P-value	Cramer's V-value	Total # of companies involved in the analysis
20	Important aspects of the working environment (Q513)	Turnover Growth	0.04 *	0.47	27
21	Methods of reporting the progress towards business objectives to workforce (Q522)	Current Ratio	0.04 *	0.44	31
22	Actions taken as a result of answers received from attitude survey (Q5311)	Accounts Receivable Days	0.05 *	0.48	27
23	Initiatives for improving the flow of materials throughout the supply chain (Q412)	Current Ratio	0.05 *	0.48	27
24	Assessing individual performance and identifying training requirements (Q531)	Current Ratio	0.05 *	0.46	31
25	Stages of designing and implementing manufacturing and supply-chain processes (Q312)	Accounts payable Days	0.05 *	0.46	31

** = significant at 0.01 level
* = significant at 0.05 level

4.3.2. Correlations in the first year after participation in the MX Awards

In the first year after participation in the MX Awards, the number of the correlated pairs for SMEs was almost twice that of the previous year (eleven correlations vs. six correlations). Conversely, the number of correlated pairs for Large companies was almost half that of the previous year (thirty-seven correlations vs. sixty-three correlations). The identified correlations for the first year are presented in tables 4-5 to 4-7.

As in the previous year, the identified correlations for SMEs were between only one operational practice and one financial ratio (table 4-5). The identified correlations were between the operational practices and their profitability, liquidity and debt management ratios. However, there was no correlation between their operational measures and their asset management and cash flow ratios.

The most significant correlation was between the SMEs' responsiveness to changes in market demand and their leverage. This can potentially show that SMEs with better awareness of market demands had better debt management and were less dependent on external financing.

Table 4-5 Results of the Fisher's exact test for SMEs in the first year after participation in the MX Awards

#	Operational Performance Measures	Financial ratios	Fisher's Exact P-value	Cramer's V-value	Total # of companies involved in the analysis
6	Manufacturing operations responsiveness to changes in market demand (Q332)	Leverage	0.01 **	0.72	19
1	Percentage of key equipment process capable to the level expected (Q477)	Current Ratio	0.02 *	0.83	11
7	Approach to win new sales (Q643)	Current Ratio	0.02 *	0.75	14
2	Groups of people involved and their contribution to develop your ICT strategy (Q712)	Current Ratio	0.03 *	0.83	10
3	Allocated resources to allow employees to access to ICT systems and their security (Q731)	Leverage	0.03 *	0.80	10
4	Actions taken to reduce all forms of waste (Q471)	Interest Cover	0.03 *	0.79	13
8	KPIs for the monitoring and control of product introduction programmes (Q233)	Leverage	0.03 *	0.75	14
5	Key factors affecting financial performance over the past three years (Q831)	Current Ratio	0.04 *	0.89	10
9	Actions taken as a result of answers received from attitude survey (Q5311)	Current Ratio	0.04 *	0.61	15
10	Adding value to customers through products and/or services (Q114)	Gross Profit Margin	0.04 *	0.58	19
11	Percentage of operating revenue spent on new product innovation (Q231)	Gross Profit Margin	0.05 *	0.63	19

** = significant at 0.01 level
* = significant at 0.05 level

For Large companies, all dimensions of their financial performance were correlated with at least one operational measure. There were five operational measures that were correlated with more than one financial ratio (table 4-6). As shown in table 4-6, 'Systems and processes to maintain equipment for production' had the highest number of correlations, with four financial ratios in the first year after participation in the MX Awards.

Table 4-6 Most influential operational practices of Large firms in the first year after participation in the MX Awards

#	Operational Performance Measures	Financial ratios	Fisher's Exact P-value	Cramer's V-value	Total # of companies involved in the analysis
1	Systems and processes in use to maintain equipment for production (Q473)	Return On Total Assets	0.01 **	0.54	26
		Accounts Payable Days	0.01 **	0.54	25
		Turnover Growth	0.03 *	0.52	23
		Return On Capital Employed	0.03 *	0.52	26
2	Approach to monitor the effectiveness of your sales process (Q644)	Interest Cover	0.01 **	0.71	21
		Asset Turnover	0.02 *	0.59	22
		Return On Capital Employed	0.04 *	0.54	22
3	Core organisational values within business (Q511)	Return On Capital Employed	0.01 **	0.53	30
		Return On Total Assets	0.03 *	0.46	30
		Margin On Sales	0.03 *	0.46	30
4	Actions taken to reduce machine changeover times (Q474)	Return On Total Assets	0.01 **	0.57	23
		Gross Profit Margin	0.03 *	0.60	17
5	Actions taken to reduce the need for regular overtime (Q544)	Turnover Growth	0.05 *	0.47	26
		Inventory Turnover	0.05 *	0.44	30

** = significant at 0.01 level
* = significant at 0.05 level

Apart from the five practices in table 4-6, there were twenty-three other operational practices of large companies that had correlations with one of their financial ratio in the first year after participation in the MX Awards (table 4-7). The most significant correlation was between large firms' 'Approach to win new sales' and their 'Asset turnover' ratio. This can potentially show that companies with a stronger sales approach were more efficient in exploiting their assets to generate sales in the first year after participation in the awards.

Table 4-7 Results of the Fisher's exact test for Large firms in the first year after participation in the MX Awards

#	Operational Performance Measures	Financial ratios	Fisher's Exact P-value	Cramer's V-value	Total # of companies involved in the analysis
1	Approach to win new sales (Q643)	Asset Turnover	0.00 **	0.73	22
2	Business drivers and key factors for investing in ICT (Q711)	Interest Cover	0.01 **	0.68	19
3	Techniques for managing information about market opportunities and competitors (Q621)	Cash Flow	0.01 **	0.66	17
4	Differentiation through partnerships between Business and Education (Q1051)	Leverage	0.01 **	0.62	24
5	Sales and/or distribution channels (Q113)	Accounts Payable Days	0.01 **	0.58	30
6	The areas of manuf. process that have been redesigned in the past three years (Q352)	Accounts Payable Days	0.01 **	0.57	31
7	Actions to ensure changes in volumes or product mix can be readily accommodated (Q413)	Cash Flow	0.01 **	0.56	25
8	Approach to identifying and managing business improvement projects (Q615)	Cash Flow	0.02 *	0.71	17
9	Controls and responsibility for managing debtors (Q844)	Margin On Sales	0.02 *	0.74	20
10	KPIs for the monitoring and control of product introduction programmes (Q233)	Current Ratio	0.02 *	0.59	24
11	Allocated resources to continuous improvement activities (Q152)	Return on Shareholders' Funds	0.02 *	0.55	27
12	Visual management tools usage and aspects of the business they cover (Q454)	Return On Total Assets	0.03 *	0.82	13
13	What percentage of working time is overtime? (Q543)	Interest Cover	0.03 *	0.69	16
14	Number of working days to prepare management report (Q848)	Return On Total Assets	0.03 *	0.57	21
15	Identifying new technologies needed for the manufacture of future products (Q314)	Current Ratio	0.03 *	0.56	25
16	Key drivers for adopting a more sustainable approach in business (Q911)	Return On Total Assets	0.05 *	0.64	16
17	Project management techniques to ensure major projects are completed on time (Q652)	Asset Turnover	0.05 *	0.60	22
18	Techniques and responsibility for controlling stocks and work in progress (Q846)	Return On Total Assets	0.02 *	0.54	21
19	Approach for ensuring people obtain required formal qualifications and training (Q534)	Accounts Payable Days	0.02 *	0.52	29
20	Customer satisfaction measurement and results (Q131)	Cash Flow	0.03 *	0.50	30
21	Procedures to monitor the gender, age, ethnic groups, and disabilities profile of workforce (Q551)	Asset Turnover	0.04 *	0.55	29
22	New products in the past five years and their % of current operating revenue (Q251)	Accounts Payable Days	0.04 *	0.45	25
23	Customers' and/or suppliers' involvement in manufacturing process innovation (Q341)	Accounts Payable Days	0.05 *	0.49	31

** = significant at 0.01 level
* = significant at 0.05 level

4.3.3. Correlations in the second year after participation in the MX Awards

In the second year after participation in the MX Awards, the number of correlated pairs for both SMEs and large companies were lower than their previous years. There were five correlations for SMEs vs. eleven in the last year and thirty correlations for large companies vs. thirty-seven in the last year. The identified correlations for the second year are presented in tables 4-8 to 4-10.

As in the previous year, the identified correlations for SMEs were between their operational practices and their profitability, debt management and cash flow ratios. Also, each operational practice was only correlated with only one financial ratio (table 4-8). The most significant correlation for SMEs was between their 'Continuous improvement initiatives' and their 'Account receivable days' which is an indicator of the firm's liquidity. This could show that companies with better continuous improvement initiatives were also more capable in collecting their receivables accounts.

Table 4-8 Results of the Fisher's exact test for SMEs in the second year after participation in the MX Awards

#	Operational Performance Measures	Financial ratios	Fisher's Exact P-value	Cramer's V-value	Total # of companies involved in the analysis
1	Continuous improvement initiatives for manufacturing process and their benefits (Q342)	Accounts Receivable	0.00 **	0.82	18
2	Sales and/or distribution channels (Q113)	Gross Profit Margin	0.01 **	0.73	14
3	Actions taken as a result of answers received from attitude survey (Q5311)	Interest Cover	0.02 *	0.81	11
4	Approach to ensure your employees remain motivated and satisfied with their job (Q553)	Quick Ratio	0.03 *	0.80	10
5	Company plan for management succession (Q533)	Accounts Payable	0.04 *	0.72	15
** = significant at 0.01 level * = significant at 0.05 level					

Unlike the previous two years, there were only two operational practices of the large companies that were correlated with more than one financial ratio (table 4-9). The most correlated operational practice of the large companies in the second year after participation in the awards was the practice of 'Identifying new technologies for the manufacture of future products' which had correlations with four financial ratios.

Table 4-9 Most influential operational practices of Large firms in the 2nd year after participation in the MX Awards

#	Operational Performance Measures	Financial ratios	Fisher's Exact P-value	Cramer's V-value	Total # of companies involved in the analysis
1	Identifying new technologies needed for the manufacture of future products (Q314)	Leverage	0.03 *	0.68	19
		Cash Flow Yield	0.03 *	0.59	25
		Current Ratio	0.03 *	0.56	25
		Quick Ratio	0.04 *	0.55	25
2	Items covered in business plan (Q612)	Accounts Receivable	0.01 **	0.75	20
		Current Ratio	0.03 *	0.67	21
		Return On Total Assets	0.03 *	0.61	21
** = significant at 0.01 level * = significant at 0.05 level					

Similar to those in the previous years, most of the financial ratios of the large companies were correlated with at least one of their operational practices (table 4-10). The most significant correlation was between large companies' 'drivers for change in business' and their inventory turnover. This can potentially show that large companies with stronger drivers to change in their business had managed to reduce their inventory turnover in the second year after participation in the awards.

Table 4-10 Results of the Fisher's exact test for Large firms in the second year after participation in the MX Awards

#	Operational Performance Measures	Financial ratios	Fisher's Exact P-value	Cramer's V-value	Total # of companies involved in the analysis
1	Significant drivers for change in business (Q614)	Inventory Turnover	0.00 **	0.73	21
2	Actions taken to improve the environmental performance of logistics operations and results (Q478)	Leverage	0.01 **	0.76	18
3	Manufacturing operations responsiveness to changes in market demand (Q332)	Leverage	0.01 **	0.61	25
4	Methods for assessing, monitoring, and reporting sustainability performance (Q922)	Asset Turnover	0.02 *	0.76	16
5	Level of statistical process capability on equipment (Q476)	Leverage	0.02 *	0.75	17
6	Company's budgeting procedures (Q871)	Asset Turnover	0.02 *	0.71	19
7	Controls and responsibility for managing debtors (Q844)	Cash Flow Yield	0.02 *	0.70	20
8	Techniques to manage information on market opportunities, and competitors (Q621)	Accounts Receivable	0.02 *	0.63	17
9	Significant investments over the last three years and its costs and benefits to the business (Q852)	Cash Flow Yield	0.02 *	0.63	21
10	KPIs for the monitoring and control of product introduction programmes (Q233)	Current Ratio	0.02 *	0.60	24
11	New products in the past five years and their % of current operating revenue (Q251)	Leverage	0.02 *	0.57	22
12	Key factors driving operational process innovation (Q311)	Cash Flow Yield	0.02 *	0.53	32
13	Actions taken to provide a safe and healthy working environment (Q461)	Gross Profit Margin	0.03 *	0.59	20
14	Allocated resources to allow employees to access to ICT systems and their security (Q731)	Return On Capital Employed	0.03 *	0.55	20
15	Actions to ensure changes in volumes or product mix can be readily accommodated (Q413)	Accounts Receivable	0.03 *	0.51	25
16	Approach to capture and manage business information and knowledge (Q661)	Asset Turnover	0.04 *	0.67	17
17	Number of: Employees, Product lines, Major customers, Key competitors, Key suppliers (Q811)	Leverage	0.04 *	0.66	18
18	Information available for customers and suppliers using ICT systems (Q732)	Asset Turnover	0.04 *	0.61	19
19	Identifying future customer requirements (Q112)	Leverage	0.04 *	0.57	20
20	Percentage of supplier base to deliver directly to production without incoming inspection (Q161)	Quick Ratio	0.04 *	0.54	30
21	Actions to reduce the environmental impact of production processes (Q343)	Accounts Payable Days	0.04 *	0.48	31
22	Actions taken to reduce machine changeover times (Q474)	Asset Turnover	0.04 *	0.46	22
23	Key drivers for adopting a more sustainable approach in business (Q911)	Leverage	0.05 *	0.65	14

** = significant at 0.01 level
* = significant at 0.05 level

4.3.4. Correlations in the third year after participation in the MX Awards

The number of the correlated pairs for the SMEs in the third year after participation in the MX Awards was less than in any of the previous years. Conversely, the correlated pairs for large companies were similar to their second year, although there were fewer than the first two years (three correlations for SMEs and thirty correlations for large companies). The identified correlations for the third year are presented in tables 4-11 to 4-13.

The identified correlations for the SMEs were mainly between two operational measures related to their 'Customers' buying criteria' and 'Stages in implementing manufacturing and supply-chain processes' and their profitability (table 4-11). However, there was no correlation between the SMEs' operational measures and other financial ratios, such as asset management, debt management, liquidity or cash flow in the third year after participation in the MX Awards. The most significant correlation was between the SMEs' 'Stages in implementing manufacturing and supply chain processes' and their gross profit margin. This could show that the better the firms plan their manufacturing processes, the better they could reduce their cost of sales and therefore improve their gross profit margin in the long term (three years).

Table 4-11 Results of the Fisher's exact test for SMEs in the third year after participation in the MX Awards

#	Operational Performance Measures	Financial ratios	Fisher's Exact P-value	Cramer's V-value	Total # of companies involved in the analysis
1	Stages in implementing manufacturing and supply-chain processes (Q312)	Gross Profit Margin	0.02 *	0.85	12
2	Customers' key buying criteria (Q111)	Return On Total Assets	0.02 *	0.73	13
3	Customers' key buying criteria (Q111)	Margin On Sales	0.03 *	0.69	13
** = significant at 0.01 level * = significant at 0.05 level					

For large companies, there were six operational practices that were correlated with more than one financial ratio (table 4-12). The most correlated operational practice was 'Allocated resources to continuous improvement activities', which was correlated with four financial ratios.

Table 4-12 Most influential operational practices of Large firms in the 2nd year after participation in the MX Awards

#	Operational Performance Measures	Financial ratios	Fisher's Exact P-value	Cramer's V-value	Total # of companies involved in the analysis
1	Allocated resources to continuous improvement activities (Q152)	Gross Profit Margin	0.00 **	0.77	23
		Return on Shareholders' Funds	0.01 **	0.64	24
		Cash Flow	0.04 *	0.54	28
		Return On Capital Employed	0.05 *	0.50	29
2	Actions to reduce the environmental impact of production processes (Q343)	Margin On Sales	0.01 **	0.59	30
		Interest Cover	0.03 *	0.55	26
		Cash Flows To Sales	0.03 *	0.50	30
3	Customer satisfaction measurement and results (Q131)	Cash Flow	0.01 **	0.56	28
		Return on Shareholders' Funds	0.03 *	0.55	24
4	Managing impact on customers when finishing production of a product (Q171)	Margin On Sales	0.02 *	0.64	18
		Cash Flow	0.03 *	0.60	17
5	Customers' and/or suppliers' involvement in manufacturing process innovation (Q341)	Margin On Sales	0.01 **	0.52	30
		Cash Flow	0.03 *	0.50	30
6	Formal business planning process and people involved (Q611)	Interest Cover	0.04 *	0.60	18
		Cash Flow	0.05 *	0.57	19

** = significant at 0.01 level

* = significant at 0.05 level

Apart from the six practices in table 4-12, there were fifteen operational practices that were correlated with only one financial ratio of large firms (table 4-13). The most significant correlation was between their practices of 'calculation of the capacity available for production to ensure on time deliveries' and their leverage. This could potentially show that companies that had more accurate calculation of their available capacity for production had better debt management and had less need for external debt in the long term (three years).

Table 4-13 Results of the Fisher's exact test for Large firms in the third year after participation in the MX Awards

#	Operational Performance Measures	Financial ratios	Fisher's Exact P-value	Cramer's V-value	Total # of companies involved in the analysis
1	Calculation of the capacity available for production to ensure on-time deliveries (Q452)	Leverage	0.00 **	0.86	19
2	Groups of people involved and their contribution to developing your ICT strategy (Q712)	Leverage	0.00 **	0.86	15
3	Percentage of key equipment processes capable to the level expected (Q477)	Gross Profit Margin	0.01 **	0.88	14
4	Usage of ICT to integrate internal business processes (Q724)	Leverage	0.01 **	0.86	15
5	Alignment between business processes, organisation structure and ICT systems (Q726)	Leverage	0.01 **	0.84	15
6	Actions taken to reduce the need for regular overtime (Q544)	Return On Total Assets	0.01 **	0.59	28
7	Significant change to projects in the last three years to make business more competitive (Q654)	Asset Turnover	0.02 *	0.66	19
8	Factors influencing the layout of production facilities (Q441)	Accounts payable Days	0.02 *	0.64	22
9	Company's apprentice scheme and number of apprentices currently employed by the company (Q535)	Current Ratio	0.02 *	0.64	20
10	Initiatives to achieve continuous improvement (Q151)	Cash Flow	0.03 *	0.56	25
11	Differentiation through product Innovation (Q261)	Leverage	0.03 *	0.51	23
12	Procedures for linking involvement with business educational partnerships to job appraisal (Q1014)	Gross Profit Margin	0.04 *	0.74	15
13	Company's financial and non-financial reward schemes and their rewards (Q541)	Inventory Turnover	0.04 *	0.52	28
14	Important aspects of the working environment (Q513)	Current Ratio	0.04 *	0.48	28
15	Percentage of on time deliveries and in full (Q133)	Gross Profit Margin	0.05 *	0.55	23

** = significant at 0.01 level

* = significant at 0.05 level

4.4. Regression analysis (the exact logistic regression)

The second analysis was to find the ability of the operational measures to predict improvement of the companies' financial performance. Therefore, only the statistically significant correlations from the previous section (4.3) were considered. To perform this analysis, Cytel-Studio LogXact version 10.0 was used to calculate the regression coefficients of the operational measures using the following equation:

$$Y = b_0 + b_1 \mathrm{X} + e$$

Where: Y = Financial measures; b_0 = the intercept; b_1 = the regression coefficient;
X= operational measures; e = error term.

In the following subsections, the results of performing logistic regression for the correlated pairs of operational practices and financial ratios over three years after their participation in the IMechE's MX Awards are explained. The tables showing the findings of the regression analysis present the following three statistics:

1. The beta coefficient of getting improvement in the companies' financial ratios based on their performance in their operational measures.
2. The P-Value of the exact logistic regression analysis which shows the significance of the regressions.
3. The total number of companies involved in the analysis which shows the reliability of the findings.

4.4.1. Regressions in the year of participation in the MX Awards

In the year of participation in the MX Awards, from the six correlated pairs for the SMEs, only three pairs had significant regressions. For the Large companies, from the sixty-three correlated pairs, forty-six pairs had significant regressions. The significant regressions are presented in tables 4-14, and 4-15 for SMEs and Large firms respectively.

For SMEs, the most important driver for improving their financial performance has been their 'approach to monitor the effectiveness of their sales processes' that have had a positive impact on their account receivable days (table 4-14). This show that SMEs with a more effective sales approach managed to collect their account receivables more quickly. In addition, in the year of participation in the awards, there was no significant regression between the SMEs' operational practices and their profitability, asset management, debt management and cash flow ratios.

Table 4-14 Results of the regressions analysis for SMEs in the same year of participation in the MX Awards

#	Operational Practices	Financial ratios	Estimated Beta-value	Exact P-value	Total # of companies involved in the analysis
1	Approach to monitoring the effectiveness of your sales process (Q644)	Accounts Receivable days	2.03	0.05 *	14
2	Project management techniques to ensure major projects are completed on time (Q652)	Accounts Payable days	1.22	0.05 *	15
3	Number of working days after the end of the reporting period to prepare management report (Q848)	Accounts Payable days	1.03	0.05 *	10
** = significant at 0.01 level * = significant at 0.05 level					

For the large companies, the identified relationships are presented in table 4-15. The relationships are ordered based on the significance of relationships (i.e. the lower p-values are at the top of the table). The relationships with similar significance levels, are ordered based on their beta values (i.e. larger beta values are presented first) to show the operational practices that have a higher impact on improving the financial performance of the companies. The most important driver for improving large companies' financial performance has been their practice to 'Differentiate themselves through people effectiveness'. This practice had a positive impact on their cash flow in general, which has resulted in improvement of their cash flow to total debt and cash flow to sales. This shows that large companies with more effective employees have managed to improve their cash flow in the year of participation in the awards.

Table 4-15 Results of the regressions analysis for Large firms in the same year of participation in the MX Awards

#	Operational Practices	Financial ratios	Estimated Beta-value	Exact P-value	Total # of companies involved in the analysis
1	Differentiation through People Effectiveness (Q571)	Cash Flow Total Debt	3.17	0.00 **	28
2	Differentiation through People Effectiveness (Q571)	Cash Flows To Sales	3.11	0.00 **	29
3	Company's collaboration with educational establishments (Q561)	Gross Profit Margin	2.79	0.00 **	23
4	Company's financial and non-financial reward schemes and their rewards (Q541)	Return on Capital Employed	2.42	0.00 **	31
5	Business drivers and key factors for investing in ICT (Q711)	Margin On Sales	2.47	0.00 **	20
6	Benefits to company from partnerships with educational establishments (Q562)	Cash Flows To Sales	2.69	0.01 **	29
7	Differentiation through People Effectiveness (Q571)	Margin On Sales	2.68	0.01 **	30
8	Benefits to company from partnerships with educational establishments (Q562)	Gross Profit Margin	2.65	0.01 **	23
9	Managing impact on customers when finishing production of a product (Q171)	Asset Turnover	2.61	0.01 **	19
10	Benefits to company from partnerships with educational establishments (Q562)	Margin On Sales	2.55	0.01 **	30
11	Differentiation through Customer Focus (Q181)	Return on Capital Employed	2.48	0.01 **	32
12	Company's financial and non-financial reward schemes and their rewards (Q541)	Turnover Growth	2.33	0.01 **	27
13	Business planning process to new products for particular markets (Q622)	Margin On Sales	2.29	0.01 **	22
14	Company's financial and non-financial reward schemes and their rewards (Q541)	Margin On Sales	1.90	0.01 **	30
15	Information on health, safety, environmental issues provided to workforce (Q462)	Quick Ratio	1.84	0.01 **	27
16	Company's financial and non-financial reward schemes and their rewards (Q541)	Cash Flows To Sales	1.84	0.01 **	29
17	Business drivers and key factors for investing in ICT (Q711)	Cash Flows To Sales	1.84	0.01 **	20
18	Formal business planning process and people involved (Q611)	Cash Flows To Sales	1.69	0.01 **	22
19	Company's collaboration with educational establishments (Q561)	Quick Ratio	1.63	0.01 **	31
20	Actions taken to reduce the need for regular overtime (Q544)	Gross Profit Margin	1.61	0.01 **	23
21	Approach for ensuring employees gain experience to take new roles (Q532)	Current Ratio	1.58	0.01 **	31
22	Significant drivers for change in business (Q614)	Margin On Sales	1.37	0.01 **	22
23	Approach for ensuring accounting practices support the business drivers (Q847)	Cash Flows To Sales	2.07	0.02 *	12
24	Benefits to company from partnerships with educational establishments (Q562)	Return on Capital Employed	2.01	0.02 *	31
25	Actions to improve customer satisfaction (Q132)	Cash Flows To Sales	1.98	0.02 *	29
26	Differentiation through Customer Focus (Q181)	Turnover Growth	1.96	0.02 *	29
27	Factors influencing the layout of production facilities (Q441)	Quick Ratio	1.49	0.02 *	27
28	Percentage of the workforce subject to skills audits (Q537)	Quick Ratio	1.48	0.02 *	31
29	Initiatives to achieve continuous improvement (Q151)	Return On Total Assets	1.31	0.02 *	28

#	Operational Practices	Financial ratios	Estimated Beta-value	Exact P-value	Total # of companies involved in the analysis
30	Approach for launching new products into manufacturing (Q321)	Quick Ratio	1.04	0.02 *	33
31	Approach for keeping specification and document control for products (Q232)	Inventory Turnover	2.54	0.03 *	29
32	Differentiation through People Effectiveness (Q571)	Return on Capital Employed	2.15	0.03 *	31
33	Methods of reporting the progress towards business objectives to workforce (Q522)	Current Ratio	1.75	0.03 *	31
34	Key factors affecting financial performance over the past three years (Q831)	Inventory Turnover	1.51	0.03 *	21
35	Benefits of after-sales to customers and company (Q122)	Margin On Sales	1.28	0.03 *	29
36	Approach for ensuring employees gain experience to take new roles (Q532)	Interest Cover	1.24	0.03 *	26
37	Company's collaboration with educational establishments (Q562)	Interest Cover	1.21	0.03 *	26
38	Significant drivers for change in business (Q614)	Cash Flows To Sales	1.10	0.03 *	22
39	Customer satisfaction measurement and results (Q131)	Return on Capital Employed	2.08	0.03 *	31
40	Differentiation through People Effectiveness (Q571)	Cash Flow	2.17	0.04 *	29
41	Differentiation through Customer Focus (Q181)	Return on Shareholders' Funds	2.09	0.04 *	30
42	Differentiation through Customer Focus (Q181)	Margin On Sales	2.09	0.04 *	31
43	Benefits to company from partnerships with educational establishments (Q562)	Return on Shareholders' Funds	1.78	0.05 *	29
44	Approach for ensuring employees gain experience to take new roles (Q532)	Cash Flows To Sales	1.04	0.05 *	29
45	Benefits of after-sales to customers and company (Q122)	Return On Total Assets	1.02	0.05 *	30
46	Stages for implementing manufacturing and supply-chain processes (Q312)	Accounts payable	0.85	0.05 *	31

** = significant at 0.01 level

* = significant at 0.05 level

4.4.2. Regressions in the first year after participation in the MX Awards

In the first year after participation in the MX Awards, from the eleven correlated pairs of SMEs, seven pairs had significant regressions. For the Large companies, from thirty-seven correlated pairs, twenty-four pairs had significant regressions. The significant regressions in the first year after participation in the awards are presented in tables 4-16 and 4-17, for SMEs and Large firms respectively.

The most significant relationship for SME is between 'responsive to changes in market demand' and their leverage (table 4-16). This shows that SMEs that were more responsive to changes in market demand had less need for external debt and reduced their leverage in the first year after participation in the awards.

Table 4-16 Results of the regressions analysis for SMEs in the first year after participation in the MX Awards

#	Operational Performance Measures	Financial ratios	Estimated Beta-value	Exact P-value	Total # of companies involved in the analysis
1	Manufacturing operations' responsiveness to changes in market demand (Q332)	Leverage	2.11	0.00 **	19
2	KPIs for the monitoring and control of product introduction programmes (Q233)	Leverage	1.76	0.01 **	14
3	Approach to winning new sales (Q643)	Current Ratio	2.66	0.02 *	14
4	Percentage of key equipment processes capable to the level expected (Q477)	Current Ratio	2.38	0.03 *	11
5	Actions taken as a result of answers received from attitude survey (Q5311)	Current Ratio	1.56	0.04 *	15
6	Adding value to customers through Products and/or services(Q114)	Gross Profit Margin	2.16	0.05 *	19
7	Groups of people involved and their contribution to develop your ICT strategy (Q712)	Current Ratio	2.08	0.05 *	10
** = significant at 0.01 level * = significant at 0.05 level					

The drivers of financial performance of large companies in the first year after participation in the awards are shown in table 4-17. The most important driver for large companies is their 'Approach to win new sales' which had a positive impact on their asset turnover. This shows that companies with a better approach to winning new sales were also more efficient in using their assets to generate sales in the first year after participation in the awards.

Table 4-17 Results of the regressions analysis for Large firms in the first year after participation in the MX Awards

#	Operational Performance Measures	Financial ratios	Estimated Beta-value	Exact P-value	Total # of companies involved in the analysis
1	Approach to winning new sales (Q643)	Asset Turnover	3.53	0.00 **	22
2	Systems and processes in use to maintaining equipment for production (Q473)	Accounts payable	3.07	0.00 **	25
3	Differentiation through Partnerships between Business and Education (Q1051)	Leverage	2.27	0.00 **	24
4	Approach for monitoring the effectiveness of your sales process (Q644)	Asset Turnover	2.32	0.01 **	22
5	Business drivers and key factors for investing in ICT (Q711)	Interest Cover	2.08	0.01 **	19
6	The areas of manuf. process that have been redesigned in the past three years (Q352)	Accounts payable	1.65	0.01 **	31
7	Procedures for monitoring the gender, age, ethnic groups, and disabilities profile of workforce (Q551)	Asset Turnover	1.17	0.01 **	29
8	Actions taken to reduce machine changeover times (Q474)	Return On Total Assets	2.46	0.02 *	23
9	Systems and processes in use to maintain equipment for production (Q473)	Return On Total Assets	2.37	0.02 *	26
10	Approach for identifying and managing business improvement projects (Q615)	Cash Flow	2.13	0.02 *	17
11	Sales and/or distribution channels (Q113)	Accounts payable	1.27	0.02 *	30
12	Project Management techniques to ensure major projects are completed on time (Q652)	Asset Turnover	1.13	0.02 *	22
13	Techniques to manage information on market opportunities, and competitors (Q621)	Cash Flow	2.51	0.03 *	17
14	Visual management tools usage and aspects of the business they cover (Q454)	Return On Total Assets	2.08	0.03 *	13
15	Customer satisfaction measurement and results (Q131)	Cash Flow	1.42	0.03 *	30
16	Approach for ensuring people obtain required formal qualifications and training (Q534)	Accounts payable	1.20	0.03 *	29
17	Actions taken to reduce the need for regular overtime (Q544)	Inventory Turnover	1.03	0.03 *	30
18	KPIs for the monitoring and control of product introduction programmes (Q233)	Current ratio	1.00	0.03 *	24
19	Allocated resources to continuous improvement activities (Q152)	Return on Shareholders' Funds	0.90	0.03 *	27
20	Systems and processes in use to maintain equipment for production (Q473)	Turnover Growth	2.51	0.04 *	23
21	Actions taken to reduce the need for regular overtime (Q544)	Turnover Growth	1.02	0.04 *	26
22	Techniques and responsibility for controlling stocks and work in progress (Q846)	Return On Total Assets	0.85	0.04 *	21
23	What percentage of working time is overtime (Q543)	Interest Cover	1.49	0.05 *	16
24	Identifying new technologies needed for the manufacture of future products (Q314)	Current ratio	0.95	0.05 *	25

** = significant at 0.01 level

* = significant at 0.05 level

4.4.3. Regressions in the second year after participation in the MX Awards

In the second year after participation in the MX Awards, three out of the five correlated pairs of the SMEs had significant regressions. For the Large companies, twenty out of the thirty correlated pairs had significant regressions. The significant regressions for the second year after participation in the awards are presented in tables 4-18 and 4-19, for SMEs and Large firms respectively.

The drivers of financial performance for SMEs in the second year after participation in the awards are shown in table 4-18. The most important operational practice for SMEs is their 'continuous improvement initiatives', which had a positive impact on their account receivable days. This shows that SMEs' continuous improvement initiatives have had a long-term advantage for them. SMEs with better scores in their continuous improvement initiatives were capable of collecting their account receivables quicker in the second year after participation in the awards than in the year of participation.

Table 4-18 Results of the regressions analysis for SMEs in the second year after participation in the MX Awards

#	Operational Performance Measures	Financial ratios	Estimated Beta-value	Exact P-value	Total # of companies involved in the analysis
1	Continuous improvement initiatives for manufacturing process and their benefits (Q342)	Accounts Receivable days	1.71	0.02 *	18
2	Sales and/or distribution channels (Q113)	Gross Profit Margin	2.44	0.03 *	14
3	Actions taken as a result of answers received from attitude survey (Q5311)	Interest Cover	1.42	0.05 *	11
** = significant at 0.01 level * = significant at 0.05 level					

For the Large companies, as shown in table 4-19, the most important driver in the second year is their approach to 'Control for managing debtors' that has had a positive impact on their cash flow yield. This shows that the large companies that had better controls for managing their debtors were more efficient in collecting their debtors. As a result, they had a better cash flow in the second year of participation in the awards than in the year of participation.

Table 4-19 Results of the regressions analysis for Large firms in the second year after participation in the MX Awards

#	Operational Performance Measures	Financial ratios	Estimated Beta-value	Exact P-value	Total # of companies involved in the analysis
1	Controls for managing debtors (Q844)	Cash Flow Yield	2.47	0.00 **	20
2	Items covered in business plan (Q612)	Accounts Receivable	2.39	0.00 **	20
3	Actions taken to improve the environmental performance of logistics operations and results (Q478)	Leverage	2.20	0.00 **	18
4	Manufacturing operations responsiveness to changes in market demand (Q332)	Leverage	1.54	0.00 **	25
5	Methods for assessing, monitoring, and reporting sustainability performance (Q922)	Asset Turnover	2.65	0.01 **	16
6	Identifying new technologies needed for the manufacture of future products (Q314)	Leverage	2.27	0.01 **	19
7	Items covered in business plan (Q612)	Return On Total Assets	2.13	0.01 **	21
8	KPIs for the monitoring and control of product introduction programmes (Q233)	Current Ratio	1.24	0.01 **	24
9	Actions taken for providing a safe and healthy working environment (Q461)	Gross Profit Margin	2.33	0.02 *	20
10	Actions to ensure changes in volumes or product mix can be readily accommodated (Q413)	Accounts Receivable	1.67	0.02 *	25
11	Company's budgeting procedures (Q871)	Asset Turnover	1.31	0.02 *	19
12	Identifying future customer requirements (Q112)	Leverage	1.79	0.03 *	20
13	New products in the past five years and their % of current operating revenue (Q251)	Leverage	1.28	0.03 *	22
14	Significant drivers for change in business (Q614)	Inventory Turnover	1.13	0.03 *	21
15	Techniques to manage information on market opportunities, and competitors (Q621)	Accounts Receivable	2.85	0.04 *	17
16	Key drivers for adopting a more sustainable approach in business (Q911)	Leverage	1.25	0.04 *	14
17	Level of statistical process capability on equipment (Q476)	Leverage	1.11	0.04 *	17
18	Approach for capturing and managing business information and knowledge (Q661)	Asset Turnover	1.89	0.05 *	17
19	Key factors driving operational process innovation (Q311)	Cash Flow Yield	1.15	0.05 *	32
20	Identifying new technologies needed for the manufacture of future products (Q314)	Current Ratio	0.95	0.05 *	25

** = significant at 0.01 level

* = significant at 0.05 level

4.4.4. Regressions in the third year after participation in the MX Awards

In the third year after participation in the MX Awards, three out of three correlated pairs of the SMEs had significant regressions. For the Large companies, nineteen out of the thirty correlated pairs had significant regressions. The significant regressions are presented in table 4-20 and 4-21, for SMEs and Large firms respectively.

As shown in table 4-20, SMEs that had higher scores in their 'Stages in implementing their manufacturing and supply chain processes' had an improved gross profit margin in the third year after participation in the awards. This shows that 'Stages in implementing manufacturing and supply chain processes' had a long-term benefit for SMEs and improved their profitability in the third year after participation in the awards.

Table 4-20 Results of the regressions analysis for Large firms in the third year after participation in the MX Awards

#	Operational Performance Measures	Financial ratios	Estimated Beta-value	Exact P-value	Total # of companies involved in the analysis
1	Stages in implementing manufacturing and supply-chain processes (Q312)	Gross Profit Margin	2.11	0.02 *	12
2	Customers key buying criteria (Q111)	Return On Total Assets	2.50	0.03 *	13
3	Customers key buying criteria (Q111)	Margin On Sales	2.98	0.05 *	13
** = significant at 0.01 level * = significant at 0.05 level					

For the Large companies, as shown in table 4-21, 'Calculation of the capacity available for production to ensure on time deliveries' is the most significant driver for their leverage. This shows that large companies that had more accurate capacity planning were less dependent on external debts. So their leverage is reduced in the third year after participation in the awards.

Table 4-21 Results of the regressions analysis for Large firms in the third year after participation in the MX Awards

#	Operational Performance Measures	Financial ratios	Estimated Beta-value	Exact P-value	Total # of companies involved in the analysis
1	Calculation of the capacity available for production to ensure on-time deliveries (Q452)	Leverage	3.23	0.00 **	19
2	Percentage of key equipment processes capable to the level expected (Q477)	Gross Profit Margin	2.61	0.00 **	14
3	Allocated resources to continuous improvement activities (Q152)	Gross Profit Margin	1.61	0.00 **	23
4	Usage of ICT to integrate internal business processes (Q724)	Leverage	2.19	0.01 **	15
5	Initiatives to achieve continuous improvement (Q151)	Cash Flow	1.93	0.01 **	25
6	Allocated resources to continuous improvement activities (Q152)	Return on Shareholders' Funds	1.89	0.01 **	24
7	Customer satisfaction measurement and results (Q131)	Cash Flow	1.86	0.01 **	28
8	Company's financial and non-financial reward schemes and their reward (Q541)	Inventory Turnover	1.78	0.01 **	28
9	Actions for reducing the environmental impact of production processes (Q343)	Margin On Sales	1.33	0.01 **	30
10	Actions for reducing the environmental impact of production processes (Q343)	Cash Flows To Sales	1.20	0.02 *	30
11	Managing impact on customers when finishing production of a product (Q171)	Margin On Sales	2.58	0.03 *	18
12	Customer satisfaction measurement and results (Q131)	Return on Shareholders' Funds	2.39	0.03 *	24
13	Formal business planning process and people involved (Q611)	Cash Flow	2.08	0.03 *	19
14	Formal business planning process and people involved (Q611)	Interest Cover	2.05	0.03 *	18
15	Alignment between business processes, organisation structure and ICT systems (Q726)	Leverage	1.63	0.03 *	15
16	Procedures for linking involvement with business educational partnerships to job appraisal (Q1014)	Gross Profit Margin	1.09	0.03 *	15
17	Actions taken to reduce the need for regular overtime (Q544)	Return On Total Assets	1.03	0.03 *	28
18	Allocated resources to continuous improvement activities (Q152)	Cash Flow	0.98	0.03 *	28
19	Allocated resources to continuous improvement activities (Q152)	Return On Capital Employed	0.96	0.04 *	29

** = significant at 0.01 level

* = significant at 0.05 level

4.5. The impact of potentially influential factors

In the last two sections (4.3 and 4.4), the results of correlation and regression analyses on the dataset of the study were discussed. The purpose of this section is to examine the impact of two potentially influential factors (i.e. industry sectors and the year of participation in the awards) on the identified relationships. Control variables are used to check if they have any influence on the identified relationships between the dependent and independent variables of the studies (Healey, 2010). Most of the previous studies used some variables to control the impact of the companies' operational performance on their financial performance. For example, Li et al. (2010), Crisostomo et al. (2011), Lee & Yang (2011) used firm ***size*** as a control variable. Braam & Nijssen (2004), Clarke et al. (2011), Lee & Roh (2012) and Saunila et al. (2014) used the companies' ***industry sectors*** as a control variable in their studies. Another potentially influential factor on the finding of this study is the year in which companies had participated in the awards. The ***year of participation*** is used as a proxy to test if the general economic condition of a particular year had any influence on the identified relationships.

In the last two sections (sections 4.3 and 4.4) the results of the correlation and regression analyses were separately analysed for SMEs and large companies; therefore, the impact of the company size on the study findings is already considered. However, the following two factors could still have influenced the findings of the study:

1. The years in which the selected companies had entered the MX Awards.
2. The characteristics of the industries, in which the companies worked.

The sample of the study consists of the companies that entered the MX Awards between 2006 and 2010, and from each year the data of between fifteen and twenty companies were available. Also, the SMEs in the sample were from ten different industry sectors and the large companies were from twenty-one different sectors. Thus, dividing the sample based on the available years or the industry sectors would result in many small datasets. This could not produce any statistically significant conclusions. Thus, the author checked whether the identified findings were mainly drawn from any particular industry sectors or any particular year of participation.

The results show that identified correlated pairs were not based on any particular industry sectors or any year of participation. For example, tables 4-22 and 4-23 show the results of the investigation on the correlation between the companies' 'return-on-shareholders-fund' and their 'Allocated-resources-to-continuous-improvement'.

First, the specific years in which the companies' participated were explored (table 4-22). Most of the companies whose financial results had deteriorated had entered in 2008 (six companies out of eleven). This could be because of a specific market condition (i.e. the 2008 financial crisis), that the majority of the companies in that year had shown deterioration on their 'return-on-shareholders-fund'. But in the original year, there were four other companies that had shown improvement in their 'return-on-shareholders-fund'. So the six deteriorated companies from the year 2008 could not have significantly impacted the findings.

Table 4-22 Influence of the year of participation on the findings

Allocated resources to continuous improvement activities (Q152)-First year Return on Shareholders' Funds			
Year of participation	**Improved Frequency**	**Deteriorated Frequency**	**Total**
2006	3	0	3
2007	2	1	3
2008	4	6	10
2009	4	2	6
2010	3	2	5
Total	16	11	27

Table 4-23, shows the result of the investigation on the industry sectors of the same companies. There were three manufacturers of fabricated metal products that had deteriorated in their 'return-on-shareholders-fund'. However, from the same industry, three companies had shown improvement in their results. Therefore, again they counterbalanced each other's influence on the findings. The same investigation was conducted for the other identified correlated pairs and the results are presented in appendix 5. Overall, the identified correlated pairs were not based on any particular industry sectors or any year of participation.

Table 4-23 Influence of the industry sectors' characteristics on the findings

Allocated resources to continuous improvement activities (Q152)-First year Return on Shareholders' Funds			
Industry Sectors	**Improved Frequency**	**Deteriorated Frequency**	**Total**
17 - Manufacture of paper and paper products	1	0	1
20 - Manufacture of chemicals and chemical products	1	0	1
22 - Manufacture of rubber and plastic products	1	2	3
25 - Manufacture of fabricated metal products, except machinery and equipment	3	3	6
26 - Manufacture of computer, electronic and optical products	2	1	3
28 - Manufacture of machinery and equipment n.e.c.	3	1	4
29 - Manufacture of motor vehicles, trailers and semi-trailers	3	2	5
30 - Manufacture of other transport equipment	0	1	1
32 - Other manufacturing	2	1	3
Total	16	11	27

In the next section, the identified relationships in the previous section will be validated by the data from the validation sample (i.e. companies that have participated in the MX Awards in 2011).

4.6. Validation of the identified relationships

Based on the regression analysis, the operational practices that have a direct positive impact on the financial performance of SMEs and Large firms were identified. In this section, the identified relationships will be validated, based on the data from twenty-one manufacturing companies in the validation sample of the study. The companies in the validation sample participated in the MX Awards in 2011. There were eight SMEs and thirteen large companies in the sample, and table 4-24 shows their industry sectors. In the following, the results of the validation analysis on the identified relationships are presented.

Table 4-24 Industry sectors of the validation sample

#	Industry Sectors of the Entire sample	SMEs		Large firms	
		Count	Percentage	Count	Percentage
1	25 - Manufacture of fabricated metal products, except machinery and equipment	1	13%	1	8%
2	28 - Manufacture of machinery and equipment n.e.c.	3	38%	2	15%
3	32 - Other manufacturing	1	13%	3	23%
4	26 - Manufacture of computer, electronic and optical products	2	25%	4	31%
5	22 - Manufacture of rubber and plastic products	1	13%	0	0%
7	29 - Manufacture of motor vehicles, trailers and semi-trailers	0	0%	1	8%
9	84 - Public administration and defence; compulsory social security	0	0%	1	8%
10	30 - Manufacture of other transport equipment	0	0%	1	8%
Total		8	100%	13	100%

Following the past studies on predictive modelling, such as Didenko et al. (2012) and Altman (2000), in this study the following four statistics are calculated:

1- $\%\ of\ correct\ predictions = \frac{\sum correct\ improvement\ predictions + \sum correct\ deteriaration\ predictions}{Total\ observations} * 100$

2- $\%\ of\ Total\ Errors = \frac{\sum incorrect\ improvement\ predictions + \sum incorrect\ deteriaration\ predictions}{Total\ observations} * 100$

3- $\text{Type I Error} = \frac{\sum incorrect\ improvement\ predictions}{Total\ improvement\ observations} * 100$

4- $\text{Type II Error} = \frac{\sum incorrect\ deterioration\ predictions}{Total\ deterioration\ observations} * 100$

Type I error shows the percentage of companies that were predicted to have improved in their financial ratios, but the actual observation shows deterioration. Type II error shows the percentage of companies that were predicted to have deteriorated in their financial ratios, but the actual observation shows improvement. In this study, similar to the past studies on predictive modelling, only the causal relationships with more than 50% correct prediction (i.e. more than pure chance) is accepted. In the following subsections, the validated relationships for each year after participation in the awards are explained.

4.6.1. Validated relationships in the year of participation in the MX Awards

In the previous section (4.4.1), three operational practices were identified that had a direct positive impact on SMEs' financial performance in the year of participation in the awards. Also, forty-six practices were identified for large firms. However, only one practice for SMEs and twenty-nine practices for large firms were validated by the data of the companies in the validation sample.

As shown in table 4-25, SMEs that had used better project management techniques to complete their projects on time, managed to improve their relationship with their suppliers and improve their liquidity by increasing their account payable days.

Table 4-25 Validated relationships for SMEs in the year of participation in the MX Awards

#	Validated relationships		Correct Prediction	Total Error	Error Type I	Error Type II	Total Observations
	Operational Practices	Financial ratios					
1	Project management techniques to ensure major projects are completed on time (Q652)	Accounts Payable Days	60%	40%	0%	67%	20

The validated relationships for large firms are presented in table 4-26. The relationships in the table are sorted based on the significance level of the regression models. Therefore, the most important practice that had a direct positive impact on large firms' financial performance is 'Differentiation through People Effectiveness'. In the year of participation in the awards, large firms that had differentiated themselves through people effectiveness had increased cash flow, which resulted in an improvement in their 'cash flow to total debt' and 'cash flow to sales'.

Table 4-26 Validated relationships for Large firms in the year of participation in the MX Awards

#	Validated relationships		Correct Prediction	Total Error	Error Type I	Error Type II	Total Observations
	Operational Practices	Financial ratios					
1	Differentiation through People Effectiveness (Q571)	Cash Flow to Total Deb	89%	11%	0%	17%	37
2	Differentiation through People Effectiveness (Q571)	Cash flows to sales	67%	33%	40%	25%	38
3	Company's financial and non-financial reward schemes and their reward (Q541)	Return on Capital Employed	70%	30%	67%	14%	41
4	Differentiation through People Effectiveness (Q571)	Profit margin	67%	33%	40%	25%	39
5	Managing impact on customers when finishing production of a product (Q171)	Asset turnover	90%	10%	0%	13%	29
6	Differentiation through Customer Focus (Q181)	Return on Capital Employed	80%	20%	0%	25%	42
7	Company's financial and non-financial reward schemes and their reward (Q541)	Profit margin	80%	20%	33%	0%	40
8	Information on health, safety, environmental issues provided to workforce (Q462)	Quick ratio	56%	44%	57%	0%	36
9	Company's financial and non-financial reward schemes and their reward (Q541)	Cash flows to sales	70%	30%	40%	20%	39
10	Formal business planning process and people involved (Q611)	Cash flows to sales	88%	13%	0%	33%	30
11	Actions taken to reduce the need for regular overtime (Q544)	Gross Profit margin	75%	25%	0%	67%	31
12	Approach for ensuring accounting practices support the business drivers (Q847)	Cash flows to sales	56%	44%	80%	0%	21
13	Benefits to company from partnerships with educational establishments (Q562)	Return on Capital Employed	78%	22%	0%	29%	40
14	Actions for improving customer satisfaction (Q132)	Cash flows to sales	80%	20%	40%	0%	39
15	Initiatives to achieve continuous improvement (Q151)	Return on total assets	90%	10%	33%	0%	38
16	Differentiation through People Effectiveness (Q571)	Return on Capital Employed	78%	22%	0%	29%	40
17	Methods of reporting the progress towards business objectives to workforce (Q522)	Current ratio	67%	33%	60%	0%	40
18	Key factors affecting financial performance over the past three years (Q831)	Inventory turnover	63%	38%	33%	40%	29
19	Benefits of after-sales to customers and company (Q122)	Profit margin	70%	30%	40%	20%	39
20	Approach for ensuring employees gain experience to take new roles (Q532)	Interest cover	63%	38%	50%	25%	34
21	Company's collaboration with educational establishments (Q562)	Interest cover	56%	44%	100%	0%	35
22	Significant drivers for change in business (Q614)	Cash flows to sales	75%	25%	20%	33%	30
23	Customer satisfaction measurement and results (Q131)	Return on Capital Employed	70%	30%	50%	29%	41
24	Differentiation through People Effectiveness (Q571)	Cash flow	78%	22%	0%	29%	38
25	Differentiation through Customer Focus (Q181)	Return on Shareholders' Funds	90%	10%	0%	14%	40
26	Differentiation through Customer Focus (Q181)	Profit margin	70%	30%	40%	20%	41
27	Benefits to company from partnerships with educational establishments (Q562)	Return on Shareholders' Funds	89%	11%	0%	17%	38
28	Approach for ensuring employees gain experience to take new roles (Q532)	Cash flows to sales	67%	33%	40%	25%	38
29	Benefits of after-sales to customers and company (Q122)	Return on total assets	90%	10%	0%	14%	40

4.6.2. Validated relationships in the first year after participation in the MX Awards

In the first year after participation in the awards, seven practices for SMEs and twenty-four practices for Large companies were identified that had a positive impact on their financial performance. Of these, five practices for SMEs and ten practices for large firms were validated by the data of companies in the validation sample.

The five validated relationships for SMEs are presented in table 4-27 in descending order of importance. The most important practice for SMEs in the first year after participation in the awards was the responsiveness of their manufacturing operations to market demand. Therefore, SMEs that had more responsive manufacturing operations had less need for external debt and reduced their leverage (debt to equity) in the first year after participation in the awards.

Table 4-27 Validated relationships for SMEs in the first year after participation in the MX Awards

#	Validated relationships		Correct Prediction	Total Error	Error Type I	Error Type II	Total Observations
	Operational Practices	Financial ratios					
1	Manufacturing operations' responsiveness to changes in market demand (Q332)	Leverage	100%	0%	0%	0%	24
2	KPIs for the monitoring and control of product introduction programmes (Q233)	Leverage	80%	20%	0%	20%	19
3	Approach to winning new sales (Q643)	Current ratio	60%	40%	0%	40%	19
4	Actions taken as a result of answers received from attitude survey (Q5311)	Current ratio	100%	0%	0%	0%	21
5	Adding value to customers through Products and/or services(Q114)	Gross Profit margin	83%	17%	25%	0%	25

Also in the first year, the most important practice for large firms was redesigning their manufacturing processes (table 4-28). Large firms that had better performance in redesigning the manufacturing processes improved their liquidity by having a better relationship with their suppliers, and increasing their account payable days.

Table 4-28 Validated relationships for Large firms in the first year after participation in the MX Awards

#	Validated relationships		Correct Prediction	Total Error	Error Type I	Error Type II	Total Observations
	Operational Practices	Financial ratios					
1	The areas of manuf. process that have been redesigned in the past three years (Q352)	Accounts payable days	63%	38%	100%	0%	39
2	Actions taken to reduce machine changeover times (Q474)	Return on total assets	67%	33%	40%	25%	32
3	Approach for identifying and managing business improvement projects (Q615)	Cash flow	63%	38%	40%	33%	25
4	Sales and/or distribution channels (Q113)	Accounts payable days	60%	40%	75%	17%	40
5	Techniques for managing information on market opportunities, and competitors (Q621)	Cash flow	88%	13%	0%	33%	25
6	KPIs for the monitoring and control of product introduction programmes (Q233)	Current ratio	56%	44%	40%	50%	33
7	Allocated resources to continuous improvement activities (Q152)	Return on Shareholders' Funds	70%	30%	40%	20%	37
8	Systems and processes in use to maintain equipment for production (Q473)	Turnover Growth	89%	11%	0%	50%	32
9	What percentage of working time is overtime? (Q543)	Interest cover	86%	14%	50%	0%	36
10	Identifying new technologies needed for the manufacture of future products (Q314)	Current ratio	89%	11%	0%	25%	34

4.6.3. Validated relationships in the second year after participation in the MX Awards

In the second year after participation in the awards, three practices for SMEs were identified that had a positive impact on their financial performance. All three identified relationships were validated by the SMEs in the validation sample. Table 4-29 shows these practices in descending order of importance. The most important practice for improving the financial performance of SMEs in the second year after participation in the awards was their 'Continuous improvement initiatives for manufacturing processes'. Therefore, continuous improvement of manufacturing processes had a long-term benefit for SMEs in the sample of this study.

Table 4-29 Validated relationships for SMEs in the second year after participation in the MX Awards

#	Validated relationships		Correct Prediction	Total Error	Error Type I	Error Type II	Total Observations
	Operational Practices	Financial ratios					
1	Continuous improvement initiatives for manufacturing process and their benefits (Q342)	Accounts Receivable days	100%	0%	0%	0%	22
2	Sales and/or distribution channels (Q113)	Gross Profit margin	75%	25%	0%	25%	18
3	Actions taken as a result of answers received from attitude survey (Q5311)	Interest cover	67%	33%	33%	0%	14

In the second year, twenty operational practices of large firms were also identified that had a positive impact on their financial performance. Of these, only seven relationships were validated by the data from large companies in the validation sample. The validated relationships for large firms in the second year after participation in the awards are presented in table 4-30 in descending order of importance. The most important practice for large firms in the second year, were their 'Controls and responsibility for managing debtors' that had a positive impact in improving their cash flow in the long term.

Table 4-30 Validated relationships for Large firms in the second year after participation in the MX Awards

#	Validated relationships		Correct Prediction	Total Error	Error Type I	Error Type II	Total Observations
	Operational Practices	Financial ratios					
1	Controls and responsibility for managing debtors (Q844)	Cash flows yield	100%	0%	0%	0%	26
2	KPIs for the monitoring and control of product introduction programmes (Q233)	Current ratio	80%	20%	0%	33%	29
3	Actions taken to provide a safe and healthy working environment (Q461)	Gross Profit margin	100%	0%	0%	0%	24
4	Company's budgeting procedures (Q871)	Asset turnover	67%	33%	20%	100%	25
5	Significant drivers for change in business (Q614)	Inventory turnover	60%	40%	0%	50%	26
6	Key drivers for adopting a more sustainable approach in business (Q911)	Leverage	100%	0%	0%	0%	19
7	Identifying new technologies needed for the manufacture of future products (Q314)	Current ratio	100%	0%	0%	0%	30

4.6.4. Validated relationships in the third year after participation in the MX Awards

Finally, in the third year after participation in the award, three operational practices for SMEs and nineteen for Large firms were identified that had a positive impact on their financial performance. Of these, only two relationships for SMEs and three relationships for large firms were validated by the data from validation sample.

As shown in table 4-31, the most important practice for SMEs in the third year was knowing their customers key buying criteria that had a long-term positive impact on two measures of their profitability (i.e. return on total asset and margin on sales).

Table 4-31 Validated relationships for SMEs in the third year after participation in the MX Awards

#	Causal relationships		Correct Prediction	Total Error	Error Type I	Error Type II	Total Observations
	Predictor variable	Response variable					
1	Customers' key buying criteria (Q111)	Return on total assets	67%	33%	0%	50%	19
2	Customers' key buying criteria (Q111)	Margin On Sales	83%	17%	0%	25%	19

Also as shown in table 4-32, the most important practice for Large firms in the third year was their 'financial and non-financial reward schemes' which had a positive impact on the inventory turnover.

Table 4-32 Validated relationships for Large firms in the third year after participation in the MX Awards

#	Causal relationships		Correct Prediction	Total Error	Error Type I	Error Type II	Total Observations
	Predictor variable	Response variable					
1	Company's financial and non-financial reward schemes and their reward (Q541)	Inventory Turnover	56%	44%	0%	33%	37
2	Managing impact on customers when finishing production of a product (Q171)	Margin On Sales	60%	40%	0%	33%	28
3	Formal business planning process and people involved (Q611)	Cash Flow	63%	38%	0%	38%	27

In general, the number of operational practices that were expected to have a positive impact on the SMEs' financial performance was lower than that of large firms. However, most of the identified relationships for SMEs were also validated by the companies in the validation sample in the year of participation and three years after that. However, the number of validated relationships for large firms reduces as we move away from the year of participation in awards. In the year of participation in the awards, twenty-eight out of forty-five relationships were validated (≈ 62%) for Large firms. However, this number is reduced to 42% in the first year, 35% in the second year and 15% in the third year. This is understandable as in this study the data about the operational practices of companies was only available for the year of participation in the award. Therefore, it is logical that the predictability of using the same operational data to predict the financial performance in the future years should gradually decrease.

In this section, the relationships between the operational practices and financial measures that were validated by the companies in the validation sample of the study were explained. In the following section, the identified relationships will be used to support or not support the hypotheses of the study.

4.7. Comparison of the findings with the hypotheses

In the last section, the relationships between the operational practices and financial performance of SMEs and Large firms were validated by the companies in the validation sample. In this section, these relationships will be used to support or not support the hypotheses of the study. Based on the findings of this study, the hypotheses can be classified into the following four groups:

1) The hypotheses that are supported by the findings of this study.
2) The hypotheses that are partially supported by the findings of this study (i.e. the practices in these hypotheses had a positive impact on the competitiveness or profitability of either SMEs or Large firms, but not both).
3) The hypotheses that are not supported by the findings of this study, but the practices in these hypotheses had a positive impact on the financial performance of the companies on the aspects other than competitiveness or profitability.
4) The hypotheses that are not supported by the findings of this study and had no positive impact on other aspects of the companies' financial performance.

In the following subsections, the findings of the study related to each of the above groups will be discussed.

4.7.1. Hypotheses that are supported

Based on the findings of the earlier studies, the practices in the hypotheses 1 and 2 were expected to have a direct positive impact on companies' profitability and competitiveness. They had the expected impact on the financial performance of the companies in this study too. Therefore, these two hypotheses are supported by the findings of this study. Also, the practices in hypotheses 7, 19 and 20 were expected to have no direct positive impact on companies' profitability and competitiveness. They also had no positive impact on the financial performance of the companies in the sample of this study. Therefore, these hypotheses are also supported. In the following, the findings of this study that support these hypotheses will be explained.

4.7.1.1. Practices related to customer satisfaction (hypothesis 1)

Hypothesis 1 of this study was as follows:

- H1: Practices related to customer satisfaction have a direct positive impact on companies' competitiveness or profitability.

To test this hypothesis, four questions from the MX survey that are related to the customer satisfaction (appendix 2) were selected. As shown in table 4-33, one of those questions (1.1.4 how do you believe your products and/or services add value to your customers?) had a direct positive impact on an SME's profitability. The other three questions had a direct positive impact on profitability, cash flow and asset management of large companies.

Table 4-33 the impact of the practices related to customer satisfaction

Identified practices from the literature	Questions from MX Awards Survey	Financial performance	Estimated Beta-value	Exact P-value	Total Observations
• Value for the money spent	1.1.4 How do you believe your products and/or services add value to your customers?	**SMEs:** 1st year gross profit margin	2.16	0.05 *	25
• Increase in customer satisfaction	1.3.2 What actions have you taken to improve customer satisfaction?	**Large firms :** Original year cash flows to sales	1.98	0.02 *	39
• Increase in customer satisfaction	1.3.1 How do you measure customer satisfaction and what are the results?	**Large firms :** original year return on capital employed	2.08	0.03 *	41
• Customer Retention Rate	6.1.4 What are the significant drivers for change in your business? (Retain key customers, Win new customers, Expand into new markets)	**Large firms :** 1-2nd year inventory turnover 2-original year cash flows to sales	1.13 1.10	0.03 * 0.03 *	26 30

The most significant practice for large firms is their actions to improve their customer satisfaction that had a positive impact on their cash flow (original year cash flow to sales). Also, the methods used by Large firms to measure their customer satisfaction and the results (1.3.1) had a positive impact on their profitability (original year return on capital employed). Therefore, the findings of this study show that practices related to customer satisfaction have a direct positive impact on the profitability of both SMEs and Large companies. Therefore, this finding of the study supports hypothesis 1 (figure 4-1).

Figure 4-1 Comparing hypothesis 1 with the results of this study

4.7.1.2. Practices related to customer focus (hypothesis 2)

Hypothesis 2 of this study was as follows:

- H2: Practices related to customer focus have a direct positive impact on companies' competitiveness or profitability.

To test this hypothesis, eight questions from the MX survey that are related to customer focus (appendix 2), were selected. Overall, six of those questions, had a direct positive impact on profitability and liquidity of SMEs and profitability, liquidity and asset management of large companies (table 4-34).

Table 4-34 The impact of the practices related to customer focus

Identified practices from the literature	Questions from MX Awards Survey	Financial performance	Estimated Beta-value	Exact P-value	Total Observations
• Identification of customer needs and expectations.	1.1.3 Which sales and/or distribution channels do you use and what benefits do they provide?	**Large firms :** 1st year accounts payable days **SMEs:** 2nd year gross profit margin	1.27 2.44	0.02 * 0.03 *	40 18
• Identification of customer needs and expectations.	6.4.3 How does your company win new sales? (Developing a product family based on particular customer needs)	**SMEs:** 1st year current ratio	2.66	0.02 *	19
• Identification of customer needs and expectations.	1.1.1 What are the key buying criteria used by your customers?	**SMEs:** 1-3rd year return on total assets 2- 3rd year margin on sales	2.50 2.98	0.03 * 0.05 *	19 19
• Assessment of customer needs and expectations.	1.7.1 How do you manage the impact on your customers when ending the manufacture of a product line?	**Large firms :** 1-original year asset turnover 2-3rd year margin on sales	2.61 2.58	0.01 ** 0.03 *	29 28
• Overall reputation score	1.8.1 How do you believe that your approach to Customer Focus differentiates your organisation?	**Large firms :** 1-original year return on capital employed 2-original year return on shareholders' funds 3-original year margin on sales	2.48 2.09 2.09	0.01 ** 0.04 * 0.04 *	42 40 41
----	1.2.2 What benefits have after-sales and product support brought to your customers and your company?	**Large firms :** 1-original year margin on sales 2-original year return on total assets	1.28 1.02	0.03 * 0.05 *	39 40

As shown in table 4-34, the most significant impact for SMEs was their choice of sales or distribution channels to find customer needs and expectations (1.1.3) that had a positive impact on their profitability (2nd year gross profit margin). For Large companies, the most significant impact was from understanding the key buying criteria of their customers (1.1.1) that had a positive impact on their profitability (3rd year return on total assets and margin on sales). Therefore, this finding of the study supports hypothesis 2 (figure 4-2).

Figure 4-2 Comparing hypothesis 2 with the results of this study

4.7.1.3. Practices related to employees' training (hypothesis 7)

Hypothesis 7 of this study was as follows:

- H7: Practices related to employees' training have no direct positive impact on companies' competitiveness and profitability.

To test this hypothesis, two questions from the MX survey that were related to employees' training, were selected are shown in table 4-35.

Table 4-35 The impact of the practices related to employees' training

Identified practices from the literature	Questions from MX Awards Survey	Financial performance	Estimated Beta-value	Exact P-value	Total Observations
• Employee training	5.3.1 How do you assess an individual's performance and identify their training requirements?	---	---	---	---
• Employee training	5.3.4 How does your company ensure people obtain the formal qualifications and the training they need to allow them to achieve their full potential?	---	---	---	---

None of these questions had a direct positive impact on the financial variables of the companies in the sample of this study. Therefore, this finding of the study supports hypothesis 7 (figure 4-3).

Figure 4-3 Comparing hypothesis 7 with the results of this study

4.7.1.4. Practices related to building relationships with suppliers (hypothesis 19)

Hypothesis 19 of this study was as follows:

- H19: Practices related to building relationships with suppliers have no positive impact on companies' competitiveness and profitability.

To test this hypothesis, three questions from the MX survey that are presented in table 4-36 were selected.

Table 4-36 The impact of the practices related to building relationship with suppliers

Identified practices from the literature	Questions from MX Awards Survey	Financial performance	Estimated Beta-value	Exact P-value	Total Observations
•Integrated closely with raw material suppliers	3.4.1 What is your customers' and/or suppliers' involvement in manufacturing process innovation? (Only improve Large firms' debt management)	---	---	---	---
•Providing feedback to suppliers on the performance of products and processes.	4.3.1 How do you determine acceptable lead times for suppliers?	---	---	---	---
•Providing feedback to suppliers on the performance of products and processes.	4.3.2 What actions do you take to improve the on-time delivery performance of your suppliers?	---	---	---	---

None of these questions had a direct positive impact on the financial performance of the companies in the sample of this study. Therefore, this finding of the study supports hypothesis 19 (figure 4-4).

Figure 4-4 Comparing hypothesis 19 with the results of this study

4.7.1.5. Practices related to supplier selection (hypothesis 20)

Hypothesis 20 of this study was as follows:

- H20: Practices related to supplier selection have no direct positive impact on companies' competitiveness and profitability.

To test this hypothesis, four questions from the MX survey that are related to supplier selection were selected (table 4-37).

Table 4-37 The impact of the practices related to supplier selection

Identified practices from the literature	Questions from MX Awards Survey	Financial performance	Estimated Beta-value	Exact P-value	Total Observations
•Considering process capability in supplier selection	1.6.1 What percentage of your supplier base, by total value, is approved to deliver directly to production without routine incoming inspection?	---	---	---	---
•Considering process capability in supplier selection	1.6.2 How do you assess your suppliers' quality performance?	---	---	---	---
•Supplier evaluation and selection	4.2.1 What factors and risks do you consider when selecting partners/suppliers?	---	---	---	---
•Considering commitment to quality in supplier selection	4.2.2 What information and resources do you make available to suppliers?	---	---	---	---

None of these questions had a direct positive impact on the financial performance of the companies in the sample of this study. Therefore, this finding of the study supports hypothesis 20 (figure 4-5).

Figure 4-5 Comparing hypothesis 20 with the results of this study

4.7.2. Hypotheses that are partially supported

Based on the findings of the earlier studies, the practices in the hypotheses (4, 6, 9, 11, and 12) were expected to have a direct positive impact on companies' profitability and competitiveness. However, they only had the expected impact for the large companies in this study. Some of the practices in hypotheses 4 and 9 had positive impact on other dimensions of SMEs' financial performance, but not on their competitiveness or profitability. Therefore, these hypotheses are partially supported by the findings of this study (i.e. only for Large firms).

Also, the practices in hypothesis 16 were expected to have no direct positive impact on companies' profitability and competitiveness. However, they had a positive impact on the profitability of the large firms in this study. Therefore, this hypothesis is partially supported by the findings of this study (i.e. only for SMEs). In the following subsections, the findings of this study that partially support these hypotheses will be explained.

4.7.2.1. Practices related to employees' effectiveness (hypothesis 4)

Hypothesis 4 of this study was as follows:

- H4: Practices related to employees' effectiveness and satisfaction have a direct positive impact on companies' competitiveness and profitability.

To test hypothesis 4, seven questions from the MX survey that are related to employees' effectiveness (appendix 2), were selected. Only two of these had a positive impact on the financial performance of the companies in the sample of this study (4-38).

Table 4-38 The impact of the practices related to employee's effectiveness

Identified practices from the literature	Questions from MX Awards Survey	Financial performance	Estimated Beta-value	Exact P-value	Total Observations
• Employee satisfaction is analysed and the results are the target of continuous improvement.	5.3.11 What actions have you taken as a result of answers received from your attitude survey?	**SMEs:** 1-1st year current ratio 2-2nd year interest cover	 1.56 1.42	 0.04 * 0.05 *	 21 14
• The competence of the employees is maintained and developed in a systematic way.	5.7.1 How do you believe that your approach to People Effectiveness differentiates your organisation?	**Large firms :** 1-original year cash flow to total debt 2-original year cash flows to sales 3-original year margin on sales 4-original year return on capital employed 5- original year cash flow	 3.17 3.11 2.68 2.15 2.17	 0.00 ** 0.00 ** 0.01 ** 0.03 * 0.04 *	 37 38 39 40 38

As shown is table 4-38, SMEs' actions as a result of answers received from their attitude survey (5.3.11) had a direct positive impact on their liquidity (1st year current ratio) and debt management (2nd year interest cover). For Large companies, their approach to differentiating themselves through people effectiveness (5.7.1) had a positive impact on their cash flow (three measures) and profitability (two measures). Therefore, only the finding of this study for large companies is aligned with the findings of the earlier studies and partially supports hypothesis 4 (figure 4-6).

Figure 4-6 Comparing hypothesis 4 with the results of this study

4.7.2.2. Practices related to employees' recruitment (hypothesis 6)

Hypothesis 6 of this study was as follows:

- H6: Practices related to employees' recruitment, reward and retention have a direct positive impact on companies' competitiveness and profitability.

To test hypothesis 6, four questions from the MX survey that are related to employees' recruitment (appendix 2), were selected. As shown in table 4-39, three of these had a positive impact on the financial performance of the large companies in the sample of this study. However, these practices had no direct positive impact on the financial performance of the SMEs in this study.

Table 4-39 the impact of the practices related to employee recruitment

Identified practices from the literature	Questions from MX Awards Survey	Financial performance	Estimated Beta-value	Exact P-value	Total Observations
•Remuneration package to promote employee retention.	5.4.1 What financial and non-financial reward schemes does your company operate and what do they reward?	**Large firms :** 1-original year return on capital employed 2- original year margin on sales 3- original year cash flows to sales 4-3rd year inventory turnover	 2.42 2.33 1.84 1.78	 0.00 ** 0.01 ** 0.01 ** 0.01 **	 41 40 39 37
•Remuneration package to promote employee retention.	5.4.4 What actions have been taken to reduce the need for regular overtime?	**Large firms :** original year gross profit margin	1.61	0.01 **	31
•Remuneration package to promote employee retention.	5.4.3 On average, what percentage of working time is overtime?	**Large firms :** 1st year interest cover	1.49	0.05 *	36

The most influential practices in this category was Large firms' financial and non-financial reward schemes (5.4.1) that had a positive impact on their profitability (such as return on capital employed), cash flow and asset management. Therefore, only the findings of this study related to the large companies is aligned with the findings of the earlier studies and partially supports hypothesis 6 (figure 4-7).

Figure 4-7 Comparing hypothesis 6 with the results of this study

4.7.2.3. Practices related to process performance improvement (hypothesis 9)

Hypothesis 9 of this study was as follows:

- H9: Practices related to process performance improvement have a direct positive impact on companies' competitiveness and profitability.

To test hypothesis 9, six questions of the MX survey that are related to process performance improvement (appendix 2), were selected. As shown in table 4-40, one of those questions had a positive impact on the financial performance of the SMEs in the sample of this study. Also, four practices had a positive impact on the financial performance of the large firms in this study.

Table 4-40 the impact of the practices related to improvement of process performance

Identified practices from the literature	Questions from MX Awards Survey	Financial performance	Estimated Beta-value	Exact P-value	Total Observations
•Quality system in our company is improved continuously.	3.4.2 What manufacturing process continuous improvement initiatives have you implemented and what benefits have they provided?	**SMEs:** 2nd year accounts receivable days	1.71	0.02 *	22
•Quality system in our company is improved continuously.	3.5.2 Please give details of the areas of your manufacturing process that have been redesigned in the past three years.	**Large firms :** 1st year accounts payable days	1.65	0.01 **	39
•Continuous efforts are made to improve quality at all levels	6.1.5 How are business improvements projects identified and managed?	**Large firms :** 1st year cash flow	2.13	0.02 *	25
•Continuous efforts are made to improve quality at all levels	1.5.1 What initiatives do you take to achieve continuous improvement?	**Large firms :** original year return on total assets	1.31	0.02 *	38
•Management provides the necessary resources to carry out activities efficiently.	1.5.2 What resources are allocated to continuous improvement activities?	**Large firms :** 1st year return on shareholders' funds	0.90	0.03 *	37

For SMEs, 'continuous improvement initiatives for their manufacturing process (3.4.2)' had a positive impact on their liquidity (2nd year accounts receivable). However, there was no practice that had a positive impact on the profitability or competitiveness of SMEs.

For Large companies, the most significant relationship was between redesigning their manufacturing processes (3.5.2) and improvement of their liquidity (1st year account payable days). However, their continuous improvement initiatives (1.5.1) had a positive impact on their profitability (original year return on total assets). Therefore, only the findings of this study related to large companies is aligned with the findings of the earlier studies and partially supports hypothesis 9 (figure 4-8).

Figure 4-8 Comparing hypothesis 9 with the results of this study

4.7.2.4. Practices related to manufacturing simplicity (hypothesis 11)

Hypothesis 11 of this study was as follows:

- H11: Practices related to manufacturing simplicity and reducing se-up times have a direct positive impact on companies' competitiveness and profitability.

To test hypothesis 11, three questions of the MX survey that are related to manufacturing simplicity (appendix 2), were selected. As shown in table 4-41, only one of those questions had a positive impact on the financial performance of the large companies in the sample of this study. However, they had no direct positive impact on the financial performance of the SMEs.

Table 4-41 The impact of the practices related to manufacturing simplicity

Identified practices from the literature	Questions from MX Awards Survey	Financial performance	Estimated Beta-value	Exact P-value	Total Observations
•Uses special tools to shorten set-up time •Trains employees to reduce set-up time	4.7.4 What actions have been taken to reduce machine changeover times?	**Large firms :** 1st year return on total assets	2.46	0.02 *	32

For Large companies, the actions which have been taken to reduce machine changeover times (4.7.4) had a positive impact on their profitability (1st year return on total assets). Therefore, only the findings of this study related to the large companies is aligned with the findings of the earlier studies and partially supports hypothesis 11 (figure 4-9).

Figure 4-9 Comparing hypothesis 11 with the results of this study

4.7.2.5. Practices related to preventive maintenance (hypothesis 12)

Hypothesis 12 of this study was as follows:

- H12: Practices related to preventive maintenance have a direct positive impact on companies' competitiveness and profitability.

To test hypothesis 12, four questions of the MX survey that are related to preventive maintenance (appendix 2), were selected. As shown in table 4-42, only one of those questions had a positive impact on the financial performance of the large companies in the sample of this study. However, they had no direct positive impact on the financial performance of the SMEs.

Table 4-42 The impact of the practices related to preventive maintenance

Identified practices from the literature	Questions from MX Awards Survey	Financial performance	Estimated Beta-value	Exact P-value	Total Observations
• Total preventive maintenance practices	4.7.3 What systems and processes do you use to maintain your equipment and ensure it is available to production when required?	**Large firms :** 1st year turnover growth	2.51	0.04 *	32

For Large companies, their systems and processes to maintain equipment (4.7.3) had a positive impact on their competitiveness (1st year turnover growth). Therefore, only the findings of this study related to the large companies is aligned with the findings of the earlier studies and partially supports hypothesis 12 (figure 4-10).

Figure 4-10 Comparing hypothesis 12 with the results of this study

4.7.2.6. Practices related to corporate social responsibility (hypothesis 16)

Hypothesis 16 of this study was as follows:

- H16: Practices related to corporate social responsibility have no direct positive impact on companies' competitiveness and profitability.

To test hypothesis 16, eleven questions from the MX survey that are related to corporate social responsibility (appendix 2) were selected. As shown in table 4-43, four of these had a positive impact on the financial performance of the large companies in the sample of this study. However, they had no impact on the financial performance of SMEs in this study.

Table 4-43 the impact of the practices related to corporate social responsibility

Identified practices from the literature	Questions from MX Awards Survey	Financial performance	Estimated Beta-value	Exact P-value	Total Observations
•Health and security risks are prevented and reduced	4.6.2 What information on health, safety, environmental issues and actual safety performance is provided to your workforce?	**Large firms :** Original year Quick ratio	1.84	0.01 **	36
•Health and security risks are prevented and reduced	4.6.1 What actions are taken to provide a safe and healthy working environment and how do you know they are effective?	**Large firms :** 2nd year gross profit margin	2.33	0.02 *	24
•Relationship with employees	5.6.2 What have been the benefits to your company from partnerships with educational establishments?	**Large firms :** 1-original year return on capital employed 2-original year interest cover 3-original year return on shareholders' funds	2.01 1.21 1.78	0.02 * 0.03 * 0.05 *	40 35 38
•Active involvement in social issues	9.1.1 What are the key drivers for adopting a more sustainable approach in your business?	**Large firms :** 2nd year leverage	1.25	0.04 *	19

For Large companies, the most important practice was sharing information on health and safety with their workforce (4.6.2) and this had a positive impact on their liquidity (Original year Quick ratio). Also, there were three other practices (4.6.1, 5.6.2, 9.1.1) that had a positive impact on large companies' profitability and debt management. Therefore, the finding of this study for SMEs is aligned with the findings of the earlier studies and partially supports hypothesis 16 (figure 4-11).

Figure 4-11 Comparing hypothesis 16 with the results of this study

4.7.3. Hypotheses that are not supported but had some positive impacts

Based on the findings of the earlier studies, the practices in hypotheses (5, 8, 13 and 18) were expected to have a direct positive impact on companies' profitability and competitiveness. They did not have the expected impact on the companies in this study. Therefore, these hypotheses are not supported. However, they had a direct positive impact on some other dimensions of the companies' financial performance. In the following subsections, the findings of this study related to the practices in these hypotheses will be explained.

4.7.3.1. Practices related to employees' involvement in business activities (hypothesis 5)

Hypothesis 5 of this study was as follows:

- H5: Practices related to employees' involvement in business activities have a direct positive impact on companies' competitiveness and profitability.

To test hypothesis 5, four questions from the MX survey related to employees' involvement in business activities were selected. As shown in table 4-44, two of these had a positive impact on debt management (interest cover), cash flow (cash flow to sales) and liquidity (current ratio) of the large companies in the sample of this study. However, they had no impact on their profitability and competitiveness. Also, these practices had no direct positive impact on the financial performance of SMEs in this study.

Table 4-44 the impact of the practices related to employee's involvement in business activities

Identified practices from the literature	Questions from MX Awards Survey	Financial performance	Estimated Beta-value	Exact P-value	Total Observations
• Employees are responsible for the tasks they perform, and inspect their own work	5.3.2 How do you ensure employees gain the necessary experience to take on new roles?	**Large firms :** 1-original year interest cover 2-original year cash flows to sales	1.24 1.04	0.03 * 0.05 *	34 38
• Effective communication system for sharing business information	5.2.2 How do you communicate this company/business information and report the progress towards achieving the business objectives to your workforce?	**Large firms :** original year current ratio	1.75	0.03 *	40

For Large companies, the most important practice was their approach for ensuring that their employees gained the necessary experience to enable them to take on new roles (5.3.2) and this had a positive impact on their debt management (original year interest cover) and cash flow (original year cash flows to sales). Therefore, this finding of the study does not support hypothesis 5 (figure 4-12).

Figure 4-12 Comparing hypothesis 5 with the results of this study

4.7.3.2. Practices related to process management (hypothesis 8)

Hypothesis 8 of this study was as follows:

- H8: Practices related to process management have a direct positive impact on their competitiveness and profitability.

To test hypothesis 8, twelve questions from the MX survey related to process management were selected. As shown in table 4-45, eight of these had a positive impact on some dimensions of the financial performance of the SMEs and Large companies in the sample of this study. However, they had no impact on their profitability and competitiveness. The most influential practices related to process management was 'choice of key performance measures for monitoring and control of their product introduction programmes (2.3.3)'. This practice had a positive impact on the financial performance of both SMEs and Large firms in this study.

Table 4-45 the impact of the practices related to process management

Identified practices from the literature	Questions from MX Awards Survey	Financial performance	Estimated Beta-value	Exact P-value	Total Observations
• The organisation has a process management method.	2.3.3 What are your key performance measures for monitoring and control of product introduction programmes?	**SMEs:** 1st year leverage **Large firms :** 1-2nd year current ratio 2-1st year current ratio	 1.76 1.24 1.00	 0.01 ** 0.01 ** 0.03 *	 19 29 33
•Systematic recording and evaluation of critical process performance	3.3.2 How do you ensure your manufacturing operations can respond quickly and effectively to changes in market demand?	**SMEs:** 1st year leverage	2.11	0.00 **	24
•Systematic recording and evaluation of critical process performance	6.5.2 What techniques are used to track progress, control expenditure, allocate resources, and ensure major projects are completed on time?	**SMEs:** original year accounts payable days	1.22	0.05 *	20
----	8.4.4 What controls do you use and who is responsible for managing debtors?	**Large firms :** 2nd year cash flow yield	2.47	0.00 **	26
•Determination of areas and points for improvement	6.1.1 What is your formal business planning process and who is involved?	**Large firms :** 1-original year cash flows to sales 2-3rd year cash flow	 1.69 2.08	 0.01 ** 0.03 *	 30 27
----	8.4.7 How do you ensure your accounting practices complement and support the business drivers and changes to operational processes?	**Large firms :** original year cash flows to sales	2.07	0.02 *	21
----	8.7.1 What are your budgeting procedures?	**Large firms :** 2nd year asset turnover	1.31	0.02 *	25
----	8.3.1 What are the key factors that have affected your financial performance over the past three years?	**Large firms :** original year inventory turnover	1.51	0.03 *	29

Overall, for SMEs in the sample of this study the most important practice in this category was their approach to ensure their manufacturing operations can respond quickly and effectively to changes in market demand (3.3.2) and this had a positive impact on their debt management (1st year leverage). For Large companies, the most important practice was their approach to managing debtors (8.4.4) and it was this that had a positive impact on their cash flow (2nd year cash flow yield). Therefore, since none of these practices had a positive impact on companies' competitiveness or profitability this finding doesn't support hypothesis 8 (figure 4-13).

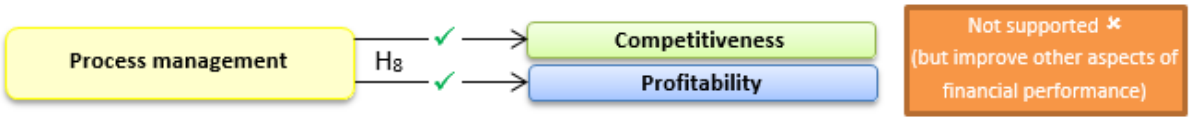


Figure 4-13 Comparing hypothesis 8 with the results of this study

4.7.3.3. Practices related to marketing (hypothesis 13)

Hypothesis 13 of this study was as follows:

- H13: Practices related to marketing have a direct positive impact on companies' profitability.

To test hypothesis 13, two questions from the MX survey related to marketing were selected. As shown in table 4-46, only for large firms, their techniques to identify and collect information on market opportunities had a direct positive impact on their cash flow (1st year cash flow).

Table 4-46 the impact of the practices related to marketing

Identified practices from the literature	Questions from MX Awards Survey	Financial performance	Estimated Beta-value	Exact P-value	Total Observations
• Benchmarking practice impact on company performance	6.2.1 What techniques do you use to identify and collect information on market opportunities, customers and competitors, and how is this information managed and exploited?	**Large firms :** 1st year cash flow	2.51	0.03 *	25

However, these practices had no positive impact on profitability or competitiveness of the large companies. Also they had no impact on the financial performance of the SMEs in this study. Therefore, this finding of the study does not support hypothesis 13 (figure 4-14).

Figure 4-14 Comparing hypothesis 13 with the results of this study

4.7.3.4. Practices related to product innovation (hypothesis 18)

Hypothesis 18 of this study was as follows:

- H18: Practices related to product innovation have a direct positive impact on companies' competitiveness and profitability.

To test hypothesis 18, four questions from the MX survey related to product innovation were selected. None of these questions had a direct positive impact on the financial performance of the SMEs in this study (table 4-47). However, for Large firms, their approach for identifying new technologies necessary for the manufacture of future products (3.1.4) had a positive impact on their liquidity (1st year and 2nd year current ratio).

Table 4-47 The impact of the practices related to product innovation

Identified practices from the literature	Questions from MX Awards Survey	Financial performance	Estimated Beta-value	Exact P-value	Total Observations
•Enhancing the manufacture technology of new products.	3.1.4 How does your company identify new technologies and gain the knowledge needed for the manufacture of future products?	**Large firms :** 1-1st year current ratio 2-2nd year current ratio	 0.95 0.95	 0.05 * 0.05 *	 34 30

However, they had no positive impact on the profitability or competitiveness of the large companies. Therefore, this finding of the study does not support hypothesis 18 (figure 4-15).

Figure 4-15 Comparing hypothesis 18 with the results of this study

4.7.4. Hypotheses that are not supported and had no positive impact

Based on the findings of the earlier studies, the practices in the hypotheses (3, 10, 14, 15 and 17) were expected to have a direct positive impact on companies' profitability and competitiveness. However, they did not have the expected impact on the profitability or competitiveness of the companies in the sample of this study. Therefore, these hypotheses are not supported by the findings of this study. In addition, these practices had no direct positive impact on any other aspects of the financial performance of the companies in this study. In the following subsections, the practices related to each of these hypotheses will be explained.

4.7.4.1. Practices related to delivery reliability (hypothesis 3)

Hypothesis 3 of this study was as follows:

- H3: Practices related to delivery reliability have a direct positive impact on companies' competitiveness or profitability.

To test hypothesis 3, two questions from the MX survey related to delivery reliability were selected and are shown in table 4-48.

Table 4-48 The impact of the practices related to delivery reliability

Identified practices from the literature	Questions from MX Awards Survey	Financial performance	Estimated Beta-value	Exact P-value	Total Observations
• Reliability of delivery	4.5.2 How do you calculate the capacity available for production to make sure deliveries can be completed by the customer requirement date?	---	---	---	---
• On-time delivery	1.3.3 What percentage of deliveries do you make on time and in full on the delivery date agreed with your customers?	---	---	---	---

None of these questions had a direct positive impact on the financial variable of the companies in the sample of this study. Therefore, this finding of the study does not support hypothesis 3 (figure 4-16).

Figure 4-16 Comparing hypothesis 3 with the results of this study

4.7.4.2. Practices related to waste reduction (hypothesis 10)

Hypothesis 10 of this study was as follows:

- H10: Practices related to waste reduction have a direct positive impact on companies' competitiveness or profitability.

To test hypothesis 10, only one question from the MX survey related to waste reduction was selected, as shown in table 4-49.

Table 4-49 The impact of the practices related to waste reduction

Identified practices from the literature	Questions from MX Awards Survey	Financial performance	Estimated Beta-value	Exact P-value	Total Observations
•Reduction of Product defects	4.7.1 What actions have been taken to reduce all forms of waste?	---	---	---	---
•Reduction of Product rework rate					
•Reduction of Non-conformances					
•Capacity utilisation					
•Reduction of Warranty compensations					

However, this question had no direct positive impact on the financial variable of the companies in the sample of this study. Therefore, this finding of the study does not support hypothesis 10 (figure 4-17).

Figure 4-17 Comparing hypothesis 10 with the results of this study

4.7.4.3. Practices related to usage of IS for internal integration (hypothesis 14)

Hypothesis 14 of this study was as follows:

- H14: Practices related to the usage of IS for internal integration have a direct positive impact on companies' competitiveness or profitability.

To test hypothesis 14, six questions from the MX survey related to waste reduction were selected, as shown in table 4-50.

Table 4-50 The impact of the practices related to usage of IS for internal integration

Identified practices from the literature	Questions from MX Awards Survey	Financial performance	Estimated Beta-value	Exact P-value	Total Observations
•Collection, analysis and use of data and quality information.	7.2.1 Does your business have an appropriate system for: Commercial and financial planning? Marketing and customer relationships?	---	---	---	---
•Important information is presented and transmitted to employees	7.2.2 What key business benefits have been obtained from information and communications technology to justify the expenditure?	---	---	---	---
•Information System support for product flexibility	7.2.4 How has ICT been used to integrate internal business processes?	---	---	---	---
•Harnesses information to improve key processes, products and services.	7.2.6 How are your business processes, organisation structure and ICT systems aligned?	---	---	---	---
	7.2.3 How has ICT been used to increase the competitive advantage of your business?	---	---	---	---
•Formal information is shared in the form of regular newsletter and hand outs	7.3.1 What resources are provided to allow employees access to your company ICT systems internally and from remote locations, and how is this access kept secure?	---	---	---	---

None of these questions had a direct positive impact on the financial variable of the companies in the sample of this study. Therefore, this finding of the study does not support hypothesis 14 (figure 4-18).

Figure 4-18 Comparing hypothesis 14 with the results of this study

4.7.4.4. Practices related to usage of IS for external partnership (hypothesis 15)

Hypothesis 15 of this study was as follows:

- H15: Practices related to usage of IS for external partnership have a direct positive impact on companies' competitiveness or profitability.

To test hypothesis 15, two questions from the MX survey related to waste reduction were selected, as shown in table 4-51.

Table 4-51 The impact of the practices related to usage of IS for external partnership

Identified practices from the literature	Questions from MX Awards Survey	Financial performance	Estimated Beta-value	Exact P-value	Total Observations
•Coordinating activities with those of customers, suppliers or distributors	7.2.5 How has ICT been used to integrate with your customers and suppliers?	---	---	---	---
•Effective coordination with customers, suppliers or distributors	7.3.2 What information is available on demand for customers and suppliers using your ICT systems?	---	---	---	---

None of these questions had a direct positive impact on the financial variable of the companies in the sample of this study. Therefore, this finding of the study does not support hypothesis 15 (figure 4-19).

Figure 4-19 Comparing hypothesis 15 with the results of this study

4.7.4.5. Practices related to product quality improvement (hypothesis 17)

Hypothesis 17 of this study was as follows:

- H17: Practices related to product quality improvement have a direct positive impact on companies' competitiveness or profitability.

To test hypothesis 17, only one question from the MX survey related to product quality improvement was selected, as shown in table 4-52.

Table 4-52 The impact of the practices related to product quality improvement

Identified practices from the literature	Questions from MX Awards Survey	Financial performance	Estimated Beta-value	Exact P-value	Total Observations
•Product quality improvement practices	2.2.1 What processes do you have for identifying and implementing improvements or cost reductions for existing products and/or new applications?	---	---	---	---

However, this question had no direct positive impact on the financial variables of the companies in the sample of this study. Therefore, this finding of the study does not support hypothesis 17 (figure 4-20).

Figure 4-20 Comparing hypothesis 17 with the results of this study

4.8. Conclusion

4.8.1. Chapter summary

In this chapter the two potential approaches that could be used to analyse the dataset of the study were explained (section 4.2). The first approach was to separately analyse the relationships between each of the explanatory variables (operational practices) and each of the response variables (financial ratios). The second approach was to simultaneously analyse the impact of many (or all of) the operational practices on the financial outcomes. The advantage of the first approach was that it could answer the research question of the study specifically by finding the relationships between specific operational practices and financial ratios. However, this method had two disadvantages including: confounding bias and multiple comparison problems. To overcome these two problems, the second approach was considered. However, the three potential methods that could be used in the second approach to either reduce the missing data or to find aggregated impact of the practices was not suitable for dataset of this study. Therefore, the first approach was selected.

To perform the first approach, the correlation between the companies' operational practices and financial results over four years (the year of participation in the MX Awards and three years after that) were examined (section 4.3). The Fisher's exact test was used to calculate the significance (exact probability values) of the correlations and the strength of the correlations was calculated using the Cramer's V formula. The results over the four years show twenty-five correlated pairs of operational practices and financial results for SMEs and 160 pairs for large firms.

Then, for each of the identified correlated pairs in section 4.3, dependence of the financial ratios on their correlated operational practices was examined using binary logistic regression (section 4.4). In each of the regression equations, the p-values show the significance of the relationship between the operational practices and financial ratios. The Beta values show the strength of the operational practices in predicting improvement of the financial ratios. The results over the four years show sixteen operational practices that had a significant positive impact on SMEs' financial performance and 109 for large firms. Then, for each of the identified relationships between the operational practices and financial ratios in section 4.4, the impact of the years of the participation in the awards and the industry sectors of the companies were examined (section 4.5). This was to reduce the impact of confounding of the potentially influential factors on the findings of the study. The results show that the identified findings were not based on any particular industry sector and they were not only taken from a specific year.

Finally, in section 4.6, the identified relationships between the operational practices and financial ratios were validated with the data in the validation sample of the study (i.e. the companies that had entered MX Awards in 2011). This was to reduce the impact of the 'multiple comparisons' problem which could result in finding false positives (falsely identifying a practice as a driver). The validation was performed by checking whether the identified relationships held true for the companies that have entered the 2011 MX Awards.

4.8.2. Revised conceptual framework

A conceptual framework based on the findings of the earlier studies was developed in chapter 2 (i.e. section 2.4). That conceptual framework shows the expected relationships between twenty categories of operational practices and financial results (including: competitiveness – i.e. sales growth – and profitability). In this study, ninety operational practices from the MX survey (appendix 2) that were similar to the variables used in the earlier studies were selected. Also, eighteen financial variables (appendix 3) in the following six categories of financial performance were selected:

1- Competitiveness (i.e. sales growth)
2- Profitability
3- Asset management
4- Liquidity
5- Debt management
6- Cash flow.

In this chapter, the impact of the ninety operational practices on the eighteen financial variables over four years was analysed. Of 90*18*4=6,480 analysed relationships, only sixty relationships (i.e. eleven for SMEs and forty-nine for large firms) were identified that shows a direct positive impact of operational practices on financial variables. In this subsection, the identified relationships in this study were used to revise the conceptual framework that was developed in chapter 2. The potential reasons for the identified relationships will be discussed in the following chapter.

4.8.2.1. Practices related to Customers

In the original conceptual framework developed in chapter 2, the following three categories of operational practices related to customers:

1- Practices related to customer satisfaction
2- Practices related to customer focus
3- Practices related to delivery reliability.

In the following subsections, the identified relationships in these three categories will be explained.

4.8.2.1.1. Practices related customer satisfaction

As discussed in section 4.7.1.1, similar to the findings of previous research, practices in this category had a direct positive impact on profitability of both SMEs and Large companies (figure 4-21). However, they had different impacts on SMEs and Large firms. For example, 'Providing a comprehensive and coherent set of benefits to customers through product/services' only had a positive impact on SMEs' profitability (1st year gross profit margin). However, this practice had no positive impact for large firms' financial performance. Conversely, the other three practices only had a direct positive impact on large firms' profitability, asset management and cash flow, and had no direct positive impact for SMEs.

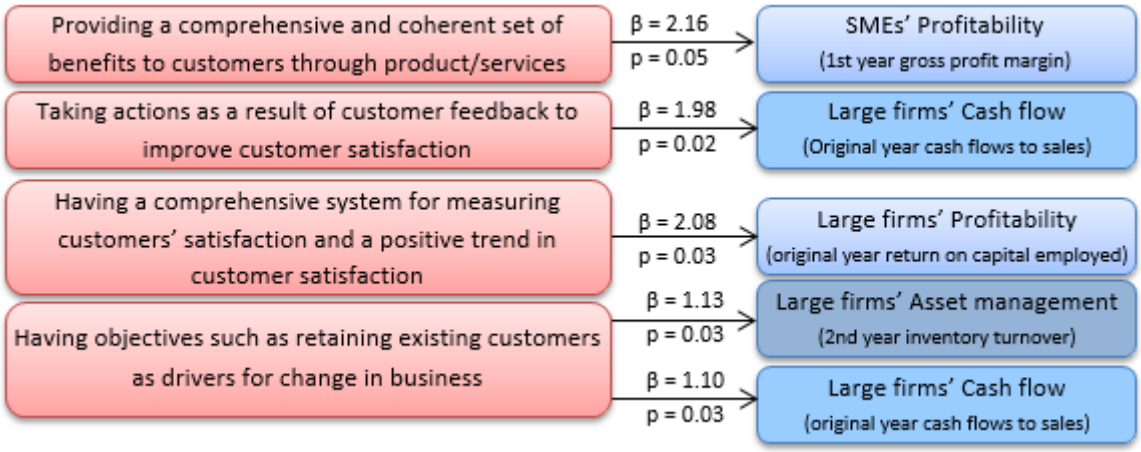


Figure 4-21 Impact of practices related to customer satisfaction based on the findings of this study

4.8.2.1.2. Practices related customer focus

As discussed in section 4.7.1.2, similar to the findings of earlier studies, practices in this category had a direct positive impact on profitability of both SMEs and Large companies (figure 4-22). However, 'Using more than one appropriate sales and/or distribution channels' is the only practice in this category that had a positive impact on financial performance of both SMEs and Large companies. This practice improved the liquidity of large firms and the profitability of SMEs in the sample of this study. The other practices in this category only had a direct positive impact on the financial performance of either SMEs or Large firms and not for both. For example, 'Approach to win new sales (e.g. developing a product family based on particular customer needs)' only improved SMEs' liquidity and did not have any positive impact for large companies.

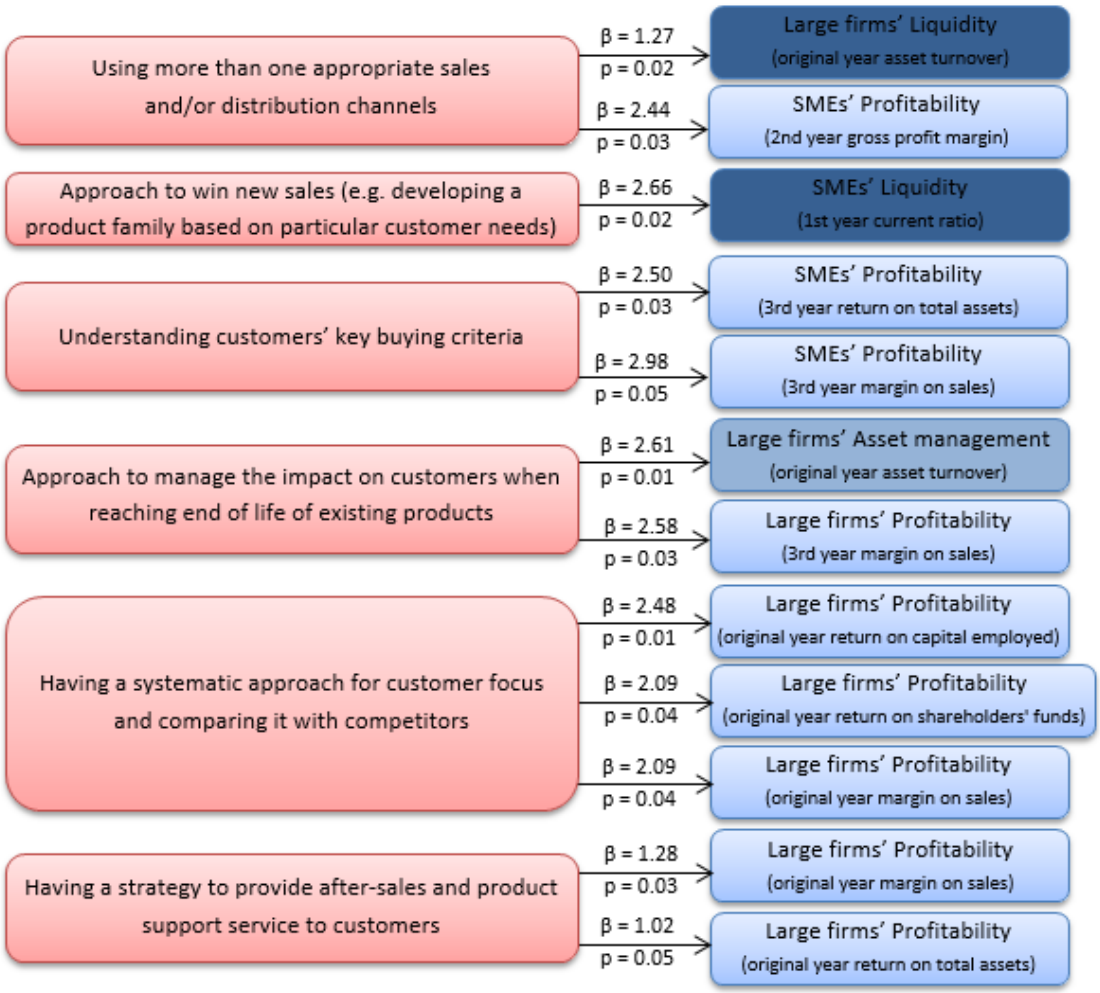


Figure 4-22 Impact of practices related to customer focus based on the findings of this study

4.8.2.1.3. Practices related to delivery reliability

As discussed in section 4.7.4.1, based on the previous research, practices in this category were expected to have a direct positive impact on profitability or competitiveness of both SMEs and Large companies. However, as shown in figure 4-23, none of those practices had a positive impact on the financial performance of the companies in the sample of this study. Therefore, unlike the findings of the earlier studies, based on the findings of this study, practices related to delivery reliability have no direct positive impact on SMEs' or Large companies' financial performance.

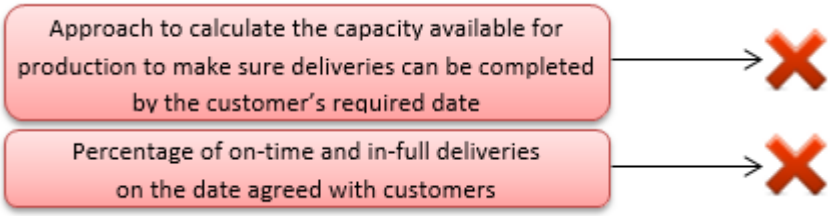


Figure 4-23 Impact of practices related to delivery reliability based on the findings of this study

4.8.2.2. Practices related to Employees

In the original conceptual framework that was developed in chapter 2, there were the following four categories related to employees:

1- Practices related to employees' effectiveness
2- Practices related to employees' involvement in business activities
3- Practices related to employees' recruitment, reward and retention
4- Practices related to employees training.

In the following subsections, the identified relationships in each of these four categories will be explained.

4.8.2.2.1. Practices related to employees' effectiveness

As discussed in section 4.7.2.1, based on the previous research, practices in this category were expected to have a direct positive impact on profitability or competitiveness of both SMEs and Large companies. As shown in figure 4-24, 'Having a systematic approach to measure employees' effectiveness and comparing it with competitors' is the only practice in this category that had the expected impact on large companies' profitability. The other practice in this category only had a positive impact on liquidity and debt management of SMEs and not their profitability or competitiveness. Therefore, this finding only supports the findings of the earlier studies for large companies.

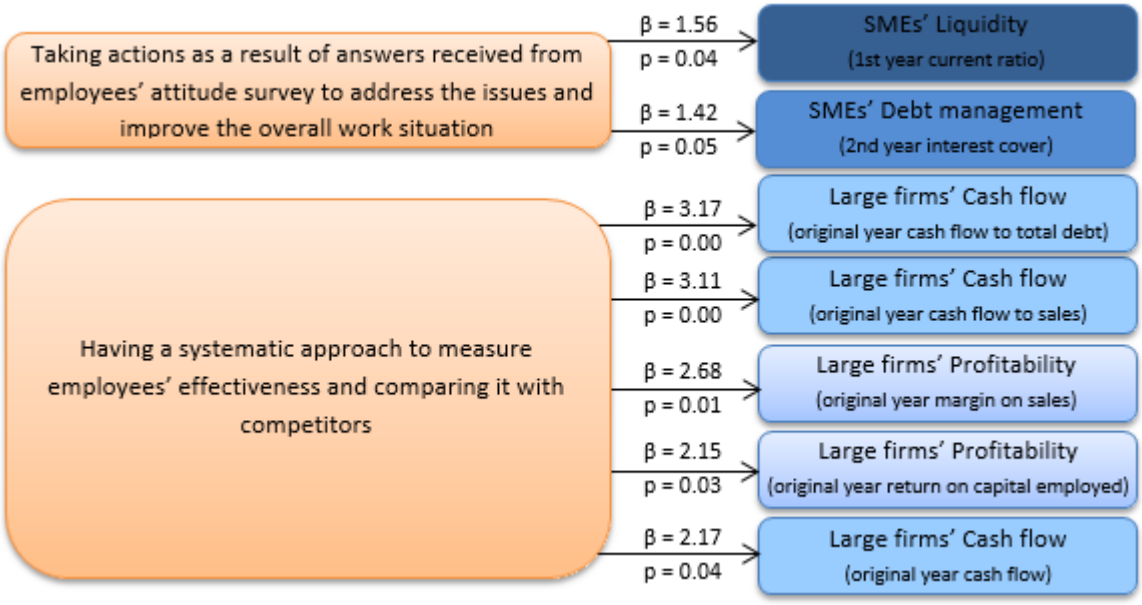


Figure 4-24 Impact of practices related to employees' effectiveness based on the findings of this study

4.8.2.2.2. Practices related to employees' involvement in business activities

As discussed in section 4.7.3.1, based on the findings of the earlier studies, practices in this category were expected to have a direct positive impact on profitability or competitiveness of both SMEs and Large companies. However, as shown in figure 4-25, these practices had a direct positive impact on debt management, cash flow and liquidity of large companies. Therefore, these practices had no direct positive impact on profitability or competitiveness of large companies and on any dimension of SMEs' financial performance. Therefore, unlike the findings of the earlier studies, these practices only have a direct positive impact on debt management, cash flow and liquidity of large companies. They have no direct positive impact on profitability and competitiveness of SMEs and Large companies.

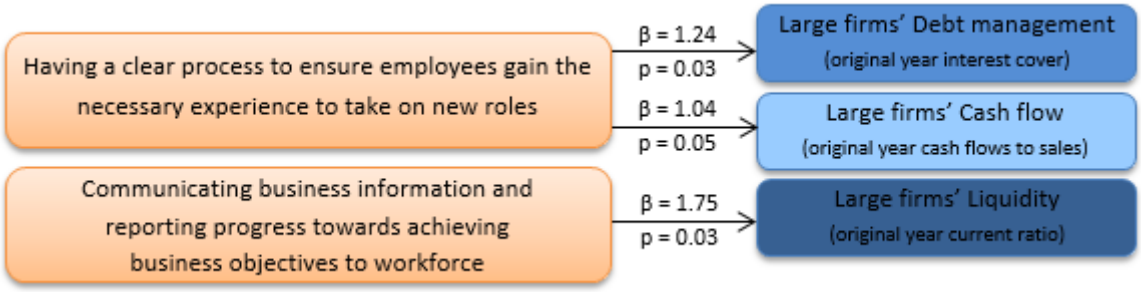


Figure 4-25 Impact of practices related to employees' involvement based on the findings of this study

4.8.2.2.3. Practices related to employees' recruitment, reward and retention

As discussed in section 4.7.2.2, based on earlier studies, these practices were expected to have a direct positive impact on profitability or competitiveness of both SMEs and Large companies. However, as shown in figure 4-26, they only had a positive impact on large companies' profitability, cash flow, asset management and debt management and had no direct positive impact for SMEs. Therefore, this finding only supports the findings of the earlier studies for large companies.

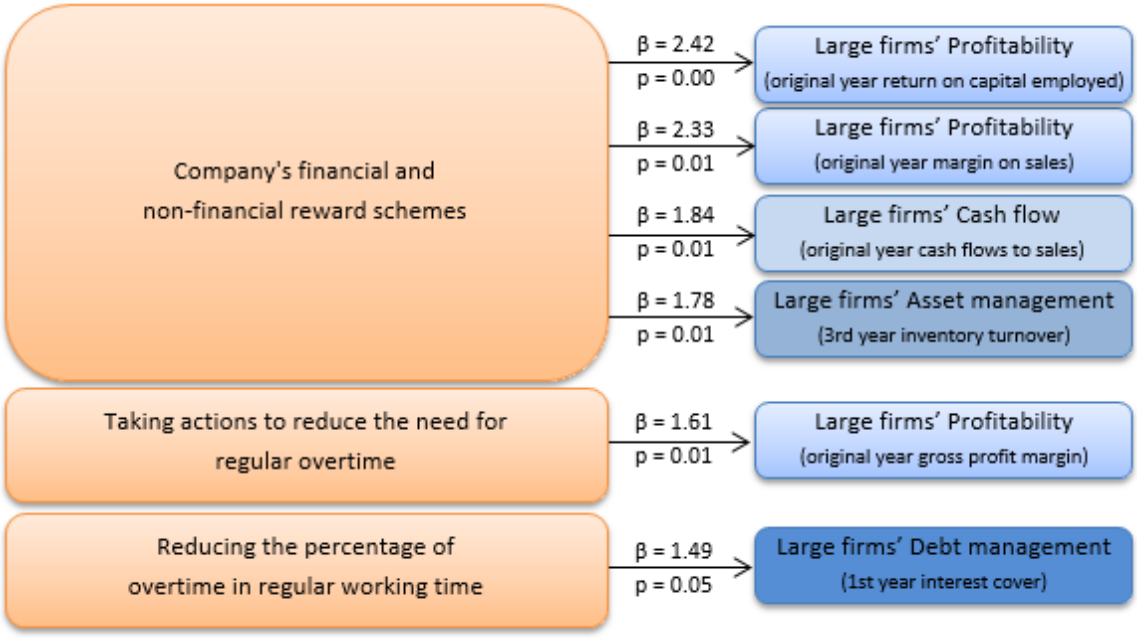


Figure 4-26 Impact of practices related to employees' recruitment based on the findings of this study

4.8.2.2.4. Practices related to employees' training

As discussed in section 4.7.1.3, based on previous research, practices in this category were expected to have no direct positive impact on profitability or competitiveness of both SMEs and Large companies. As shown in figure 4-27, these two practices that were analysed in this study also had no direct positive impact on any aspects of the financial performance of the companies in the sample of this study. Therefore, similar to the findings of the earlier studies, practices related to employees' training have no direct positive impact on companies' financial performance.

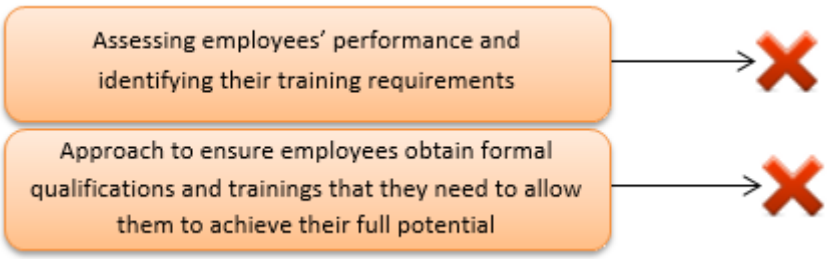


Figure 4-27 Impact of practices related to employees' training based on the findings of this study

4.8.2.3. Practices related to internal processes

In the original conceptual framework that was developed in chapter 2, the following nine categories related to internal processes:

1- Practices related to process management
2- Practices related to process performance improvement
3- Practices related to waste reduction
4- Practices related to manufacturing simplicity
5- Practices related to preventive maintenance
6- Practices related to marketing
7- Practices related to usage of IS for internal integration
8- Practices related to usage of IS for external partnership
9- Practices related to corporate social responsibility.

In the following subsections, the identified relationships in each of these nine categories will be explained.

4.8.2.3.1. Practices related to process management

As discussed in section 4.7.3.2, based on the findings of earlier studies, these practices were expected to have a direct positive impact on profitability or competitiveness of both SMEs and Large companies. As shown in figure 4-28, these practices had a positive impact on some dimensions of financial performance of the SMEs and Large companies in the sample of this study. However, their impact was not on companies' profitability or competitiveness and therefore this finding does not support the findings of the earlier studies.

In addition, as shown in figure 4-28, only one of the practices in this category had a positive impact on the financial performance of both SMEs and Large companies in the sample of this study. 'Using KPIs for monitoring and control of product introduction programmes that allows taking timely action to correct deviances' had a positive impact on debt management of SMEs and liquidity of large companies. The other practices had a positive impact on either SMEs' or Large companies' financial performance and not for both.

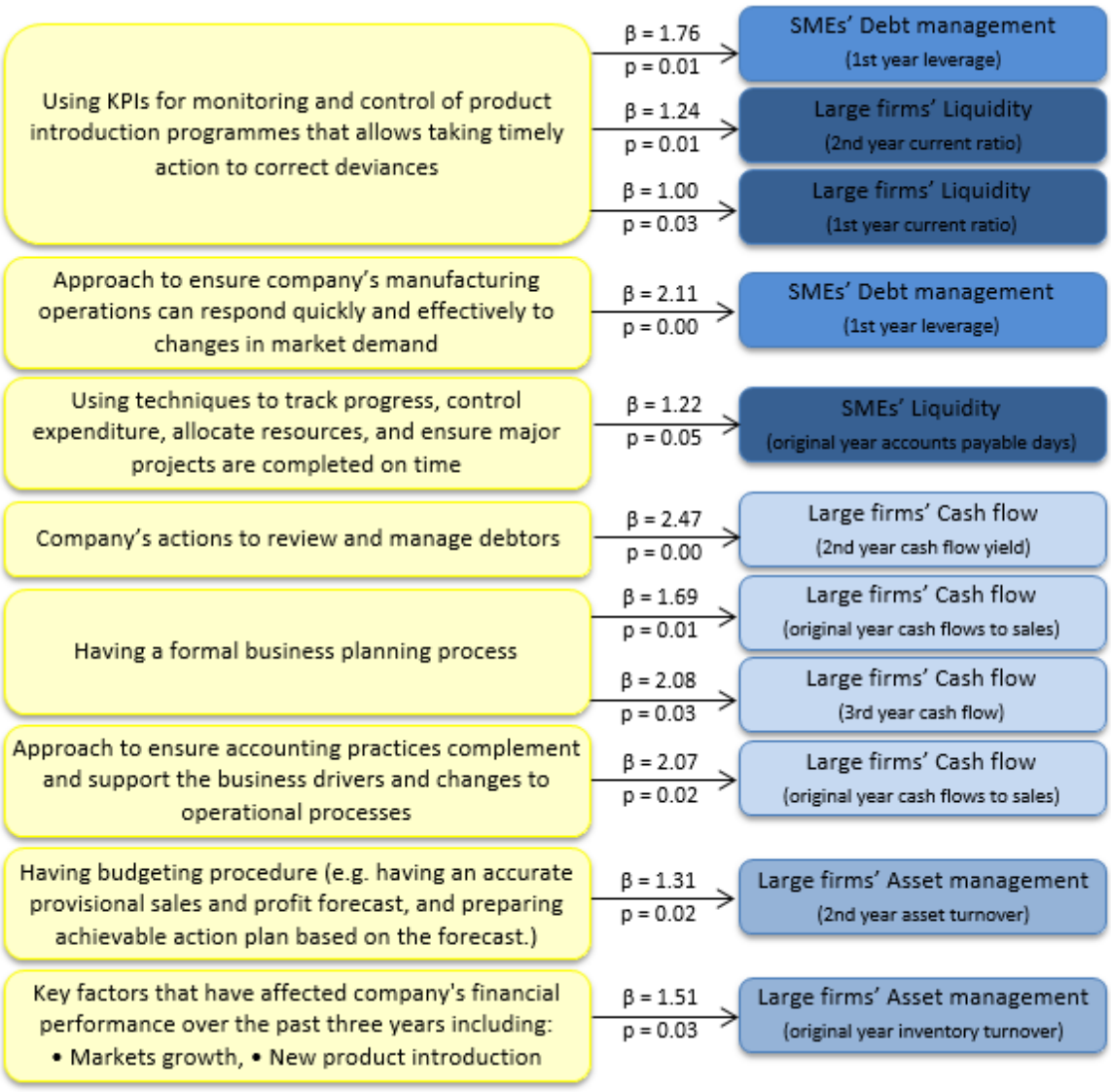


Figure 4-28 Impact of practices related to process management based on the findings of this study

4.8.2.3.2. Practices related to process performance improvement

As discussed in section 4.7.2.3, based on earlier studies, these practices were expected to have a direct positive impact on profitability or competitiveness of both SMEs and Large companies. As shown in figure 4-29, these practices had a direct positive impact on some dimensions of SMEs' and Large firms' financial performance. However, only two of those practices had a positive impact on large firms' profitability. The other practices in this category had a positive impact on other dimensions of SMEs' and Large firms' financial performance, other than their profitability or competitiveness. Therefore, this finding only supports the findings of the earlier studies for large companies.

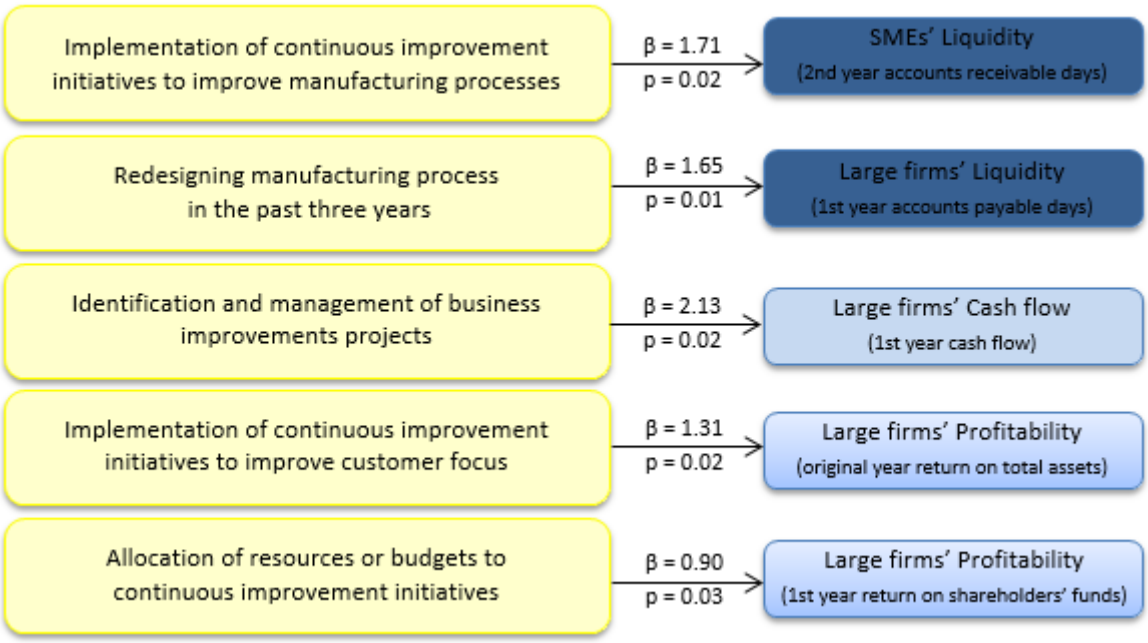


Figure 4-29 Impact of practices related to process performance improvement based on the findings of this study

4.8.2.3.3. Practices related to waste reduction

As discussed in section 4.7.4.2, based on previous research, practices in this category were expected to have a direct positive impact on profitability or competitiveness of both SMEs and Large companies. However, as shown in figure 4-30, the only practice in this category that was analysed in this study did not have any positive impact on any dimension of the financial performance of the companies in the sample of this study. Therefore, unlike the findings of the earlier studies, based on the findings of this study, practices related to waste reduction have no direct positive impact on SMEs' or Large companies' financial performance.

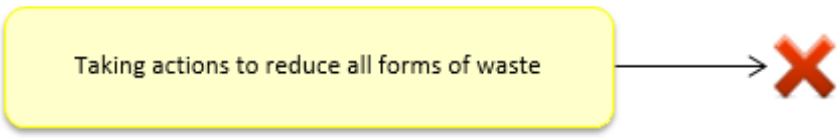


Figure 4-30 Impact of practices related to waste reduction based on the findings of this study

4.8.2.3.4. Practices related to manufacturing simplicity

As discussed in section 4.7.2.4, based on the findings of the earlier studies, practices in this category were expected to have a direct positive impact on profitability or competitiveness of both SMEs and Large companies. As shown in figure 4-31, only one practice in this category had a direct positive impact on the profitability of the large companies in the sample of this study. However, these practices had no positive impact on SMEs' financial performance. Therefore, this finding only supports the findings of the earlier studies for large companies.

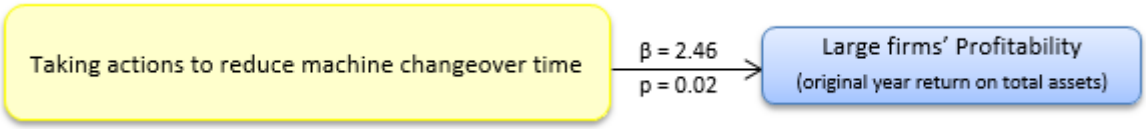


Figure 4-31 Impact of practices related to manufacturing simplicity based on the findings of this study

4.8.2.3.5. Practices related to preventive maintenance

As discussed in section 4.7.2.5, based on previous research, practices in this category were expected to have a direct positive impact on profitability or competitiveness of both SMEs and Large companies. However, as shown in figure 4-32, only one practice in this category had a positive impact on competitiveness of large companies in the sample of this study. However, they had no direct positive impact on the financial performance of the SMEs. Therefore, this finding only supports the findings of the earlier studies for large companies.

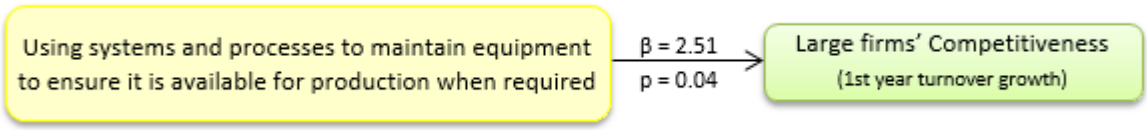


Figure 4-32 Impact of practices related to preventive maintenance based on the findings of this study

4.8.2.3.6. Practices related to marketing

As discussed in section 4.7.2.5, based on the findings of the earlier studies, practices in this category were expected to have a direct positive impact on profitability or competitiveness of both SMEs and Large companies. However, as shown in figure 4-33, only one practice in this category had a direct positive impact on large firms' cash flow. However, this practice had no direct positive impact on profitability or competitiveness of the large companies. Also, it had no direct positive impact on the financial performance of the SMEs in this study. Therefore, unlike the findings of previous research, in this study, this practice of marketing only had a positive impact on large firms' cash flow.

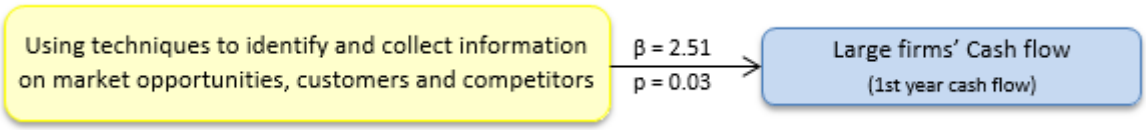


Figure 4-33 Impact of practices related to marketing based on the findings of this study

4.8.2.3.7. Practices related to usage of IS for internal integration

As discussed in section 4.7.4.3, based on the findings of the earlier studies, practices in this category were expected to have a direct positive impact on profitability or competitiveness of both SMEs and Large companies. However, as shown in figure 4-34, none of the practices in this category had a direct positive impact on any aspect of the financial performance of the companies in the sample of this study. Therefore, unlike the findings of the earlier studies, practices related to usage of IS for internal integration have no direct positive impact on SMEs' or Large companies' financial performance in this study.

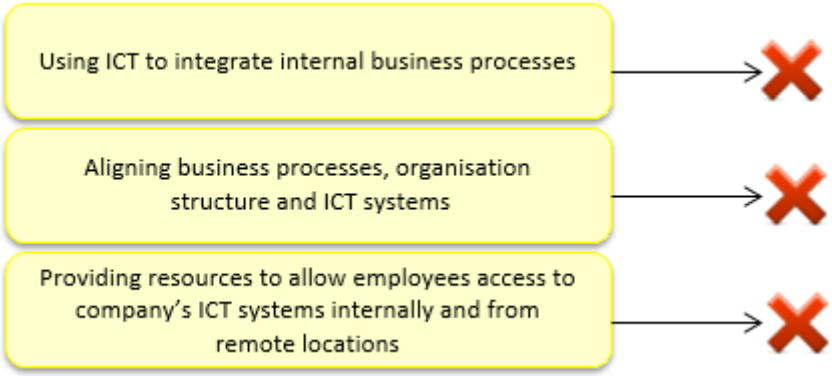


Figure 4-34 Impact of practices related to usage of IS for internal integration based on the findings of this study

4.8.2.3.8. Practices related to usage of IS for external partnership

As discussed in section 4.7.4.4, based on the findings of the earlier studies, practices in this category were expected to have a direct positive impact on profitability or competitiveness of both SMEs and Large companies. However, as shown in figure 4-35, none of the practices in this category had a direct positive impact on any aspect of the financial performance of the companies in the sample of this study. Therefore, based on the findings of this study, practices related to usage of IS for internal integration has no direct positive impact on SMEs' or Large companies' financial performance.

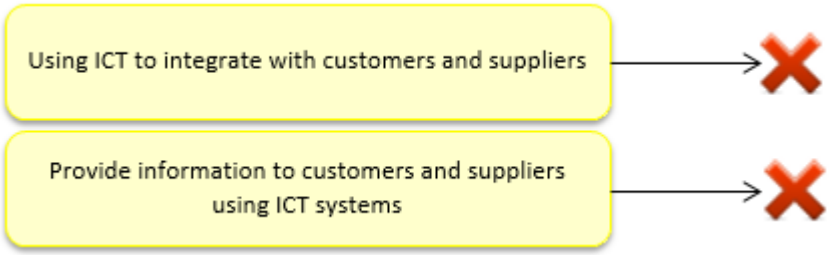


Figure 4-35 Impact of practices related to usage of IS for external partnership based on the findings of this study

4.8.2.3.9. Practices related to corporate social responsibility

As discussed in section 4.7.2.6, based on the findings of the earlier studies, practices in this category were expected to have no direct positive impact on profitability or competitiveness of both SMEs and Large companies. As shown in figure 4-36, four practices in this category had a direct positive impact on liquidity, profitability and debt management of large companies in the sample of this study. However, as expected, these practices had no positive impact for SMEs. Therefore, this finding only supports the findings of the earlier studies for SMEs.

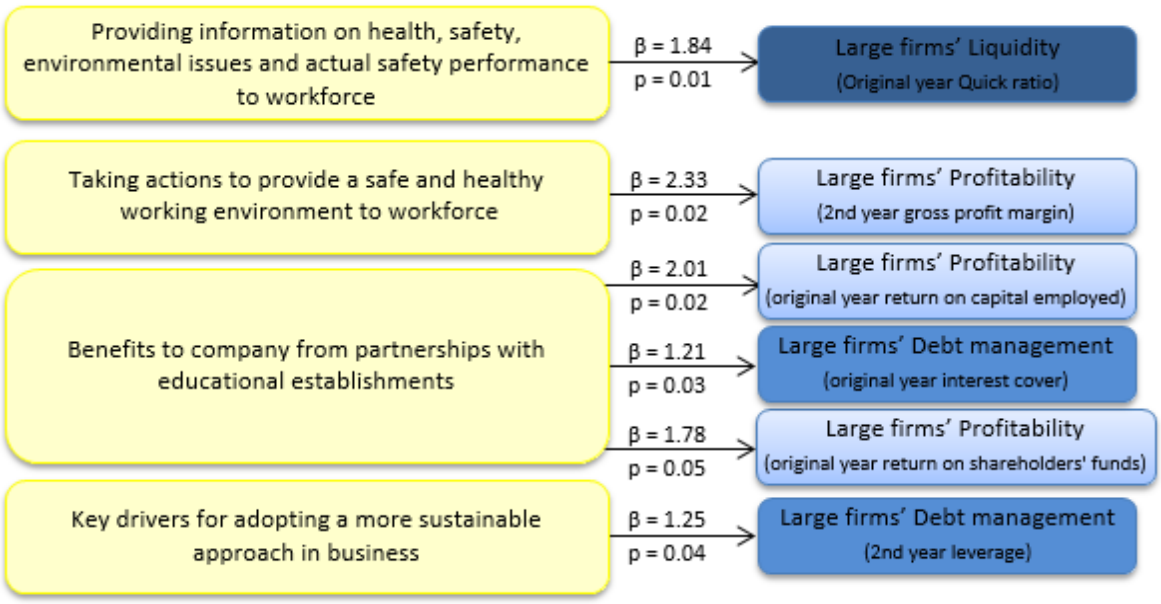


Figure 4-36 Impact of practices related to corporate social responsibility based on the findings of this study

4.8.2.4. Practices related to products

In the original conceptual framework developed in chapter 2, the following two categories of operational practices related to products:

1- Practices related to product quality improvement
2- Practices related to product innovation.

In the following subsections, the identified relationships in these two categories will be explained.

4.8.2.4.1. Practices related to product quality improvement

As discussed in section 4.7.4.5, based on previous research, practices in this category were expected to have a direct positive impact on profitability or competitiveness of both SMEs and Large companies. However, as shown in figure 4-37, the only practice in this category that was analysed in this study did not have any positive impact on any dimension of the financial performance of the companies in the sample of this study. Therefore, unlike the findings of the earlier studies, based on the findings of this study, practices related to product quality improvement have no direct positive impact on SMEs' or Large companies' financial performance.

Figure 4-37 Impact of practices related to product quality improvement based on the findings of this study

4.8.2.4.2. Practices related to product innovation

As discussed in section 4.7.3.4, based on previous research, practices in this category were expected to have a direct positive impact on profitability or competitiveness of both SMEs and Large companies. However, as shown in figure 4-38, one practice in this category had a direct positive impact on liquidity of large companies in the sample of this study. However, this practice had no direct positive impact on profitability or competitiveness of the large companies. Also, it had no direct positive impact on the financial performance of the SMEs in this study. Therefore, unlike the findings of previous research, in this study, this practice of product innovation only had a positive impact on large firms' liquidity.

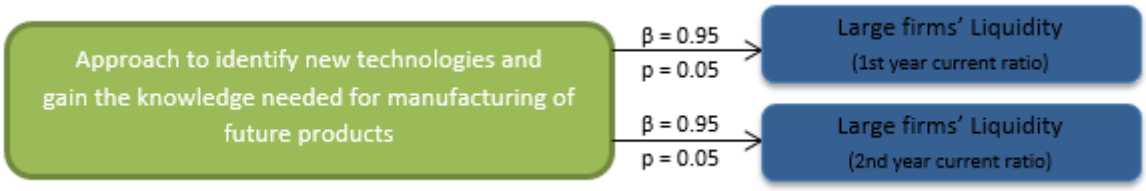


Figure 4-38 Impact of practices related to product innovation based on the findings of this study

4.8.2.5. Practices related to suppliers

In the original conceptual framework developed in chapter 2, the following two categories of operational practices related to suppliers:

1- Practices related to building relationships with suppliers
2- Practices related to supplier selection.

In the following subsections, the identified relationships in these two categories will be explained.

4.8.2.5.1. Practices related to building relationship with suppliers

As discussed in section 4.7.1.4, based on the findings of the earlier studies, practices in this category were expected to have no direct positive impact on profitability or competitiveness of both SMEs and Large companies. As shown in figure 4-39, practices that were analysed in this study also had no direct positive impact on any dimensions of the financial performance of the companies in the sample of this study. Therefore, similar to the findings of the earlier studies, practices related to building relationships with suppliers have no direct positive impact on companies' financial performance.

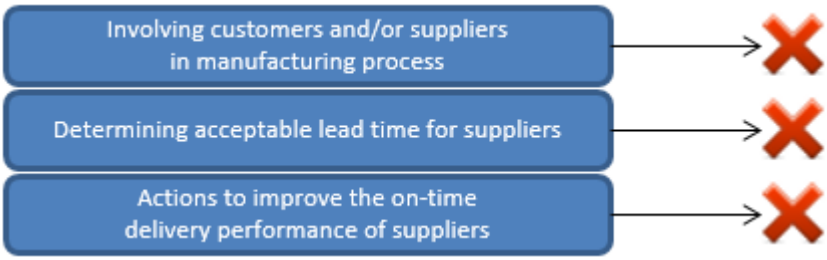


Figure 4-39 Impact of practices related to building relationship with suppliers based on the findings of this study

4.8.2.5.2. Practices related to supplier selection

As discussed in section 4.7.1.5, based on previous research, practices in this category were expected to have no direct positive impact on profitability or competitiveness of both SMEs and Large companies. As shown in figure 4-40, the practices that were analysed in this study also had no direct positive impact on any dimensions of the financial performance of the companies in the sample of this study. Therefore, similar to the findings of the earlier studies, practices related to building relationships with suppliers have no direct positive impact on companies' financial performance.

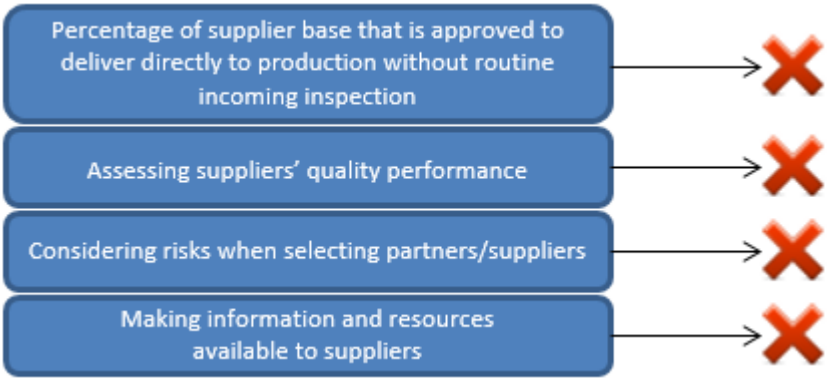


Figure 4-40 Impact of practices related to supplier selection based on the findings of this study

5. Discussion

5.1. Introduction

In the previous chapter, the findings of the study were used to either support, partially support or not support the hypotheses of the study. The purpose of this chapter is to review the findings of the study and compare with the findings of previous research. In the previous chapter, the hypotheses of the study were classified into the following four categories:

1. The hypotheses that are supported by the findings of this study.
2. The hypotheses that are only are partially supported for SMEs or Large companies. Practices in these hypotheses only had a positive impact on the competitiveness or profitability of either SMEs or Large firms, but not for both.
3. The hypotheses that are not supported. However, practices in these categories had a positive impact on other aspects of companies' financial performance other than their competitiveness or profitability.
4. The hypotheses that are not supported and practices in these hypotheses had no positive impact on other aspect of companies' financial performance.

In the following subsections, potential explanations for the identified relationships in each of these categories are elaborated. Also, the most significant findings in each category were investigated using focus groups and interviews with ten experts (academics or business consultants) in the context of UK manufacturing companies (please refer to appendix 7 for transcript of focus groups and interviews). This helps to get a better understanding on the applicability of the findings of the study for UK manufacturing companies. In each of the following subsections, a summary of the experts' opinions on those findings are discussed. Finally, for the findings of the study that contradicts with the findings of previous studies (i.e. practices in category 4), the author contacted the authors of those studies. The suggestions of the authors of those studies about the potential reasons for the differences between the findings of the studies are also discussed for each of those findings.

5.2. Hypotheses that are supported

The findings of this study with regard to the following five categories were similar to the findings of the earlier studies; therefore, the hypotheses related to these practices are supported. In the following subsections, potential explanations for the identified relationships in these categories will be discussed:

1. Customer satisfaction
2. Customer focus
3. Employees' training
4. Building relationships with suppliers
5. Supplier selection

5.2.1. Practices related to customer satisfaction (hypothesis 1)

Based on the findings of the majority of the earlier studies, practices related to customer satisfaction were expected to have a direct positive impact on companies' competitiveness or profitability (table 5-1).

Table 5-1 Findings of the earlier studies related to customer satisfaction

Customers related practices	**Authors/Date**	**Financial perspectives**	
		Competitiveness: • Increased market share • Sales growth	**Profitability:** • Return on investment • Return On Capital Employed • Return on total assets
H1. Practices related to customer satisfaction such as: • Increased customer satisfaction • Decreased customer complaints • Customer Retention Rate • Personalised service • Value for the money spent	Fotopoulos & Psomas (2010)	✓	✓
	Han et al. (2007)	✓	✓
	Nilsson et al. (2001)	---	✓
	Yasin et al. (2004)	---	✓
	Ittner & Larcker (1998)	✓	✓
	Sila (2007)	✓	✓
	Tarigan & Widjaja (2012)	---	×
✓= Direct positive impact on financial performance		×= No direct positive impact on financial performance	

As discussed in section 4.7.1.1 of the previous chapter, practices related to customer satisfaction in this study had a positive impact on the financial performance of SMEs and Large companies. However, the impact of these practices is not similar for SMEs and Large companies. In the following subsections, some potential reasons for the differences between SMEs and Large companies will be explained.

5.2.1.1. The impact of improving customer satisfaction

Based on the findings of this study, the practice of 'Adding value to customers through product/services (1.1.4)' only had a positive impact on SMEs' profitability (table 5-2). However, other practices, such as 'actions to improve customer satisfaction (1.3.2)' or 'measuring customer satisfaction and its results (1.3.1)', only had a positive impact for large firms and not for SMEs.

Table 5-2 The impact of practices related to improving customer satisfaction

Identified practices from the literature	Questions from MX Awards Survey	Financial performance	Estimated Beta-value	Exact P-value	Total Observations
• Increased customer satisfaction	1.3.2 What actions have you taken to improve customer satisfaction?	**Large firms:** Original year cash flows to sales	1.98	0.02 *	39
• Increase customer satisfaction	1.3.1 How do you measure customer satisfaction and what are the results?	**Large firms:** original year return on capital employed	2.08	0.03 *	41
• Value for the money spent	1.1.4 How do you believe your products and/or services add value to your customers?	**SMEs:** 1st year gross profit margin	2.16	0.05 *	25

This difference can be partially explained by the difference between SMEs and Large companies in the way that they measure their customer satisfaction. For example, Walsh & Lipinski (2009) identified that measuring customer satisfaction in SMEs is not as developed as that in large firms, which influence their performance in improving their customer satisfaction.

Fernandez-Gonzale & Prado (2007), based on a study on Spanish and Portuguese companies, conclude that SMEs usually rely on one method of measuring their customer satisfaction (e.g. written surveys), while larger companies use more than one method. For example, Maguire & Huang (2007) identify a list of customer satisfaction measurement tools used by two large multinational UK-based companies, including: Relationship surveys, customer complaints, dissatisfaction surveys, customer visits. Also, it is more likely for large companies to rely on external services to collect data which can provide more reliable information, while SMEs use their own resources (Fernandez-Gonzale & Prado, 2007).

In addition, Valsamakis & Sprague (2001), based on 202 UK manufacturing SMEs concludes that the long-term relationship with the customer has a significant influence on SMEs' sales growth. However customer satisfaction did not have a similar influence. Therefore, it seems that SMEs can achieve more financial benefits from their customers' long-term commitments than purely short-term satisfaction. These differences can partially explain why practices related to improving customer satisfaction are not similarly influential for SMEs and Large firms. However, to better understand the differences between SMEs and Large companies; the most significant finding in this category was also discussed with the experts.

5.2.1.1.1. Opinions of the experts regarding the impact of improving customer satisfaction

The most significant relationship in this category is the relationship between 'taking actions to improve customer satisfaction (1.3.2)' that only had a positive impact on large companies' cash flow to sales. However, this practice had no positive impact for SMEs. A summary of the experts' opinion on the difference between SMEs and Large companies regarding this practice is provided in table 5-3.

Table 5-3 Summary of experts' opinions regarding the impact of customer satisfaction

#	Summary of Expert's opinions
Focus Group 1- 23rd June 2016	1. The ownership of companies (private or listed) influences their behaviour with their customers. 2. Customer satisfaction is very difficult to measure, unless you do it by a third party company. Even when it is done by third party company, it is difficult to rely on the result. 3. SMEs have a limited number of customers and have a deep relationship with them. So taking action becomes like a normal procedure in SMEs. 4. Competition level also plays an important role on the relationship between customer satisfaction and financial performance. So there might be less competition for SMEs in this study and as a result their customer satisfaction had less impact on their financial results.
Interview 1- 30th June 2016	Generally not agree with this finding; however, also suggest that it could be because of the statistical methods that are used for analysis that has resulted in losing granularity of data.
Focus Group 2- 14th July 2016	1. It could be because of the characteristic of SMEs, that they don't have the resources and expertise to have a formal procedure to collect their customer feedback, whereas large companies have a formal procedure for doing this. 2. It depends on whether you are in a business to business or a business to customer environment. Smaller companies tend to operate more in a business to business environment and have fewer customers. Therefore, not satisfying their customers has a very serious impact on their financial performance and even survival of their business. So they usually have a close and direct relationship with their customers, rather than having a formal procedure for it. Whereas larger companies normally have a large number of end user customers. Therefore, having a formal procedure to collect customer feedback and taking action to improve their customer satisfaction would help them to receive more orders and more frequently and therefore improve their cash flow. 3. It also depends on the types of feedback (i.e. either it is complaint or warranty or customer satisfaction) and what companies do with it.
Interview 2- 18th July 2016	SMEs do not have a formal procedure for collecting data about their customer satisfaction. It is normally done through informally checking non-conformance or a quality issue with their customers, rather than having a formal procedure for collecting this data.

The most commonly suggested explanation by the experts was that SMEs usually have a limited number of customers and have a close relationship with them. Therefore, taking action to improve customer satisfaction does not have a significant impact on increasing their customer base and does not have a significant impact on improving their financial performance. Table 5-4 shows the number of companies in the sample of this study for which data on 'taking actions to improve customer satisfaction (1.3.2)' was available.

Table 5-4 Companies in the dataset for which data regarding question 1.3.2 was available

Company sizes	Not providing answer	Worst performing	Category 2	Category 3	Best performing	Total companies in the dataset
SMEs	10	2	5	12	1	30
Large firms	23	3	6	20	3	55

As shown in table 5-4, the majority of the SMEs in the dataset for which data was available (12 out of 30), were scored in category 3, which is just one level below the best performing category. This shows that the majority of the SMEs in the dataset had a strong performance in improving their customer satisfaction. However, although SMEs had taken actions to improve their customer satisfaction, its impact had not been significant on their financial performance. This supports the suggestion by the experts that since SMEs usually have a fewer number of customers, improving their customer satisfaction didn't have a significant impact on improving their financial performance. However, since large companies normally have more end-user customers, improving their customer satisfaction can lead to receiving more orders and more frequent orders which can improve their cash flow.

5.2.1.2. Drivers for change in business

Another difference between SMEs and Large firms regarding practices related to customer satisfaction was 'drivers for change in business to retain customers or to win new customers' (6.1.4). This practice only had a positive impact on large firms' financial performance and not on SMEs' financial performance (table 5-5).

Table 5-5 The impact of practices related to drivers for change in business to retain customers

Identified practices from the literature	Questions from MX Awards Survey	Financial performance	Estimated Beta-value	Exact P-value	Total Observations
• Customer Retention Rate	6.1.4 What are the significant drivers for change in your business? (Retain key customers, Win new customers, Expand into new markets)	**Large firms:** 1-2nd year inventory turnover 2-original year cash flows to sales	1.13 1.10	0.03 * 0.03 *	26 30

Based on MX best practices, the drivers to make changes in business are one of the key aspects for 'formal business planning' in companies (Garside, 2009). However, formal business planning is less common in UK SMEs (Stonehouse & Pemberton, 2002). Also, the empirical findings on the impact of formal business planning on SMEs' financial performance are mixed. Some studies, such as Peel & Bridge (1998), found that formal business planning can improve their financial performance. Other studies, such as McKiernan & Morris (1994), found that formal business planning has no influence on companies' financial performance. Therefore, the SMEs in the sample of this study might not have used formal planning in their business or if they have used it, the impact was not as significant as it was for large companies.

5.2.1.3. Conclusion on practices related to customer satisfaction

Overall, based on the findings of this study and the majority of the earlier studies, practices related to customer satisfaction have a direct positive impact on the UK manufacturing companies' (i.e. SMEs and Large firms) financial performance. However, the impacts of these practices are different for SMEs and Large companies. Also, the impact of these practices is not always on firms' profitability or sales growth. They could also have positive impact on firms' cash flow or asset management as identified in this study.

5.2.2. Practices related customer focus (hypothesis 2)

Based on the findings of the majority of the earlier studies, practices related to customer focus were expected to have a direct positive impact on companies' competitiveness or profitability (table 5-6). Nevertheless, there are some studies that found contradicting results. For example, Han et al. (2007) consider practices related to customer focus as a part of a bundle of TQM practices and claim that they have an indirect impact on a firm's financial performance via improving their customer satisfaction and quality performance. Similarly, Fotopoulos & Psomas (2010) find that they have an indirect impact on companies' financial performance through improving their 'process management' and 'quality improvement' practices. Abusa & Gibson (2013) also find that these practices only have a direct positive impact on companies' 'exports growth', which can be expected to result in higher sales and profitability in the long-term.

Table 5-6 Findings of the earlier studies related to customer focus

Customers related practices	Authors/Date	Financial perspectives	
		Competitiveness: • Increased market share • Sales growth	**Profitability:** •Return on investment • Return On Capital Employed • Return on total assets
H2. Practices related to customer focus such as: • Identification of customer needs and expectations. • Customer integration in product development process. • Assessment of customer needs and expectations. • Customers are encouraged to submit proposals and complaints • Overall reputation score	Lakhal et al. (2006)	✓	✓
	Valmohammadi (2011)	✓	✓
	Lakhal (2014)	✓	✓
	Lee & Roh (2012)	✓	✓
	Banker & Mashruwala (2007)	✓	✓
	Lee et al. (2009)	✓	✓
	Fotopoulos & Psomas (2010)	×	×
	Abusa & Gibson (2013)	×	×
	Han et al. (2007)	×	×
✓= Direct positive impact on financial performance		×= No direct positive impact on financial performance	

As discussed in section 4.7.1.2 of the previous chapter, practices related to customer focus in this study had a positive impact on the financial performance of SMEs and Large companies. However, the impact of these practices was different for SMEs and Large companies. In the following subsections, some potential reasons for the differences between SMEs and Large firms will be explained.

5.2.2.1. Having a strategy for managing the end of life of existing products

In this study, only Large firms that had better approach to managing the impact on their customers when reaching the end of life of their existing products (1.7.1) had achieved improved financial performance (original year asset turnover). However, this practice did not have a similar impact for SMEs in the sample of this study (table 5-7).

Table 5-7 The impact of having a strategy for managing end of life of existing products

Identified practices from the literature	Questions from MX Awards Survey	Financial performance	Estimated Beta-value	Exact P-value	Total Observations
• Assessment of customer needs and expectations.	1.7.1 How do you manage the impact on your customers when ending the manufacture of a product line?	**Large firms:** 1-original year asset turnover 2-3rd year margin on sales	 2.61 2.58	 0.01 ** 0.03 *	 29 28

Based on the MX Scoring guideline, companies' strategy for managing the impact on customers when reaching the end of life for existing products includes:

- Informing customers with timely warnings
- Discussing their future requirements
- Building stock to cover future customers' spares demand
- Contracting spares, repairs to specialist service provider
- Increasing prices and encouraging customers to purchase new model (MX Scoring guideline, 2010)

These strategies have resulted in an increased net sale for the large firms in this study and improved their asset turnover. However, Kuik et al. (2011) suggested the following four supporting elements that can ensure successful implementation of these types of approaches:

1- Management commitment
2- Management Systems e.g. ISO 9001
3- Resource management for training programmes
4- Adoption of technology for continuous improvement.

Because of limited resources or lack of expertise, it might not be possible for many SMEs to successfully implement their strategies for managing the end of life of their products. Therefore, the financial impact of this practice has been less significant for SMEs than for large companies. However, the difference between SMEs and Large firms on the impact of this practice was also discussed with the experts, and is discussed in the following subsection.

5.2.2.1.1. Opinions of the experts regarding having a strategy for managing end of life of existing products

A summary of the experts' opinions on the difference between SMEs and Large companies on this practice is provided in table 5-8. One potential explanation that was suggested by the experts was that SMEs are usually suppliers of components to larger companies that manufacture end-products. Therefore, SMEs generally only need to make small changes to their products throughout their lifecycle. In addition, SMEs have a fewer number of products and accordingly have a fewer number of products that are at the end of their lifecycle. Therefore, the impact of having a strategy for managing the impact of the end of life of existing products on their customers is less significant on their financial performance.

Table 5-8 Summary of experts' opinions regarding the impact of managing end of life of existing products

#	Summary of Expert's opinions
Focus Group 1- 23rd June 2016	1. It depends on the industry: In some industries, such as aerospace, having a strategy for managing the impact of the end of life existing products is a real issue. But in some other industries, such as automotive, it is not issue, because the product can be substituted. 2. SMEs have limited resources and low capacity, so the future contracts get higher priority than dealing with the end of life of existing products. Also, SMEs might not see a future market opportunity for after-market of their existing products. 3. It depends on the strategy of companies. Some might decide to not extend the life of their products that have come to the end of its life.
Interview 1- 30th June 2016	It depends on the type of products that companies manufacture. For some companies, managing the end of life of their products has a direct positive impact on financial performance. However, that should be the same for SMEs too.
Focus Group 2- 14th July 2016	1. SMEs have a fewer number of products and accordingly have fewer products that are at the end of their life cycles, so the impact of this practice is less significant for them. 2. Larger companies have more formal procedures for managing the end of life of their existing products. However, normally in SMEs only small changes are required to their existing products and therefore it is less common that their products would come to the end of their lifecycle. Managing the end of life is less of an issue. 3. It is only the in recent years that the importance of managing the end of life of products is realised by companies and particularly by larger companies. So SMEs still haven't realised that there is opportunity in it for them. 4. Also agrees with the potential explanations from the literature.
Interview 2- 18th July 2016	Since Large companies have a greater number of products, it is understandable that they have a formal strategy for managing the impact on customers and achieve financial benefits from it, whereas in SMEs this process is normally performed in in an ad hoc way, since they have fewer products.

Table 5-9 shows the number of companies in the sample of this study for which data on 'strategy for managing end of life of existing products' (1.7.1) was available.

Table 5-9 Companies in the dataset for which data regarding question 1.7.1 was available

Company sizes	Not answered	Worst performing	Category 2	Category 3	Best performing	Total companies
SMEs	22	0	3	4	1	30
Large firms	35	1	0	5	14	55

As shown in table 5-9, only eight out of the thirty SMEs in the sample of this study answered this question (i.e. that they had a strategy for managing the impact of the end of life of their products). The majority of the SMEs (i.e. 22 out of 30) did not answer this question. This can potentially reflect that these companies either did not have any strategy, or managing the end of life of existing products was less important for them. Therefore, the proposed explanation by the experts that this practice is less common for SMEs can be a reasonable explanation for why this practice did not have any impact for SMEs.

5.2.2.2. Differentiation through customer focus

Large companies in the sample of this study that had differentiated themselves through their customer focus practices (1.8.1) experienced an improvement in three measures of their profitability in the year of participation in the MX Awards. However, these practices did not have a similar impact for the SMEs (table 5-10).

Table 5-10 The impact of differentiation through customer focus

Identified practices from the literature	Questions from MX Awards Survey	Financial performance	Estimated Beta-value	Exact P-value	Total Observations
• Overall reputation score	1.8.1 How do you believe that your approach to Customer Focus differentiates your organisation?	**Large firms:** 1-original year return on capital employed 2-original year return on shareholders' funds 3-original year margin on sales	 2.48 2.09 2.09	 0.01 ** 0.04 * 0.04 *	 42 40 41

Liu (1995), based on a survey study conducted with 253 UK manufacturing SMEs and Large firms, concludes that large and extra-large organisations are more customer-orientated than SMEs. It is claimed that this difference could be because of the differences in their financial, human and technological resources (Liu, 1995). Therefore, this finding of the study – that differentiation through customer focus did not have the same impact for SMEs – is aligned with Liu's (1995) study.

5.2.2.3. Usage of sales/distribution channels

Based on the findings of this study, using more than one sales and/or distribution channels for identifying customers' needs and expectations (question 1.1.3) had influenced profitability of SMEs and liquidity of Large companies (table 5-11).

Table 5-11 The impact of sales and/or distribution channels

Identified practices from the literature	Questions from MX Awards Survey	Financial performance	Estimated Beta-value	Exact P-value	Total Observations
• Identification of customer needs and expectations.	1.1.3 Which sales and/or distribution channels do you use and what benefits do they provide?	**Large firms:** 1st year accounts payable days **SMEs:** 2nd year gross profit margin	 1.27 2.44	 0.02 * 0.03 *	 40 18

Based on MX best practices, using more than one appropriate sales and distribution channel can help companies to increase their sales by selling other products/services to their existing customers and by finding new customers (Garside, 2009). However, for the SMEs in the sample, this increased sale has been larger than their cost of sale and, therefore, has improved their gross profit margin. For Large companies it has improved their liquidity (account payable days).

5.2.2.4. Approach to winning new sales

In this study, SMEs that had a more effective approach to winning new sales (6.4.3) experienced an improvement in their liquidity (1st year current ratio). However, this practice did not have similar impact for large firms (table 5-12).

Table 5-12 The impact of having an approach to win new sales

Identified practices from the literature	Questions from MX Awards Survey	Financial performance	Estimated Beta-value	Exact P-value	Total Observations
• Identification of customer needs and expectations.	6.4.3 How does your company win new sales? (Developing a product family based on particular customer needs)	**SMEs:** 1st year current ratio	2.66	0.02 *	19

Based on MX best practices, having an effective approach to win new sales has helped companies to have more satisfied customers and a more reliable customer base (Garside, 2009). In this study, this has led to increased current assets: cash, account receivable for SMEs and therefore, an improvement in their current ratio. An effective sales approach may include following factors:

- Preparing a sales campaign to identify potential customers
- Developing a product family based on particular customer needs
- Introducing appropriate incentives for the sales force
- Expanding a range of products and services sold to existing customers (MX Scoring guideline, 2010).

Wahlberg & Strandberg (2009) identified the following six features of SMEs that differentiate them from large companies in finding new sales:

1- Limited financial resources
2- Limited expertise
3- Limited number of customers and products
4- Regional focus
5- Manager/owner dominance
6- Constant time pressure.

Because of these differences, the generation of new sales is more crucial for the growth of SMEs (Wahlberg & Strandberg, 2009). In this study, the approach to finding new sales has improved SMEs' current assets and current ratio. However, for large firms with a larger customer base, winning new sales has not been equally influential.

5.2.2.5. Benefits of after-sales and product support services

In this study only large firms that have a more effective after-sales service (1.2.2) achieved an improved profitability (original year margin on sales and original year return on total assets). However, this practice did not have a similar impact for SMEs in the sample (table 5-13).

Table 5-13 The impact of after-sales and product support services

Identified practices from the literature	Questions from MX Awards Survey	Financial performance	Estimated Beta-value	Exact P-value	Total Observations
----	1.2.2 What benefits have after-sales and product support brought to your customers and your company?	**Large firms:** 1-original year margin on sales 2-original year return on total assets	1.28 1.02	0.03 * 0.05 *	39 40

An effective after-sales strategy provides an additional revenue stream that in some industries are more profitable than the original sales (Garside, 2009). This has resulted in an increased income and improved return on total assets for the large firms in this study. Saccani (2007) identified the main benefits of providing after-sales services for manufacturing companies including:

1. Having a larger market than new products
2. Generating higher revenue than the original product
3. Having an important role in increasing customer satisfaction
4. Increasing success rate of new products.

However, Malleret (2006) states that for gaining such benefits companies should produce and provide their services to their customers at a lower price than their competitors. This requires awareness of costs related to those services and appropriate pricing that would be acceptable for customers. Larger firms with larger resources are more likely to have accurate costing systems for measuring costs of their services. Also, Gebauer et al. (2005) stated three main barriers to providing after-sales service for manufacturing companies:

1- Managerial preference
2- Difficulties of changing organisational structure
3- Difficulties of implementing those changes.

Therefore, the lack of relationship between this measure and SMEs' financial performance in this study could be because of those reasons.

5.2.2.6. Conclusion on practices related to customer focus

Overall, it can be concluded that practices related to customer focus have a direct positive impact on the UK manufacturing companies' financial performance. However, the impact of these practices is different for SMEs and Large companies. Also, besides profitability and sales growth, these practices could also have a positive impact on companies' liquidity and asset management, as identified in this study.

5.2.3. Practices related to employees' training (hypothesis 7)

Based on the findings of the majority of the earlier studies, practices related to employees' training were expected to have no direct positive impact on companies' competitiveness and profitability (5-14). However, as shown in table 5-14, there are also some studies that found that these practices do have a direct positive impact on companies' financial performance. For example, Lakhal (2014) and Kannan & Tan (2005) claim that these practices have a direct positive impact on companies' sales growth and profitability. However, in these two studies, practices related to employees' training are considered as a part of a bundle of TQM practices. Therefore, the impact of other TQM practices might have influenced their identified relationship.

Table 5-14 Findings of the earlier studies related to employees' training

Employees related practices	Authors/Date	Financial perspectives	
		Competitiveness: • Increased market share • Sales growth	**Profitability:** • Return on investment • Return On Capital Employed • Return on total assets
H7. Practices related to employees' training, such as: • Employee training • Management training • Employee training in quality management and control • Empowerment of shop operators to correct quality problems • The company practices employee satisfaction with training received.	Lakhal (2014)	✓	✓
	Kannan & Tan (2005)	✓	×
	Lakhal et al. (2006)	×	×
	Han et al. (2007)	×	×

✓= Direct positive impact on financial performance ×= No direct positive impact on financial performance

As discussed in section 4.7.1.3 of the previous chapter, practices related to employees' training also had no direct positive impact on the financial performance of the companies in the sample of this study. So this finding was aligned with the findings of previous studies. However, to better understand the impact of employees' training on UK manufacturing companies' financial performance, the impact of one practice from this category was discussed with the experts, which will be explained in the following subsection.

5.2.3.1. Opinions of the experts regarding the impact of employees' training

One practice in the category of employees' training was 'assessing employees' performance and identifying their training requirements (5.3.1)', which had no positive impact on the financial performance of the SMEs and Large companies in the sample of this study. A summary of the experts' opinion regarding this finding is provided in table 5-15.

Table 5-15 Summary of experts' opinions regarding the impact of employees' training

#	Summary of Expert's Opinions
Focus Group 1- 23rd June 2016	1. Employees' training has a positive impact on quality and quality, in turn, has a positive impact on financial performance. 2. It depends on the types of training. The job-related training or skills training are necessary to improve product quality. However, sending the workforce to obtain university qualifications might have a negative impact on financial performance. 3. Training employees is very common in UK manufacturing companies, but their influence on improving financial performance is not very noticeable. However, not providing training for employees might have a negative impact on companies' financial performance.
Interview 1- 30th June 2016	It depends on the type of training; job-related training which can improve employees' skills in performing their tasks could have a direct positive impact, while management training is not expected to have a direct impact on financial performance, and could have an indirect impact.
Focus Group 2- 14th July 2016	1. There is a time lag between providing training for employees and achieving financial performance improvement. So improvement is not expected in the short-term, but in the long term it will have a positive impact. 2. It depends on the type of training. If it is not job-related training, then it is not expected to improve financial performance.
Interview 2- 18th July 2016	It depends on the type of training and if it is job-related training it will certainly have a positive impact on financial performance. However, if training is only for getting a qualification without improving employees' skills, then it does not have any impact on financial performance.

One of the most commonly suggested explanations by the experts was that the impact of employees' training on financial performance depends on the types of training. Job-related training which are intended to improve employees skills are expected to have a positive impact on financial performance. However, sending employees to obtain university qualifications might have a negative impact on financial performance. Table 5-16 shows the number of companies in the sample of this study for which data regarding 'assessing employees' performance and identifying their training requirements (5.3.1)' was available.

Table 5-16 Companies in the dataset for which data regarding question 5.3.1 was available

Company sizes	Not answered	Worst performing	Category 2	Category 3	Best performing	Total companies
SMEs	12	1	5	4	8	30
Large firms	24	0	5	5	21	55

As shown in table 5-16, the majority of the SMEs (eight out of eighteen) and the majority of Large companies (twenty-one out of thirty-one) for which answers were available, scored as the best performing companies. However, this practice did not have a positive impact on their financial performance. This indicates that as suggested by the experts, not all types of training have a positive impact on companies' financial performance. The alternative explanation suggested by the experts is that since providing employee training is common in UK manufacturing companies, this practice does not have a direct positive impact on companies' financial performance. However, not providing training for the workforce could potentially have a negative impact which is not examined in this study.

5.2.3.2. Conclusion on practices related to employees' training

Overall, based on the findings of this study and the earlier studies and suggestions of the experts, it can be concluded that not all types of employees' training have a direct positive impact on UK manufacturing companies' financial performance. However, in the dataset of this study, all types of training that the companies had offered to their workforce are collectively collected. Therefore the types of training is not separated, so that their impact could be separately analysed. Also as suggested by the experts, not providing training for the workforce could potentially have a negative impact on companies' financial performance which is not investigated in this study and needs further investigation.

5.2.4. Practices related to building relationships with suppliers (hypothesis 19)

Based on the findings of the majority of the earlier studies, practices related to building relationships with suppliers were expected to have no direct positive impact on companies' competitiveness or profitability (table 5-17). Valmohammadi (2011) and Rosenzweig et al. (2003) found contradicting results in regard to these practices having a direct positive impact on companies' sales growth and profitability. However, the majority of other studies, such Jayaram et al. (2008), Han et al. (2007), Abusa & Gibson (2013) and Hofer et al. (2012) suggest that these practices do have an indirect impact on firms' financial performance. Even in Valmohammadi's (2011) study, it is stated that the identified relationship is weak.

Table 5-17 Findings of the earlier studies related to building relationships with suppliers

Suppliers related practices	Authors/Date	Financial perspectives	
		Competitiveness: • Increased market share • Sales growth	**Profitability:** • Return on investment • Return On Capital Employed • Return on total assets
H19. Building relationships with suppliers, including practices such as: •Integrated closely with raw material suppliers •Providing feedback to suppliers on the performance of products and processes •Fulfilment of needs and expectations of suppliers. •Suppliers located in close proximity •Establishing long-term relationships with suppliers	Valmohammadi (2011)	✓	✓
	Rosenzweig et al. (2003)	×	✓
	Jayaram et al. (2008)	---	×
	Han et al. (2007)	×	×
	Abusa & Gibson (2013)	×	×
	Hofer et al. (2012)	---	×
✓= Direct positive impact on financial performance		×= No direct positive impact on financial performance	

For example, Han et al. (2007) consider the impact of 'building relationships with suppliers' practices as a part of a bundle of TQM practices. This study suggests that these practices have an indirect impact on firms' financial performance via improving their quality, cost, delivery and flexibility. Hofer et al. (2012) also consider the impact of 'building relationships with suppliers' practices as a part of a bundle of external lean practices. This study finds that 'building relationships with suppliers' practice has an indirect impact on firms' financial performance via improving their inventory leanness. Jayaram et al. (2008) also suggest that these practices have an indirect impact on firms' financial performance via their impact on their lean design practices such as standardisation and concurrent engineering. Rosenzweig et al. (2003) and Abusa & Gibson (2013) have also suggested that these practices have an indirect impact on financial performance. This impact is either via their impact on other TQM practices, as suggested by Abusa & Gibson (2013), or on other operational capabilities, such as process flexibility and cost leadership, as suggested by Rosenzweig et al. (2003).

As discussed in section 4.7.1.4 of the previous chapter, practices related to building relationships with suppliers also did not have a positive impact on the financial performance of the companies in the sample of this study. Therefore, this finding supports the findings of the previous studies. However, to better understand the impact of buildings relationship with suppliers on UK manufacturing companies' financial performance, the impact of one practice from this category was discussed with the experts. In the following subsection, a summary of the experts' opinions is given.

5.2.4.1. Opinions of the experts regarding the impact of building relationships with suppliers

One practice in the category of building relationships with suppliers was 'Involving customers and/or suppliers in the manufacturing process (3.4.1)', which had no positive impact on the financial performance of the SMEs and Large companies in the sample of this study. A summary of the experts' opinions regarding this finding is provided in table 5-18.

Table 5-18 Summary of experts' opinions regarding the impact of building relationship with suppliers

#	Summary of Experts' Opinions
Focus Group 1- 23rd June 2016	Generally do not agree with this finding. However, it was also suggested that it depends on the quality of the relationship and it is difficult to measure how good the relationship is, since there are different categories of suppliers: a System critical supplier is the most important supplier and it drops down to buying pencils. And it is categorising the suppliers as to where you want the relationship and where you don't want the relationship. But there are certain suppliers that are system-critical, and you have no option but to have a relationship with them.
Interview 1- 30th June 2016	There are other studies that suggest different findings; however, their findings are based on surveys which are less reliable than this study. However, the potential explanations from the literature are acceptable.
Focus Group 2- 14th July 2016	1-Do not agrees with this finding, and suggests that there is a need to involve customers and suppliers in the manufacturing process and it has a positive impact on financial performance. 2-Based on the Kraljic's matrix, all suppliers are not the same; there are strategic suppliers and commodities suppliers and while there is a need to develop a long-term relationship with strategic suppliers, there is no need to have strong relationships with commodities suppliers. 3-Also based on Andrew Cox's power matrix, it depends on the position of the company in the supply chain and the dominance of suppliers or buyers in their relationship. So if the supplier has more dominance in the relationship, then their involvement in the manufacturing process is not expected to have a positive impact on financial performance.
Interview 2- 18th July 2016	Since it is common for the majority of companies to involve their customers and/or suppliers in their manufacturing process, so its impact on their financial performance is not significant.

The majority of the experts were expecting to find that the involvement of customers and/or suppliers in the manufacturing process should have a direct positive impact on the UK manufacturing companies' financial performance. Therefore, the majority of the experts disagree with this finding of the study. However, there were also two key potential explanations by the experts regarding this finding:

The first explanation was that the impact of building relationships with suppliers depends on the types of supplier. While it is necessary for a company to build a long-term relationship with its strategic supplier, there is no need to build a strong relationship with commodities suppliers. The other explanation was regarding the position of a company in the supply chain and the dominance of suppliers or buyers in their relationship. If the supplier has more dominance in the relationship, then their involvement in the manufacturing process is not expected to have a positive impact on financial performance. However the information about the companies in the sample of the study is not sufficient to distinguish between the impacts of building relationship with strategic versus commodity suppliers. Also the position of position of the companies in the supply chain and the dominance of suppliers or buyers in their relationship is not available for the companies in the dataset. Table 5-19 shows the number of companies in the sample of this study for which data regarding 'Involving customers and/or suppliers in manufacturing process (3.4.1)' was available.

Table 5-19 Companies in the dataset for which data regarding question 3.4.1 was available

Company sizes	Not answered	Worst performing	Category 2	Category 3	Best performing	Total companies
SMEs	9	4	7	4	6	30
Large firms	22	1	9	12	11	55

As shown in table 5-19, performance of the SMEs in the sample of this study is different. There are seven SMEs that scored in category 2, which shows that they had a poor performance, and six SMEs scored as the best performing companies. Therefore, their results could have counterbalanced each other. However, the majority of the large companies in the sample scored either in category 3 or best performing companies. Therefore, if this practice could have a direct positive impact on the financial performance, it should have been detected at least for the large companies in this study. Nevertheless, since there was a disagreement between the findings of this study and the majority of the previous studies and the opinions of the experts on the UK manufacturing companies, this finding needs further investigation.

5.2.4.2. Conclusion on practices related to building relationships with suppliers

Overall, based on the findings of this study and the majority of the previous studies, it can be concluded that practices related to building relationships with suppliers have no direct positive impact on UK manufacturing companies' financial performance. However, this is a controversial finding and contradicts the opinions of the majority of the experts. Therefore, the impact of practices related to building relationships with suppliers needs further investigation.

5.2.5. Practices related to supplier selection (hypothesis 20)

Based on the findings of the two previous studies that are reviewed in this research, practices related to supplier selection were expected to have no direct positive impact on companies' competitiveness or profitability. As shown in table 5-20, Huang et.al (2008) found that these practices have a direct positive impact on companies' profitability and competitiveness. However, in that study, the exact measures of competitiveness and financial performance are not provided. It can be assumed that similar to Rosenzweig et al.'s (2003) study, competitiveness is measured by product quality, delivery reliability, process flexibility and cost leadership. In this way, the findings of Huang et al.'s (2008) study is similar to Kannan & Tan's (2005), which claims that practices related to supplier selection only have a direct positive impact on companies' product quality and customer service (Kannan & Tan, 2005). Therefore, it can be concluded that practices related to supplier selection have an indirect impact on companies' financial performance.

Table 5-20 Findings of the earlier studies related to supplier selection

Suppliers related practices	**Authors/Date**	**Financial perspectives**	
		Competitiveness: • Increased market share • Sales growth	**Profitability:** • Return on investment • Return On Capital Employed • Return on total assets
H20. Supplier selection practices including: •Selecting suppliers striving to eliminate waste •Considering process capability in supplier selection •Supplier evaluation and selection •Considering commitment to quality in supplier selection •Reducing supplier base	Huang et al. (2008)	✓	---
	Kannan & Tan (2005)	×	×
✓= Direct positive impact on financial performance		×= No direct positive impact on financial performance	

As discussed in section 4.7.1.5 of the previous chapter, practices related to supplier selection also did not have a positive impact on the financial performance of the companies in the sample of this study. Therefore, this finding supports the findings of the previous studies. However, to better understand the impact of supplier selection on the UK manufacturing companies' financial performance, the impact of one practice from this category was discussed with the experts. In the following subsection, a summary of the experts' opinions will be given.

5.2.5.1. Opinions of the experts regarding the impact of supplier selection

One practice in the category of supplier selection was 'assessing suppliers' quality performance (1.6.2)' that had no positive impact on the financial performance of the SMEs and Large companies in the sample of this study. A summary of the experts' opinions regarding this finding is provided in table 5-21.

Table 5-21 Summary of experts' opinions regarding the impact of building relationships with suppliers

#	Summary of Experts' Opinions
Focus Group 1- 23rd June 2016	Generally do not agree with this finding. However, also suggested that the companies in the sample of this study probably already have the best suppliers that they can have. So the impact of assessing supplier quality has not been significant on their financial performance. And not assessing suppliers' quality could have a negative impact which is not investigated in this study.
Interview 1- 30th June 2016	The potential explanations from the literature that suggest there might be a mediating variable between assessing supplier's performance and financial result is reasonable.
Focus Group 2- 14th July 2016	Generally do not agree with this finding. However, also suggested the following potential explanations: 1. As a process for selecting suppliers, assessing suppliers' performance is a qualifying criterion. So suppliers need to comply with certain criteria to be eligible for doing business, but this doesn't necessarily improve financial performance of the buyer company. 2. It also depends on governance of the relationship between buyers and suppliers that can have a positive impact on financial performance, rather than only assessing suppliers' quality performance. 3. It might be that the company in the sample of this study have had good suppliers for a long time and therefore the impact of assessing their quality performance does not have a significant impact on their financial performance.
Interview 2- 18th July 2016	SMEs are more likely to only have commodity suppliers that have no significant influence on their manufacturing process. Therefore, assessing their quality performance is not expected to have a positive impact on their financial results. However, for Large companies a high percentage (about 80%) of their quality problems is from their suppliers. Therefore, it is expected that assessing suppliers' quality performance should have a positive impact on Large companies' financial performance.

The majority of the experts disagree with this finding of the study and expected a direct positive impact from assessing suppliers' quality performance on financial performance. Table 5-22 shows the number of companies in the sample of this study for which data regarding 'assessing suppliers' quality performance (1.6.2)' was available.

Table 5-22 Companies in the dataset for which data regarding question 1.6.2 was available

Company sizes	Not answered	Worst performing	Category 2	Category 3	Best performing	Total companies
SMEs	11	2	4	8	5	30
Large firms	23	0	6	11	15	55

As shown in table 5-22, the majority of SMEs and Large companies for which data were available, scored in category 3 or as the best performing companies. This shows that despite the majority of the companies in the sample of this study having a strong performance in assessing their suppliers' quality performance, this practice did not have a direct positive impact on their financial performance.

Therefore, two potential explanations from the experts are more likely for the companies in the sample of this study. The first explanation is that companies need to assess their suppliers' quality performance to make sure they conform to certain criteria for doing business. However, this practice doesn't necessarily improve financial performance of the buyer company. The other potential explanation is that companies in the sample of this study already had the best suppliers that they can have for a long time. Therefore, assessing their suppliers' quality performance doesn't have a significant impact on improving their financial performance to any further extent.

5.2.5.2. Conclusion on practices related to building relationships with suppliers

Overall, based on the findings of this study and the earlier studies, practices related to supplier selection have no direct positive impact on UK manufacturing companies' financial performance. However similar to the finding regarding the practices related to practices building relationship with suppliers, this finding is also controversial and contradicts the opinions of the majority of the experts. Therefore, the impact of practices related to suppliers' selection needs further investigation.

5.3. Hypotheses that are partially supported

Based on the findings of the earlier studies, practices in the following five categories were expected to have a direct positive impact on companies' profitability and competitiveness:

1. Employees' effectiveness
2. Employees' recruitment reward and retention
3. Process performance improvement
4. Manufacturing simplicity
5. Preventive maintenance.

However, they only had the expected impact for the large companies in this study. Therefore, the hypotheses related to these practices are only partially supported in this study (i.e. only for Large firms). Also, practices related to 'corporate social responsibility' were expected to have no direct positive impact on companies' profitability and competitiveness. However, they had a positive impact on the profitability of the large firms in this study. Therefore, the hypothesis related to this practice is only partially supported for SMEs by the findings of this study. In the following subsections, the potential explanations for the identified relationships for practices in these categories will be discussed.

5.3.1. Practices related to employees' effectiveness (hypothesis 4)

Based on the findings of the majority of the earlier studies, such as Valmohammadi (2011) and Nilsson et al. (2001), practices related to employees' effectiveness were expected to have a direct positive impact on companies' competitiveness or profitability (table 5-23).

Table 5-23 Findings of the earlier studies related to employees' effectiveness

Employees related practices	Authors/Date	Financial perspectives	
		Competitiveness: • Increased market share • Sales growth	**Profitability:** • Return on investment • Return On Capital Employed • Return on total assets
H4. Practices related to employees' effectiveness and satisfaction, such as: • Transparency of mission and vision. • Providing participative environment for employees. • The competence of the employees is maintained and developed in a systematic way. • Empowerment of staff for continuous improvement. • Employee satisfaction is analysed and the results are the target of continuous improvement.	Valmohammadi (2011)	✓	✓
	Banker & Mashruwala (2007)	✓	✓
	Tarigan & Widjaja (2012)	✓	✓
	Nilsson et al. (2001)	---	✓
	Kumar et al. (2009)	---	✓
	Dubey & Gunasekaran (2015)	---	✓
	Sila (2007)	×	×
	Fotopoulos & Psomas (2010)	×	×
	Abusa & Gibson (2013)	×	×
✓= Direct positive impact on financial performance ×= No direct positive impact on financial performance			

However, Sila (2007), Fotopoulos & Psomas (2010) and Abusa & Gibson (2013) find that these practices have an indirect impact on financial performance. For example, Sila (2007) considers these practices as a part of a bundle of TQM practices and finds that they have indirect impact on companies' financial performance via improving organisational effectiveness, employee involvement and customer satisfaction. Fotopoulos & Psomas (2010) also find that they have an indirect impact on financial performance via improving customer satisfaction. Abusa & Gibson (2013) find that these practices have no direct impact on companies' financial performance and can only improve their employees' morale.

As discussed in section 4.7.2.1 of the previous chapter, two practices related to employees' effectiveness had a positive impact on the financial performance of the companies in the sample in this study. However, their impact was different for SMEs and large companies 'Having a systematic approach to measure employees' effectiveness and comparing it with competitors (5.7.1)' only had a positive impact on cash flow and profitability of large companies. And 'taking action as a result of answers received from your attitude survey (5.3.11)' only had a positive impact on liquidity and debt management of SMEs. Some potential reasons for the difference between SMEs and Large companies in the way that these practices have influenced their financial results will be explained in the following subsections.

5.3.1.1. Differentiation through employees' effectiveness

In this study only large firms that had 'a systematic approach to measure employees' effectiveness and comparing it with competitors (5.7.1)'had experienced an improved cash flow (3 ratios) and profitability (2 ratios).However, this practice did not have similar impact for SMEs. A potential explanation for this can be that SMEs usually have an informal human resource management (Marlow, 2000), and there are fewer employees than in Large firms. Therefore, the benefit of having more skilled and motivated employees is expected to be greater in larger firms than in SMEs. Also, similar to Sila's (2007) study, this practice might have an indirect impact on the financial performance of SMEs via improving their organisational effectiveness, employee involvement and customer satisfaction. However, the impact of this practice on UK manufacturing companies' financial performance was also discussed with the experts, which will be explained in the following subsection.

5.3.1.1.1. Opinions of the experts regarding measuring employees' effectiveness

A summary of the experts' opinions on the reasons for the lack of impact of this practice for SMEs in this study is provided in table 5-24. One of the commonly suggested potential explanations by the experts for this practice is that measuring employees' effectiveness is less formal in SMEs. This is because SMEs usually have fewer employees and the effectiveness – or not – of their employees is more visible. So there is less need for formal measurement in SMEs. Also, SMEs usually have less capability than large companies to compare their performance with their competitors and they are more likely focus on achieving their own internal targets.

Table 5-24 Summary of experts' opinions regarding measuring employees effectiveness

#	Summary of Expert's Opinions
Focus Group 1- 23rd June 2016	1. It is less important for SMEs to compare their performance with their competitors. They usually tend to only have their own targets and internal measures for their own business. 2. Measuring employees' effectiveness is less formal in SMEs than in Large firms and it is easier to see which employees are effective and which are not. So there is less need for formal measurement. 3. It depends on what is measured as employees' effectiveness. Certain things will affect cash flow; certain things will affect sales, and so on.
Interview 1- 30th June 2016	Large companies have more robust systems for measuring employees' effectiveness, which smaller companies might not have. Also Large companies have more defined job roles, whereas in SMEs, employees are expected to do a little of everything.
Focus Group 2- 14th July 2016	1. Larger companies have a larger number of employees so they need to have formal procedures to measure their employees' effectiveness, whereas in SMEs that have fewer employees, there is less need for having a formal procedure. 2. There might be a time lag between improving employees' effectiveness and improvement in financial performance. So it might take more than three years to observe its impact for SMEs. 3. It might depend on the nature of the question that SMEs do not have the capability to compare their performance with their competitors, whereas is it easier for larger companies to perform this comparison.
Interview 2- 18th July 2016	Large companies are more likely to have laid down standardised ways of working and have processes in place that standardises what is going on, and that enables employees to be more effective, whereas smaller companies don't have the resources and standardisation to measure employees' effectiveness similar to Large companies. Also, the potential explanations from the literature are reasonable.

Table 5-25 shows the number of companies in the sample of this study for which data on 'having a systematic approach to measure employees' effectiveness and comparing it with competitors (5.7.1)' was available.

Table 5-25 Companies in the dataset for which data regarding question 5.7.1 was available

Company sizes	Not answered	Worst performing	Category 2	Category 3	Best performing	Total companies
SMEs	12	0	1	5	12	30
Large firms	24	0	0	9	22	55

As shown in table 5-25, the majority of SMEs and Large companies for which data was available in this study were scored as the best performing companies. Therefore, as suggested by the experts, the impact of measuring employees' effectiveness is more significant for large companies. Since SMEs have fewer employees, they are more able to identify the less effective employees; therefore, having a formal procedure for measuring employees' effectiveness has a less significant impact on their financial result.

5.3.1.2. Taking actions as a result of answers received from the attitude survey

In this study SMEs that have taken action as a result of the answers that they have received from their attitude survey (5.3.11) have experienced an improvement in their liquidity (1st year current ratio) and debt management (2nd year interest cover). High Performance Work Practices (HPWPs) are modern employee management practices including: usage of self-directed teams, group-based performance, high pay levels and formal employee training (Kroon et al., 2013). Wu (2011) identified the relationship between the acceptances of (HPWPs) in the UK SMEs and its impact of their financial performance. In this study it is claimed that because of informal relationships in SMEs, it is not common for them to use attitude surveys to collect their employees' viewpoints on management issues. Those that use such techniques can improve their employees' satisfaction and overall performance (Wu, 2011). Therefore, this finding of the study is aligned with Wu (2011).

The individual practices did not have a positive impact on the financial performance of the large firms in this study. However, as explained in the previous subsection, large firms that have differentiated themselves through their employees' effectiveness experience an improvement in their profitability and cash flow. Therefore, it seems that the impact of this individual practice has not been large enough to be detected for large firms.

5.3.1.3. Conclusions vis-a-vis practices related to customer focus

Overall, it can be concluded that practices related to employees' effectiveness have a direct positive impact on UK manufacturing companies' financial performance. However, the impact of these practices is different for SMEs and Large companies. Also, the impact of these practices might not always be in terms of firms' sales growth and profitability. They could also have positive impact on SMEs' liquidity and debt management or large firms' cash flow, as identified in this study.

5.3.2. Practices related to employees' recruitment (hypothesis 6)

Both of the earlier studies that have considered the impact of these practices on the companies' financial performance found that they have a direct positive impact on their sales growth and profitability (table 5-26).

Table 5-26 Findings of the earlier studies related to employees' recruitment

Employees related practices	Authors/Date	Financial perspectives	
		Competitiveness: • Increased market share • Sales growth	**Profitability:** • Return on investment • Return On Capital Employed • Return on total assets
H6. Practices related to employees' recruitment, reward & retention, such as: •Rigorous staff selection process •Employees having suitable work experience for accomplishing their job successfully in our company. •Our performance appraisals emphasise outcomes. •Remuneration package to promote employee retention. •Employees are creative in our company.	Ngo et al. (2008)	✓	✓
	Wang et al. (2014)	✓	✓
✓= Direct positive impact on financial performance ×= No direct positive impact on financial performance			

As discussed in section 4.7.2.2 of the previous chapter, practices related to customer satisfaction only had a positive impact on the financial performance of large companies in the sample of this study. However, they had no direct positive impact for SMEs. In the following subsections, the potential reasons for the differences between SMEs and Large companies will be explained.

5.3.2.1. Financial and non-financial reward schemes

In this study, only large firms that had more effective financial and non-financial reward schemes (5.4.1) had experienced an improvement in their profitability, cash flow and asset management. One potential explanation for not detecting the same impact for SMEs can be because large firms have a larger number of employees, and therefore the impact of their reward scheme has been greater on their financial performance. Also, Barrett & Mayson (2007) argue that SMEs' human resource practices are focused more on selecting and recruiting staff and record-keeping than on reward schemes for the workforce. Therefore, large companies, by having a more advanced rewards scheme, gained a better financial return from it. The difference between SMEs and Large firms on the impact of this practice was also discussed with the experts and this will be explained in the following subsection.

5.3.2.1.1. Opinions of the experts regarding financial and non-financial reward schemes

A summary of the experts' opinions on the reasons for the lack of impact of this practice for SMEs in this study is provided in table 5-27. The experts agree with the potential explanation from the literature that SMEs' human resource practices are focused more on selecting and recruiting staff and record-keeping than on reward schemes for workforce (Barrett & Mayson, 2007). Also, it was suggested that SMEs' reward schemes are mainly individual payment systems. Therefore, the benefits of their reward schemes go to individual employees, rather than affecting the company's financial performance.

Table 5-27 Summary of experts' opinions regarding financial and non-financial reward scheme

#	Summary of Expert's Opinions
Focus Group 1- 23rd June 2016	It is likely that SMEs might still be working on piece rate systems, and their reward schemes are more individual payment systems. Therefore, the incentives of their reward schemes go to the employees rather than the firm or the team.
Interview 1- 30th June 2016	The potential explanation from the literature is reasonable, since SMEs are generally just trying to survive and it is less common for them to have reward schemes.
Focus Group 2- 14th July 2016	It depends on the ownership of the companies and the types of bonus schemes, which is different between SMEs and larger companies. SMEs have more informal reward schemes which concentrate on rewarding individuals.
Interview 2- 18th July 2016	---

Table 5-28 shows the number of companies in the sample of this study for which data on 'financial and non-financial reward schemes (5.4.1)' was available.

Table 5-28 Companies in the dataset for which data regarding question 5.4.1 was available

Company sizes	Not answered	Worst performing	Category 2	Category 3	Best performing	Total companies
SMEs	12	0	4	12	2	30
Large firms	24	1	3	17	10	55

As shown in table 5-28, only two out of the eighteen SMEs for which data was available were scored as best performing companies and there were twelve SMEs that did not answer this question. This shows that it is less common for SMEs to have a formal reward schemes and, therefore, this practice had no direct positive impact on their financial results.

5.3.2.2. Actions for reducing the need for regular overtime

In this study only large firms that had taken action 'to reduce the need for regular overtime (5.4.3) had experienced improvement in their financial performance. However, this practice did not have a similar impact for SMEs. In general, the cost of overtime payments negatively influenced companies' cost of sales. Based on MX best practices, companies can employ self-directed motivated employees and make required resources available to meet changes in demands, in order to reduce their need for regular over-time work (Garside, 2009). Large companies in the sample of this study that reduced their need for regular over-time reduced their cost of sales and improved their gross profit margin.

A potential explanation that this practice has only improved the financial performance of large companies, could be because SMEs have a more informal structure and, therefore, their workforce might not charge higher wages for their over-time work. Also, based on empirical studies on UK companies (Muravyev, 2009) and Belgian companies (Lallemand, 2005), it is identified that larger firms pay higher wages than SMEs. Higher wages in larger firms and having a larger number of employees can explain that it has been more financially helpful for large firms to reduce their need for overtime work.

5.3.2.3. Conclusions vis-a-vis practices related to employees' recruitment

Overall, it can be concluded that practices related to employees' recruitment, reward & retention have a direct positive impact on the UK manufacturing companies' financial performance. However, large firms are more likely to yield financial benefits from these practices. Also, the impact of these practices is not always on firms' sales growth and profitability. They could have a positive impact on the firms' cash flow and asset management, as identified in this study.

5.3.3. Practices related to process performance improvement (hypothesis 9)

Based on the findings of Lee et al. (2009), Wang et al. (2014), Abusa & Gibson (2013) and Lakhal (2014), practices related to process performance improvement have a direct positive impact on companies' sales growth and profitability (table 5-29). However, Lakhal et al. (2006) find that these practices have an indirect impact on a firm's financial performance via improving their product quality. Also, Han et al. (2007) and Duh et al. (2012) have considered the impact of these practices on companies' financial performance as a part of a bundle of TQM practices. Both of these found that these practices have an indirect impact on financial performance via improving customer satisfaction, quality improvement and cost reduction.

Table 5-29 Findings of the earlier studies related to process performance improvement

Internal processes related practices	Authors/Date	Financial perspectives	
		Competitiveness: • Increased market share • Sales growth	**Profitability:** • Return on investment • Return On Capital Employed • Return on total assets
H9. Practices related to process performance improvement, such as: •Continuous efforts are made to improve quality at all levels •Management provides the necessary resources to carry out activities efficiently. •Quality system in our company is improved continuously. •Involvement in establishing and communicating the organisation's vision, goals, plans, and values for its quality programme; •Clear set of work instructions.	Lee et al. (2009)	✓	✓
	Wang et al. (2014)	✓	✓
	Abusa & Gibson (2013)	✓	✓
	Lakhal (2014)	✓	✓
	Huang et.al (2008)	✓	---
	Lakhal et al. (2006)	×	×
	Han et al. (2007)	×	×
	Duh et al. (2012)	---	×
✓= Direct positive impact on financial performance		×= No direct positive impact on financial performance	

As discussed in section 4.7.2.3 of the previous chapter, practices related to process performance improvement only had a positive impact on the financial performance of large companies in the sample of this study. Therefore, this finding of the study partially supports the findings of Lee et al. (2009), Wang et al. (2014), Abusa & Gibson (2013) and Lakhal (2014). However, these practices had no direct positive impact on the sales growth or profitability of the SMEs in the sample. In the following subsections, potential reasons for the different findings for SMEs and Large firms will be explained.

5.3.3.1. Redesigning manufacturing processes

Only Large firms in the sample of this study that had redesigned their manufacturing processes in the three years before participation in the awards (3.5.2.) had experienced improvement in their liquidity (1st year accounts payable days).Based on MX best practices, the following benefits from redesigning manufacturing process could result in increased sales, competitiveness and sustainable processes (Garside, 2009).

- Reducing manufacturing cost, waste-reduction
- Improving product quality, on-time delivery
- Making processes more capable and more responsive.
- Introducing new product family to meet customer requirements
- Making the supply chain more flexible to changes in market demand (MX Scoring guideline, 2010).

For the Large firms in this study, this practice had resulted in improved supplier relationship and reducing account payable and increasing their sales which reduce their account payable days. However, the benefit of business process redesign is not restricted to large companies. Riley & Brown (2001) describe a case study of a UK contractor SME that had redesigned its processes and gained benefit from doing it. However, Chang & Powel (1998) identified factors that inhibit successful process redesigning in SMEs, including:

1- Financial capacity
2- Human resources
3- Strategic planning
4- IT/IS infrastructure
5- IT/IS expertise.

These factors could partially explain why only large firms have gained financial benefit from investing in process redesigning. The difference between SMEs and Large firms on the impact of this practice was also discussed with the experts and this will be explained in the following subsection.

5.3.3.1.1. Opinions of the experts regarding redesigning manufacturing processes

A summary of experts' opinions regarding the lack of impact of redesigning manufacturing process on SMEs' financial performance is provided in table 5-30. One of the commonly suggested explanations by the experts was that SMEs are continuously in the process of changing some parts of their manufacturing processes; however, their overall process is working the same way. Therefore, redesigning their manufacturing process does not have a significant impact on their financial performance.

Table 5-30 Summary of experts' opinions regarding redesigning manufacturing processes

#	Summary of Experts' Opinions
Focus Group 1- 23rd June 2016	It depends on the types of planning and control classification (Runners, repeaters and strangers). Since SMEs tend to be more jobbing shops, therefore they are in the process of continuous redesigning their manufacturing processes all the time. So it has less impact on their financial performance.
Interview 1- 30th June 2016	It could be because of the nature of the companies in the sample of this study, that most of the companies are well-performing companies, so redesigning their manufacturing process did not have a significant impact on their financial performance.
Focus Group 2- 14th July 2016	1. Redesigning manufacturing processes is not common in SMEs and they usually only change some part of their processes and the overall process will be operating the same way. Therefore, this process didn't have a significant impact on their financial performance. 2. SMEs don't have the knowledge and resources to redesign their manufacturing processes. Therefore, this process did not have a significant impact on their financial performance. 3. Redesigning manufacturing process only has an immediate impact and therefore if the companies in the sample of this study have redesigned their processes during the previous three years, its financial benefit is not going to be shown in the following years.
Interview 2- 18th July 2016	It is less common for SMEs to redesign their processes. They might not have the scope to redesign their entire manufacturing processes because of the variety of their products. So generally SMEs might only re-layout as they go to new factory or new volume.

The other potential explanation is that redesigning the manufacturing process has an immediate impact on improving financial performance. So if the companies in the sample of this study have redesigned their processes in the previous three years, its financial benefit is not going to be shown in the following years. Table 5-31 shows the number of companies in the sample of this study for which data on redesigning their manufacturing processes in the last three years before participation in the awards (3.5.2.) was available. As shown in table 5-31, the majority of the SMEs in the sample were scored in category 3 or as the best performing companies.

Table 5-31 Companies in the dataset for which data regarding question 3.5.2 was available

Company sizes	Not answered	Worst performing	Category 2	Category 3	Best performing	Total companies
SMEs	9	4	0	10	7	30
Large firms	22	0	5	12	16	55

Therefore, the suggested potential explanation given by the experts that since SMEs are more often redesigning their manufacturing processes, the impact of this practice is less significant on their financial performance is more aligned with the results of this study.

5.3.3.2. Continuous improvement activities

In general, continuous improvement activities had a positive impact on the financial performance of SMEs and Large companies in this study. However, their impact has been through different practices, for different company sizes. For example, 'Implementation of continuous improvement initiatives to improve manufacturing processes (3.4.2)' had a positive impact on liquidity of SMEs (2nd year accounts receivable). Kumar & Antony (2008), based on 64 UK manufacturing SMEs, identified the following main reasons that prevent SMEs from implementing continuous improvement practices:

1- Lack of time and financial resources
2- Lack of knowledge
3- Lack of enough evidence for the success of these practices
4- Complexity of implementation.

SMEs in the sample of this study that had overcome those barriers managed to improve their customer relationships and therefore collected their accounts receivable more quickly. For the Large companies, the impact of this individual impact has not been large enough to de detected. However, large companies that had better performance in 'continuous improvement initiatives to increase their customer satisfaction (1.5.1)' have had improved profitability (original year return on total assets). Also, regarding the 'allocation of effective resources to continuous improvement initiatives (1.5.2)', there has been a difference between SMEs and Large companies. Large companies in this study that had allocated larger resources to their continuous activities experienced improved profitability (1st year return on shareholders' funds). However, the impact of resource allocation for continuous improvement activities was not similar for SMEs.

As identified by Kumar & Antony (2008), the most important barrier to successful implementation of continuous improvement practices in SMEs is lack of resources, including financial, time and human resources. This is followed by lack of knowledge, poor training, internal resistance and poor employee participation. Therefore, this can partially explain why large companies in this study were more capable of achieving financial benefits from this practice.

5.3.3.3. Identification and management of business improvements projects

In this study, large firms that had more effective 'approaches to identifying and managing their business improvements projects (6.1.5)' had experienced an improvement in their cash flow (1st year cash flow). However, this practice did not have a similar impact for SMEs in the sample.

Based on MX Scoring guidelines, companies' approach to identifying and managing business improvement projects can include the following factors:

- Gap analysis, Benchmarking, SWOT analysis
- General manager takes responsibility for overall ownership of the projects
- Prepare detailed project plans including budget and timescale
- Hold regular reviews with senior managers to obtain their support for necessary changes
- Report progress at the board meeting.

These approaches help companies in satisfying their customers and competing with their competitors (Garside, 2009). For the Large companies in the sample of this study, these practices have resulted in an increased level of cash flow from business operations in the first year after participation in awards.

However, identifying and managing business improvement projects are a part of the business planning procedure (MX Scoring guideline, 2010). Therefore, the reason that this measure was not similarly helpful for SMEs could be because of their lack of formal business planning, as stated by Stonehouse & Pemberton (2002). Alternatively, it could be similar to the findings of McKiernan & Morris (1994) that using formal planning has no impact on SMEs' financial performance for the following reasons:

1- Lack of awareness of the benefits of formal planning for their business
2- Usefulness of planning only in turbulent conditions and it has less impact on improvement of performance
3- Their planning might have lost its impact over time and it needs updating (McKiernan & Morris, 1994).

5.3.3.4. Conclusions vis-a-vis practices related to employees' recruitment

Overall it can be concluded that practices related to process performance improvement have a direct positive impact on the UK manufacturing companies' financial performance. However, because of the stated limitations given in the previous sections, SMEs are less likely to gain benefit from these practices. Also, the impact of these practices is not always on companies' sales growth or profitability. As identified in this study, these practices can have a positive impact on cash flow, debt management and profitability of large companies and liquidity of SMEs.

5.3.4. Practices related to manufacturing simplicity (hypothesis 11)

As shown in table 5-32, the majority of the earlier studies, such as that of Agus & Hajinoor (2012), that have considered practices related to manufacturing simplicity, found that they have direct positive impact on companies' sales growth and profitability.

Table 5-32 Findings of the earlier studies related to manufacturing simplicity

Internal processes related practices	Authors/Date	Financial perspectives	
		Competitiveness: • Increased market share • Sales growth	**Profitability:** • Return on investment • Return On Capital Employed • Return on total assets
H11. Practices related to manufacturing simplicity and reducing set-up time, such as: •Reducing lot size •Cellular manufacturing (Equipment's redesign) •Daily schedule adherence •Inventory transportation and management system •Manufacture broad product mix within same facilities •Uses special tools to shorten set-up time •Trains employees to reduce set-up time	Fullerton & Wempe (2009)	---	✓
	Dubey et al. (2014)	---	✓
	Callen et al. (2000)	---	✓
	Matsui (2007)	---	✓
	Hofer et al. (2012)	---	✓
	Agus & Hajinoor (2012)	✓	✓
	Kannan & Tan (2005)	×	×
	Jayaram et al. (2008)	---	×
	Rosenzweig et al. (2003)	×	×
	Durate et al. (2011)	×	×
✓= Direct positive impact on financial performance		×= No direct positive impact on financial performance	

However, some studies also found contradicting results. For example, Kannan & Tan (2005) find that these practices only have a direct impact on companies' product quality and customer satisfaction; however, they have no direct impact on their financial performance. Rosenzweig et al. (2003) also find that these practices can only improve firms' customer satisfaction, and have no direct impact on their financial performance. Jayaram et al. (2008) and Durate et al. (2011) also find that these practices have no impact on firms' financial performance. Durate et al. (2011) suggest that the impact of these practices on financial performance might be too small to be detected. Alternatively, their impact might be context-specific or depend on other operational capabilities.

As discussed in section 4.7.2.4 of the previous chapter, only one practice related to manufacturing simplicity, i.e. taking actions to reduce machine changeover time (4.7.4) had a positive impact on the financial performance of large companies. Therefore, this finding supports those of some of the earlier studies, such as Fullerton & Wempe (2009) and Dubey et al. (2014). However, reducing set-up time, for example, had no impact on SMEs' financial performance. Also, practices such as having an improved 'manufacturing layout' or 'material flow' have no direct impact on SMEs' or Large firms' financial performance. This finding supports those of earlier studies, such Rosenzweig et al. (2003) and Durate et al. (2011), who also found no direct impact from these practices on firms' financial performance. Also, to better understand the impact of manufacturing simplicity on UK manufacturing companies' financial performance, the impact of reducing machine changeover time was discussed with the experts, which will be explained in the following subsection.

5.3.4.1. Opinions of the experts regarding the impact of reducing machine changeover time

One practice in the category of manufacturing simplicity was 'taking actions to reduce machine changeover time (4.7.4)' which only had a direct positive impact on the profitability of Large companies in the sample of this study. A summary of the experts' opinions regarding this finding is provided in table 5-33.

Table 5-33 Summary of experts' opinions regarding the impact of reducing machine changeover time

#	Summary of Experts' Opinions
Focus Group 1- 23rd June 2016	1. SMEs are constantly in the process of changing over relatively quickly and make a whole range of products. So the impact of reducing the set-up time on their financial performance has not been significant. 2. It also depends on the types of industry. In some industries reducing the machine changeover time has a positive impact on the financial performance; in others, this impact is less significant.
Interview 1- 30th June 2016	It depends on the types of industry and types of companies and whether they are project-based or not. For project-based companies, the impact of reducing machine changeover time is less significant. Also agrees with the potential explanation from the literature that machine changeover time should be complemented with other factors to have a positive impact on financial performance.
Focus Group 2- 14th July 2016	Large companies have understood the importance of reducing machine changeover time, but there is a lack of knowledge in SMEs and therefore there is a little evidence of deliberate activities to reduce their changeover times in SMEs.
Interview 2- 18th July 2016	Similar impact is expected for SMEs, so maybe there was not enough SMEs in the sample of this study that have taken action to reduce machine changeover time.

As shown in table 5-33, the most commonly suggested explanation by the experts was that the impact of reducing the machine changeover time depends on the industry sectors. In some industries, reducing machine changeover time has a positive impact on financial performance; in other industries it has less significant impact. Table 5-34 shows the number of companies in the sample of this study for which data regarding 'taking actions to reduce machine changeover time (4.7.4)' was available.

Table 5-34 Companies in the dataset for which data regarding question 5.3.1 was available

Company sizes	Not answered	Worst performing	Category 2	Category 3	Best performing	Total companies
SMEs	14	0	1	6	9	30
Large firms	31	0	1	12	11	55

As shown in table 5-34, the majority of SMEs for which data was available in this study, were scored in category 3 or as the best performing companies. Therefore, as suggested by the experts, it could be because of the industry sector of the SMEs in this study. Alternatively, it could be because of other potential explanations that SMEs are constantly changing over quickly and making various products. So the impact of reducing set-up time on their financial performance has not been significant.

5.3.4.2. Conclusions vis-a-vis practices related to manufacturing simplicity

Overall, it can be concluded that these practices related to manufacturing simplicity have a direct positive impact on the UK manufacturing companies' financial performance. However, as suggested by Durate et al. (2011), their impact might be too small for SMEs to be detected or might be context-specific or depend on other operational capabilities.

5.3.5. Practices related to preventive maintenance (hypothesis 12)

As shown in table 5-35, the majority of the earlier studies that investigated the impact of preventive maintenance found that of practices related to preventive maintenance have a direct positive impact on companies' sales growth and profitability. However, Durate et al. (2011) find that these practices have no impact on companies' financial performance. It is suggested that the impact of these practices on financial performance might be too small to be detected or their impact is context-specific or depends on other operational capabilities (Durate et al., 2011).

Table 5-35 Findings of the earlier studies related to preventive maintenance

Internal processes related practices	Authors/Date	Financial perspectives	
		Competitiveness: • Increased market share • Sales growth	**Profitability:** • Return on investment • Return On Capital Employed • Return on total assets
H12. Practices related to preventive maintenance, such as: • Total preventive maintenance practices •Productive maintenance •Undertaking programmes for the improvement of your equipment productivity •Multi-function employees	Dubey et al. (2014)	---	✓+ liquidity
	Fullerton et al. (2003)	---	✓+ cash flow
	Fullerton & McWatters (2001)	---	✓
	Yang et al. (2011)	✓	✓
	Durate et al. (2011)	×	×
✓= Direct positive impact on financial performance		×= No direct positive impact on financial performance	

As discussed in section 4.7.2.5 of the previous chapter, only one practice related to preventive maintenance (i.e. 'Using systems and processes to maintain equipment to ensure it is available for production when required (4.7.3)') had a positive impact on the financial performance of Large companies in the sample of this study (i.e. 1st year turnover growth). Therefore, this finding supports those of some of the earlier studies, such as Dubey et al. (2014) or Fullerton et al. (2003), which also find that these practices have a direct positive impact on companies' financial performance.

However, Attri et al. (2013) present the following list of ten main barriers for successful implementation of total productive maintenance (TPM) in manufacturing companies:

1- Lack of commitment from top management
2- Lack of education and training
3- Lack of motivation
4- Resistance from employees
5- Cultural resistance
6- Not allowing time for evolution,
7- Conflict between production and maintenance departments
8- Lack of communication
9- Limited financial resources
10- Lack of knowledge of TPM.

Some of the barriers identified by Attri et al. (2013), such as lack of knowledge of TPM and limited financial resources, are more likely to influence the maintenance systems of SMEs than Large companies. Therefore, it might partially explain why large companies manage to have a more effective maintenance system, which contributes to their turnover growth. Otherwise, as suggested by Durate et al. (2011), their impact might be too small to be detected for SMEs or their impact is context-specific or depends on other operational capabilities. In addition, to better understand the impact of preventive maintenance on the UK manufacturing companies' financial performance, the impact of equipment maintenance was discussed with the experts, which will be explained in the following subsection.

5.3.5.1. Opinions of the experts regarding the impact of equipment maintenance

One practice in the category of preventive maintenance was 'using systems and processes to maintain equipment to ensure it is available for production when required (4.7.3)'. This practice only had a direct positive impact on large companies' turnover growth in this study. A summary of the experts' opinions regarding this finding is provided in table 5-36. One commonly suggested potential explanation by the experts which was also similar to the suggested reason in Durate et al.'s (2011) study, is that equipment maintenance has an indirect impact on financial performance. For example, it is expected that equipment maintenance has a positive impact on product quality, which, in turn, is expected to have a positive impact on financial performance.

Table 5-36 Summary of experts' opinions regarding the impact of equipment maintenance

#	Summary of Experts' Opinions
Focus Group 1- 23rd June 2016	1. It is more probable for larger companies to have continuous manufacturing which needs preventive maintenance. So those companies that had preventive maintenance had less down time and therefore improved their sales growth. However, SMEs in the sample of this study might not have continuous manufacturing and so did not need preventive maintenance. 2. Also, SMEs have a less formal structure and they can fix their equipment's failures more quickly, whereas larger companies need to have formal preventive maintenance to maintain their equipment. 3. Preventive maintenance can have a positive impact on quality and quality, in turn, can improve sales growth.
Interview 1- 30th June 2016	Generally does not agree with the finding, as it is expected to be a direct relationship between availability of equipment for production and profitability. However, the potential explanation from the literature is also plausible that the impact of this practice might be too small to be detected or there might be some barriers that prevent SMEs from successfully implementing their preventive maintenance.
Focus Group 2- 14th July 2016	1. Not having a process to maintain equipment could have a negative impact, but having it doesn't improve financial performance. 2. Preventive maintenance could have a positive impact on other operational capability, and doesn't have a direct impact on financial performance.
Interview 2- 18th July 2016	It is less common for SMEs to have preventive maintenance. However, for those companies (especially Large companies) that have preventive maintenance, since it can increase their capacity, it is understandable to see that it has a positive impact on their sales growth.

Table 5-37 shows the number of companies in the sample of this study that their data regarding 'using systems and processes to maintain equipment to ensure it is available for production when required (4.7.3)' was available.

Table 5-37 Companies in the dataset for which data regarding question 4.7.3 was available

Company sizes	Not answered	Worst performing	Category 2	Category 3	Best performing	Total companies
SMEs	11	0	0	12	7	30
Large firms	28	0	0	11	16	55

As it is shown in table 5-37, the majority of the SMEs for which data was available in this study, were scored in category 3 or as the best performing companies. This shows that despite having a strong performance in this practice, no direct positive impact of this practice was detected on their financial performance. Therefore, either the sample size of SMEs was too small, or as suggested by experts and Durate et al. (2011), this practice has an indirect impact on SMEs' financial performance.

5.3.5.2. Conclusions vis-a-vis practices related to preventive maintenance

Overall, it can be concluded that practices related to preventive maintenance have a direct positive impact on the UK manufacturing companies' financial performance. However, large companies are more likely to successfully implement these practices and gain financial benefit from them.

5.3.6. Practices related to corporate social responsibility (hypothesis 16)

As shown in table 5-38, of the four reviewed studies in this thesis that have considered practices related to corporate social responsibility, only Lee & Roh (2012) report that they have a direct positive impact on companies' sales growth.

Table 5-38 Findings of the earlier studies related to corporate social responsibility

Internal processes related practices	Authors/Date	Financial perspectives	
		Competitiveness: • Increased market share • Sales growth	**Profitability:** • Return on investment • Return On Capital Employed • Return on total assets
H16. Corporate social responsibility practices, such as: •Programmes to improve environmental performance of processes and products •Relationship with employees •Health and security risks are prevented and reduced •Active involvement in social issues	Lee & Roh (2012)	✓	×
	Yang et al. (2011)	×	×
	Crisostomo et al. (2011)	---	×
	Fotopoulos & Psomas (2010)	×	×
✓= Direct positive impact on financial performance ×= No direct positive impact on financial performance			

The other studies found contradictory results. For example, Crisostomo et al. (2011) found that these practices either have no impact on companies' financial performance or even for they have a negative impact on employee relationship. The other two studies found that these practices have an indirect impact on companies' financial performance. Yang et al. (2011) found that in the short-term (i.e. less than 3 years), practices related to environmental management can only improve companies' environmental performance which, in turn, has a direct impact on their financial performance. Fotopoulos & Psomas (2010) also found that practices related to social responsibility have an indirect impact on companies' financial performance via their impact on their customer satisfaction.

Studies on the impact of these practices on SMEs' financial performance also reveal contradictory results. For example, Simpson et al.'s (2004) study, based on a survey on 63 UK SMEs, found that most SMEs could not find competitive advantage by employing sustainable practices in their business. Most SMEs consider these practices as a cost to their business that had a poor opinion of these practices (Simpson et al., 2004).

Roberts et al. (2006) found that the main barriers preventing SMEs from adopting sustainable practices in their business included:

1. Lack of external support
2. Lack of time and short-term planning
3. Fear of doing things wrong
4. Lack of information
5. Supply chain and procurement barriers.

On the other hand, Brammer et al.'s (2012) study, based on a survey of 100 UK SMEs, found that medium-sized organisations gained higher financial benefits from adopting sustainability practices in their business than small-sized companies. The main drivers for adopting such practices were found to be their strategic goal and legislations in SMEs (Brammer et al., 2012). Therefore, the impact of corporate social responsibility practices for SMEs' financial performance is mixed in the literature.

As discussed in section 4.7.2.3 of the previous chapter, practices related to corporate social responsibility only had a positive impact on the financial performance of large companies in the sample of this study. Therefore, the findings of the study for Large companies does not support the findings of the earlier studies, such as Yang et al. (2011) or Crisostomo et al. (2011). However, these practices had no direct positive impact on the sales growth or profitability of the SMEs in the sample. Therefore, this finding of the study for SMEs in aligned with the findings of the earlier studies. In addition, to better understand the impact of corporate social responsibility, the impact of one practice in this category was discussed with the experts in this study, which will be discussed in the following subsection.

5.3.6.1. Opinions of the experts regarding the impact of corporate social responsibility

One practice in the category of corporate social responsibility was 'providing information on health, safety, environmental issues and actual safety performance to workforce (4.6.2)' that only had a direct positive impact on large companies' liquidity (Original year Quick ratio). However, this practice had no direct positive impact on SMEs' financial performance. A summary of the experts' opinion regarding this finding is provided in table 5-39.

As shown in table 3-39, one of the commonly suggested potential explanations by the experts in this study was that it is more common for large companies to comply with health, safety and environmental issues. Because of limited financial resources and knowledge it is less common for SMEs to implement these practices. However, this was not the case for the SMEs in the sample of this study.

Table 5-39 Summary of experts' opinions regarding corporate social responsibility

#	Summary of Experts' Opinions
Focus Group 1- 23rd June 2016	It is more probable for Large companies to comply with health, safety and environmental issues and it is less probable for SMEs.
Interview 1- 30th June 2016	The impact of health and safety on the financial performance can be mixed; however, one potential explanation could be that they had fewer accidents and therefore they paid less.
Focus Group 2- 14th July 2016	1. Companies that consider health and safety issues as a part of their discipline are not producing scrap or waste and it has a positive impact on their financial performance. However, these disciplines are not equally implemented in SMEs because of fewer financial resources or lack of knowledge. 2. Providing information on health, safety, environmental issues is a qualifying criterion for companies to bid for public contracts, which is more likely to happen for large companies than in SMEs.
Interview 2- 18th July 2016	Generally, companies that perform this practice well are more forward looking and have better plans and KPIs; therefore, it is not surprising that their financial performance is improved as well. However, SMEs do not do this practice systematically, which might be the case for the majority of the SMEs in the sample of this study.

Table 5-40 shows the number of companies in the sample of this study for which data regarding 'providing information on health, safety, environmental issues and actual safety performance to workforce (4.6.2)' was available.

Table 5-40 Companies in the dataset for which data regarding question 4.6.2 was available

Company sizes	Not answered	Worst performing	Category 2	Category 3	Best performing	Total companies
SMEs	10	2	2	8	8	30
Large firms	28	1	3	11	12	55

As shown in table 5-40, the majority of the SMEs for which data was available in this study were scored in category 3 or as the best performing companies. This shows that despite having a strong performance in this practice, no direct positive impact of this practice was detected on their financial performance. Therefore, the other potential explanation by the experts that 'providing information on health, safety, environmental issues is a qualifying criterion for companies to bid for public contracts,

which is more likely to happen for Large companies than in SMEs' might be a reasonable explanation for this finding.

5.3.6.2. Conclusions vis-a-vis practices related to corporate social responsibility

Overall, based on the findings of this study and the earlier studies, it is not confirmed that these practices have a direct positive impact on companies' financial performance. On some occasions these practices might have a direct impact on companies' sales growth, such as in Lee & Roh's (2012) study or their debt management and asset management, as in this study. Similarly, as stated by Roberts et al. (2006), SMEs have some barriers that prevent them from implementing such practices. Or, if they implement such practices, they might not have any impact on their financial performance, as found in this study or Simpson et al.'s (2004) study.

5.4. Hypotheses that are not supported but had some positive impacts

Based on the findings of the earlier studies, practices in the following four categories were expected to have a direct positive impact on companies' profitability and competitiveness:

1. Employees' involvement in business activities
2. Process management
3. Marketing
4. Product innovation.

They did not have the expected impact on the companies in this study, and the hypotheses related to these practices are not supported. However, they had direct positive impact on some other aspects of the companies' financial performance. In the following subsections, potential explanations for the identified relationships for practices in these categories will be discussed.

5.4.1. Practices related to employees' involvement in business activities (hypothesis 5)

As shown in table 5-41, based on the findings earlier studies such as Lakhal (2014), it was expected that these practices have a direct positive impact on companies' sales growth and profitability. However, Fotopoulos & Psomas (2010) found that these practices had an in indirect impact on companies' financial performance through improving their product quality. Similarly, Lakhal et al. (2006) found that these practices had an indirect impact on companies' financial performance through improving their core practices, such as 'quality system improvement'.

Table 5-41 Findings of the earlier studies related to employees' involvement

Employees related practices	**Authors/Date**	**Financial perspectives**	
		Competitiveness: • Increased market share • Sales growth	**Profitability:** • Return on investment • Return On Capital Employed • Return on total assets
H5. Practices related to employees' involvement in business activities, such as: • Employees are responsible for the tasks they perform, and inspect their own work. • Number of employee suggestions • Employees working in teams, having open access to management and corrective action programme striving for continuous improvement. • Actively participate in meetings & workshops • Employees take part in designing quality improvement activities	Lakhal (2014)	✓	✓
	Lee & Lee (2015)	✓	---
	Dubey & Gunasekaran (2015)	✓	---
	Fotopoulos & Psomas (2010)	×	×
	Lakhal et al. (2006)	×	×
✓= Direct positive impact on financial performance ×= No direct positive impact on financial performance			

As discussed in section 4.7.3.1 of the previous chapter, two practices related to employees' involvement in business activities had a positive impact on the financial performance of the large companies in the sample of this study. However, these practices had no direct positive impact on the sales growth or profitability of SMEs and Large companies in this study.

Therefore, this finding of the study support the findings of Fotopoulos & Psomas (2010) and Lakhal et al. (2006) that practices related to employee's involvement in business activities have no direct impact on firm's sales growth and profitability. In the following subsections, the potential reasons for the different findings for SMEs and Large firms will be explained.

5.4.1.1. Communicating business information with workforce

In this study, large companies that had better performance in 'communicating business information with their workforce (5.2.2)' have had better liquidity (original year current ratio). However, this practice did not have a similar impact for SMEs. The findings for SMEs in the literature are mixed. For example, Drummond & Stone's (2006) study, based on thirty highly successful UK SMEs, found that companies that have better performance in communicating their business information with their workforce had increased turnover and better performance compared with other businesses in their sectors. However, Godard (2004) claims that the impact of these practices on improving financial performance is unjustified.

Therefore, this finding of the study that communicating business information with workforce has no direct positive impact on SMEs financial performance is aligned with the finding of Godard (2004). Alternatively, as suggested by Fotopoulos & Psomas (2010) and Lakhal et al. (2006), this practice might have an indirect impact on companies' financial performance. The difference between SMEs and Large firms on the impact of this practice was also discussed with the experts, which will be explained in the following subsection.

5.4.1.1.1. Opinions of the experts regarding communicating business information with workforce

A summary of the experts' opinions regarding the difference between SMEs and Large companies on the impact of communicating business information with workforce is provided in table 5-42. In general, experts agree with the potential explanation that was identified from the earlier studies, such as Fotopoulos & Psomas (2010) and Lakhal et al. (2006), that this practice might have an indirect impact on companies' financial performance.

Table 5-42 Summary of experts' opinions regarding communicating business information with workforce

#	Summary of Experts' Opinions
Focus Group 1- 23rd June 2016	Communicating business information with the workforce is more common in SMEs than in a larger organisation. Therefore, the impact of communicating business information with the workforce is more significant for Large companies than SMEs.
Interview 1- 30th June 2016	The potential explanation from the literature that there might be a mediating factor between this communicating business information with the workforce and improvement in financial performance is conceivable. Also suggests that there might be a time lag between this practice and achievement of financial improvement.
Focus Group 2- 14th July 2016	Generally disagree with this finding. The expected impact was on profitability and not liquidity.
Interview 2- 18th July 2016	The potential explanation from the literature is reasonable.

The other potential explanation suggested by the experts was that SMEs are always communicating their business information with their workforce. Therefore, the impact of this practice is less significant on their financial performance. Table 5-43 shows the number of companies in the sample of this study for which data on communicating business information with workforce (5.2.2.) was available.

Table 5-43 Companies in the dataset for which data regarding question 5.2.2 was available

Company sizes	Not answered	Worst performing	Category 2	Category 3	Best performing	Total companies
SMEs	12	0	6	5	7	30
Large firms	24	0	2	13	16	55

As shown in table 5-43, SMEs in the sample of this study had a diverse performance in communicating their business information with their workforce. There were six companies that were scored in category 2 which shows that they had poor performance and seven companies were scored as best performing companies. Therefore, their results could have counterbalanced each other. However, the majority of large companies in the sample of this study were scored in category 3 or as the best performing companies and this practice had a direct positive impact on improving their liquidity. Therefore, it can be expected that this practice could have a positive impact on improving companies' financial performance; however, this impact might not always reflect in improving their sales growth or profitability.

5.4.1.2. Gaining necessary experience to take on new roles

Also, large firms' approach to 'ensure employees gain the necessary experience to take on new roles (5.3.2)' had a direct impact on their debt management and cash flow. However, this practice did not have a similar impact for SMEs. This finding is similar that by Wang et al. (2004), who based their study on 169 UK SMEs. They identified that taking new roles for employees as a part of succession-planning programmes has a positive impact on firms' profitability and sales growth. However, this impact is significant for medium-sized companies, but not small-sized. This shows that the impact of employees' involvement is associated with a company's size. As businesses grow, their structures become more hierarchical and formalised and the impact of employees' involvement becomes greater. This could partially explain this finding of the study.

5.4.1.3. Conclusions vis-a-vis practices related to employees' involvement in business activities

Overall, it can be concluded that practices related to employees' involvement in business activities have a direct positive impact on the UK manufacturing companies' financial performance. However, this impact in not always on firms sales growth and profitability and could be on their debt management, cash flow or liquidity, as found in this study. Also, large companies are more likely to gain financial benefit from them.

Practices related to process management (hypothesis 8)

As shown in table 5-44, some of the earlier studies, such as Lakhal et al. (2006) and Valmohammadi (2011), found that practices related to process management have a direct positive impact on companies' sales growth and profitability. However, both Fotopoulos & Psomas (2010) and Abusa & Gibson (2013) found that these practices have no direct impact on the firms' financial performance. Fotopoulos & Psomas (2010) found that these practices have an indirect impact on financial performance through quality improvement practices, such as reducing product defect rate. Abusa & Gibson (2013) also found that these practices only have a direct impact on reducing companies' defect rate and customer satisfaction, yet they have no impact on their financial performance.

Table 5-44 Findings of the earlier studies related to process management

Internal processes related practices	Authors/Date	Financial perspectives	
		Competitiveness: • Increased market share • Sales growth	**Profitability:** • Return on investment • Return On Capital Employed • Return on total assets
H8. Practices related to process management, such as: • The organisation has a process management method. •Clarity and transparency of procedures and work instructions of processes and operations. •Systematic recording and evaluation of critical process performance • There is a little bureaucracy (formal hierarchy, procedures and detailed rules) in the organisation. •Determination of areas and points for improvement	Lakhal et al. (2006)	✓	✓
	Valmohammadi (2011)	✓	✓
	Lakhal (2014)	✓	✓
	Fotopoulos & Psomas (2010)	×	×
	Abusa & Gibson (2013)	×	×
✓= Direct positive impact on financial performance		×= No direct positive impact on financial performance	

As discussed in section 4.7.3.2 of the previous chapter, eight out of the twelve practices related to process management had a direct positive impact on the financial performance of SMEs and Large companies in the sample of this study. However, the impact of these practices was on the other aspects of the companies' financial performance other than their profitability or sales growth. Therefore, this finding of the study supports the findings of Fotopoulos & Psomas (2010) and Abusa & Gibson (2013) that these practices have no direct impact on firms' sales growth and profitability. In the following subsections, some potential reasons for the different findings for SMEs and Large firms will be explained.

5.4.1.4. Responsiveness of manufacturing operations

In this study, companies' approach to have more 'responsive manufacturing operations (3.3.2)' only had a positive impact on SMEs' debt management and did not have any positive impact on Large firms' financial performance. Ates et al. (2013) has classified responsiveness as one of the characteristics of SMEs that differentiate them from large companies. SMEs' processes are not as structured as those of large companies and, therefore, they could have a higher level of responsiveness to market demands. However, larger firms have more formalised and structured processes to run their operation which reduce their responsiveness. This can partially explain why this practice did not have a similar impact on large firms' financial performance. However, to better understand the impact of responsiveness of manufacturing operations on SMEs' and Large firms' financial performance, this finding of the study was discussed with the experts, which will be explained in the following subsection.

5.4.1.4.1. Opinions of the experts regarding responsiveness of manufacturing operations

A summary of the experts' opinions regarding the difference between SMEs and Large companies on the impact of responsiveness of manufacturing operations is provided in table 5-45. One of the commonly suggested potential explanations by the experts was aligned with the findings from the literature that SMEs have less formalised organisational structures and it is easier for them to respond quickly to the changes in the market demand than it is for larger companies.

Table 5-45 Summary of experts' opinions regarding redesigning manufacturing processes

#	Summary of Experts' Opinions
Focus Group 1- 23rd June 2016	1. SMEs have the ability to change more quickly, whereas large companies do not have this ability because of larger infrastructure. 2. Not adapting to changes in the market has a negative impact, which is not investigated in this study. 3. It depends on the industry sectors: In lower margin industries, companies need to be more flexible to meet the changes in market demand, whereas for higher margin industries this is not the case.
Interview 1- 30th June 2016	Does not agree with the finding. The explanation from the literature that the lack of impact for Large companies is reasonable. The relationship with SMEs' debt management could be because of a noise in data as it is expected to have a positive impact on profitability and not debt management.
Focus Group 2- 14th July 2016	1. At the beginning it costs to have the capacity to respond quickly to the changes in market demand; however, in the longer term it can have positive impact on the financial performance of large companies too. 2. Agrees with the potential explanation from the literature. Also large companies' organisational structure might not be aligned with their strategy and, therefore, they cannot respond as quickly as expected to the changes in market demand.
Interview 2- 18th July 2016	This is more likely for SMEs but also for Large firms. So the impact of this practice might not be directly on improving their sales growth or profitability; however, they are still making money. However, not responding to the changes in the market demand has negative impact on financial performance which is not investigated in this study.

Table 5-46 shows the number of companies in the sample of this study for which data on 'responsive manufacturing operations (3.3.2)' was available.

Table 5-46 Companies in the dataset for which data regarding question 5.2.2 was available

Company sizes	Not answered	Worst performing	Category 2	Category 3	Best performing	Total companies
SMEs	9	5	8	4	4	30
Large firms	22	4	10	4	15	55

As shown in table 5-46, large companies in the sample of this study had a different performance on the responsiveness of their manufacturing operations. There were fifteen companies that scored as best performing companies. However, there were also fourteen companies that scored as either worst performing companies or scored in category two. Therefore, the large number of poor performing companies in this study is in line with the suggested explanation that it is difficult for larger companies to respond quickly to the changes in market demand. Thus, the result of poor performing companies could have counterbalanced the result of a well-performing one in this study. Also, the other commonly suggested explanation by the experts was that not responding to the changes to the market demand could have a negative impact on the financial performance of the companies. However, the negative impact of poor performance in operational practices is not investigated in this study.

5.4.1.5. Control and monitoring of product introduction programmes

In this study, the practice to 'control and monitor product introduction programmes (2.3.3)' had a direct positive impact on debt management of SMEs and liquidity of Large companies in the sample of this study. Owens's (2007) study, based on interviewing twelve manufacturing SMEs in the UK, identified the following five main reasons for failure of SMEs' product introduction programmes that cause delay in these projects:

1. Poor product specification
2. Technological uncertainty
3. Lack of support from senior management
4. Lack of resources
5. Poor project management.

SMEs in the sample that have used effective KPIs to control recurring costs of their projects managed to finish their project on time and on budget. This practice has also reduced the cost of product introduction programmes for large companies in the sample. However, for SMEs, reduction of the cost has impacted their total liabilities and, therefore, reduced their leverage. For Large companies, this reduction only reduced their current liabilities and, therefore, improved their current ratio.

5.4.1.6. Project management techniques

Using effective 'approaches for managing time, cost and risk of major project (6.5.2)' only had positive impact on SMEs' liquidity (original year accounts payable days). However, this practice did not have a similar impact for large firms. Based on MX best practices, a detailed project plan with monitoring systems for time, cost and risk management help companies in controlling the cost of their project and have a sustainable business (Garside, 2009). For SMEs in the sample of this study, this has led to increasing average sales and decreasing account payable days.

Gunasekaran et.al (2000) highlights that cost control is one of the main problems for SMEs. Therefore, applying an effective cost monitoring system as a part of the SMEs' project plan can help them to complete their projects on time and on budget. By having a better relationship with their suppliers they increased the time to pay back their account payables, which, as a result, improved their account payable days. However, for large companies that did not have limited resources such as SMEs, the impact of cost monitoring has been less significant.

5.4.1.7. Controls for managing debtors

Large firms in the sample of this study that had used more effective controls for managing their debtors had experienced an improvement in their cash flow (2nd year cash flow yield). However, this practice did not have a similar impact for SMEs in the sample.

Based on MX best practices, having an agreement to collect customers' payments on time is essential for keeping the necessary cash flow to run the business (Garside, 2009). However, Peel et al. (2000) show that late payment is one of the key reasons for SMEs' financial distress and a major barrier to their growth. Based on a survey on 211 UK SMEs, it has been identified that large companies were the worst in delaying their payment to SMEs followed by small firms. However, medium-sized companies found to have the least delay in their payments (Peel et al., 2000). Also, SMEs believe that the introduction of more effective legislation is more helpful for them in collecting their late payment than having more advanced financial management or training (Peel et al., 2000). This could be a potential reason to explain why large companies in this sample were more effective than SMEs in managing their debtors.

5.4.1.8. Formal business planning process

Large companies in the sample of this study that had more effective business planning procedures had experienced an improvement in their cash flow (original year cash flows to sales and 3rd year cash flow). However, this practice did not have a similar impact for SMEs in the sample.

Based on MX best practice, having a robust business planning process is a necessary requirement for effective management of any company to ensure its sustainable growth and profitability (Garside, 2009). However, Stonehouse & Pemberton (2002) claim that compared with large organisations, SMEs use less formal business planning. This can be because SMEs' managers are unconvinced or unaware of the benefits of formal business planning (Stonehouse & Pemberton, 2002). The empirical findings in the literature on the relationship between SMEs' formal planning and financial performance are mixed. McKiernan & Morris (1994) found no causal relationship between SMEs' formal business planning and improved financial performance. Peel & Bridge (1998) found that SMEs with formal business planning had improved profitability and sales growth. McKiernan & Morris (1994) point out the following three possible reasons for the lack of relationship:

1- Owners' lack of awareness of formal planning
2- Formal planning is only necessary for business survival in turbulent conditions, but is less influential on improving their financial performance
3- Formal planning decays over time and its impact will reduce.

Therefore, this finding of the study supports McKiernan & Morris's (1994) study.

5.4.1.9. Accounting practices to support business drivers

In this study, large companies that had more effective accounting practices to support their business drivers had experienced improvement in their cash flow (original year cash flows to sales). However, these practices did not have a similar impact for SMEs. Based on MX best practices, companies that use effective approaches to provide accurate, timely and relevant information to support their business objectives could benefit from taking more accurate decisions based on rigorous information (Garside, 2009).

Nandan (2010) argues that similar to large companies, SMEs need to have sophisticated accounting approaches to manage their limited financial resources. However, the evidence in the literature shows that SMEs do not obtain suitable information from their accounting practices. For example, Marriott & Marriott's (2000) study based on interviewing 15 small companies' managers in the UK, conclude that computerised accounting systems used in the majority of companies could not support their accounting services. This is because their system was purchased and installed without consulting professional accountants. The study suggests that managers' lack of financial knowledge and their reluctance to consult professional accountants (because of high charges) were the main reasons for their inappropriate usage of their accounting systems (Marriott & Marriott, 2000).

Similarly, Kirby & King's (1997) study, based on a survey on 31 small business owners and 33 accountancy practices, claims that a lack of trust on the accountants' relevant expertise is the main reason why managers were reluctant to consult them. Therefore, similar reasons might have prevented the SMEs in the sample to achieve benefit from their accounting practices.

5.4.1.10. Budgeting procedures

In this study large firms that had an effective budgeting procedure, experienced improvement in their asset management (2nd year asset turnover). However, this practice did not have a similar impact for SMEs in the sample. Based on MX best practices, companies that have more accurate provisional sales and profit forecast, and prepare an achievable action plan based on their forecast, managed to have higher levels of sales (Garside, 2009).

However, Ates & Bititci's (2009) work, based on four case studies in UK manufacturing SMEs, found that SMEs have limited usage of management tools and techniques. Of the four SMEs in their study, three companies did not have planning and budgeting as a part of their strategy implementation. It is claimed that SMEs strategic planning is more customer-driven instead of being based on their internal resources and capabilities (Ates & Bititci, 2009). Also Wang et al. (2007) suggest that the lack of strategic planning in SMEs could be because of their owners' lack of motivation. SMEs' owners with the motivation to encourage growth in their company have more strategic planning in their business than those with the motivation for a non-economic reason (Wang et al., 2007). Also, Stonehouse and Pemberton (2002) claim that SMEs might not be aware of the benefits of strategic planning may not be convinced of those benefits. Therefore, these suggestions could be the potential reason for why SMEs in the sample did not get similar benefits from their budgeting procedures as large companies.

5.4.1.11. Key factors influencing financial performance

Based on the MX Scoring guideline, the following key factors, could improve firms' financial performance:

1. Growth of company's markets at home and overseas
2. Introduction of new products to meet customers' requirements
3. Outsourcing non-core components to reduced manufacturing costs
4. Redesigning business process to reduce business overheads (MX Scoring guideline, 2010)

These factors only had a positive impact on the asset management (original year inventory turnover) of the large firms in the sample of this study. They could have similar benefits for SMEs too. However, one of the features of SMEs that differentiate them from large firms is that they have lower number of products and customers (Wahlberg & Strandberg, 2009). Therefore, the impact of these factors has been less significant for SMEs than Large firms.

5.4.1.12. Conclusions vis-a-vis practices related to process management

Overall, it can be concluded that practices related to process management have a direct impact on UK manufacturing firms' financial performance. However, this impact is not always on companies' sales growth or profitability and, as identified in this study, their impact could be on firms' liquidity, asset management or cash flow. Also, large companies are more likely to gain financial benefit from these practices than SMEs.

5.4.2. Practices related to marketing (hypothesis 13)

As shown in table 5-47, Dubey et al. (2014) analysed the impact of marketing practices and found that it has a direct positive impact on companies' profitability and liquidity.

Table 5-47 Findings of the earlier studies related to marketing

Internal processes related practices	Authors/Date	Financial perspectives	
		Competitiveness: • Increased market share • Sales growth	**Profitability:** • Return on investment • Return On Capital Employed • Return on total assets
H13. Marketing practices such as: • Benchmarking practice impact on company performance • Effective sales promotion • Marketing research	Dubey et al. (2014)	---	✓+ liquidity
✓= Direct positive impact on financial performance		×= No direct positive impact on financial performance	

As discussed in section 4.7.3.3 of the previous chapter, one of the two practices related to marketing (i.e. 'using techniques to identify and collect information on market opportunities, customers and competitors (6.2.1)') had a direct impact on increasing the cash flow of large companies. However, the impact of this practice has not been large enough to influence their sales growth or profitability. Also, this practice has no direct positive impact on SMEs' financial performance.

Therefore, this finding of the study does not support the findings of Dubey et al. (2014). Also, as suggested by Wahlberg & Strandberg (2009), SMEs have fewer customers and products than large companies which is one of the features of SMEs that differentiate them from large firms. Therefore, there is less need for SMEs to use specific techniques to collect information about market opportunities, customers and competitors compared with large companies. However, to better understand the difference between SMEs and Large firms, the impact of this practice was also discussed with the experts, which will be explained in the following subsection.

5.4.2.1. Opinions of the experts regarding the impact of marketing practices

One practice in the category of marketing was 'using techniques to identify and collect information on market opportunities, customers and competitors (6.2.1)' that only had a direct positive impact on large companies' cash flow in this study. A summary of the experts' opinions regarding this finding is provided in table 5-48. As shown in table 5-48, one of the commonly suggested explanations by the experts was that SMEs have fewer customers and have a close relationship with them. Therefore, there is a less need for them to use specific techniques to collect information about market opportunities, customers and competitors.

Table 5-48 Summary of experts' opinions regarding the impact of marketing practices

#	Summary of Experts' Opinions
Focus Group 1- 23rd June 2016	1. SMEs have fewer customers and they have a close relationship with them, so there is less need for them to go out to the market to find out about their customers or competitors. 2. It also depends on the type of business. Some companies, for example, distribution businesses, need to collect information about their customers and competitors, whereas for other businesses, this might not be the case.
Interview 1- 30th June 2016	The potential explanation from the literature is reasonable as the collection of information in SMEs is more ad hoc, whereas larger companies need to use specific techniques to collect information about their customers.
Focus Group 2- 14th July 2016	Because of the position of the SMEs in the supply chain structure, they tend to have only a few key customers and have a close relationship with them and there is less need for specific techniques for collecting information about their customers.
Interview 2- 18th July 2016	There is less need for SMEs to use specific techniques to collect information about their customers.

Also, table 5-49 shows the number of companies in the sample of this study for which data regarding 'using techniques to identify and collect information on market opportunities, customers and competitors (6.2.1)' was available.

Table 5-49 Companies in the dataset for which data regarding question 6.2.1 was available

Company sizes	Not answered	Worst performing	Category 2	Category 3	Best performing	Total companies
SMEs	22	0	0	2	6	30
Large firms	38	0	0	7	10	55

As shown in table 5-49, of the SMEs for which data was available in this study, only eight companies answered this question. This shows that this question was less important for the majority of the SMEs in the sample of this study. It also supports the experts' suggested explanations that there is less need for SMEs to use specific techniques to collect information about market opportunities, customers and competitors.

5.4.2.2. Conclusions vis-a-vis practices related to preventive maintenance

Overall, it can be concluded that practices related to marketing have a direct positive impact on the UK manufacturing companies' financial performance. However, their impact is more likely to be achievable for large companies and their impact might be on aspects other than sales growth or profitability of companies.

5.4.3. Practices related to product innovation (hypothesis 18)

As shown in table 5-50, the majority of the earlier studies found that these practices related to product innovation have a direct positive impact on companies' sales growth and profitability. However, Lee & Roh (2012) found that contrary to their expectations, product innovation practices had no direct positive impact on firms' sales growth and profitability.

Table 5-50 Findings of the earlier studies related to product innovation

Product/Service related measures	Authors/Date	Financial perspectives	
		Competitiveness: • Increased market share • Sales growth	**Profitability:** • Return on investment • Return On Capital Employed • Return on total assets
H18. Practices related to product innovation, such as: •Increasing the variety of product/service •Technical innovation •Improving the quality of products and services •Enhancing the manufacture technology of new products. •Extending the market coverage of product/service	Li et al. (2010)	✓	✓
	Han et al. (2007)	✓	✓
	Dubey et al. (2014)	---	✓ + liquidity
	Lee & Roh (2012)	×	×
✓= Direct positive impact on financial performance		×= No direct positive impact on financial performance	

As discussed in section 4.7.3.4 of the previous chapter, of the four practices related to product innovation only one practice (i.e. 'Approach to identify new technologies and gain the knowledge needed for manufacturing of future products (3.1.4)') had a direct positive impact on the liquidity of large companies. However, this practice has no direct positive impact on SMEs' financial performance and had no direct positive impact on profitability and sales growth of large companies in the sample of this study. Therefore, this finding of the study is consistent with the finding of Lee & Roh's (2012) study.

In addition, to better understand the impact of product innovation on UK manufacturing companies' financial performance, the impact of this practice was also discussed with the experts, which will be explained in the following subsection.

5.4.3.1. Opinions of the experts regarding the impact of marketing practices

A summary of the experts' opinions regarding the impact of the 'approach to identify new technologies and gain the knowledge needed for manufacturing of future products (3.1.4)' is provided in table 5-51. As shown in table 5-51, one of the commonly suggested potential explanations by the experts is that there might be a time lag between identifying new technologies and its impact on financial performance. So it might take more than three years for companies to achieve the financial benefits of this practice.

Table 5-51 Summary of experts' opinions regarding the impact of marketing practices

#	Summary of Experts' Opinions
Focus Group 1- 23rd June 2016	1. There might be a time lag between identifying new technologies and its impact of financial performance. 2. Sponsorship of the product innovation is usually with original equipment manufacturers (OEMs) (which are expected to be larger companies and not SMEs) and as we go down the supply chain, design sponsorship reduces. So there might be less need for SMEs in the sample of this study to invest in product innovation. 3. SMEs have fewer skills for developing product knowledge for improving the product.
Interview 1- 30th June 2016	It depends on industry sectors; some industries, such as high-tech industries, are more willing to learn from outside, whereas this is not the case for low-tech industries.
Focus Group 2- 14th July 2016	1. It could be that this data is collected from companies in the period just after the financial crisis, so companies were in a difficult financial situation to implement new technologies, or they didn't have knowledge to use them. 2. There might be a time lag between implementing these technologies and achieving financial benefit from it. So it might take more than three years to achieve these financial benefits. 3. Companies in general and especially SMEs do not have a formal approach for identifying new technologies. Companies normally tend to rely on the expertise of the individuals to identify new technology. 4. It also depends on the types of company. Technology leaders have to heavily invest in R&D, whereas there is less need for followers to invest in new technology and still can have a successful business. 5. It is more likely for SMEs to be the creator of new technologies and large companies to be buyers of new technologies.
Interview 2- 18th July 2016	SMEs often do not have their own products and often make components for Large companies. Therefore, they do not have design authority, and do not have the scope to identify new technologies and gain knowledge to manufacture future products.

The other commonly suggested explanation by the experts was that the sponsorship of product innovation and design authority is usually with original equipment manufacturers (OEMs) which are usually larger companies. Therefore, usually it is not in the scope of SMEs to identify new technologies and gain knowledge to manufacture future products. Also, table 5-52, shows the number of companies in the sample of this study for which data regarding 'approach to identify new technologies and gain the knowledge needed for manufacturing of future products (3.1.4)' was available.

Table 5-52 Companies in the dataset for which data regarding question 3.1.4 was available

Company sizes	Not answered	Worst performing	Category 2	Category 3	Best performing	Total companies
SMEs	18	3	1	3	5	30
Large firms	30	4	3	11	7	55

As shown in table 5-52, the majority of SMEs in the sample of this study did not answer this question (eighteen out of thirty). Also, SMEs for which data was available in this study had a diverse performance in this practice. Therefore, the financial results of well performing and poor performing companies have counterbalanced each other and no statistically significant finding could be found for this sample. However, the majority of large companies were scored in either category 3 or as the best performing companies; therefore, the positive impact of this practice on large companies' financial performance could be detected in this study.

5.4.3.2. Conclusions vis-a-vis practices related to product innovation

Overall, it can be concluded that practices related to product innovation have a direct positive impact on UK manufacturing companies' financial performance. However, this impact is more likely for large companies and the impact of these practices is not always on companies' sales growth or profitability.

5.5. Hypotheses that are not supported and had no positive impact

Based on the findings of the earlier studies, practices in the following five categories were expected to have a direct positive impact on companies' profitability and competitiveness:

1. Delivery reliability
2. Waste reduction
3. Usage of Information Systems (IS) for internal integration
4. Usage of IS for external partnership
5. Product quality improvement

However, they did not have the expected impact on the profitability or competitiveness of the companies in the sample of this study. Therefore, the hypotheses related to these practices are not supported by the findings of this study. In addition, these practices had no direct positive impact on any other aspects of the financial performance of the companies in this study. In the following subsections, potential explanations for the identified relationships for practices in these categories will be discussed.

5.5.1. Practices related to delivery reliability (hypothesis 3)

As shown in table 5-53, both of the earlier studies that investigated the impact of delivery reliability in their research suggest that these practices have a direct positive impact on firms' sales growth and profitability.

Table 5-53 Findings of the earlier studies related to delivery reliability

Customers related practices	Authors/Date	Financial perspectives	
		Competitiveness: • Increased market share • Sales growth	**Profitability:** • Return on investment • Return On Capital Employed • Return on total assets
H3. Practices related to delivery reliability ,such as: • Delivery speed • Reliability of delivery times (on time) • On-time delivery • Promptly handle customer complaints	Han et al. (2007)	✓	✓
	Rosenzweig et al. (2003)	✓	✓
✓= Direct positive impact on financial performance		×= No direct positive impact on financial performance	

However, both of these studies have considered these practices as a part of a bundle of multiple capabilities. For example, Han et al. (2007) have considered these practices as a part of companies' competitive capabilities, including: cost, quality, delivery and flexibility. Similarly, Rosenzweig et al. (2003) have considered these practices as a part of competitive capabilities, including: product quality, delivery reliability, process flexibility and cost leadership.

Therefore, a possible explanation could be that delivery reliability by itself has no direct positive impact on firms' financial performance and it should be complemented by other elements of companies' capabilities such as: cost, quality and flexibility. Also as discussed in section 4.7.4.1 of the previous chapter, none of the two practices related to delivery reliability had a direct positive impact on the financial variable of the companies in the sample of this study. Therefore, this finding of the study is not aligned with the findings of Han et al. (2007) and Rosenzweig et al. (2003).The author also directly asked the opinions of Professor Han and Professor Rosenzweig, informing them that their findings were different from the findings of this study.

5.5.1.1. Opinions of the authors of earlier studies

Only Professor Han replied to the author's email. He agrees that this finding of the study is aligned with the finding of their 2012 study. In their 2007 paper, Han et al. (2007) identified that organisational competitiveness, which is defined by cost, quality, delivery and flexibility, has a positive impact on business performance, which is defined by profitability and market share. However, their 2012 paper suggest that for electronics firms, quality, cost and flexibility have a direct positive correlation with profitability, but delivery does not. In addition, to better understand the impact of delivery reliability on the financial performance of UK manufacturing companies, the impact of one practice in this category was discussed with the experts. This will be reported in the following subsection.

5.5.1.2. Opinions of the experts regarding the impact of marketing practices

One practice in the category of delivery reliability was 'Percentage of on-time and in-full deliveries on the date agreed with customers (1.3.3)' that had no direct positive impact on the financial performance of SMEs and Large firms in this study. A summary of the experts' opinions regarding this finding is provided in table 5-54.

Table 5-54 Summary of experts' opinions regarding the impact of delivery reliability

#	Summary of Experts' Opinions
Focus Group 1- 23rd June 2016	1. Not delivering on time could have a negative impact, but the negative impact is not investigated in this study. 2. It depends on the level of stock and how mature the business is. Many companies hold a large amount of work in progress in inventory, so it does not matter if they don't deliver on time, and probably it does not have an impact on their financial performance too. 3. Having an on-time and full delivery is a given for the companies in the sample of this study, since they were well-performing companies that have put themselves forward for a manufacturing excellence competition.
Interview 1- 30th June 2016	Generally disagree with this finding. However, also suggests that it could depend on the type of industry. So for some industries, such as the electronic industry, on-time and in-full delivery might not have a positive impact, whereas in other industries, it could be a critical factor.
Focus Group 2- 14th July 2016	1. It depends on many factors including: whether it is about delivering to customers or businesses? Is it direct or is it indirect through distributors or retailers? 2. Delivery reliability has a positive impact on five basic performance objectives (i.e. quality, dependability, speed, cost and flexibility), but not on financial performance based on statutory account. 3. The companies in the sample of this study are already well-performing companies. So if they had good delivery reliability over the past, then the impact of this practice on their financial performance is not noticeable. So time difference between having good performance in delivery reliability and improvement in financial performance should be considered. 4. Delivery reliability should be complemented with other factors such as quality to influence financial performance. 5. It depends on market condition; regardless of delivery reliability, any company can grow if they are in a growing market. And the other way round, if they are in declining market.
Interview 2- 18th July 2016	Companies often deal with poor scheduling from their customers, which has a negative impact on financial performance. So because of poor scheduling, as far as their customers are concerned, they are delivering on time and without any problem. However, the reality is that schedules of order are often changed and companies have to adapt to these changes, which have a negative impact on their financial performance.

One of the commonly suggested potential explanations by the experts is that this finding is because of the characteristics of the companies in the sample of this study. Since the companies in the sample of this study are already well-performing companies, therefore, the impact of on-time and in-full delivery is not noticeable on their financial performance. Also table 5-55, shows the number of companies in the sample of this study for which data regarding 'percentage of on-time and in-full deliveries on the date agreed with customers (1.3.3)' was available.

Table 5-55 Companies in the dataset for which data regarding question 1.3.3 was available

Company sizes	Not answered	Worst performing	Category 2	Category 3	Best performing	Total companies
SMEs	10	1	2	7	10	30
Large firms	23	1	5	5	21	55

As shown in table 5-55, the majority of the SMEs and Large companies for which data were available were scored as best performing companies. Therefore, the suggested potential explanation that because of being well-performing companies, the impact of having a strong performance on delivery reliability is not noticeable on their financial performance is reasonable for this finding of the study.

5.5.1.3. Conclusions vis-a-vis practices related to product innovation

Overall, there was no agreement between this finding of the study, the earlier studies and the opinion of the experts. Therefore, it is not possible to get a consistent conclusion about the impact of delivery reliability on the UK manufacturing companies' financial performance. Therefore, there is need for further investigation to support or not support this finding in the future studies.

5.5.2. Practices related to waste reduction (hypothesis 10)

As shown in table 5-56, the earlier studies that have considered these practices suggested that they have a direct positive impact on firms' sales growth and profitability.

Table 5-56 Findings of the earlier studies related to waste reduction

Internal processes related practices	Authors/Date	Financial perspectives	
		Competitiveness: • Increased market share • Sales growth	**Profitability:** • Return on investment • Return On Capital Employed • Return on total assets
H10. Practices related to waste reduction, such as: •Reduction of product defects •Reduction of product rework rate •Reduction of non-conformances •Capacity utilisation •Reduction of warranty compensations	Fotopoulos & Psomas (2010)	✓	✓
	Duh et al. (2012)	---	✓
	Han et al. (2007)	✓	✓
✓= Direct positive impact on financial performance		×= No direct positive impact on financial performance	

Also as discussed in section 4.7.4.2 of the previous chapter, the only practice related to waste reduction had no direct positive impact on the financial variable of the companies in the sample of this study. Therefore, this finding of the study is not aligned with the findings of the earlier studies. A possible explanation could be that waste reduction practices can reduce companies' operational cost. However, because of the small fraction of operational cost in profit calculation, sales revenue should be considerably higher to achieve improvement in profitability (Jin, 2006).

Alternatively, as suggested by Duh et al. (2012), 'waste reduction' by itself has no direct positive impact on firms' financial performance and it should be complemented by other elements such as 'employee morale' and 'customer satisfaction' in influencing financial performance. The author also directly asked the opinions of the authors of the previous studies, informing them that their findings were different from the findings of this study.

5.5.2.1. Opinions of the authors of earlier studies

Only Professor Hsu (the corresponding author of Duh et al. (2012) study) replied to the author's email. Based on Professor Hsu's opinion, 'employee morale' and 'customer satisfaction' are important mediating variables in the relationship between TQM and financial performance. Therefore, practices related to waste reduction are likely to indirectly influence financial performance via improving 'employee morale' and 'customer satisfaction'. In addition, to better understand the impact of waste reduction on the financial performance of the UK manufacturing companies, the impact of this practice was discussed with the experts and this will be discussed in the following subsection.

5.5.2.2. Opinions of the experts regarding the impact of marketing practices

A summary of the experts' opinions regarding the impact of 'taking actions to reduce all forms of waste (4.7.1)' is provided in table 5-57. As shown in table 5-57, the majority of the experts agree with Jin's (2006) study that waste reduction can reduce operational cost. However, because of a small fraction of operational cost in profit calculation, sales revenue should be considerably higher to achieve improvement in profitability.

Table 5-57 Summary of experts' opinions regarding the impact of waste reduction

#	Summary of Experts' Opinions
Focus Group 1- 23rd June 2016	1. Companies in the dataset of this study have participated in the MX Awards. Therefore, they are well-performing companies and have a certain amount of waste reduction in their manufacturing operations already. Therefore, the impact of this practice has been less significant for them. 2. The explanation from the literature that the impact of waste reduction is in reducing operational cost, which is small fraction of overall profit calculation; therefore its impact has been less significant is a reasonable conclusion.
Interview 1- 30th June 2016	The potential explanation from the literature that waste reduction could reduce operational cost, but because of a small fraction of operational cost in overall profit calculation, it doesn't have a significant impact on profitability is a reasonable conclusion.
Focus Group 2- 14th July 2016	1. Waste reduction has a short-term positive impact on cost reduction. However, its impact decreases over time; therefore, if the companies in the sample of this study have implemented waste reduction a long time ago, then the impact of it on their financial performance might not be noticeable. 2. It depends on the competitive environment too. So if all companies in the same environment had reduced their waste, then the impact of this practice on financial performance is not noticeable. But if any company has decided to not reduce their waste, then it could have negative impact on their financial performance which could result in them going out of the business. 3. Also agree with the potential explanation from the literature. 4. Also, it depends on the industry, because in some industries like mining, the operational cost is a large percentage of their sales price, whereas in some other industries, such as the pharmaceutical industry, the operational cost is a very small percentage.
Interview 2- 18th July 2016	The potential explanation that waste reduction can reduce operational cost but that its impact on improving other financial measures might not be noticeable is reasonable.

The other potential explanation is that waste reduction practices have a more noticeable impact on the financial performance of the companies in the short term. Therefore, if the companies in the sample of this study have implemented their waste reduction practices from a long time ago, this practice does not have a significant impact on their financial performance. Also table 5-58 shows the number of companies in the sample of this study for which data regarding 'taking actions to reduce all forms of waste (4.7.1)' was available.

Table 5-58 Companies in the dataset for which data regarding question 4.7.1 was available

Company sizes	Not answered	Worst performing	Category 2	Category 3	Best performing	Total companies
SMEs	10	3	1	8	8	30
Large firms	28	0	5	12	10	55

As shown in table 5-58, the majority of the SMEs and Large companies for which data was available in this study were scored in either category 3 or as the best performing companies. This shows that despite having a strong performance in reducing all forms of waste, this practice did not have a direct positive impact on the financial performance of the companies in the sample of this study. Therefore, the identified potential explanations in Jin's (2006) study and the suggested explanations by the experts seem reasonable for this finding of the study.

5.5.2.3. Conclusions vis-a-vis practices related to waste reduction

Overall, based on this finding of the study, practices related to waste reduction have no direct positive impact on the UK manufacturing companies' financial performance. Conversely, based on the findings of the earlier studies and the suggestions of the experts, this practice can have a direct positive impact on companies' financial performance. However, the impact of this practice depends on the industry sectors. In some industries, such as the mining industry, where that particular operational cost is a large percentage of their sales price, the impact of this practice is more noticeable. However, in the pharmaceutical industry where their operational cost is a small percentage of their sales price, this impact is less noticeable. Also, the impact of this practice is more noticeable in the short term after the implementation of waste reduction practices and it gradually decreases over time. Therefore, there is a need to further investigate the impact of these practices on the financial performance of specific industry groups or in the period before and after implementation of waste reduction practices.

5.5.3. Practices related to usage of IS for internal integration (hypothesis 14)

As shown in table 5-59, the earlier studies that have considered these practices in their studies suggest that these practices have a direct positive impact on firms' sales growth and profitability. However, as discussed in the previous chapter (section 4.7.4.3), none of the practices in this category had a direct positive impact on the financial variable of the companies in the sample of this study. Therefore, this finding of the study is not aligned with the findings of the earlier studies. A possible explanation could be that the impact of IS investment is subject to a longer time lag (between 3-5 years (Zhang, 2005)). Or, they can only complement other operational practices and have no separable impact on a firm's financial performance (Zhang, 2005). Alternatively, these practices might have a small impact on reducing the operational costs of the companies in this study. Therefore, their impact is not large enough to be detected in other aspects of financial performance such as profitability.

Table 5-59 Findings of the earlier studies related to usage of IS for internal integration

Internal processes related practices	Authors/Date	Financial perspectives	
		Competitiveness: • Increased market share • Sales growth	**Profitability:** • Return on investment • Return On Capital Employed • Return on total assets
H14. Practices related to usage of information systems for internal integration, such as: •Collection, analysis and use of data and quality information. •Important information is presented and transmitted to employees •Information System support for product flexibility •Harnesses information to improve key processes, products and services. •Formal information are shared in the form of regular newsletter and hand outs	Lakhal et al. (2006)	✓	✓
	Valmohammadi (2011)	✓	✓
	Lakhal (2014)	✓	✓
	Zhang (2005)	✓	✓
	Dubey & Gunasekaran (2015)	---	✓
✓= Direct positive impact on financial performance ×= No direct positive impact on financial performance			

The author also directly asked the opinion of the authors of the previous studies, informing them that their findings were different from the findings of this study and which will be explained in the following subsection.

5.5.3.1. Opinions of the authors of earlier studies

Only Dr Valmohammadi replied to the author's email. He suggested the differences between the characteristics of the companies in the samples and the contextual differences between the two countries as potential reasons for the difference in the findings of the two studies. Valmohammadi's (2011) study is based on fifty-three Iranian manufacturing SMEs and this study is based on seventy-nine UK manufacturing companies. Also, to better understand the impact of IS for internal integration, the impact of one practice in this category was discussed with the experts and this will be discussed in the following subsection.

5.5.3.2. Opinions of the experts regarding the impact of usage of IS for internal integration

One practice in the category of usage of IS for internal integration was 'using ICT to integrate internal business processes (7.2.4)'. This practice had no direct positive impact on the financial performance of SMEs and Large firms in this study. A summary of the experts' opinions regarding this finding is provided in table 5-60. As shown in table 5-60, the experts suggest that it is not acceptable for companies and especially for SMEs to wait three to five years to achieve the financial benefits of their ICT investment. Therefore, the experts disagree with the potential explanation form Zhang's (2005) study.

Table 5-60 Summary of experts' opinions regarding the impact of usage of IS for internal integration

#	Summary of Experts' Opinions
Focus Group 1- 23rd June 2016	1. Some IT systems fail to achieve the goals that they are set up for. For example, systems like SAP are useful for planning, but not for control. And systems like Kanban are useful for control, but not for planning. 2. IT systems are only as good as the data put in them. So the companies in the sample of this study might not input reliable data into their systems to get the benefit from them. 3. Companies often customise their IT systems, rather than configuring them. So if a breakdown happen it is difficult for them to handle the breakdown of their customised systems.
Interview 1- 30th June 2016	The potential explanation from the literature that there might be a mediating factor between usage of ICT for integration of internal processes and financial performance is reasonable. This is because implementation of ICT usually has a negative impact on financial performance; therefore, ICT should first improve a process which could lead to better financial performance.
Focus Group 2- 14th July 2016	1. It could be because of the timing of analysing this relationship. If companies in the sample of this study had used ICT systems for integration of their internal processes from a long time ago, then its impact on their financial performance is not noticeable. 2. Do not agree with the explanation from the literature and suggest that it is not acceptable to wait for between three and five years to realise the financial benefits of ICT investment, and it is even more critical for SME to gain financial benefits of their investment. 3. Using ICT to integrate internal process could leads to complexity, which could have a negative impact on financial performance. For example, Siemens and Rolls-Royce have stopped using their complex ICT systems (i.e. SAP and MRP systems) or replaced them with less complex ones to reduce complexity.
Interview 2- 18th July 2016	ICT systems can improve information flow between internal processes; however, it cannot improve their operational performance if they do not have suitable processes in place. Also, companies need to have a full package of their ICT systems to achieve full benefits of their ICT systems; however, companies often only have disconnected components of a system rather than a full package.

However, the expert opinions support the other potential explanation from the literature that the usage to integrate internal business can only complement other operational practices and have no separable direct positive impact on firms' financial performance (Zhang, 2005). This is because ICT implementation usually has a negative impact on financial performance; therefore, ICT systems should be complemented with other operational capabilities to have a positive impact on companies' financial performance.

Table 5-61, shows the number of companies in the sample of this study for which data regarding 'using ICT to integrate internal business processes (7.2.4)' was available. As shown in table 5-61, the majority of the SMEs and Large companies did not answer this question. This shows that either this practice was not important for the companies in the sample of this study or their performance has not been good enough in which case they want to evaluate their performance in the MX Awards competition. However, even the companies for which data was available in this study had a diverse performance in this practice. Therefore, it could be because of the small sample size of the study that no statistically significant finding is found for this practice.

Table 5-61 Companies in the dataset for which data regarding question 7.2.4 was available

Company sizes	Not answered	Worst performing	Category 2	Category 3	Best performing	Total companies
SMEs	19	3	2	3	3	30
Large firms	34	1	6	7	7	55

5.5.3.3. Conclusions vis-a-vis practices related to usage of IS for internal integration

Overall, based on this findings of the study, it can be concluded that practices related to usage of IS for internal integration have no direct positive impact on the UK manufacturing companies' financial performance. However, this is also a contentious finding and contradicts the findings of the earlier studies. In addition, the sample size of this study was small and, therefore, there is a need for future research to further study the impact of these practices.

5.5.4. Practices related to usage of IS for external partnership (hypothesis 15)

As shown in table 5-62, some of the earlier studies, such as Dubey & Gunasekaran (2015) and Liu & Barrar (2009), find that these practices have a direct positive impact on companies' financial performance. However, Zhang (2005) and Jin (2006) find contradictory results. Zhang (2005) suggests the following three possible explanations:

1. Impact of IS investment is subject to a time lag of three to five years.
2. Cost of IS projects for external relationship is high and therefore take a longer time to achieve benefits from those projects.
3. Information systems need support from other complementary practices to improve financial performance.

Jin (2006) also suggests there is a time lag for learning and adjustment between the implementation of these practices and the realisation of their financial benefits. Jin (2006) also suggests that because of the small fraction of operational cost in profit calculation, sales revenue should be considerably higher to achieve improvement in profitability.

Table 5-62 Findings of the earlier studies related to usage of IS for external partnership

Internal processes related practices	Authors/Date	Financial perspectives	
		Competitiveness: • Increased market share • Sales growth	**Profitability:** • Return on investment • Return On Capital Employed • Return on total assets
H15. Practices related to usage of information systems for external partnership, such as: •Coordinating activities with those of customers, suppliers or distributors •Discovering and solving problems through intimate communication and effective collaboration. •Maintaining appropriate interactions with stakeholders •Effective coordination with customers, suppliers or distributors •Customers and partners give suggestions and feedback and take the responsibility of managing system	Dubey & Gunasekaran (2015)	---	✓
	Liu & Barrar (2009)	---	✓
	Wang et al. (2014)	✓	✓
	Zhang (2005)	×	×
	Jin (2006)	×	×
✓= Direct positive impact on financial performance ×= No direct positive impact on financial performance			

Also as discussed in the previous chapter (section 4.7.4.4), none of the two practices related to 'usage of IS for external partnership' had a direct positive impact on the companies in the sample of this study. Therefore, this study supports the findings of Zhang (2005) and Jin (2006). The author also directly asked the opinions of the authors of the previous studies, informing them that their findings were different from the findings of this study.

5.5.4.1. Opinions of the authors of earlier studies

Only Dr Dubey replied to the author's email. He suggests that the difference between the findings of their study and this study could be because of the industry sector of the companies. Dubey & Gunasegaram's (2015) study is based on 132 Indian firms only in the cement manufacturing sector and the usage of IT has significant influence on their financial performance. However, this study is based on a heterogeneous sample of seventy-nine UK manufacturing companies in twenty-one different industry sectors. Therefore, the difference between the samples of the studies could be a potential reason for the difference between the findings of the two studies. In addition, to better understand the impact of IS for external partnership, the impact of one practice in this category was discussed with the experts and this will be discussed in the following subsection.

5.5.4.2. Opinions of the experts regarding the impact of usage of IS for external partnership

One practice in the category of usage of IS for external partnership was 'using ICT to integrate with customers and suppliers (7.2.5)'. This practice had no direct positive impact on the financial performance of both SMEs and Large firms in this study. A summary of the experts' opinions regarding this finding is provided in table 5-63. As shown in table 5-63, one commonly suggested explanation by the experts was that using ICT to integrate with customers and suppliers is necessary for companies; however, it does not necessarily have a direct positive impact on their financial performance. Not using ICT could have a negative impact of financial performance which is not investigated in this study.

Table 5-63 Findings of the earlier studies related to usage of IS for external partnership

#	Summary of Experts' Opinions
Focus Group 1- 23rd June 2016	1. There might be a time lag between using ICT to integrate with customers and suppliers and achieving financial benefits from it. 2. It also depends on the types of industry and ownership of the companies. For example, in some industries, such as applied material, it is essential to have ICT integration with suppliers. 3. Not using ICT systems to integrate with customers and/or suppliers could have a negative impact, which is not investigated in this study.
Interview 1- 30th June 2016	In addition to the potential reasons from the literature, similar to the usage of ICT for internal integration, here it is also expected to have a mediating factor between the usage of ICT and its impact on financial performance.
Focus Group 2- 14th July 2016	1. The lack of impact for SMEs could be because SMEs have fewer customers and have a close relationship with them. So there is less need for them to use specific ICT systems for external partnership. 2. Not having an ICT system for external partnership could have a negative impact on financial performance particularly for large companies, but having it does not have a significant positive impact on financial performance. 3. It could be because of the complexity of these systems, that many companies have problems with training their workforce to use them. 4. Also, because of poor input data, many companies could not get advantage from their ICT system. For example, Syngenta, which has spent 54 million dollars to implement their APO (Advanced Planning and Optimization) in to their SAP system, did not get benefit from it because they did not have a good forecasting system. 5. Agrees with the points from the literature
Interview 2- 18th July 2016	The principle of using ICT for integration between customers and suppliers is right. However, because of poor scheduling of the orders from the customers, companies often cannot get full benefit from their ICT systems for external partnership.

Table 5-64 shows the number of companies in the sample of this study for which data regarding 'using ICT to integrate with customers and suppliers (7.2.5)' was available. As shown in table 5-64, only eight out of the thirty SMEs in the sample of this study answered this question. All of those companies had poor performance (i.e. they are scored as either worst performing companies or in category 2).

Table 5-64 Companies in the dataset for which data regarding question 7.2.5 was available

Company sizes	Not answered	Worst performing	Category 2	Category 3	Best performing	Total companies
SMEs	22	1	7	0	0	30
Large firms	43	0	4	4	4	55

Also only twelve out of fifty-five large companies in the sample of this study answered this question, and their performance is diverse. Therefore, it could be because of the small sample size of this study that no statistically significant finding is identified for this practice.

5.5.4.3. Conclusions vis-a-vis practices related to usage of IS for external partnership

Overall, based on the findings of this study and some of the earlier studies, it can be concluded that practices related to usage of IS for external partnership have no direct positive impact on the UK manufacturing companies' financial performance. However, future studies could use a larger sample size to either support or not support this finding of the study.

5.5.5. Practices related to product quality improvement (hypothesis 17)

As shown in table 5-65, the majority of the earlier studies find that these practices have a direct positive impact on firms' sales growth and profitability.

Table 5-65 Findings of the earlier studies related to product quality improvement

Product/Service related practices	Authors/Date	Financial perspectives	
		Competitiveness: • Increased market share • Sales growth	**Profitability:** • Return on investment • Return On Capital Employed • Return on total assets
H17. Practices related to product quality improvement, such as: •Product quality improvement practices •Conformance to design specification •Product durability, reliability •Using objective data as the basis for quality improvement •Encouragement for continuous improvement of all products, services and processes	Hertenstein et al. (2005)	✓	✓+ cash flow
	Jayaram et al. (2008)	---	✓
	Han et al. (2007)	✓	✓
	Fullerton & McWatters (2001)	---	✓
	Agus & Hajinoor (2012)	✓	✓
	Rosenzweig et al. (2003)	✓	×
	Kaynak (2003)	✓	✓
	Sila (2007)	✓	✓
	Lee & Roh (2012)	✓	✓
	Abusa & Gibson (2013)	×	×
	Fullerton et al. (2003)	---	× + cash flow
✓= Direct positive impact on financial performance		×= No direct positive impact on financial performance	

However, Rosenzweig et al. (2003), Abusa & Gibson (2013) and Fullerton et al. (2003) found contradictory results. Rosenzweig et al. (2003) found that product quality improvement only has a direct impact on the companies' sales growth, but not on their profitability. This shows that the cost of these practices has been larger than the generated sales from them.

This is also suggested by Fullerton et al. (2003) that practices related to product quality improvement impose high costs for companies and only have negative impact on firms' profitability and cash flow. Abusa & Gibson (2013) also found that these practices have no direct impact on firms' profitability and sales growth.

Also, as discussed in section 4.7.4.5 of the previous chapter, the only practice related to product quality improvement had no direct positive impact on the financial variable of the companies in the sample of this study. Therefore, this finding contradicts the findings of majority of the previous studies that found that these practices have a direct positive impact on firms' sales growth and profitability. However, this finding supports the work of Rosenzweig et al. (2003), Abusa & Gibson (2013) and Fullerton et al. (2003). The author also directly asked the opinions of the authors of the previous studies, informing them that their findings were different from this finding of the study, which will be explained in the following subsection.

5.5.5.1. Opinions of the authors of earlier studies

Of the authors of the previous studies that were contacted, Professor Agus, Professor Silla and Professor Kaynak replied to the author's email. Professor Agus suggests the difference in the findings of their study and this study could be because of contextual differences between the two studies. Agus & Hajinoor's (2012) study is based on 200 Malaysian manufacturing companies. Professor Silla also suggests that apart from the differences between the characteristics of the samples of the studies, the difference between the methods of defining variables in the two studies could be a reason for the difference in the findings. Finally, Professor Kaynak suggests that the small sample size of the study could be a reason for non-significant findings in this study.

In addition, to better understand the impact of product quality improvement on the financial performance of UK manufacturing companies, the impact of this practice was discussed with the experts and this will be discussed in the following subsection.

5.5.5.2. Opinions of the experts regarding the impact of product quality improvement

A summary of the experts' opinions regarding the impact of 'processes for identifying and implementing improvements or cost-reductions for existing products and/or new applications (2.2.1)' is provided in table 5-66. As shown in table 5-66, one potential explanation by the experts was that it has become part of the culture of the UK manufacturing companies to continuously improve the quality of their products and to reduce their cost of manufacturing. Therefore, the impact of this practice is not noticeable on their financial performance.

Table 5-66 Summary of experts' opinions regarding the impact of product quality improvement

#	Summary of Experts' Opinions
Focus Group 1- 23rd June 2016	1. It has become part of the culture of the UK manufacturing sector (particularly the companies in the sample of this study that have participated in the MX Awards) to have continuous improvement and cost reduction. So its impact on improving financial performance is less noticeable. 2. Also, it could be that not having a process for improving the quality of existing products can negatively influence financial performance, which is not investigated in this study.
Interview 1- 30th June 2016	The potential explanation that the cost of these practices might be too high is not convincing. There should be other reasons, such as the process of making improvements to the quality of existing products can distort normal practices, and employees' resistance to change, which has a negative impact on financial performance. Also, it could be that there is not enough data to find statistically significant positive impact.
Focus Group 2- 14th July 2016	1. Agrees with the potential explanation from the literature that these practices might impose high costs and therefore might have negative impact. 2. Not having a process for improving products or reducing their cost could have a negative impact, which is not investigated in this study. 3. The data is from the period in which the financial crisis have happened, so companies in the sample of this study might be in a difficult financial situation to implement these practices in order to improve the quality of their products.
Interview 2- 18th July 2016	Improving product quality is not optional and since the majority of companies are doing this practice nowadays, therefore, companies have to do this to stay in business and do not necessarily have a positive impact on their financial performance.

Table 5-67 shows the number of companies in the sample of this study for which data regarding 'processes for identifying and implementing improvements or cost reductions for existing products and/or new applications (2.2.1)' was available. As shown in table 5-67, the majority of the SMEs and Large companies in the sample of this study were scored in either category 3 or as the best performing companies. Therefore, the potential suggestion that this practice has become as part of the culture of these companies seems reasonable for this finding.

Table 5-67 Companies in the dataset for which data regarding question 4.7.1 was available

Company sizes	Not answered	Worst performing	Category 2	Category 3	Best performing	Total companies
SMEs	9	4	1	13	3	30
Large firms	25	4	1	19	6	55

5.5.5.3. Conclusions vis-a-vis practices related to product quality improvement

Overall, based on this finding of the study, practices related to product quality improvement have no direct positive impact on the UK manufacturing companies' financial performance. However, this finding contradicts the findings of the majority of the earlier studies. Also, the majority of the experts disagree with this finding and suggest that other factors could have influenced this finding. For example, the sample of the study is dominated by well-performing companies which had put themselves forward to enter the MX Awards competition. Another potential explanation could be that the implementation of these practices could have distorted the normal practice of companies and employees' resistance to the changes in their normal practice, which has negatively influence financial performance of the companies. Therefore, the impact of practices related to product quality improvement also needs further investigation.

5.6. Conclusions

In the previous sections, the findings of the study are reviewed against the following three areas:

1. Findings of the earlier studies
2. Opinions of ten experts in the context of the UK manufacturing companies
3. Opinions of other key researchers whose findings contradict the findings of this study.

In each of the previous sections, potential explanations for the identified relationships in the twenty categories of operational practices that are analysed in this study are discussed. In conclusion, based on the findings of this study, there is a direct positive impact between practices in the following twelve categories and the financial performance of the UK manufacturing companies in the sample of this study:

1. Customer satisfaction
2. Customer focus
3. Employees' effectiveness
4. Employees' recruitment reward and retention
5. Process performance improvement
6. Manufacturing simplicity
7. Preventive maintenance
8. Corporate social responsibility
9. Employees' involvement in business activities
10. Process management
11. Marketing
12. Product innovation.

The findings of the study regarding the impact of those categories, either support, partially support or do not support the findings of the earlier studies. The potential explanations for the findings of the study in those categories were discussed with the experts. The majority of the experts agree with the suggested potential explanations. Therefore, in the following subsections, the findings in those categories are used to develop two separate frameworks for the UK manufacturing SMEs and Large companies.

5.6.1. Business performance measurement framework for SMEs

Based on the findings of this study, there were nine operational practices that had a direct positive impact on eleven financial ratios of SMEs in the sample of this study. Figures 5-1 to 5-3 show the identified relationships for practices in the following three categories:

1- Practices related to customers
2- Practices related to employees
3- Practices related to internal processes

5.6.2.1. Practices related to customers

Based on the findings of this study, four practices related to customer satisfaction and customer focus had a positive impact on financial performance of SMEs in this study (figure 5-1). Except for one practice, the rest of the practices in this category had a positive impact on SMEs' profitability. Only 'approach to win new sales (e.g. by developing a product family based on a particular customer needs) had positive impact on SMEs' liquidity.

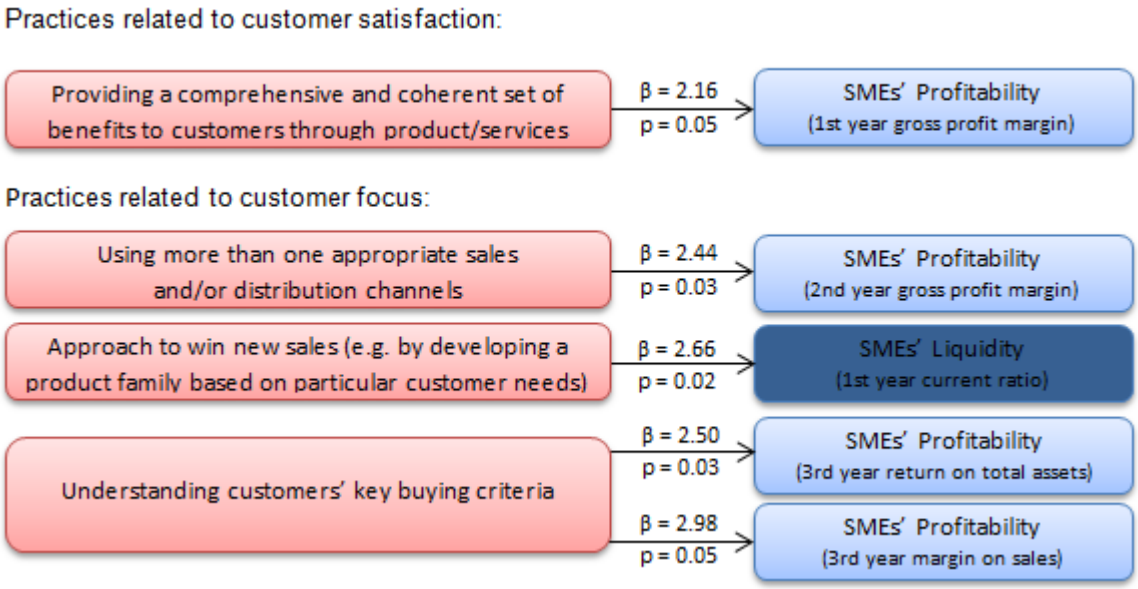


Figure 5-1 Practices related to customers that had a positive impact for SMEs

5.6.2.2. Practices related to employees

As shown in figure 5-2, there was only one practice related to employees' effectiveness that had a positive impact on liquidity and debt management of SMEs in the sample of this study.

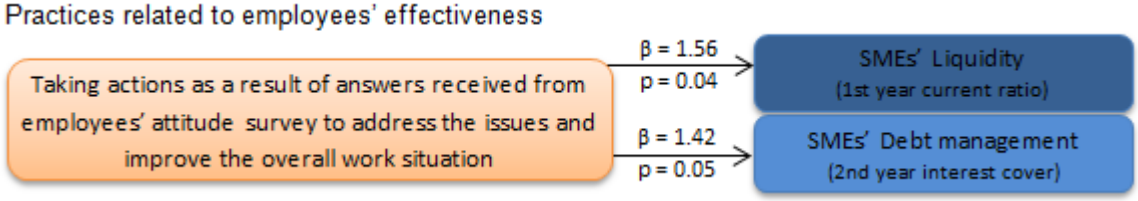


Figure 5-2 Practices related to employees that had a positive impact for SMEs

5.6.2.3. Practices related to internal processes

Figure 5-3 shows practices related to internal processes that had a positive impact on debt management and liquidity of the SMEs in the sample of this study.

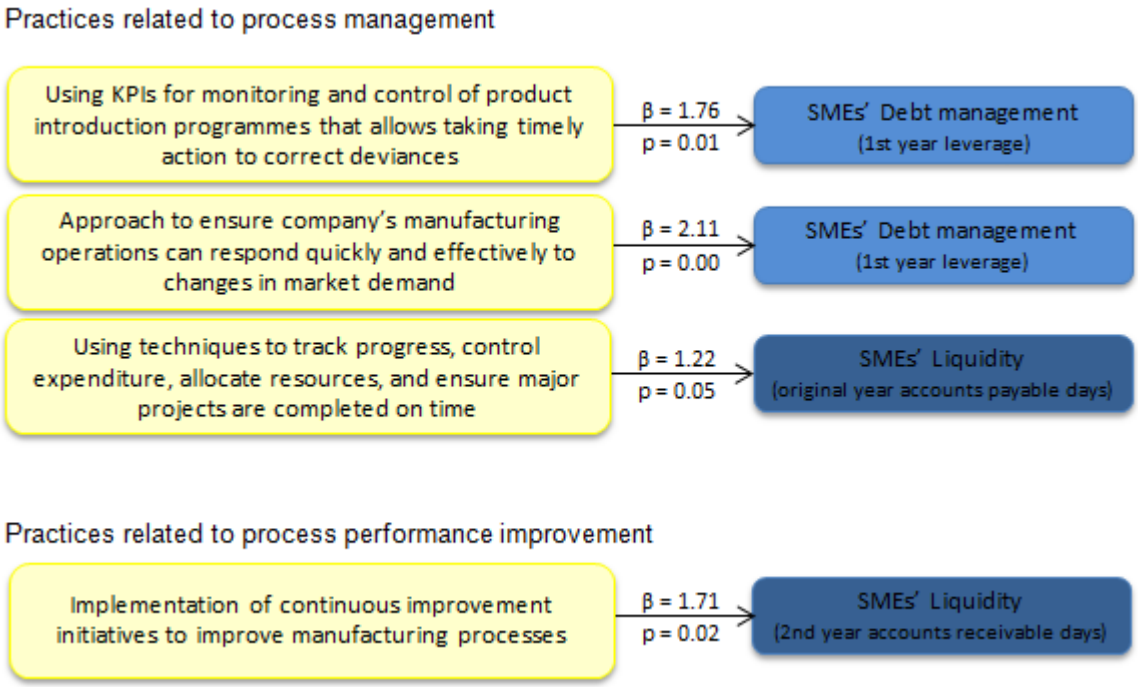


Figure 5-3 Practices related to internal processes that had a positive impact for SMEs

5.6.2. Business performance measurement framework for large companies

In this study there were thirty-one operational practices that had a direct positive impact on forty-nine financial ratios of large companies in the sample of this study. Figures 5-4 to 5-8 show the identified relationships for practices in the following four categories:

1- Practices related to customers
2- Practices related to employees
3- Practices related to internal processes
4- Practices related to products.

5.6.2.1. Practices related to customers

Based on the findings of this study, three practices related to customer satisfaction and four practices related to customer focus had a positive impact on financial performance of the large companies in the sample of this study (figure 5-4). The majority of these practices had a direct positive impact on large companies' profitability. However, three of these practices also had a positive impact on other aspects of large companies' financial performance, including cash flow, asset management and liquidity.

Figure 5-4 Practices related to customers that had a positive impact for Large firms

5.6.2.2. Practices related to employees

Based on the findings of this study, there were six practices in three categories of practices related to employees that had a positive impact on the financial performance of the large companies in the sample of this study (figure 5-5). These practices mainly had a positive impact on profitability and cash flow of large companies. However, four of these practices had a positive impact on other aspects of financial performance including debt management, liquidity and asset management.

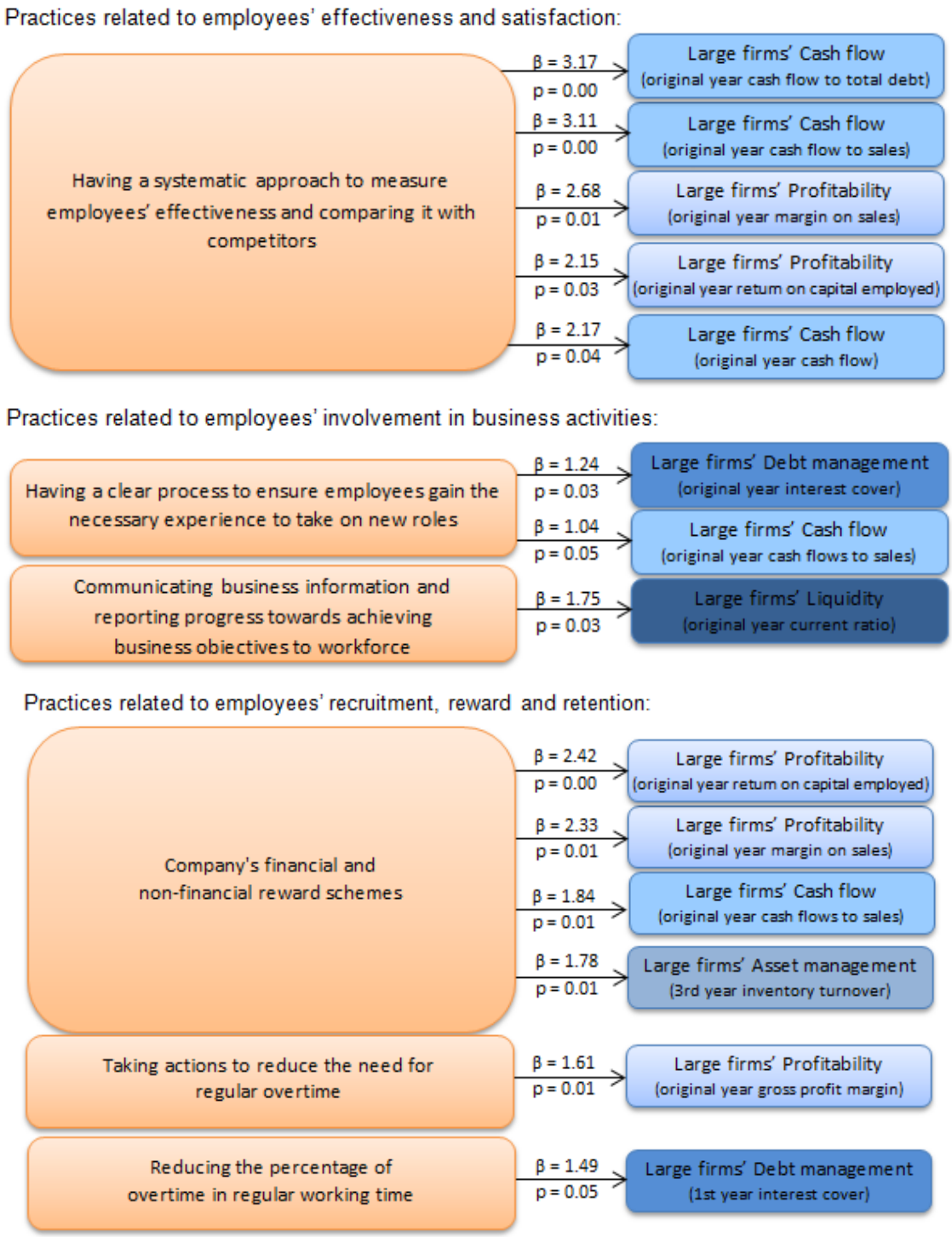
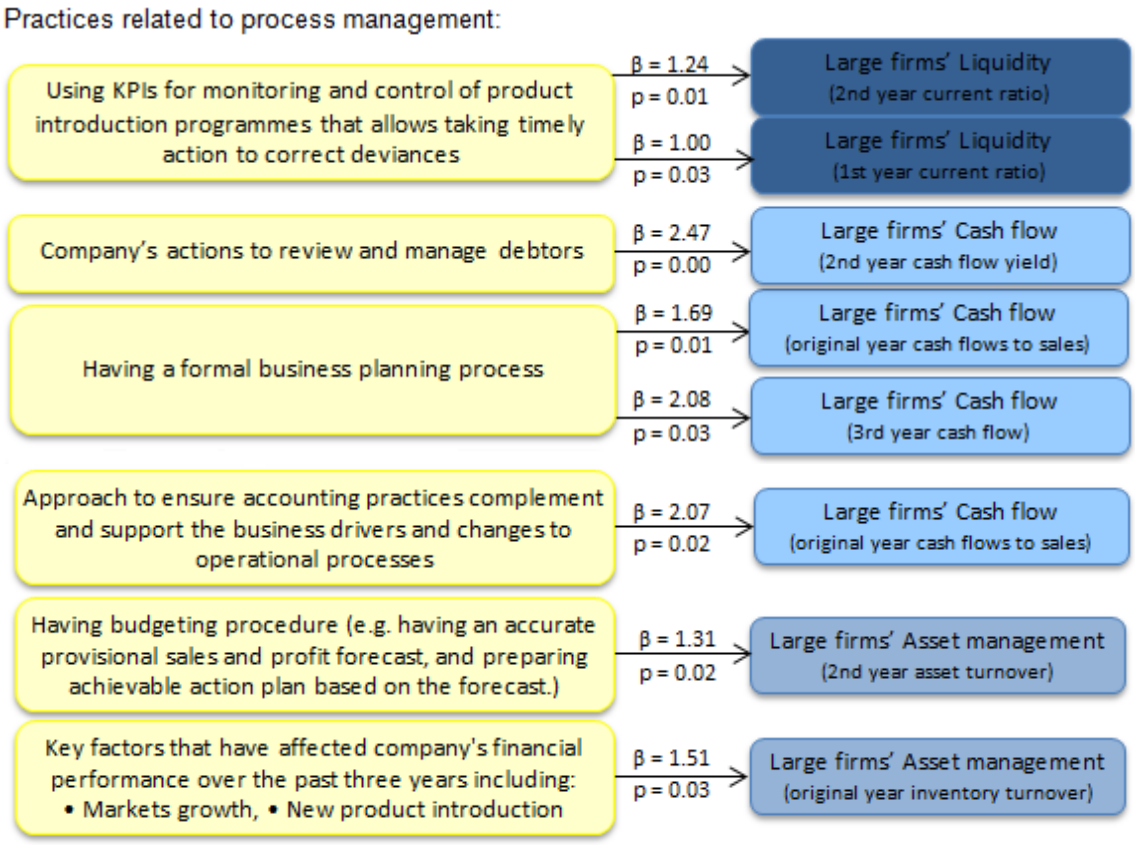


Figure 5-5 Practices related to employees that had a positive impact for Large firms

5.6.2.3. Practices related to internal processes

Based on the findings of this study, there were seventeen practices in six categories of practices related to internal processes that had a positive impact on financial performance of the large companies in the sample of this study (figure 5-6). These practices mainly had a positive impact on cash flow and profitability of large companies. However, there were also three practices in this category that had a positive impact on liquidity of large firms. Two practices had a positive impact on their debt management and one practice had a positive impact on sales growth of large firms.



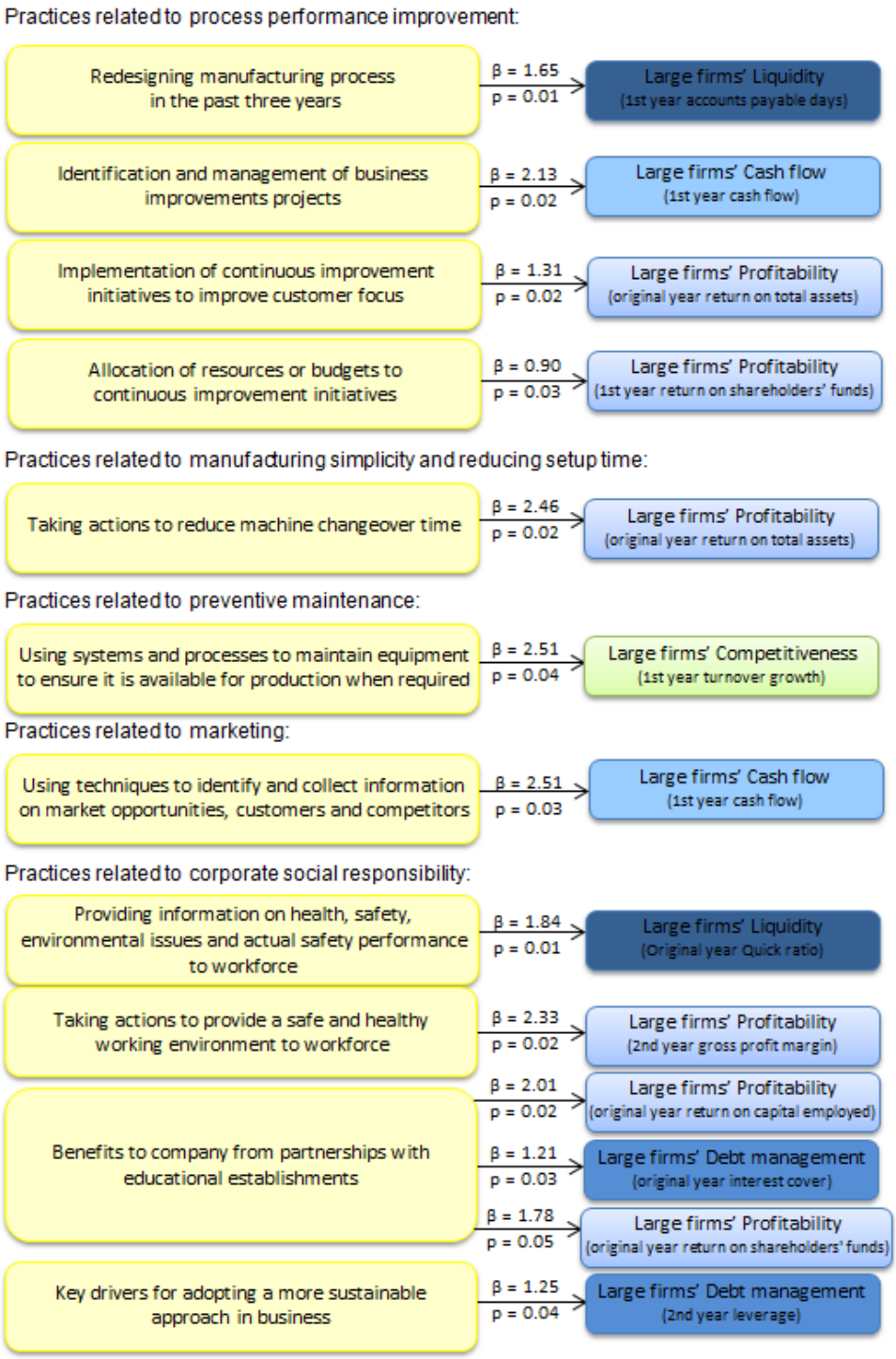


Figure 5-6 Practices related to internal processes that had a positive impact for Large firms

5.6.2.4. Practices related to products

As shown in figure 5-7, based on the findings of this study there was only one practice related to product innovation that had a direct positive impact on the liquidity of large companies.

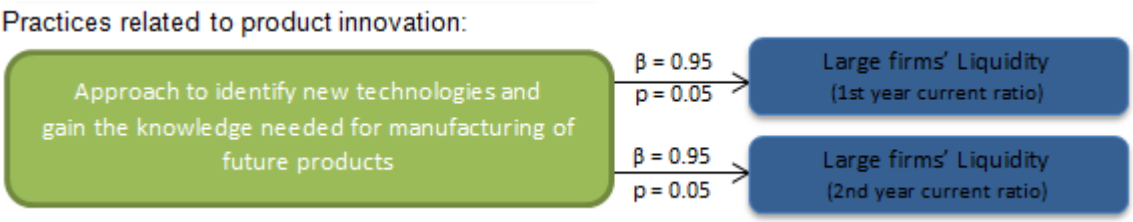


Figure 5-7 Practices related to products that had a positive impact for Large firms

5.6.3. Practices that are excluded from the frameworks

In the previous two subsections, practices that had a direct positive impact on the financial performance of the companies in the sample of this study are included in the frameworks. In contrast, practices in the following eight categories had no direct positive impact on the financial performance of the companies in the sample of this study:

1. Employees' training
2. Building relationship with suppliers
3. Supplier selection
4. Delivery reliability
5. Waste reduction
6. Usage of Information Systems (IS) for internal integration
7. Usage of IS for external partnership
8. Product quality improvement

The findings of this study regarding the first three of those categories support the findings of the earlier studies that practices in those categories have no direct positive impact on companies' financial performance. However, for the other five categories, the findings of the study contradict the findings of the majority of the earlier studies. In addition, there was no consensus between the experts regarding the suggested potential explanations for the findings of the study in those categories. Therefore, the impacts of practices in those categories need further investigation and are excluded from the frameworks of the study.

6. Conclusion

In the previous chapter, the findings of the study were reviewed against the findings of the earlier studies and the opinions of ten business experts in the context of UK manufacturing companies plus comment from published researchers with related findings. This chapter concludes the thesis by discussing the achievements of the study against the research questions. Then, based on the findings of the study, the contributions of this study to knowledge and practice will be explained. Finally, the limitations of the study and opportunities for future research will be provided.

6.1. Achievements against the research questions

This section explains the achievements of the study against the research questions. As explained in chapter one (section 1.3.1), the research questions of this study are as follows:

1- What operational practices in UK manufacturing companies have a positive impact on their financial performance?
2- What is the difference between SMEs and Large companies in the way in which their operational practices influence their financial performance?

This study addressed both of the research questions. The findings of the study identify eleven relationships between operational practices and financial results of SMEs and forty-nine relationships for large companies. These findings specifically address the first research question. Also, with regard to the second question, there were only the following two operational practices that had a positive impact on the financial performance of both SMEs and Large companies.

1. Using more than one appropriate sales and/or distribution channels (Q113) for identifying the needs and expectations of the customers. This practice had a positive impact on the profitability (2nd year gross profit margin) of the SMEs and liquidity (1st year accounts payable days) of the Large firms in the sample.

2. Using KPIs for monitoring and controlling product introduction programmes that allow taking timely action to correct deviances (Q233). This practice had a positive impact on debt management (1st year leverage) of the SMEs and liquidity (1st and 2nd year current ratio) of the large firms.

Apart from these two practices, the other operational practices in this study either had a positive impact on the financial performance of SMEs or Large companies and none for both. Therefore, the findings of the study show the difference between SMEs and Large companies in the way in which their operational practices influence their financial performance and address the second research question.

Tables 6-1 and 6-2 show the results for SMEs and Large companies in descending order of importance based on the significance of the identified relationships (p-values) and the strength of the relationships (Beta values). As shown in table 6-1, the most significant relationship for SMEs was between their 'Approach to ensure company's manufacturing operations can respond quickly and effectively to changes in market demand' and improvement of their debt management (first year leverage). This shows that SMEs that were more responsive to changes in market demand had less need to external debt and therefore reduced their leverage (debt to equity) in the first year after participation in the awards. In addition, the following two practices had influence on more than one financial ratio of SMEs:

1- Approach to identifying the key buying criteria used by their customers (1.1.1) that had a positive impact on their:
    a. 3rd year return on total assets and
    b. 3rd year margin on sales.
2- Actions as a result of answers received from their attitude survey (5.3.11), that had a positive impact on their
    a. 1st year current ratio and
    b. 2nd year interest cover.

Table 6-1 Identified relationships for SMEs over four years after participation in the MX Awards

#	Operational Practices	Financial ratios	Total Observations	Estimated Beta-value	Exact P-value
1	Approach for ensuring company's manufacturing operations can respond quickly and effectively to changes in market demand (Q332)	First year Leverage	24	2.11	0.00 **
2	Using KPIs for monitoring and control of product introduction programmes that allows taking timely action to correct deviances (Q233)	First year Leverage	19	1.76	0.01 **
3	Approach to winning new sales (e.g. developing a product family based on particular customer needs) (Q643)	First year Current ratio	19	2.66	0.02 *
4	Implementation of continuous improvement initiatives to improve manufacturing processes (Q342)	Second year Accounts Receivable days	22	1.71	0.02 *
5	Using more than one appropriate sales and/or distribution channels (Q113)	Second year Gross Profit margin	18	2.44	0.03 *
6	Understanding customers' key buying criteria (Q111)	Third year Return on total assets	19	2.50	0.03 *
7	Taking actions as a result of answers received from employees' attitude survey to addressing the issues and improving the overall work situation (Q5311)	First year Current ratio	21	1.56	0.04 *
8	Providing a comprehensive and coherent set of benefits to customers through product/services (Q114)	First year Gross Profit margin	25	2.16	0.05 *
9	Taking actions as a result of answers received from employees' attitude survey to addressing the issues and improving the overall work situation (Q5311)	Second year Interest cover	14	1.42	0.05 *
10	Understanding customers' key buying criteria (Q111)	Third year Margin On Sales	19	2.98	0.05 *
11	Using techniques to track progress, control expenditure, allocate resources, and ensure major projects are completed on time (Q652)	Original year Accounts payable days	20	1.22	0.05 *
** = significant at 0.01 level					
* = significant at 0.05 level					

As shown in table 6-2, the most significant relationship for large companies was related to 'Having a systematic approach to measure employees' effectiveness and comparing it with competitors'. This practice had a direct positive impact on their cash flow in the year of participation in the awards. In addition, the following eleven practices had influence on more than one financial ratio of large companies. The practice of 'Having a systematic approach to measure employees' effectiveness and comparing it with competitors' was also the most influential practice for Large firms. This practice had a positive impact on five ratios of cash flow and profitability in the year of participation in the awards.

1- Having a systematic approach to measuring employees' effectiveness and comparing it with competitors (5.7.1) that had a positive impact on their:

   a. Original year cash flow to total debt
   b. Original year cash flows to sales
   c. Original year margin on sales
   d. Original year return on capital employed
   e. Original year cash flow.

2- Company's financial and non-financial reward schemes (5.4.1) that had a positive impact on their:

   a. Original year return on capital employed
   b. Original year margin on sales
   c. Original year cash flows to sales
   d. 3rd year inventory turnover.

3- Having a systematic approach for customer focus and comparing it with competitors (1.8.1) that had a positive impact on their:

   a. Original year return on capital employed
   b. Original year return on shareholders' funds
   c. Original year margin on sales.

4- Benefits to company from partnerships with educational establishments (5.6.2) that had a positive impact on their:

   a. Original year return on capital employed
   b. Original year interest cover
   c. Original year return on shareholders' funds.

5- Having objectives such as retaining existing customers as drivers for change in business (6.1.4) that had positive impact on their:
   a. 2nd year inventory turnover
   b. Original year cash flows to sales.

6- Approach to managing the impact on customers when reaching the end of life of existing products (1.7.1) that had a positive impact on their:
   a. Original year asset turnover
   b. 3rd year margin on sales.

7- Having a strategy for providing after-sales and product support service to customers (1.2.2) that had a positive impact on their:

   a. Original year margin on sales
   b. Original year return on total assets.

8- Using KPIs for monitoring and control of product introduction programmes that allows taking timely action to correct deviances (2.3.3) that had a positive impact on their:

   a. 2nd year current ratio
   b. 1st year current ratio.

9- Having a formal business planning process (6.1.1) that had a positive impact on their:

   a. Original year cash flows to sales
   b. 3rd year cash flow.

10- Having a clear process to ensure employees gain the necessary experience to take on new roles (5.3.2) that had a positive impact on their:

   a. Original year interest cover
   b. Original year cash flows to sales.

11- Approach for identifying new technologies and gain the knowledge needed for the manufacturing of future products (3.1.4) that had a positive impact on their:

   a. 1st year current ratio
   b. 2nd year current ratio.

Table 6-2 Identified relationships for Large firms over four years after participation in the MX Awards

Validated relationships for Large firms over four years after participation in the MX Awards					
#	Operational Practices	Financial ratios	Total Observations	Estimated Beta-value	Exact P-value
1	Having a systematic approach for measuring employees' effectiveness and comparing it with competitors (Q571)	Original year Cash Flow to Total Deb	37	3.17	0.00 **
2	Having a systematic approach for measuring employees' effectiveness and comparing it with competitors (Q571)	Original year Cash flows to sales	38	3.11	0.00 **
3	Company's financial and non-financial reward schemes (Q541)	Original year Return on Capital Employed	41	2.42	0.00 **
4	Company's actions to review and manage debtors (Q844)	Second year Cash flows yield	26	2.47	0.00 **
5	Having a systematic approach for measuring employees' effectiveness and comparing it with competitors (Q571)	Original year Profit margin	39	2.68	0.01 **
6	Approach for managing the impact on customers when reaching end of life of existing products (Q171)	Original year Asset turnover	29	2.61	0.01 **
7	Having a systematic approach for customer focus and comparing it with competitors (Q181)	Original year Return on Capital Employed	42	2.48	0.01 **
8	Company's financial and non-financial reward schemes (Q541)	Original year Profit margin	40	2.33	0.01 **
9	Providing information on health, safety, environmental issues and actual safety performance to workforce (Q462)	Original year Quick ratio	36	1.84	0.01 **
10	Company's financial and non-financial reward schemes (Q541)	Original year Cash flows to sales	39	1.84	0.01 **
11	Having a formal business planning process (Q611)	Original year Cash flows to sales	30	1.69	0.01 **
12	Taking actions to reduce the need for regular overtime (Q544)	Original year Gross Profit margin	31	1.61	0.01 **
13	Redesigning manufacturing process in the past three years (Q352)	First year Accounts Payable Days	39	1.65	0.01 **
14	Using KPIs for monitoring and control of product introduction programmes that allows taking timely action to correct deviances (Q233)	Second year Current ratio	29	1.24	0.01 **
15	Company's financial and non-financial reward schemes (Q541)	Third year Inventory Turnover	37	1.78	0.01 **
16	Approach for ensuring accounting practices complement and support the business drivers and changes to operational processes (Q847)	Original year Cash flows to sales	21	2.07	0.02 *
17	Benefits to company from partnerships with educational establishments (Q562)	Original year Return on Capital Employed	40	2.01	0.02 *
18	Taking actions as a result of customer feedback to improve customer satisfaction (Q132)	Original year Cash flows to sales	39	1.98	0.02 *
19	Implementation of continuous improvement initiatives to improve customer focus (Q151)	Original year Return on total assets	38	1.31	0.02 *
20	Taking actions to reduce machine changeover time (Q474)	First year Return on total assets	32	2.46	0.02 *
21	Identification and management of business improvements projects (Q615)	First year Cash flow	25	2.13	0.02 *
22	Using more than one appropriate sales and/or distribution channels (Q113)	First year Accounts payable days	40	1.27	0.02 *
23	Taking actions to provide a safe and healthy working environment for workforce (Q461)	Second year Gross Profit margin	24	2.33	0.02 *
24	Having budgeting procedure (e.g. having an accurate provisional sales and profit forecast, and preparing achievable action plan based on the forecast) (Q871)	Second year Asset turnover	25	1.31	0.02 *
25	Having a systematic approach for measuring employees' effectiveness and comparing it with competitors (Q571)	Original year Return on Capital Employed	40	2.15	0.03 *

#	Operational Practices	Financial ratios	Total Observations	Estimated Beta-value	Exact P-value
26	Communicating business information and reporting progress towards achieving business objectives to workforce (Q522)	Original year Current ratio	40	1.75	0.03 *
27	Key factors that have affected company's financial performance over the past three years including: • Markets growth, • New product introduction (Q831)	Original year Inventory turnover	29	1.51	0.03 *
28	Having a strategy to provide after-sales and product support service to customers (Q122)	Original year Profit margin	39	1.28	0.03 *
29	Having a clear process to ensure employees gain the necessary experience to take on new roles (Q532)	Original year Interest cover	34	1.24	0.03 *
30	Benefits to company from partnerships with educational establishments (Q562)	Original year Interest cover	35	1.21	0.03 *
31	Having objectives such as retaining existing customers as drivers for change in business (Q614)	Original year Cash flows to sales	30	1.10	0.03 *
32	Having a comprehensive system for measuring customers' satisfaction and a positive trend in customer satisfaction (Q131)	Original year Return on Capital Employed	41	2.08	0.03 *
33	Using techniques to identify and collect information on market opportunities, customers and competitors (Q621)	First year Cash flow	25	2.51	0.03 *
34	Using KPIs for monitoring and control of product introduction programmes that allows taking timely action to correct deviances (Q233)	First year Current ratio	33	1.00	0.03 *
35	Allocation of resources or budgets to continuous improvement initiatives (Q152)	First year Return on Shareholders' Funds	37	0.90	0.03 *
36	Having objectives such as retaining existing customers as drivers for change in business (Q614)	Second year Inventory turnover	26	1.13	0.03 *
37	Approach for managing the impact on customers when reaching end of life of existing products (Q171)	Third year Margin on Sales	28	2.58	0.03 *
38	Having a formal business planning process (Q611)	Third year Cash Flow	27	2.08	0.03 *
39	Having a systematic approach for measuring employees' effectiveness and comparing it with competitors (Q571)	Original year Cash flow	38	2.17	0.04 *
40	Having a systematic approach for customer focus and comparing it with competitors (Q181)	Original year Return on Shareholders' Funds	40	2.09	0.04 *
41	Having a systematic approach for customer focus and comparing it with competitors (Q181)	Original year Profit margin	41	2.09	0.04 *
42	Using systems and processes to maintain equipment to ensure it is available for production when required (Q473)	First year Turnover Growth	32	2.51	0.04 *
43	Key drivers for adopting a more sustainable approach in business (Q911)	Second year Leverage	19	1.25	0.04 *
44	Benefits to company from partnerships with educational establishments (Q562)	Original year Return on Shareholders' Funds	38	1.78	0.05 *
45	Having a clear process to ensure employees gain the necessary experience to take on new roles (Q532)	Original year Cash flows to sales	38	1.04	0.05 *
46	Having a strategy to provide after-sales and product support service to customers (Q122)	Original year Return on total assets	40	1.02	0.05 *
47	Reducing the percentage of overtime in regular working time (Q543)	First year Interest cover	36	1.49	0.05 *
48	Approach for identifying new technologies and gaining the knowledge needed for manufacturing of future products (Q314)	First year Current ratio	34	0.95	0.05 *
49	Approach for identifying new technologies and gaining the knowledge needed for manufacturing of future products (Q314)	Second year Current ratio	30	0.95	0.05 *
** = significant at 0.01 level					
* = significant at 0.05 level					

To answer the research questions of the study, first, as explained in chapter 2 (section 2.3.3), the identified relationships between operational practices and financial measures in the earlier studies are used to develop twenty hypotheses. Then, to test these hypotheses in the context of the UK manufacturing companies, two independent archival datasets are used. This was to overcome the following two limitations of the earlier studies that their findings were based on survey data:

1- Data based on survey data may not reflect the actual performance of companies (Teeratansirikool et al., 2013).

2- Using one respondent for collecting data about both independent variables (operational practices) and dependant variables (financial performance) can lead to finding a false covariance between them independent of their actual relationship (Podsakoff et al., 2003).

In this study, the companies' operational data is collected from the ImechE's archival data. The financial data of those companies is collected from two financial databases (i.e. FAME and Amadeus). The suitability of these two archival data sources for answering the research questions in comparison to alternative sources is discussed in chapter 3 (section 3.4.1). Then, as discussed in chapter 3 (section 3.4.2), the following two methods were selected as the most suitable for analysing the relationship between the operational and financial variable of the study:

1- The Fisher's exact test to find the potential correlation(s) between the companies' operational measures and their financial ratios

2- The exact logistic regression analysis to find the coefficients of the operational practices to predict improvement in financial results.

The result of the analyses are eleven relationships for SMEs and forty-nine relationships for Large firms that are presented in tables 6-1 and 6-2. The potential explanations for identified relationships, based on the findings of the earlier studies and suggestions by the experts in the context of the UK manufacturing companies, are discussed in chapter 5 (sections 5.2 to 5.5).

6.2. Contributions

The main contributions of this study are the two separate business performance measurement frameworks for the UK manufacturing SMEs and Large companies which was developed in the previous chapter (section 5.6). Comparing them with the fifteen business performance measurement frameworks that were reviewed in chapter two (section 2.2); the proposed frameworks of this study are the only frameworks that suggest relationships between specific operational practices and specific financial ratios. Also, forty studies that had analysed the impact of operational practices on financial results were reviewed in chapter two (section 2.3). Comparing them with those forty studies, this research is the only study that has separately analysed the relationships for SMEs and Large companies and suggest different findings for different company sizes.

As well as the proposed frameworks of the study, in the following, the main contributions of this research, including both contributions to knowledge and practice, are explained.

6.2.1. Contributions to knowledge

The five key contributions of this study to knowledge are as follows:

1. In this study, a few operational practices of SMEs and Large firms had a direct positive impact on their financial results.

In this study, the relationships between ninety operational practices and eighteen financial ratios over four years have been analysed. This is 6480 relationships (6480= 90 x. 18 x. 4) separately for SMEs and Large firms. However, eventually, only eleven relationships were confirmed to have a positive impact for SMEs and forty-nine relationships for large firms. This could be because of the specific characteristics of the companies in the sample of this study or because of using a small sample size. Also, it could be because other factors (such as market competition) have influenced the impact of companies' operational practices on their financial results which are not examined in this study.

For example, Banker & Mashruwala (2007) studied the impact of employee satisfaction and customer satisfaction on profitability and revenue of 800 stores of a US retailer. The result of that study shows that for the stores in high intense market competition, employee satisfaction and customer satisfaction were useful in predicting the stores' future profitability. However, for stores in conditions of less intense market competition, neither employee satisfaction nor customer satisfaction could predict the stores' future profitability. As suggested by Banker & Mashruwala's (2007) study, the market competition for the companies in the sample of this study could have influenced the relationship between their operational practices and financial results. Also, as suggested by the experts that have participated in this study, the industry sector and the ownership of the companies could also have influenced the identified result.

2. Overall, more operational practices of large firms have a direct positive impact on their financial results than those of SMEs.

As shown in table 6-2, for large firms, there were forty-nine operational practices that had a direct positive impact on their financial result. However, as shown in table 6-1, there were only eleven operational practices for SMEs. This again could be due to the sample of the study, since there were thirty-eight SMEs and sixty-eight large firms in the sample of this study. Therefore, the difference between the number of SMEs and Large firms could partially explain the difference between the number of findings for SMEs and Large firms. However, this could also be because the individual operational practices of large firms have a more direct impact on their financial result than that of SMEs.

3. It takes longer for SMEs than Large firms to realise the financial benefits of their operational practices.

As shown in table 6-3, for Large companies, in the year of participation in the awards, the highest number of correlated pairs of operational practices and financial results were identified (twenty nine out of forty nine). Then, in the succeeding years, this number was gradually decreased. However, for SMEs, the highest number of correlated pairs of operational practices and financial results was identified in the first year after participation in the awards (five out of eleven). Therefore, based on the findings of this study, for large companies, improvement in operational practices had an immediate positive impact on their financial results. However for SMEs it took one year until improvement in their operational practices influenced their financial results.

Table 6-3 The number of identified relationships for SMEs and Large firms

	Original year of participation	1st year	2nd year	3rd year	Total
SMEs	1	5	3	2	11
Large firms	29	10	7	3	49

4. There is a difference between SMEs and Large firms in the ways in which their operational practices influence their financial results.

By comparing the identified results for SMEs and Large firms in tables 6-1 and 6-2, only two operational practices can be identified that had a positive impact on the financial performance of both SMEs and Large firms. These two practices include:

a) Using more than one appropriate sales and/or distribution channels (Q113) for identifying the needs and expectations of the customers. This practice had a positive impact on the profitability (2nd year gross profit margin) of the SMEs and liquidity (1st year accounts payable days) of the Large firms in the sample.

b) Using KPIs for monitoring and control of product introduction programmes that allows taking timely action to correct deviances (Q233). This practice had a positive impact on debt management (1st year leverage) of the SMEs and liquidity (1st and 2nd year current ratio) of the large firms.

However, apart from these two practices, the other practices either had a positive impact for SMEs or Large firms and none for both. Therefore, there is clear difference between SMEs and Large firms in the way in which their operational practices influence their financial results.

5. The impact of the operational practices on financial results has not been continual over time.

As shown in tables 6-1 and 6-2, the impact of the majority of the operational practices has been only in one financial year and their impact has not been continual over time. The only two exceptions are:

a) Using key performance measures for the monitoring and control of product introduction programmes (2.3.3). As previously explained, this practice had a positive impact on the liquidity of the large firms in two successive financial years (1st and 2nd years).
b) Having a process to identify new technologies for the manufacture of future products (3.1.4). This process also had a positive impact on the liquidity of the large firms in two successive financial years (1st and 2nd years).

However, apart from these two practices, the influence of the other operational practices has been only on the improvement of the financial performance of the companies in one financial year. Therefore, the impact of the operational practices on the financial result has not been continual.

6.2.2. Contributions to practice

The limitations of previous research which generate opportunities for conducting this study were highlighted in chapter 1 (section 1.2.2). This section explains the main contributions of this study to the practice of conducting research in the performance measurement field of study.

1. The majority of the earlier studies only explore the relationship between a few limited aspects of companies' operational practices and financial performance. Some of those key studies include: Duarte et al. (2011); Ittner & Larcker (1998); Dubey et al. (2014) and call for future research to include a broader set of operational and financial measures.

In this study, the relationship between ninety measures of operational performance in twenty hypotheses (appendix 2) and eighteen financial ratios in six categories of financial performance (appendix 3) are investigated. Comparing with the earlier studies, such as those by Dubey et al. (2014) that examine the impact of the four operational competencies on two financial measures; this study extends the exploration of the financial impact of operational practices. By considering a more comprehensive set of operational and financial performance measures, this study responds to the call for future research from the earlier studies, such as Duarte et al. (2011) and Dubey et al. (2014).

2. The majority of the earlier studies relied on managerial opinion to find the relationship between their operational practices and financial performance. Some studies, including Teeratansirikool et al. (2013); Klingenberg et al. (2013) and Saunila et al. (2014) specify that their collected data might not reflect the real firms' performance. Also, many of the earlier studies used only one survey to collect both operational practices and financial performance data. Some of them, including Sila (2007); Li et al. (2010) and Sadikoglu & Zehir (2010) suggest that this method of data collection might have caused false relationships between their studied variables independent of their actual relationship.

In this study, the data regarding the companies' operational practices were collected from the IMechE's MX Awards archival data. As explained in section 1.3.3, the companies' operational practices were assessed and ranked by the IMechE's assessors based on their common scoring guideline. So although the data that is used in this study is based on assessors' judgements, those judgements are based on one common guideline, and therefore are consistent for all companies.

Therefore, this data is less biased than the majority of the earlier studies, in which every manager's judgement about their own company's performance was used which might be different from another manager's judgement. Also, the data from the companies is also verified by a group of experts from the IMechE to ensure their submitted data is matching with their actual performance. Therefore, the reliability of the data is higher than the majority of the earlier studies.

In addition, the financial data of the companies were collected from two financial databases (FAME and Amadeus) which are independent from the IMechE and the companies whose information is used in this study. Therefore, the data is less biased than the majority of the earlier studies in which both operational and financial were provided by one respondent. Therefore, there is a higher chance of finding false relationship between their studied variables independent of their actual relationship. Therefore, by using archival data from two independent data sources this study addresses some of the limitations of the past studies that rely on only one data collection method or managerial perceptual data.

3. Some of the findings of the earlier studies, including Lakhal et al. (2006); Abusa & Gibson (2013); Valmohammadi (2011); Han et al. (2007) are mixed and context-specific. As explained in section 1.2.2.3, in this study seventy-two journal articles from six major databases that have explored the impact of operational practices on financial results were selected. Out of those studies, only one (i.e. Liu & Barrar, 2009) has used UK manufacturing companies in their sample. However, that study only examines the impact of the integration between companies' strategy and technology on their profitability.

Therefore, a limited study on the relationship between companies' operational practices and financial performance in the context of UK manufacturing has been conducted before. By using data from UK manufacturing companies, this study complements and extends the limited study undertaken previously.

4. Some of the earlier studies, including Lie et al. (2010) and Crisostomo et al. (2011) consider a firm's size as control variables when analysing the relationship between operational practices and financial performance. However, they have not stated how SMEs and Large companies vary in the way their operational practices impact their financial performance.

In this study, both SMEs and Large companies are included in the sample and separate findings for each group of company sizes are identified. Therefore, this study shows how different company sizes influence the way their operational practices impact their financial performance.

In this section, the main contributions of the study were highlighted. The next section explains the limitations of the study and opportunities for further research.

6.3. Limitations

In section 2.3.4 of chapter 2, fourteen different limitations of the earlier studies were classified and explained. Some of these limitations are not applicable to this study. For example, studies such as Teeratansirikool et al. (2013) only analysed the impact of the extent of use of the performance measurement systems on companies' financial performance. Therefore, the result of performance measurement is not analysed in those studies. Similarly, studies such as Klingenberg et al. (2013) use a substitution, such as winning a quality award, as a proxy for successful implementation of operational practices. Therefore, the actual performance of companies is not analysed in those studies. However, in this study the actual result of performance measurement of the companies which have participated in MX Awards is considered. Therefore, neither of those two types of limitations is applicable to this study.

In addition, this study has reduced some of the limitations that were in the earlier studies. For example, studies such as Dubey et al. (2014) only examined the impact of a few operational practices on companies' financial performance. The selected operational practices in those studies explain only a small fraction of the variance in companies' financial performance (e.g. 45.7% in Dubey et al. (2014)). Therefore, there was a need to study the impact of a larger number of operational practices on financial performance. This study reduces the limitation of previous research by considering the impact of ninety operational practices in twenty categories of operational practices and eighteen financial ratios in six categories of financial performance. Also, the findings of the majority of the earlier studies, such as Dubey & Gunasekaran (2015) and Wang et al. (2014), were based on self-reported company measures and were therefore subjective data. In this study, companies' operational practices and financial results were collected from two independent archival data. Therefore, the limitation of using subjective data was reduced.

Nevertheless, the following are identified as the key limitations of this study:

1- Limitations related to the sample of the study
2- Limitations related to the selected statistical analysis methods
3- Lack of sufficient data to justify the findings of the study related to eight categories of operational practices.

1- Limitations related to the sample of the study:

The sample of this study consists of seventy-nine UK manufacturing companies (thirty-one SMEs and forty-eight large companies). As discussed in chapter 2 (section 2.3.1), the majority of the earlier studies (twenty-five out of forty) include more than 100 companies in their samples. Therefore, the sample size of this study is smaller than the majority of the earlier studies. However, the size of the sample is still larger than some of the earlier studies, such as Kumar et al. (2009) which incorporated only fourteen Canadian manufacturing companies in their sample. Nevertheless, as suggested by Lakhal et al. (2006), since most of the statistical analysis methods are sensitive to sample size, using a larger sample size could give more reliable results and increase the generalisability of the findings.

There are also two characteristics of the sample of the study which limits the generalisability of the findings. The first characteristic is that companies in the sample of this study had participated in the ImechE's manufacturing excellence awards. Therefore, at least based on their own judgement, they considered themselves as well-performing companies in the categories of operational practices in which they have applied. Therefore, similar to some of the earlier studies, such as Fullerton & Wempe (2009), the sample of the study was dominated by particular types of companies which limit the generalisability of the findings.

In addition, the companies in the sample of the study had participated in the ImechE's MX Awards between 2006 and 2011. In the middle of that timeframe, the 2008 global financial crisis happened. Therefore, the lack of relationship between some of the operational practices and financial results in this study could have been because of the general economic condition of the companies during that period. Therefore, similar to some of the earlier studies, such as Hofer et al. (2012), the findings of this study could be time-dependent or the artefact of a particular dataset.

2- Limitations related to the selected statistical analysis methods

Because of the small sample size and missing data for some of the variables in the dataset, it was not possible to simultaneously analyse the impact of all operational practices on financial ratios. Therefore, in this study, the impact of each of the operational practices is separately analysed. As explained in chapter 4 (section 4.1), the advantage of this approach is that it shows the impact of individual operational practices on individual financial measures and can specifically answer the research question of the study. However, there are two problems associated with this approach:

a. Confounding bias: this problem refers to not considering the potential impact of other influential variables on the relationship between individual operational practice and financial ratio. Therefore, an operational practice might look like an important driver for a particular financial ratio. However, when the same operational practice is considered with other practices, its impact could be less noticeable.

To reduce the impact of this problem in this study, the potential impact of industry sectors and the year of participation (as a proxy for the general economic condition) were considered. The identified relationships in the study were not based on any particular industry sector and they were not only taken from a specific year. However, the impact of other influential factors, such as market competition, is not analysed in this study. Also, the impact of operational practices on each other is also not studied.

b. Multiple comparisons: this problem refers to performing many statistical analyses on the same dataset (Kaltenbach, 2012). Thus, the probability of falsely finding an operational practice as a driver of financial ratios would become greater than the acceptable rate. For example if the overall significance level of several tests is expected to be at 5%, then for performing five tests simultaneously, the significance level of each test must be at 1%, so that the overall risk of a false positive becomes 5% (Hinton, 2014). In this study, 6480 tests are performed and the significance level of each test is set between 1% and 5%. Therefore, it was expected that between 68 (6480*0.01) and 324 (6480*0.05) false positive relationships would be found.

To reduce the impact of this problem, the identified relationships, based on the estimation sample, were validated with the validation sample. Also, the identified relationships were discussed with ten business experts who have participated in the study. The findings that the majority of the experts disagree with are excluded from the final frameworks of the study. However, if the sample size of the study was larger and there was less missing data in the dataset, the impact of operational variables could be simultaneously analysed. Therefore, the number test would be reduced and there would be less probability of finding false positive relationships.

3- Lack of sufficient data to justify the findings of the study related to eight categories of operational practices.

As discussed in the previous chapter (section 5.2 and 5.5), operational practices in the following eight categories did not have any direct positive impact on the financial performance of the companies in the sample of this study.

1. Employees' training
2. Building relationship with suppliers
3. Supplier selection
4. Delivery reliability
5. Waste reduction
6. Usage of Information Systems (IS) for internal integration
7. Usage of IS for external partnership
8. Product quality improvement

However, there was no consensus between the identified potential explanations from the literature and the experts opinion regarding the findings of the study related to these categories. Overall there were insufficient data in the following three ways to justify the findings of the study related to those eight categories.

First, there were insufficient data available about the companies in the dataset. For example as it was discussed in section 5.2.3, practices related to 'employees training' had no direct positive impact on the financial performance of the companies in the sample of this study. This finding support the findings of the majority of the earlier studies. However one of the most commonly suggested explanation by the experts was that the impact of employees training on companies' financial performance depends on the type of training. Job-related training are expected to have a positive impact on financial performance. On the other hand sending employees to obtain university qualifications might have a negative impact on financial performance. However in the available data about the companies in the sample of this study the types of training is not separately collected. Therefore the impact of different types of trainings could not be separately analysed. Similarly as it was discussed in section 5.2.4, there were insufficient data about the types of suppliers (strategic vs. commodity) of the companies in the sample of this study.

Secondly, small number of companies in different industry sectors were available in the dataset. As it was discussed in sections 5.5.1 and 5.5.2, practices related to 'Delivery reliability' and 'Waste reduction' had no direct positive impact on financial performance of the companies in this study. One potential explanation for practices in these categories was that their impact depends on the industry sectors of the companies. Because of the small sample size, it was not possible to divide the sample of the study based on the industry sectors. This is because it would result in many smaller datasets, which could not produce any statistically significant conclusions. Therefore analysing the impact of different categories of operational practices for different industry sectors was not possible in this study.

Thirdly, the majority of companies in the dataset were well-performing companies and there insufficient data about poor performing companies. As it was discussed in section 5.5.5, practices related to product quality improvement had no direct positive impact on financial performance of the companies in this study. One potential explanation by the experts for this finding was that not having a process for improving the quality of existing products could have a negative impact on financial performance. However the majority of the companies in the sample of this study were well-performing companies. Therefore there were insufficient data available from poor performing companies to investigate if the lack of this practice has a negative impact on companies' financial performance.

Therefore, practices related to these categories are excluded from the frameworks of the study. There is a need to study the impact of these practices in future studies to further support or not support the findings of the study.

6.4. Further Work

Based on the limitations of the study that were discussed in the previous section, the following are two potential areas for future research:

1- Validating the findings by applying the proposed frameworks to SMEs or Large companies.
2- Developing a customised framework for a particular industry sector.

1- Validating the findings by applying the proposed frameworks to SMEs or Large companies

One potential opportunity for future research is to apply the proposed frameworks in this study to a particular SME or Large company. This could verify if the suggested operational practices in the framework have the expected impact on the financial performance of the companies or not.

This study would be similar to Rucci et al.'s (1998) study in which a performance measurement model is developed at Sears (Chain of American department stores) during eighteen months, from mid-1994 to the end of 1995. The model's structure is based on their top manager's viewpoint to make their company a "compelling place to work, to shop and to invest". Using statistical techniques, such as cluster and factor analysis, they linked their company's performance measures related to relationship with their customers, employees and shareholders. They claim the developed model is not perfect and never will be; however, it helps them to run their company and predict their future financial performance with high accuracy. Similar to Rucci et al.'s (1998) study, the frameworks of this study can be used as a starting point to suggest the expected impact of specific operational practices on specific financial ratios to companies.

2- Developing a customised framework for a particular industry sector

As discussed in the previous section, the operational practices in eight categories did not have any direct positive impact on the financial performance of the companies in the sample of this study. One potential explanation by the experts who participated in this study was that the lack of impact of these practices could be related to the industry sector of the companies. For example, having a high 'percentage of on-time and in-full deliveries on the date agreed with customers (1.3.3)' did not have any positive impact on the financial performance of the companies in the sample of this study. Based on the experts' opinion, the majority of the companies in the sample of this study are already well-performing companies. Therefore, this practice did not have a noticeable impact on improving their financial performance.

However, this finding is similar to the finding of Han et al.'s (2012) study that also suggest that for electronics firms, delivery reliability does not have a direct positive impact on their profitability. One potential suggestion by the experts was that the findings of Han et al.'s (2012) study could be because for the electronic industry sector, the impact of delivery reliability is not noticeable. However, for some other industry sectors, this practice could have a direct positive impact. There were similar suggestions by the experts regarding the practices in other categories too. For that reason, future studies could only study the impact of operational practices that are essential to a particular industry sector.

Also, one of the limitations of this study was the small sample size of the study and there were some missing data for some of the variables in the dataset. Future studies could incorporate a larger sample size with fewer missing data to resolve this limitation. Though there is a rule of thumb in regression analysis that for every ten events in response variables, one explanatory variable can be included in the regression model (van Belle, 2008). Therefore, for example, to analyse the impact of the ninety operational practices that were analysed in this study there is the need to have at least 900 companies with improvement in their financial ratios and 900 with deterioration. Therefore, 1800 companies are needed to find the impact of all operational variables which could be investigated simultaneously. Future studies could reduce number of operational practices to only the operational practices that are essential for a particular industry sector and, therefore, also reduce the need for larger sample size.

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Appendices

Appendix 1. Existing Business Performance Measurement frameworks

Please refer to appendix 1 file in the accompanied CD-ROM for complete review of the fifteen existing business performance measurement frameworks that are reviewed in this study.

Appendix 2. Operational variables

Table A2-1 shows the ninety operational variables of the study. These variables are selected from MX survey questions that are matching with the variables that were used in the earlier studies. Please refer to the 4 excel sheets in the accompanied CD-ROM for companies data on these variables.

Table A2-1 Operational variables of the study

#	Questions from MX Awards Survey	Identified practices from the literature	Author(s)/Date
H1: Practices related to customer satisfaction have a direct positive impact on companies' competitiveness or profitability.			
1	1.3.1 How do you measure customer satisfaction and what are the results?	• Increase customer satisfaction	Fotopoulos & Psomas (2010)
2	1.3.2 What actions have you taken to improve customer satisfaction?		
3	1.1.4 How do you believe your products and/or services add value to your customers?	• Value for the money spent	Sila, (2007)
4	6.1.4 What are the significant drivers for change in your business? (Retain key customers, Win new customers, Expand into new markets)	• Customer Retention Rate	Han et al. (2007)
H2: Practices related to customer focus have a direct positive impact on companies' competitiveness or profitability.			
5	1.1.1 What are the key buying criteria used by your customers?	• Identification of customer needs and expectations.	Valmohammadi (2011)
6	1.1.3 Which sales and/or distribution channels do you use and what benefits do they provide?		
7	6.4.3 How does your company win new sales? (Developing a product family based on particular customer needs)		
8	1.1.2 How do you identify future customer requirements?	• Customer integration in product development process.	Lakhal et al. (2006)
9	1.4.2 How do you ensure customer requirements are understood and are delivered throughout your company and supply chains?	• Assessment of customer needs and expectations.	Lakhal (2014)
10	1.7.1 How do you manage the impact on your customers when ending the manufacture of a product line?		
11	1.8.1 How do you believe that your approach to Customer Focus differentiates your organisation?	• Overall reputation score	Lee & Roh (2012)
12	1.2.2 What benefits have after-sales and product support brought to your customers and your company?	----	----
H3: Practices related to delivery reliability have a direct positive impact on companies' competitiveness or profitability.			
13	4.5.2 How do you calculate the capacity available for production to make sure deliveries can be completed by the customer requirement date?	• Reliability of delivery	Han et al. (2007)
14	1.3.3 What percentage of deliveries do you make on time and in full on the delivery date agreed with your customers?	• on-time delivery	Rosenzweig et al. (2003)
H4: Practices related to employees' effectiveness and satisfaction have a direct positive impact on companies' competitiveness or profitability.			
15	5.7.1 How do you believe that your approach to People Effectiveness differentiates your organisation?	• The competence of the employees is maintained and developed in a systematic way.	Nilsson et al. (2001)
16	5.1.1 What are the core organisational values within your business?	• Transparency of mission and vision.	Valmohammadi (2011)
17	5.1.3 What are the most important aspects of the working environment that you have established for your employees?	• Providing participative environment for employees.	Valmohammadi (2011)
18	5.3.11 What actions have you taken as a result of answers received from your attitude survey?	• Employee satisfaction is analysed and the results are the target of continuous improvement.	Nilsson et al. (2001)
19	5.5.2 What support do you have in place for helping employees to return to work following a prolonged absence/career break?		
20	5.5.1 What procedures do you use to monitor the gender, age, ethnic groups, and disabilities profile of your workforce?		
21	5.5.3 How do you ensure your employees remain motivated and satisfied with their job?		

#	Questions from MX Awards Survey	Identified practices from the literature	Author(s)/Date
H5: Practices related to employees' involvement in business activities have a direct positive impact on companies' competitiveness or profitability.			
22	5.3.2 How do you ensure employees gain the necessary experience to take on new roles?	• Employees are responsible for the tasks they perform, and inspect their own work.	Lakhal (2014)
23	5.2.2 How do you communicate this company/business information and report the progress towards achieving the business objectives to your workforce?	• Effective communication system for sharing business information	Abusa & Gibson (2013)
24	5.3.6 How are people encouraged to provide leadership, accept additional responsibility, and acquire new skills?	• Actively participate in meetings & workshops	Dubey & Gunasekaran (2015)
25	5.3.3 How do you plan for management succession?	• Employees take part in designing quality improvement activities	Fotopoulos & Psomas (2010)
H6: Practices related to employees' recruitment, reward & retention have a direct positive impact on companies' competitiveness or profitability.			
26	5.4.1 What financial and non-financial reward schemes does your company operate and what do they reward?	•Remuneration package to promote employee retention.	Ngo et al. (2008)
27	5.4.3 On average, what percentage of working time is overtime?		
28	5.4.4 What actions have been taken to reduce the need for regular overtime?		
29	5.3.7 What percentage of the workforce are subject to skills audits?	•Our performance appraisals emphasize outcomes.	Ngo et al. (2008)
H7: Practices related to employees' training have no direct positive impact on companies' competitiveness or profitability.			
30	5.3.1 How do you assess an individual's performance and identify their training requirements?	• Employee training	Lakhal (2014)
31	5.3.4 How does your company ensure people obtain the formal qualifications and the training they need to allow them to achieve their full potential?		
H8: Practices related to process management have a direct positive impact on their competitiveness or profitability.			
32	2.3.2 How do you maintain the configuration, specification, and document control for your products?	• The organization has a process management method.	Lakhal et al. (2006)
33	2.3.3 What are your key performance measures for the monitoring and control of product introduction programmes?		
34	3.3.1 What actions do you take to ensure your manufacturing operations work effectively?	•Clarity and transparency of procedures and work instructions of processes and operations.	Valmohammadi (2011)
35	3.3.2 How do you ensure your manufacturing operations can respond quickly and effectively to changes in market demand?	•Systematic recording and evaluation of critical process performance	Fotopoulos & Psomas (2010)
36	6.5.2 What techniques are used to track progress, control expenditure, allocate resources, and ensure major projects are completed on time?		
37	1.4.1 To which national/international standards does your business quality system conform?	•Quality System	Han et al. (2007)
38	6.1.1 What is your formal business planning process and who is involved?	•Determination of areas and points for improvement	Fotopoulos & Psomas (2010)
39	8.3.1 What are the key factors that have affected your financial performance over the past three years?	----	----
40	8.4.4 What controls do you use and who is responsible for managing debtors?		
41	8.4.7 How do you ensure your accounting practices complement and support the business drivers and changes to operational processes?		
42	8.6.1 Financial Risk management		
43	8.7.1 What are your budgeting procedures?		

#	Questions from MX Awards Survey	Identified practices from the literature	Author(s)/Date
H9: Practices related to process performance improvement have a direct positive impact on companies' competitiveness or profitability.			
44	1.5.1 What initiatives do you take to achieve continuous improvement?	•Continuous efforts are made to improve quality at all levels	Duh et al. (2012)
45	6.1.5 How business improvement projects are identified and managed?		
46	1.5.2 What resources are allocated to continuous improvement activities?	•Management provides the necessary resources to carry out activities efficiently.	Lakhal (2014)
47	3.4.2 What manufacturing process continuous improvement initiatives have you implemented and what benefits have they provided?	•Quality system in our company is improved continuously.	Lakhal et al. (2006)
48	3.5.2 Please give details of the areas of your manufacturing process that have been redesigned in the past three years.		
49	5.2.1 What company/business information do you share with your workforce?	•Involvement in establishing and communicating the organisation's vision, goals, plans, and values for its quality program.	Abusa & Gibson (2013)
H10: Practices related to waste reduction have a direct positive impact on companies' competitiveness or profitability.			
50	4.7.1 What actions have been taken to reduce all forms of waste?	•Reduction of Product defects	Fotopoulos & Psomas (2010); Duh et al. (2012); Han et al. (2007)
		•Reduction of Product rework rate	
		•Reduction of Non-conformances	
		•Capacity utilization	
		•Reduction of Warranty compensations	
H11: Practices related to manufacturing simplicity and reducing setup time have a direct positive impact on companies' competitiveness or profitability.			
51	4.7.4 What actions have been taken to reduce machine changeover times?	•Uses special tools to shorten setup time	Fullerton & Wempe (2009)
		•Trains employees to reduce setup time	
52	4.4.1 What factors influence the layout of your production facilities?	•Cellular manufacturing (Equipment's redesign)	Jayaram et al. (2008)
53	4.1.2 What initiatives have you introduced to improve the flow of materials throughout: a) the supply chain? / b) The factory?	•Inventory transportation and management system	Callen et al. (2000)
H12: Practices related to preventive maintenance have a direct positive impact on companies' competitiveness or profitability.			
54	4.7.3 What systems and processes do you use to maintain your equipment and ensure it is available to production when required?	• Total preventive maintenance practices	Dubey et al. (2014)
55	4.5.3 What internal measures are used for controlling and monitoring production performance?	•Productive maintenance	Fullerton et al. (2003)
56	4.7.6 What level of statistical process capability do you strive for on your equipment, and how is this confirmed?	•Undertaking programs for the improvement of your equipment productivity	Yang et al. (2011)
57	4.7.7 What percentage of your key equipment is process capable to the level expected?		
H13: Practices related to marketing have a direct positive impact on companies' profitability.			
58	6.2.1 What techniques do you use to identify and collect information on market opportunities, customers and competitors, and how is this information managed and exploited?	• Benchmarking practice impact on company performance	Dubey et al. (2014)
59	6.2.2 What is your business planning process that determines which new products should be developed for particular markets?	• Marketing research	Dubey et al. (2014)

#	Questions from MX Awards Survey	Identified practices from the literature	Author(s)/Date
H14: Practices related to usage of IS for internal integration have a direct positive impact on companies' competitiveness or profitability.			
60	7.2.1 Does your business have an appropriate system for: Commercial and financial planning? Marketing and customer relationships?	•Collection, analysis and use of data and quality information.	Valmohammadi (2011)
61	7.2.2 What key business benefits have been obtained from information and communications technology to justify the expenditure?	•Important information is presented and transmitted to employees	Lakhal et al. (2006)
62	7.2.4 How has ICT been used to integrate internal business processes?	•Information System support for product flexibility	Zhang (2005)
63	7.2.6 How are your business processes, organisation structure and ICT systems aligned?	•Harnesses information to improve key processes, products and services.	Lakhal et al. (2006)
64	7.2.3 How has ICT been used to increase the competitive advantage of your business?		
65	7.3.1 What resources are provided to allow employees access to your company ICT systems internally and from remote locations, and how is this access kept secure?	•Formal information are shared in the form of regular newsletter and hand outs	Dubey & Gunasekaran (2015)
H15: Practices related to usage of IS for external partnership have a direct positive impact on companies' competitiveness or profitability.			
66	7.2.5 How has ICT been used to integrate with your customers and suppliers?	•Coordinating activities with those of customers, suppliers or distributors	Zhang (2005)
67	7.3.2 What information is available on demand for customers and suppliers using your ICT systems?	•Effective coordination with customers, suppliers or distributors	Zhang (2005)
H16: Practices related to corporate social responsibility have no direct positive impact on companies' competitiveness or profitability.			
68	2.4.1 What actions have you taken to improve the environmental performance and sustainability of your products and packaging?	•Programs to improve environmental performance of processes and products	Yang et al. (2011)
69	3.4.3 What actions have you taken to reduce the environmental impact of your production processes?		
70	4.7.8 What actions have you taken to improve the environmental performance of your logistics operations and what results have been achieved?		
71	9.1.1 What are the key drivers for adopting a more sustainable approach in your business?	•Active involvement in social issues	Fotopoulos & Psomas (2010)
72	9.2.1 How your organisation is accredited externally for your sustainability achievements?		
73	9.1.2 How do you identify and prioritise areas for improving sustainability?		
74	5.6. Partnerships between business and education	•Relationship with employees	Crisostomo et al. (2011)
75	5.6.1 How does your company collaborate with educational establishments?		
76	5.6.2 What have been the benefits to your company from partnerships with educational establishments?		
77	4.6.1 What actions are taken to provide a safe and healthy working environment and how do you know they are effective?	•Health and security risks are prevented and reduced	Fotopoulos & Psomas (2010)
78	4.6.2 What information on health, safety, environmental issues and actual safety performance is provided to your workforce?		
H17: Practices related to product quality improvement have a direct positive impact on companies' competitiveness or profitability.			
79	2.2.1 What processes do you have for identifying and implementing improvements or cost reductions for existing products and/or new applications?	•Product quality improvement practices	Fullerton & McWatters (2001)

#	Questions from MX Awards Survey	Identified practices from the literature	Author(s)/Date
H18: Practices related to product innovation have a direct positive impact on companies' competitiveness or profitability.			
80	2.1.1 What are the key factors that drive your product innovation?	•Innovation to improving the quality of products and services	Li et al (2010)
81	2.1.2 How do you identify opportunities for innovation and how do you foster this process?	•Technical innovation	Han et al. (2007)
82	3.1.4 How does your company identify new technologies and gain the knowledge needed for the manufacture of future products?	•Enhancing the manufacture technology of new products.	Li et al (2010)
83	2.1.7 How do you assess and confirm that emerging technologies are developed to a level that is suitable for use in new products?		
H19: Practices related to building relationship with suppliers have no positive impact on companies' competitiveness or profitability.			
84	3.4.1 What is your customers' and/or suppliers' involvement in manufacturing process innovation?	•Integrated closely with raw material suppliers	Rosenzweig et al. (2003)
85	4.3.1 How do you determine acceptable lead times for suppliers?	•Providing feedback to suppliers on the performance of products and processes.	Valmohammadi (2011)
86	4.3.2 What actions do you take to improve the on-time delivery performance of your suppliers?		
H20: Practices related to supplier selection have no direct positive impact on companies' competitiveness or profitability.			
87	1.6.1 What percentage of your supplier base, by total value, is approved to deliver directly to production without routine incoming inspection?	•Considering process capability in supplier selection	Kannan & Tan (2005)
88	1.6.2 How do you assess your suppliers' quality performance?		
89	4.2.1 What factors and risks do you consider when selecting partners/suppliers?	•Supplier evaluation and selection	Huang et.al (2008)
90	4.2.2 What information and resources do you make available to suppliers?	•Considering commitment to quality in supplier selection	Kannan & Tan (2005)

Appendix 3. Financial variables

A3.1. *Financial ratios used in the study*

Table A3-1 shows the eighteen financial variables of the study. These variables are selected from the list of twenty-five financial variables that were identified in chapter 2 (section 2.2.4). The following eighteen ratios were available from the financial sources of the study (i.e. FAME and Amadeus). The constituent elements of these ratios are explained in table A3-2. Please refer to the 4 excel sheets in the accompanied CD-ROM for companies' data on these variables.

Table A3-1 Financial variables of the study

Category	Ratio	Formula
Competitiveness	Turnover Growth rate (%) ↑	(Present Year Turnover - Past year Turnover/ Past year Turnover)x 100
Corporate Profitability	Return on Shareholders' Funds (%) ↑	(Profit (Loss) before Tax/ Shareholders' Funds)x 100
	Return on Capital Employed (%) ↑	(Profit (Loss) before Tax/Total Assets less Current Liability)x 100
	Return on total assets (%) ↑	(Profit (Loss) before Tax/Total Assets)x 100
	Margin on sales (Profit margin) (%) ↑	(Profit (Loss) before Tax/Turnover)x 100
	Gross Profit margin (%) ↑	(Gross Profit/ Turnover)x 100
Asset management ratios	Net Assets Turnover (x) ↑	(Turnover/Total Assets less Current Liability)
	Stock Turnover (x) ↑	(Turnover/Stock & W.I.P.)
Corporate liquidity	Accounts Receivable (days) ↓	(Trade Debtors/Turnover) x 365
	Accounts payable (days) ↑	(Trade Creditors/Turnover) x 365
	Current ratio (x) ↑	(Current Assets/ Current Liabilities)
	Liquidity ratio (x) ↑	(Current Assets - Stock & W.I.P.)/ Current Liabilities
Debt Management Ratios	Interest cover (Times-interest-earned) (x) ↑	(Profit (Loss) before Interest/ Interest Paid)
	Leverage (Gearing) (Debt-to-equity ratio) (%) ↓	((Short Term Loans & Overdrafts + Long Term Liabilities/ Shareholders' Funds) x 100
Cash flow ratios	Cash flows to sales (%) ↑	(Cash flow/Turnover)x 100
	Cash Flow/Total Debt (%) ↑	(Cash flow/Total Debt)x 100
	Cash flow yield (%) ↑	(Cash flow/Profit (Loss) for Period)x 100
	Cash flow (x) ↑	(Cash flow)
↑ :	The higher this ratio, the better for the business	
↓ :	The Lower this ratio, the better for the business	
% :	Percentage	
X :	Whole number	
days :	Number of Days	

A3.2. *Constituent elements of the ratios*

Table A3-2 constituent elements of the financial variables

constituent elements of ratios	Formula
Current Assets	Stock & W.I.P. + Trade Debtors + Bank and Deposits + Other Current Assets + Investments
Current Liabilities	Trade Creditors + Short Term Loans & Overdrafts + Total Other Current Liabilities
Exceptional Items	Profit (Loss) on Sale of Operations + Costs of Reorganisation + Profit (Loss) on Disposal + Other Exceptional Items
Fixed Assets	Tangible Assets + Intangible Assets + Investments
Gross Profit	Turnover - Cost of Sales + Exceptional Items pre GP + Other Income pre GP
Hire Purchase & Leas. (short term)	Hire Purchase (short t.) + Leasing (short t.)
Hire Purchase & Leas. (long term)	Hire Purchase (long term) + Leasing (long term)
Interest Paid	Paid to Bank + Paid on Hire Purchase + Paid on Leasing + Other Interest Paid
Issued Capital	Ordinary Shares+ Preference Shares + Other Shares
Land & Buildings	Freehold Land + Leasehold Land
Long Term Debt	Group Loans (long term) + Director Loans (long term) + Hire Purchase Leas. (long term) + Preference Shares + Other Long Term Loans
Long Term Liabilities	Long Term Debt + Total Other Long Term Liability + Provisions for Other Liability + Pension Liabilities + Balance Sheet Minorities
Other Current Assets	Group Loans (asset) + Directors Loans (asset) + Other Debtors + Prepayments + Deferred Taxation
Plant & Vehicles	Plant + Vehicles
Profit (Loss) before Interest	Operating Profit + Other Income + Exceptional Items + Interest Received
Profit (Loss) before Tax	Operating Profit + Total Other Income & Interest Received + Exceptional Items-Interest Paid
Provisions for Other Liability	Deferred Tax + Other provisions
Shareholders' Funds	Issued Capital + Total Reserves
Short Term Loans & Overdrafts	Bank Overdrafts + Group Loans (short term) + Director Loans (short term) + Hire Purchase & Leas. (short term) + Other Short Term Loans
Stock & W.I.P.	Stock + W.I.P. + Finished Goods
Tangible Assets	Land & Buildings + Fixtures & Fittings + Plant & Vehicles + Other Fixed Assets
Total Assets	Fixed Assets + Current Assets
Total Assets less Current Liability	Fixed Assets + Current Assets - Current Liabilities
Total Debt	Current Liabilities + Long term Liabilities
Total Other Current Liabilities	Corporation Tax + Dividends + Accruals & Def. Inc. (short t.) + Social Securities & V.A.T. + Other Current Liabilities
Total Other Income & Interest Received	Other Income + Interest Received
Total Other Long Term Liability	Accruals & Def. Inc. (long term) + Other Long Term Liability
Total Reserves	Share Premium Account + Revaluation Reserves + Profit (Loss) Account + Other Reserves
Turnover	UK Turnover + Export Turnover

Appendix 4. Basis of the correlations

Please refer to appendix 4 file in the accompanied CD-ROM for summary of the calculated correlations.

Appendix 5. Impacts of potentially influential factors

Please refer to appendix 5 file in the accompanied CD-ROM for result of testing the impact of industry sectors and the year of participation in the awards on the identified relationships.

Appendix 6. Ethical approval letter

The following letter confirms ethical approval for conducting focus groups and interviews with ten business experts in this study from medical school, University of Warwick.

PRIVATE
Mr Seyyed Mohammad
Flat 3
Alvis House
Manor House Drive
Coventry
CV1 2EE

29th January 2016

Dear Mr Mohammad,

Relationship between the UK manufacturing companies' operational activities and financial performance
REGO-2016-1755

Thank you for submitting the above-named project to the University of Warwick Biomedical and Scientific Research Ethics Committee for research ethical review.

I am pleased to advise that research ethical approval is granted.

In undertaking your study, you are required to comply with the University of Warwick's *Research Data Management Policy*, details of which may be found on the Research and Impact Services' webpages, under "Codes of Practice & Policies" » "Research Code of Practice" » "Data & Records" » "Research Data Management Policy", at:
http://www2.warwick.ac.uk/services/ris/research_integrity/code_of_practice_and_policies/research_code_of_practice/datacollection_retention/research_data_mgt_policy

You are also required to comply with the University of Warwick's *Information Classification and Handling Procedure*, details of which may be found on the University's Governance webpages, under "Governance" » "Information Security" » "Information Classification and Handling Procedure", at:
http://www2.warwick.ac.uk/services/gov/informationsecurity/handling.
Investigators should familiarise themselves with the classifications of information defined therein, and the requirements for the storage and transportation of information within the different classifications:

Information Classifications:
http://www2.warwick.ac.uk/services/gov/informationsecurity/handling/classifications
Handling Electronic Information:
http://www2.warwick.ac.uk/services/gov/informationsecurity/handling/electronic/
Handling Paper or other media
http://www2.warwick.ac.uk/services/gov/informationsecurity/handling/paper/.

www.warwick.ac.uk

Please also be aware that BSREC grants **ethical approval** for studies. **The seeking and obtaining of *all* other necessary approvals is the responsibility of the investigator**

These other approvals may include, but are not limited to:

1. Any necessary agreements, approvals, or permissions required in order to comply with the University of Warwick's Financial Regulations and Procedures.
2. Any necessary approval or permission required in order to comply with the University of Warwick's Quality Management System and Standard Operating Procedures for the governance, acquisition, storage, use, and disposal of human samples for research.
3. All relevant University, Faculty, and Divisional/Departmental approvals, if an employee or student of the University of Warwick.
4. Approval from the applicant's academic supervisor and course/module leader (as appropriate), if a student of the University of Warwick.
5. NHS Trust R&D Management Approval, for research studies undertaken in NHS Trusts.
6. NHS Trust Clinical Audit Approval, for clinical audit studies undertaken in NHS Trusts.
7. Approval from Departmental or Divisional Heads, as required under local procedures, within Health and Social Care organisations hosting the study.
8. Local ethical approval for studies undertaken overseas, or in other HE institutions in the UK.
9. Approval from Heads (or delegates thereof) of UK Medical Schools, for studies involving medical students as participants.
10. Permission from Warwick Medical School to access medical students or medical student data for research or evaluation purposes.
11. NHS Trust Caldicott Guardian Approval, for studies where identifiable data is being transferred outside of the direct clinical care team. Individual NHS Trust procedures vary in their implementation of Caldicott guidance, and local guidance must be sought.
12. Any other approval required by the institution hosting the study, or by the applicant's employer.

There is no requirement to supply documentary evidence of any of the above to BSREC, but applicants should hold such evidence in their Study Master File for University of Warwick auditing and monitoring purposes. You may be required to supply evidence of any necessary approvals to other University functions, e.g. The Finance Office, Research & Impact Services (RIS), or your Department/School.

May I take this opportunity to wish you success with your study, and to remind you that any Substantial Amendments to your study require approval from BSREC before they may be implemented.

Yours sincerely

Professor Scott Weich
Chair
Biomedical and Scientific
Research Ethics Sub-Committee

Biomedical and Scientific Research Ethics Sub-Committee
A010 Medical School Building
Warwick Medical School,
Coventry, CV4 7AL.
T: 02476-528207
E: BSREC@Warwick.ac.uk

http://www2.warwick.ac.uk/services/ris/research_integrity/researchethicscommittees/biomed

Appendix 7. Transcript of focus groups and interviews

Please refer to appendix 7 file in the accompanied CD-ROM for transcript of the focus groups and interviews conducted in this study. The following experts have participated in this study.

- **Focus Group 1**- 23rd June 2016 – between 11:00 a.m. and 1:00 p.m. including the following participants:

    1. **Mr Simon Brook –** had 18 years career in engineering, primarily in the automotive sector, he has provided consultancy and technical support to clients in the UK and Germany including Jaguar Land Rover, Ford, Porsche.
    2. **Dr John Garside –** responsible for compiling the IMechE MX Self-Assessment Audit which ran in UK and Germany between 2000 and 2012.
    3. **Professor Gordon Smith –** had worked with the major automotive suppliers in the introduction of many material innovations e.g. highly structural polymeric composite components such as safety critical sub-frames, wheels and wishbones.
    4. **Dr Peter Summerfield –** had over 40 years of experience in the world of Manufacturing including being a Managing Director within BAE Systems & Rolls Royce Aerospace.

- **Focus Group 2-** 14th July 2016 – between 11:00 a.m. and 1:00 p.m. including the following participants:

    1- **Ms Deborah Hunt –** Senior Teaching Fellow in Strategy and Operations at WMG.
    2- **Dr Ton van Esch –** Principle Fellow at WMG. He had 36 years of Supply Chain Operational and Management experience covering strategy, organisational enablers, operational process and technology change.
    3- **Dr Adrian Watt –** Senior Teaching Fellow in Strategy and Operations at WMG. Main areas of interest include how quality is affected by capacity utilisation and determining priorities for strategic and operational improvement, and the link between quality, customer satisfaction and profitability.
    4- **Mr David Williams –** had 20 years' experience in managing product and process development projects in IT and automotive sectors, specialising in simulation and modelling of solid and fluid systems, dimensional management and product complexity.

- **Interview 1-** 30th June 2016 – between 5:00 p.m. and 7:00 p.m. with the following participant:

    Dr Christos Tsinopoulos – Member of the executive committee and a lead assessor of the IMechE MX Awards and Senior Lecturer in Operations & Project Management at Durham University.

- **Interview 2-** 18th July 2016 – between 1:00 p.m. and 3:00 p.m. with the following participant:

    Mr Iain Robertson – Responsible for the operational structure and delivery of the Manufacturing Advisory Service (MAS) across a quarter of England. Also as a MAS practitioner, visiting 100's of manufacturing businesses, advising, guiding and supporting them to improve.