An examination of the antecedents and consequences of cost system sophistication in UK manufacturing industry

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Abstract

Cost systems play a major role in contemporary organisations by determining the costs of various organisational activities and products. The provision of accurate cost information by the cost system can enhance the quality of decision making and, subsequently, organisational performance. Therefore, academics and practitioners have paid particular attention to the role of cost systems, in addition to their determinant factors and consequences. However, our understanding of the antecedents and consequences of cost system sophistication (CSS), reflected mainly by the dimensions of cost pools and cost drivers, remains contested due to mixed findings in terms of the impact of antecedent factors on the cost systems and the latter's impact on organisational performance. In response to the limitations in this stream of literature, this research develops a more comprehensive theoretical model, which can better explain the impact of a set of contextual variables on CSS and the latter's impact on firm performance. By doing so, the current study uses the mediation perspective of the contingency theory to explain (1) how contingency factors influence CSS; and (2) how strategic decisions (product planning) and operational decisions (cost management) can mediate the relationship between CSS and organisational performance. The mediation approach can consider organisational performance and examining the impact of multiple contingency factors. More specifically, it can demonstrate the causal chain of relationships between the antecedents and consequences of the cost system by simultaneously examining the causal paths between the independent, mediator, and outcome variables.

An explanatory sequential design methodology was adopted in order to acquire quantitative data to test the research model, followed by the collection of qualitative data to explain the quantitative results. The quantitative element consisted of a questionnaire, distributed to 1,957 medium and large UK manufacturing companies, which yielded 401 usable questionnaires (20.5% effective response rate). The quantitative analysis adopted structural equation modelling (SEM) and showed that size, the role of management accountants, business strategy, advanced manufacturing technologies, and cost structure had a direct effect on the level of CSS, which also affected organisational performance through the improvement in cost management. However, product diversity and competition were not significantly related to CSS, while the improvement in product planning did not mediate the CSS-organisational performance relationship. The

qualitative findings supported the quantitative results, but also modified some of the tested hypotheses, introducing new antecedent factors, namely enterprise resource planning systems and top management awareness of the importance of cost information, and found no relationship between sustainability and CSS.

This research contributes to the development of knowledge at three levels. At the theoretical level, it adopts the mediation approach, which can enable the investigation of multiple contingency variables and outcome variables in relation to the design of cost systems in order to foster our understanding of the complexity of the business environment by depicting the links and mechanisms among different organisational variables in one holistic model. At the methodological level, it is one of the few cost system studies to provide quantitative and qualitative evidence that enhances the validity and reliability of the research findings. Finally, it contributes to practice by directing managers to the importance of aligning the design of a highly sophisticated cost system to the most important factors embedded in the business environment of UK manufacturing companies. This can direct managers' attention to increase the level of the functionality of the cost system so as to match these factors. Finally, this study highlights the most important strategic and operational decisions brought about by sophisticated cost systems, which can guide managers in improving organisational performance.

Dedication

This thesis is dedicated to my parents, my wife, and my children Albandary & Rima.

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AA	Activity analysis
ABB	Activity based budgeting
ABC	Activity based costing
ABM	Activity based management
ACA	Activity cost analysis
AGFI	Adjusted goodness-of-fit index
AM	Activity management
AMOS	Analysis of a moment structures
AMTs	Advanced manufacturing technologies
AVE	Average variance extracted
C.R.	Critical ratio
CAD	Computer-aided design
CAE	Computer-aided engineering
CAM	Computer-aided manufacturing
CFA	Confirmatory factor analysis
CFI	Comparative fit index
CFO	Chief financial officers
CR	Composite reliability
CSS	Cost system sophistication
DF	Degree of freedom
EFA	Exploratory factor analysis
ERP	Enterprise resource planning
FAME	Online-financial analysis made easy database
FMS	Flexible manufacturing systems
GFI	Goodness-of-fit index
IMA	Institute of Management Accountants
IT	Information technology
JIT	Just-in-time
MA	Management accounting
MAS	Management accounting system
MCS	Management control systems
MLE	Maximum likelihood estimation
MRP	Material requirement planning
RIO	Return on investment
RMSEA	Root mean square error of approximation
ROA	Return on assets
ROS	Return on sales
SEM	Structural equation modeling
SMA	Strategic management accounting

SPSS	Statistical package for the social sciences
TDA	Tailored design method
TLI	Tucker-lewis index
TM	Top management
TQM	Total quality management
UK	United Kingdom
US	United States
WCM	World-class manufacturing

Chapter 1: Introduction

1.1 Introduction

This introduction chapter aims to provide a general background to the research area investigated by the present thesis as well as the research issues, the research questions and objectives, and the research context. The following section will present brief background information about the cost system, how it has been investigated in the past, and how it will be investigated in this study. This is followed by a section on the research issues. Next, the research questions and objectives will be presented in section 1.4, followed by a section devoted to the importance of the UK manufacturing industry as the research context. Finally, the chapter summary and thesis structure will be outlined in the last section of this chapter.

1.2 Background to the study

Since the beginning of the 1980s, the business environment has witnessed several changes, such as the emergence of deregulation and global competition that have put pressure on companies to develop and implement a refined cost system that varies in terms of its capability of providing more relevant information that suits the requirements of the new business environment (Kaplan, 1986a; Johnson and Kaplan, 1987; Berliner and Brimson, 1988; Drury and Tayles, 2005; Al-Omiri and Drury, 2007; Krumwiede and Charles, 2014; Maiga et al., 2014; Drury, 2015). These changes have triggered criticism, from the academic perspective, against traditional cost systems because these were developed prior to the new changes and consequently became obsolete and irrelevant to the new business environment (Kaplan, 1983, 1984, 1986, 1988; Johnson and Kaplan, 1987; Berliner and Brimson, 1988; Cooper and Kaplan, 1988a; Dhavale, 1989; Kaplan and Cooper, 1998).

In response to these criticisms, activity-based costing (ABC) systems were introduced into the realm of the management accounting (MA) field, which was considered one of the most innovative techniques during the 20th century because it uses new overhead cost assignment methods that can overcome the limitations associated with the traditional cost systems by furnishing more accurate cost information for strategic decisions (hereafter product planning) and operational decisions (hereafter cost management) (Johnson, 1990; Turney, 1991; Kaplan and Cooper, 1998; Krumwiede and Charles, 2014). Since its inception, many studies have sought to understand the contingency factors affecting ABC adoption (e.g. Malmi, 1999; Cohen et al., 2005; Drury and Tayles, 2005; Al-Omiri and Drury, 2007; Al-Sayed and Dugdale, 2016) and/or the benefits of this with regard to organisational profitability (e.g. Cagwin and Bouwman, 2002; Ittner et al., 2002; Maiga and Jacobs, 2003; Krumwiede and Charles, 2014).

Despite ABC's high profile, and the considerable attention it attracts from an academic perspective, recent reviews of MA research show that the topic of cost systems represents an important aspect of MA research that still requires further work to explore how companies design a cost system and the implications of this (Chenhall and Smith, 2011; Otley, 2016). Nevertheless, relying on the concept of ABC adoption vs. non-adoption to spotlight the practice of cost systems is problematic for several reasons. First, "there is some confusion about what ABC really is" (Gosselin, 2006, p. 656), especially from the practitioners' point of view (Dugdale and Jones, 1997; Abernethy et al., 2001). To exacerbate this situation, there is considerable discrepancy between the diffusion rates of ABC, as some studies found high adoption rates and other studies low ones (Brierley, 2011; Askarany and Yazdifar, 2012).

Second, it is argued that such an approach has yielded inconsistent findings in regard to the contingency factors influencing ABC adoption as well as the benefits of ABC for organisational performance due to the different categories exhibiting ABC adoption and non-adoption, such as; ABC consideration, ABC actual use, and the initial interest in ABC (Drury and Tayles, 2005; Pizzini, 2006; Al-Omiri and Drury, 2007; Brierley, 2011; Askarany and Yazdifar, 2012).

There have been recent calls to go beyond characterising the cost system according to "ABC adoption vs. non-adoption" and to characterise it instead by the level of sophistication reflected by the assignment of overhead costs (Abernethy et al., 2001; Drury and Tayles, 2005; Al-Omiri and Drury, 2007; Brierley, 2008b; Schoute, 2009). More precisely, the dimensions of mainly cost pools and cost drivers of the overhead assignment procedures are argued to be critical elements that can reveal how companies design their cost systems and, consequently, define the sophistication level of the cost system (Abernethy et al., 2001; Drury and Tayles, 2005; Al-Omiri and Drury, 2007; Brierley, 2008b; Schoute, 2009). This research, thus, applies the concept of cost system sophistication (CSS), as this incorporates important dimensions of the cost system that can uncover its level of sophistication to supply an incremental understanding of why companies design a sophisticated cost system, the most important factors of CSS, and the consequences of CSS regarding organisational profitability.

In addition, contingency theory, which is often used in MA research, clarifies the circumstances under which management accounting systems (MAS) or organisational systems are more likely to be effective, since there is no universal system that can be equally effective across all contexts (Otley, 1980, 2016; Fisher, 1998; Chenhall, 2003; Gerdin and Greve, 2004). The contingency theory has been relied upon by many studies to explain the factors and outcomes related to a cost system (Gosselin, 1997; Nguyen and

Brooks, 1997; Krumwiede, 1998; Malmi, 1999; Hoque, 2000; Baird et al., 2004; Brown et al., 2004; Drury and Tayles, 2005; Al-Omiri and Drury, 2007; Brierley, 2008a; Schoute, 2009; Krumwiede and Charles, 2014; Phan et al., 2014; Al-Sayed and Dugdale, 2016). A closer look at this cost system literature stream reveals that common issues exist in most of the prior studies, thereby justifying the need for further research.[1] These include: (1) a tendency to rely on the selection approach of contingency theory by ABC adoption and CSS studies rather than the mediation approach of contingency theory (e.g. Drury and Tayles, 2005; Al-Omiri and Drury, 2007; Al-Sayed and Dugdale, 2016)[2]; (2) inconclusive evidence about whether the cost structure, product diversity and advanced manufacturing technologies (AMTs) have direct or moderation effects on cost system design (e.g. Nguyen and Brooks, 1997; Hoque, 2000; Abernethy et al., 2001; Al-Omiri and Drury, 2007; Askarany et al., 2007; Schoute, 2011); (3) the omission of the role of the management accountants as a potential facilitator of cost system design (e.g. Shields, 1995; Chenhall, 2004; Maiga and Jacobs, 2007); (4) a reliance on a single indicator or few indicators that may not reflect the domain of the antecedent factors of cost system design (product diversity, competition and business strategy) (e.g. Malmi, 1999; Drury and Tayles, 2005; Brierley, 2007); and (5) the omission of intermediate outcomes in terms of product planning and cost management that can reflect the strategic and operational mechanisms that mediate the linkage and process between CSS and organisational performance (e.g. Cagwin and Bouwman, 2002; Ittner et al., 2002; Maiga and Jacobs, 2003, 2008; Cagwin and Barker, 2006; Banker et al., 2008; Xiao et al., 2011; Pokorná, 2016).

[1] The issues will be discussed in more detail in section 1.3.

[2] Different terminologies have been used to describe a similar type of fit in contingency management accounting research (Gerdin and Greve, 2004). For example, the selection and congruence have been used interchangeably.

Due to the aforementioned reasons, developing and investigating a holistic mediation model based on the contingency theory that links the contingency factors to CSS, which in turn is hypothesised to influence product planning and cost management and, ultimately, the business unit performance, is the key aim of the current thesis. To address this aim, seven contingency variables were derived from the contingency management and cost accounting literature to explain their influence on the level of CSS. These include competition, business strategy, the role of management accountants, cost structure, product diversity, AMTs, and size. The current study also augments the cost system-performance literature by explaining the mechanisms that link the cost system to performance through the mediation role of product planning and cost management that can transform the effect of cost system on performance. The following section will discuss the research issues along with their importance in addressing these issues.

1.3 The research issues

A cost system represents an important aspect of many manufacturing companies (Kaplan, 1984; Johnson and Kaplan, 1987; Kaplan and Cooper, 1998). Despite the important role of cost systems, there is a limited knowledge about why manufacturing companies design sophisticated cost systems and how the presence of a sophisticated cost system can influence organisational performance. Several theoretical and methodological issues have been highlighted in the cost system literature, and thus further research is required to address these areas. The following sub-section will outline the theoretical issues, followed by a sub-section devoted to the methodological issues.

1.3.1 Theoretical issues

Theoretical issues stem from the fact that many contingency cost system studies have failed to provide a proper understanding of the factors influencing CSS and the outcomes of CSS. Different scholars have argued that a conceptual model of the cost system that mirrors its role within organisations should be depicted as a causal chain in which the environment and organisational factors will determine the design of the cost system, thus enabling management to make the right strategic and operational decisions, leading to improved economic performance (Kaplan and Cooper, 1998; Drury and Tayles, 2005; Pizzini, 2006). For example, Cooper (1988b) points out that an increase in the levels of competition, product diversity, and overhead costs requires an increase in the level of the cost system's sophistication in order to provide accurate cost information that can enhance the quality of strategic and operational decisions and, ultimately, organisational performance.

Unfortunately, most prior cost system studies have failed to provide a model that can capture the causal chain of relationships that link the cost system to its environmental and organisational factors and the outcomes of the cost system. This can be attributed to the lack of an appropriate application of contingency theory in the study of the causal chain of the antecedents and consequences of the cost system. More specifically, the majority of cost system studies have relied on the selection approach of fit in order to examine the effect of one or limited isolated factors on the design of the cost system CSS, without considering the outcomes of the cost system in assessing its efficacy (Shim, 1996; Bjørnenak, 1997; Gosselin, 1997; Nguyen and Brooks, 1997; Booth and Giacobbe, 1998; Krumwiede, 1998; Clarke et al., 1999; Malmi, 1999; Hoque, 2000; Baird et al., 2004; Brown et al., 2004; Bhimani et al., 2005; Drury and Tayles, 2005; Al-Omiri and Drury, 2007; Brierley, 2007, 2008a; Askarany et al., 2012; Phan et al., 2014; Al-Sayed and Dugdale, 2016). This approach is insufficient because it cannot capture the causal chain of relationships between the antecedents and consequences of the cost system, and it excludes a measure of effectiveness in assuming that all survival organisations are in equilibrium (Ittner and Larcker, 2001; Chenhall and Chapman, 2006; Otley, 2016). Scholars argue that some firms can be in disequilibrium because they experience a misfit and can continue to exist for a prolonged period of time, even though their performance deteriorates (Donaldson, 2001; Ittner and Larcker, 2001; Chenhall and Chapman, 2006; Hall, 2016; Otley, 2016).

Another group of contingency studies overcomes the limitations of the selection approach by adopting the interaction approach of contingency theory, which allows for an examination of the outcomes of the cost system in terms of performance (Cagwin and Bouwman, 2002; Maiga and Jacobs, 2003; Cagwin and Barker, 2006; Krumwiede and Charles, 2014; Maiga et al., 2014). The interaction approach investigates the impact of the interaction of pairs of factors on a third variable, such as organisational performance (Luft and Shields, 2003). However, this approach cannot demonstrate the causal chain of relationships between the antecedents and consequences of the cost system as presented by different scholars because it does not capture the links between contingency factors and the cost system and it cannot reflect the mechanisms of the factors that transform the effect of the cost system into enhanced organisational performance (Kaplan and Cooper, 1998; Kennedy and Affleck-Graves, 2001; Drury and Tayles, 2005; Pizzini, 2006). In addition, this approach only considers a limited number of factors in the analysis, which may lead to researchers finding no significant relationships, given that many contingency factors have some degree of relevance that should be accounted for in the analysis (Smith and Langfield-Smith, 2004). For example, Van de Van and Drazin (1985, p. 358) argue that “a major limitation of many studies has been an overly narrow focus on only one or a few contextual dimensions, which limit the studies from exploring the effects of multiple and conflicting contingencies on organisation design and performance”.

To capture the causal chain of relationships between the antecedent contingency factors and the consequences of the cost system, the current study relies on the mediation approach of contingency theory, which can show, simultaneously, the causal chain of relationships between multiple contingency factors and the cost system design and the relationships between the cost system, strategic and operational decisions, and economic performance. The mediation form of fit can examine the direct effect and/or the indirect effect between different multiple types of variables (Gerdin and Greve, 2004). While it has been used recently in MAS research to signal the paths whereby the contingency variables influence MAS design, ultimately influencing profitability, this is not the case in the cost system research (e.g. Chong and Chong, 1997; Lau and Lim, 2002; Baines and Langfield-Smith, 2003; Hoque, 2004, 2011; Gerdin, 2005; Naranjo-Gil and Hartmann, 2006; Widener, 2007; Cadez and Guilding, 2008; Kallunki et al., 2011; Fullerton et al., 2014).

As suggested by different scholars, the importance of the mediation approach lies in its ability to capture the different relationships represented by a causal chain that govern the role of the cost system within its context (Kaplan and Cooper, 1998; Kennedy and Affleck-Graves, 2001; Drury and Tayles, 2005; Pizzini, 2006). Unlike the selection approach, it can allow for the incorporation of realistic measures of outcome variables in assessing the efficacy of the cost system (Gerdin and Greve, 2004). By simultaneously investigating the effect of multiple contingency factors on the design of the cost system and the consequences of cost system on organisational performance, the mediation approach of contingency theory can account for the commonality among the contingency factors and provide a broader understanding of the context within which the cost system operates (Smith and Langfield-Smith, 2004; Cadez and Guilding, 2008).

By adopting the mediation approach, this research will examine multiple contingency factors and outcome variables in relation to the design of the cost system. Among these contingency factors is the role of management accountants, which has been neglected in prior research. The importance of investigating the role of management accountants stems from the fact that a sophisticated cost system requires different facilitator factors to be in place in order to be successfully implemented (Shields, 1995; Foster and Swenson, 1997; Innes et al., 2000; Maiga and Jacobs, 2007). This is because business-oriented accountants, as opposed to traditional accountants, can be in a position to include the information requirements of other non-accountant managers into the design of new, innovative accounting techniques, demonstrate their benefits, and persuade and educate others to support and use such new techniques (Argyris and Kaplan, 1994; Emsley, 2005; Cadez and Guilding, 2008).

Investigating the role of management accountants can contribute to scholarship and practice by including such a role within the group of facilitator factors that should be considered when designing a cost system implementation strategy that can improve the successful implementation and use of a sophisticated cost system. In addition, our knowledge of the role of management accountants in facilitating the adoption and use of a sophisticated cost system has originated from both case and conceptual studies (Cooper and Turney, 1990; Argyris and Kaplan, 1994; Friedman and Lyne, 1997; Chenhall and Langfield-Smith, 1999; Johnston et al., 2002). While these types of research have provided an in-depth understanding of the theoretical and empirical relationships that exist between variables, they cannot test prior theory or hypotheses due to their reliance on small samples (Shields, 1995; Brierley, 2014). Exploring the nature of the role of management accountants, and the extent to which they support other business activities, by using a large-scale questionnaire can provide important knowledge about what role they play in contemporary UK manufacturing companies, their characteristics, and the implication of their roles regarding cost system design.

In addition to the role of management accountants, it is anticipated that a cost system needs to be designed to support environmental and organisational factors, namely competition, business strategy, and product diversity, if companies are to compete successfully within their respective industry (Cooper, 1988b; Kaplan and Cooper, 1998; Drury and Tayles, 2005; Al-Omiri and Drury, 2007). While prior research has investigated these three important factors, such investigations have been subject to several methodological limitations that preclude the provision of informed conclusions about the relevance of cost system design in this regard. Further discussion of these limitations is presented when outlining the methodological issues in section 1.3.2.

Further, there remains ambiguity about whether cost structure, product diversity, and AMTs have a direct effect on CSS level or moderated one by other contextual variables. This ambiguity arises largely because of inconsistent results in prior research with regard to these factors (Nguyen and Brooks, 1997; Clarke et al., 1999; Baird et al., 2004; Brown et al., 2004; Al-Omiri and Drury, 2007; Brierley, 2007, 2008a; Charaf and Bescos, 2013). The discrepancy in the results reported by prior studies are surprising and are perhaps attributable to the main focus of previous research, which examined the direct effects alone, without considering AMTs' role in moderating the effect of product diversity and cost structure on cost system design. Recent quantitative and qualitative evidence shows that companies with high AMTs may not need a highly sophisticated cost system (Abernethy et al., 2001; Schoute, 2011). The current study examines the moderating role of AMTs on the relationships between product diversity-CSS and cost structure-CSS, which will have both theoretical and practical implications.[3] From a theoretical perspective, the detection of a moderating effect would help to explain the inconsistent results regarding product diversity and cost structure produced by prior research, as these studies may have relied on a simplistic unconditional association to investigate the effect of product diversity and cost structure on the cost system. From a practical perspective, the findings may also help companies to assess the available options: investment in AMTs and/or a highly sophisticated cost system in order to manage a high level of product diversity and high overhead costs. Such knowledge is critical because implementing AMTs requires considerable resources and investment (Boyer et al., 1996), and a sophisticated cost system also requires resources, training, and education (Shields, 1995; Foster and Swenson, 1997).

Finally, the present study investigates the non-direct impact of CSS on business unit performance through the mediating role of product planning and cost management. Business managers and scholars are naturally interested in whether investment in a highly sophisticated cost system would be financially beneficial, since such a system will require high costs, time, employee commitment, technological investment, and process interruption (Cooper and Kaplan, 1992; Shields, 1995; Maiga and Jacobs, 2008). Given the importance of this point, the cost system-performance relationship has been subject to different investigations from various perspectives in order to assess the efficacy of the cost system (Cooper and Kaplan, 1991b; Kennedy and Affleck-Graves, 2001; Cagwin and Bouwman, 2002; Ittner et al., 2002; Maiga and Jacobs, 2008; Xiao et al., 2011; Krumwiede and Charles, 2014).

[3] This study also investigated the interaction approach of contingency for a certain number of hypotheses, but such an investigation was conducted separately and was excluded from the mediation analysis.

While a few studies report a positive, significant, and direct association between cost systems and organisational performance (Frey and Gordon, 1999; Kennedy and Affleck-Graves, 2001; Pizzini, 2006), nearly all prior research failed to find a direct relationship between cost systems and performance (Gordon and Silvester, 1999; Cagwin and Bouwman, 2002; Ittner et al., 2002; Cagwin and Barker, 2006; Banker et al., 2008; Maiga and Jacobs, 2008; Xiao et al., 2011; Maiga et al., 2014; Pokorná, 2016). In addition, some studies even found that such a relationship was negative and insignificant (Ittner et al., 2002; Xiao et al., 2011). Alternatively, researchers have explored conditions (moderation) (Cagwin and Bouwman, 2002; Maiga and Jacobs, 2003) and mechanisms (mediation) (Banker et al., 2008; Maiga and Jacobs, 2008) in order to examine the processes that would entail an understanding of the connection between the cost systems and profitability.

Kennedy and Affleck-Graves (2001), who reported a significant direct relationship between ABC and performance, warn researchers that such an effect is more likely to be expected through the actions that add value to organisational profitability. This entails the use of a mediation approach rather than a moderation approach to investigate how the cost system can influence organisational performance. Thus, this research investigates the mediation role of product planning and cost management between CSS and organisational performance. Investigating the different circumstances under which sophisticated cost systems are more likely to be financially beneficial for manufacturing companies has theoretical contributions. First, finding a significant mediation effect would help to explain the reasons behind the inconsistent results of the association between the cost system and organisational performance reported by prior research, as these studies used either the direct approach or the interaction approach, which do not reflect the actions through which the cost system can improve organisational performance. Second, such an investigation can extend the theory of the association between cost systems and performance by determining on which path(s), i.e. product planning and/or cost management, the cost system is more likely to influence organisational performance. This can provide a deeper understanding by segregating the effects of the cost system on performance into direct and indirect components in order to highlight how the immediate and mediator outcomes may transform the effect of MAS on performance (Shields et al., 2000; Chenhall and Smith, 2011).

Third, a simultaneous examination of product planning and cost management can show whether a sophisticated cost system can also have the capability of supporting both product planning and cost management, since each of these requires a cost system with a different level of sophistication (Kaplan and Cooper, 1998; Cokins, 2001; Schoute, 2009). This represents a critical area to investigate because the literature on cost systems indicates that, compared to product planning, a highly sophisticated cost system is desirable for cost management usage because it is a continuing process that requires detailed information about each activity to understand the production process (Swenson, 1995; Kaplan and Cooper, 1998; Cokins, 2001; Schoute, 2009). Therefore, there is the possibility that a cost system may be unable to support both areas, as a highly sophisticated cost system will be overly complex for product planning decisions and a less sophisticated cost system may be insufficient for cost management (Cokins, 2001; Schoute, 2009).

From a practical point of view, business managers also require a full understanding of the conditions under which investing in a highly sophisticated cost system is most likely to pay off. With this in mind, the current study can direct professional practitioners regarding the importance of evaluating the worth of investing in a highly sophisticated cost system design by highlighting the most critical areas (i.e. product planning and/or cost management) that would benefit from a sophisticated cost system and positively contribute to the profitability of the organisation.

1.3.2 Methodological issues

Other critical areas that the current study focuses on are the methodological limitations associated with many of the previous cost system studies. As mentioned earlier, one of the aims of the current research is to investigate the relevance of CSS to competition, business strategy and product diversity. This is because a plethora of studies did not find any significant findings regarding the competition-cost system design (Bjørnenak, 1997; Cohen et al., 2005; Drury and Tayles, 2005; Brierley, 2007, 2008a), business strategy-cost system design (Frey and Gordon, 1999; Malmi, 1999; Bhimani et al., 2005; Elhamma and Zhang, 2013), and product diversity-cost system design relationships (Bjørnenak, 1997; Nguyen and Brooks, 1997; Clarke et al., 1999; Brown et al., 2004; Al-Omiri and Drury, 2007; Brierley, 2007, 2008a; Charaf and Bescos, 2013). A closer look at these studies reveals the existence of certain methodological limitations that may preclude the detection of the effect of competition, business strategy and product diversity on cost system design.

First, some studies relied on a small sample size that lacked sufficient power, and thus were insufficiently sensitive to detect any relationships between the independent and dependent variables (Hair et al., 2010). Second, many MA variables are latent constructs that require a series of indicators to capture the domain of these constructs (Smith and Langfield-Smith, 2004; Edwards, 2010; Hair et al., 2010). Most of the prior cost system research represented the constructs of interest narrowly based on a single or few measures, especially for competition (Bjørnenak, 1997; Malmi, 1999; Drury and Tayles, 2005; Brierley, 2007), business strategy (Gosselin, 1997; Malmi, 1999; Bhimani et al., 2005), and product diversity (Bjørnenak, 1997; Nguyen and Brooks, 1997; Clarke et al., 1999; Groot, 1999; Malmi, 1999), which can lead to biased findings and difficulties in interpreting the empirical findings (McGowan and Klammer, 1997; Drury and Tayles, 2005; Al-Omiri and Drury, 2007). Such an approach is too narrow and coarse to capture the domain of the constructs and consequently reduces the reliability of the measured constructs (Foster and Swenson, 1997; McGowan and Klammer, 1997; Smith and Langfield-Smith, 2004; Pizzini, 2006).

The above issues are also exacerbated when the statistical analyses employed fail to control for the measurement errors associated with regression coefficients. Most studies that investigate the antecedents of cost systems rely on bivariate statistical tests and/or multiple regression analyses - both of which treat the indicators of the hypothesised constructs as being free from measurement errors (Smith and Langfield-Smith, 2004; Blanthorne et al., 2006). Unless the reliability estimate for each construct is one, which is almost impossible for many constructs to achieve, these statistical techniques will lead to biased estimates of the regression coefficients of the antecedent variables and consequently undermine the research findings (Ittner and Larcker, 2001; Smith and Langfield-Smith, 2004; Blanthorne et al., 2006). Therefore, scholars in the MA field have called for the greater use of a rigorous analysis technique, namely structural equation modeling (SEM), to test complex theory and simultaneous relationships while at the same time controlling for the measurement errors associated with the indicators of the constructs (Chenhall, 2003; Smith and Langfield-Smith, 2004; Blanthorne et al., 2006; Henri, 2007; Otley, 2016).

To address the aforementioned issues, the current study applied several methodological procedures. First, unlike the majority of previous cost system studies, a large-scale questionnaire was distributed to 1,957 medium- and large-scale UK manufacturing companies. While targeting a large sample is costly and time consuming, a large sample was advisable in order to improve the power of the statistical analysis, particularly for complex model analysis (Roberts, 1999; Chenhall, 2003; Davila and Oyon, 2008; Hair et al., 2010).

Second, it employs multi-indicators for the research constructs under consideration to capture the different aspects of, and improve the reliability and validly of, the research constructs. In addition, the SEM will be relied upon to examine the simultaneous relationships and address the measurement errors for the research constructs and relationships. Finally, most of the prior contingency management and cost accounting research relies on a single source, namely the cross-sectional survey method (Chenhall, 2003; Tillema, 2005). The cross-sectional survey is subject to some limitations, such as the difficulty of supplying explanations about the research findings from a practical point of view (Brierley, 2014). In response, the current study employs mixed methods research in the form of an explanatory sequential design (Creswell and Plano Clark, 2011) to collect quantitative and qualitative data to improve our understanding of the antecedents and consequences of CSS, and also enhance the validity and reliability of the research findings (Modell, 2005; Brierley, 2014; Ittner, 2014).

1.4 Research questions and objectives

The overall aim of the current study is to advance a contingency model that goes beyond the traditional approach of only a contingency factors-cost system design association or a cost system-performance association by examining simultaneously the antecedents and consequences of CSS. Given this aim, the current thesis seeks to answer the following two questions:

1. Which contingent factors influence the sophistication level of a cost system?
2. Does CSS have an indirect impact on business unit performance through its role in product planning and cost management?

To answer these research questions, the explanatory mixed methods design is used to collect quantitative and qualitative data. In addition, six objectives were developed to help answer the research questions. The first five objectives listed below will be investigated by the first phase of the explanatory mixed methods strategy, namely a survey questionnaire, while the last objective will be achieved through the field interviews.

1. To explore the level of sophistication of cost system design among medium and large UK manufacturing companies.
2. To examine empirically the degree to which competition, business strategy, size, the role of management accountants, cost structure and product diversity influence the sophistication level of the cost system.
3. To investigate empirically the moderating role of AMTs between the cost structure-CSS and product diversity-CSS relationships.
4. To assess empirically the ability of CSS to influence product planning and cost management.
5. To examine empirically the mediating role of product planning and cost management between CSS and organisational performance.
6. To provide explanations about the statistical results obtained from the first phase, based on the perceptions of cost system practitioners and to identify possible new factors that can affect CSS.

1.5 The UK manufacturing environment context

Selecting a research context that is suitable for the research questions is paramount in order to target a population that can maximise the likelihood of collecting meaningful data to investigate the developed research model. The UK manufacturing industry was selected as the research context due to its relevance to the variables of interests. Many of the innovative MA techniques, like the ABC system, which represents part of the concept of CSS, were first introduced in developed westernized countries. Targeting a population in a developing country context may be problematic and endanger the detection of the developed hypotheses, since such countries have different social, political and cultural contexts that may render modern MAS irrelevant (Ashraf and Uddin, 2011). Recent surveys in non-westernized, developing countries also show that the use of sophisticated cost systems was very limited and that there was a lack of knowledge about the concepts of ABC systems, and advanced MA techniques (Triest and Elshahat, 2007; Ismail and Mahmoud, 2012).

The manufacturing sector is an important element of the UK economy, being the third major sector after the service and retail sectors (Warwick, 2010). It contributes about 53 percent (£256 billion in 2012) to all UK exports and has a global reputation within the aerospace, pharmaceutical, and automotive industries (Lapthorne et al., 2014). The UK is one of the top global manufacturers and has the ninth largest manufacturing industry worldwide (Manufacturer, 2017). In 2011, the manufacturing sectors were responsible for hiring 2,740,000 employees (Fothergill and Gore, 2013), although this figure has fallen from 8,940,000 employees in 1966 (Fothergill and Gore, 2013). One of the factors that has led to this reduced employment in the manufacturing sectors is the use of AMTs (Davis et al., 2012). In a UK government report, Fothergill and Gore (2013) stated that AMTs had changed the composition of manufacturing labour's role by automating many of the mechanical tasks, consequently reducing the need for workers. Abdel-Kader and Dugdale (1998) reveal empirical evidence that 77% of their 102 surveyed UK manufacturing companies invested in different types of AMTs to gain various benefits, including reduced manufacturing costs, improved competitive position, and the ability to respond more swiftly to market needs.

Further, Warwick (2010) and Davis et al. (2012) discussed the challenges facing UK manufacturing companies, including increased global competition and the need for a differentiation strategy. UK manufacturing companies face intensive global competition since many value-chain activities, such as production and distribution, have been outsourced to emerging countries like China, India and Brazil (Warwick, 2010; Davis et al., 2012). Further, these emerging countries have specialised in a low-cost strategy due to their low labour costs, which have forced developed countries, including the UK, to adopt a differentiation strategy, in which 'they must develop and bring to market new, more sophisticated and better quality products and adapt their business models in ways that add further value to the manufactured products which they supply' (Warwick, 2010, p. 19).

Given the aforementioned reasons, the current study argues that the UK manufacturing context is appropriate for investigating the research model because the characteristics of the constructs under consideration are prevalent within the UK manufacturing environment, which allows the collection of meaningful data about the practice of CSS, as well as the antecedents and consequences of CSS.

Finally, the service industry was excluded from the study because: (1) there is a far stronger trend of heterogeneity within this sector compared to the manufacturing sector (Brierley et al., 2008); and (2) intangibility and perishability represent important elements of service sector output (Brignall et al., 1991; Brierley et al., 2008). Therefore, it is far more difficult to define service sector output (Brierley et al., 2008). The inclusion of manufacturing and non-manufacturing companies into a single sample can increase the ambiguity of the questionnaire items and the length of the questionnaire, since both have different outputs (product vs. service) that require special wordings. Moreover, the AMTs construct investigated in this study is irrelevant to the service industry.

1.6 Chapter summary and thesis structure

The current chapter provides general background information about the thesis, presents the research issues, questions and objectives, and finally outlines the relevance of the research context of UK manufacturing companies. In addition to this chapter, the remainder of this thesis is organised into eight chapters.

Chapter 2 will review the literature that is relevant to the research questions and objectives and highlight the limitations of the literature and how these are overcome by the current study. In particular, three types of literature will be presented, each of which focuses on a different aspect of the cost system including (1) the literature of cost system design; (2) the literature of the purposes of the cost system; and (3) the cost system-performance literature.

Chapter 3 elaborates on the contingency theory as a framework for the research model and the development of the research hypotheses. First, the contingency theory of MA research will be explored and explained followed by the development of the theoretical research model and hypotheses. The research methodology and methods adopted by the current study is the focus of chapter 4. In this chapter, the different paradigms and philosophical assumptions are briefly explained, along with a justification of the choice of the research paradigm for the current study. Additionally, the various methodological strategies are presented, accompanied by the rationale for adopting an explanatory mixed methods design. After discussing the explanatory mixed methods strategy, the postal survey questionnaire, which represents the first phase of data collection, will be described in detail followed by a discussion of the field study, including the interview method.

Chapter 5 outlines the statistical procedures undertaken to prepare the data for a preliminary empirical descriptive analysis and the assessment of the measurement model of SEM. First, a preliminary examination of missing data, normality and outliers is conducted, followed by a statistical descriptive section to outline the trends found within the data. The confirmatory factor analysis (CFA) and explanatory factor analysis (EFA) are elucidated and conducted to evaluate the research constructs of interest. The reliability and validity of these constructs are then reported.

After cleaning, measuring and assessing the research constructs in chapter 5, the focus in chapter 6 is on testing the research model along with the hypotheses developed in chapter 3. In chapter 7, the results of the field interviews are presented. It starts by providing general background information about the interviewees' companies. The findings of the qualitative analysis will be provided, followed by a discussion of possible new factors that were uncovered by the field study.

Chapter 8 provides a discussion of the overall research results. The findings from the quantitative and qualitative phases are discussed alongside the findings of prior literature in order to highlight any differences and similarities between the two and deduce the implications of the research findings. Finally, in chapter 9, the main conclusion drawn from our investigation of the antecedents and consequences model of CSS is presented. The limitations associated with the current study are also highlighted. The last section will be devoted to possible avenues for future research based on the results of our field study.

Chapter 2: Literature Review

2.1 Introduction

Academics, professional accounting bodies, and practitioners have paid particular attention to the important role of cost systems in contemporary companies during the last few decades, but how have cost systems been conceptualised in previous research? What are the main contingent factors that can highlight and determine changes in the level of sophistication of cost systems? What are the mechanisms or processes whereby cost system sophistication (CSS) is associated with organisational performance? The objective of the current chapter is to discuss the literature pertaining to these questions, as well as the limitations associated with the cost system literature. To achieve this objective, this chapter is divided into three main sections. Section 2.2 aims to discuss the main types of cost system and how prior research has conceptualised and approached cost system design. This section ends with a critical evaluation of the shortcomings of these approaches (section 2.2.3). Section 2.3 is devoted to the different purposes for which a cost system is used. Next, the literature on the association between the cost system and performance will be examined in section 2.4. The penultimate section highlights the limitations associated with literature of cost system purposes and cost system-performance. This chapter will end with a summary of the main discussion within this chapter.

2.2 Cost system design

A cost system plays a major role in managing and tracking the cost of organisational activities (Kaplan and Cooper, 1998). Its main classical role is to supply cost information in order to assist the organisational managers to take the right decisions to accomplish the organisational goals (Cooper and Kaplan, 1991b). Different types of cost systems have been developed over time in response to the changes occurring within the internal and external organisational environments. More specifically, the traditional cost systems, namely the direct costing systems and the traditional absorption cost systems, and ABC systems were developed in the last century (Cooper and Kaplan, 1988a, 1988b). In the direct cost systems, only direct manufacturing costs are included in the assignment of costs to products (Al-Omiri and Drury, 2007). Fixed or overhead costs that cannot be directly traced to products are excluded from the product costs (Robinson, 1990), and treated instead as period costs and charges against the profit for the period during which they were incurred (see Drury, 2015 for more information about direct cost systems). Examples of direct costs are direct material and direct labour costs. Unlike direct costing, traditional absorption costing system charges overhead costs plus all variable costs to products (Drury and Tayles, 2005). It accumulates overhead costs to the different service and production cost pools and then applies a very limited number of only volume-overhead drivers to assign these costs to products (Kaplan and Cooper, 1998; Horngren et al., 2012; Drury, 2015).

It has been argued that the information provided by the traditional cost systems was considered to arrive too late and to be too aggregate to allow corrective actions to be carried out in the new business environment, which can negatively influence many types of decision (Kaplan, 1989; Cooper and Kaplan, 1991b, 1998; Narayanan and Sarkar, 2002). This is because the business environment witnessed rapid and different changes during the 1980s including globalisation, deregulation, the advent of sophisticated information technology (IT) and more modern manufacturing technologies and philosophies (just-in-time), and shorter product life cycles (Johnson and Kaplan, 1987; Drury, 2015).

These changes in the business environment led to aggressive competition between companies (Johnson and Kaplan, 1987). Firms also sought different strategies, such as producing a plethora of customised products to meet the customers' expectations (Kaplan, 1989; MacDuffie et al., 1996), which consequently increased the level of overhead costs and product diversity (Berliner and Brimson, 1988; Hoque, 2000). In this regard, it was argued that the traditional cost systems could not cope with this new environment, since they were developed in a time when: (1) competition was low; (2) the majority of overhead costs were labour-dominated and so relatively low (3); the production process was simple due to the low variety of products produced; and (4) the focus by the accounting function on inventory valuation and financial reporting was paramount (Cooper, 1988a, 1988b, 1989a, 1989b; Shank and Govindarajan, 1993). Due to the simplistic assignment procedures of the traditional cost systems, it is argued that they can distort cost information, thereby reducing the relevance of cost information to different decisions in a business environment that is characterised by various contextual elements, such as the production of diverse and customised products (Kaplan and Cooper, 1998; Drury and Tayles, 2005; Al-Omiri and Drury, 2007).

There were calls from management accounting scholars to develop more relevant cost techniques and practices that can suit the new business environment during the 1980s. This led to the introduction of ABC concepts, based on the work of Cooper and Kaplan, to overcome the limitations of the traditional cost systems (Major and Hoque, 2005; Innes and Kouhy, 2011). Rather than accumulating overhead costs to departmental cost pools, the ABC system accumulates costs into the activities that cause these costs, based on either resource drivers or direct assignment. The ABC system then proceeds to allocate these costs to cost objects based on volume and non-volume cost drivers (Cooper, 1988a; Kaplan and Cooper, 1998). The identification of the activities and the volume and non-volume cost drivers can eventually lead to the construction of a cost hierarchy system consisting of four types of activity, namely unit-level activities, batch-level activities, product-sustaining activities and facility-level activities (Cooper and Kaplan, 1991b). Unit level activities are volume driven and conducted every time a unit of product is produced. They change with the level of change in the number of units produced (e.g. direct labour, and material costs). The batch-level activities demand resources that are not volume driven and these resources vary with the number of batch processes despite the number of units within batches (e.g. setting up machine). The product-sustaining activities are conducted to support a particular type of product to be produced (e.g. process engineering). Facility-sustaining activities are supplied to provide the capability that help companies to sustain the facilities under which products, services, and customers benefits from these activities (e.g. plant management). Traditional cost system stops at the unit level activities while ABC systems continue to assign non-unit level activities based on non-unit cost drivers.

While the ABC system was introduced during the late 1980s, prior research has tended to focus on classifying and characterising the different types of cost systems based on ABC adoption vs. non-adoption. The following section will discuss this literature followed by a section that focuses on a different conceptualisation of the cost system, namely the cost system sophistication (CSS).

2.2.1 The ABC adoption vs. non-adoption approach

Early descriptive studies of ABC provided several conditions that are conducive to ABC adoption (Cooper, 1988a, 1988b, 1989a, 1989b, 1989c; Cooper and Kaplan, 1991a). For example, Cooper (1988b) reported some contingent factors that rationalise the adoption of ABC, including competition, overhead costs, and product diversity. These claims triggered an investigation from the academic perspective of the contingent factors that lead to ABC adoption (e.g. Anderson, 1995; Innes and Mitchell, 1995; Gosselin, 1997; Nguyen and Brooks, 1997; Shim and Stagliano, 1997; Krumwiede, 1998; Hoque, 2000; Brown et al., 2004; Bhimani et al., 2005; Cohen et al., 2005; Brierley, 2008a; Schoute, 2011; Al-Sayed and Dugdale, 2016). Nonetheless, prior research has defined ABC adoption and non-adoption in many different ways (Gosselin, 2006; Brierley, 2011; Krumwiede and Charles, 2014). Table 2.1 below, shows the operationalisations of the different terminologies and measurements constituting the approach of ABC adoption and non-adoption. These studies can generally be classified into three groups in terms of their operationalisation of ABC adoption vs. non-adoption.

First, one large group of the studies focuses on ABC adoption and includes several experiences of the ABC system, such as ABC use, consideration, implementation, future plan to implement, etc. (Bjørnenak, 1997; Nguyen and Brooks, 1997; Krumwiede, 1998; Malmi, 1999; Chen et al., 2001; Brown et al., 2004; Chongruksut and Brooks, 2005; Brierley, 2008a; Schoute, 2011; Fadzil and Rababah, 2012; Charaf and Bescos, 2013; Nassar et al., 2013; Al-Sayed and Dugdale, 2016). This stream of literature assumes that companies with some experience or knowledge of ABC, even though they do not use it, share the same characteristics as those that actually use the ABC system.

In contrast, another group of studies relied on a single experience of an ABC system as a measurement for ABC adoption, such as ABC actual use, while non-adoption includes either single or multiple experiences that, overall, resemble the non-actual use of ABC (Innes and Mitchell, 1995; Lukka and Granlund, 1996; Groot, 1999; Hoque, 2000; Innes et al., 2000; Bhimani et al., 2005; Cohen et al., 2005; Carenzo and Turolla, 2010; Pavlatos, 2010; Askarany et al., 2012; Rundora et al., 2013; Elhamma and Moalla, 2015; Pokorná, 2015). For example, Innes and Mitchell (1995) treated ABC adopters as only those currently using an ABC system.

Finally, another group of research studies measures ABC adoption differently. They argue that an ABC system is the ultimate stage of the three-stage activity management (AM) approach, which also includes activity cost analysis (ACA) as the second stage, and activity analysis (AA) as the first stage (Gosselin, 1997; Baird et al., 2004; Baird, 2007). This ranking of the tiers of AM allows researchers to spotlight the range of companies that can opt to implement the first and/or second levels or all three tiers. Drury (2015) argues that the AM approach is mainly used for cost management, such as removing redundant activities, because some companies may omit the last stage of overhead assignment (namely the assignment of overhead costs to cost objects) and use AA and ACA to manage the costs rather than determining the cost of the products.

As mentioned earlier, this stream of research has mainly focused on examining different environmental and organisational factors that stimulate ABC adoption. Appendix 1 presents a table that summarises this literature as well as the various types of contingent factors that influence ABC adoption. This literature stream improves our knowledge of the most important reasons and mechanisms that trigger the connection between the environmental and organisational factors and ABC adoption, but it is difficult to interpret its results and findings (Brierley, 2011) for several reasons.[4] These include: (1) the reliance on several categories of ABC adoption and non-adoption that do not reflect cost system design in terms of sophistication; (2) the inconsistency of using different definitions for ABC adoption yielding inconsistent results about the relationship between several contingency factors and ABC adoption; and (3) the difficulty of understanding the ABC concept by practitioners. Therefore, several scholars have relied on alternative

[4] These reasons will be discussed in more details in the critical evaluation section (section 2.2.3).

conceptualisations of cost system design, namely CSS to overcome the limitations outlined above. The following section will discuss the CSS approach.

Table 2.1: A sample of the various operationalisations of the measurements of ABC adoption and non-adoption.

Authors	**Measures of ABC adopters**	**Measures of non-ABC adopters**
Drury et al. (1993)	ABC introduced	Considering ABC, intending to introduce ABC, ABC is rejected and not considered
Innes and Mitchell (1995)	Using ABC	Considering ABC, ABC is considered, ABC is rejected, ABC is not considered
Bjørnenak (1997)	ABC is implemented, currently implementing ABC, wanted to implement ABC	Not considered ABC, not decided yet
Gosselin (1997)	Implemented activity analysis (AA), activity cost analysis (ACA), and/or ABC	Not adopting AA, ACA and ABC, and not implementing AA, ACA and ABC after having adopted it
Nguyen and Brooks (1997)	Currently using ABC, future plans to adopt ABC, ABC is adopted then rejected it but planned to adopt it again in the future	No plan to use ABC
Joshi (1998)	Currently implementing ABC	Considering ABC, ABC is considered and rejected, ABC is not considered
Clarke et al. (1999)	ABC is adopted	Rejecting ABC after consideration, ABC is not considered
Krumwiede (1998)[a]	ABC is approved for implementation, analysis of ABC, getting acceptance of ABC, ABC is implemented then abandoned, ABC is used somewhat, ABC is used extensively	ABC is not considered, considering ABC, ABC is considered then rejected
Groot (1999)	Currently using ABC	Decided not to use ABC
Innes et al. (2000)	Currently using ABC	Currently considering ABC adoption, rejecting ABC after assessment, and no consideration of ABC to date
Hoque (2000)	Use of ABC	Use of volume traditional cost system
Baird et al. (2004)	High usage of AA, ACA and ABC	Low usage of AA, ACA and ABC
Bhimani et al. (2005)	ABC implemented	ABC not implemented
Chongruksut and Brooks (2005)	ABC implemented, currently implementing ABC, and wanted to implement ABC	ABC not considered, and not decided yet
Bhimani et al. (2005)	ABC is implemented	ABC is not implemented
Kallunki and Silvola (2008)	Currently using ABC	Not using ABC
Schoute (2011)	Currently using ABC, and currently implementing ABC	Currently considering ABC adoption, no consideration of ABC to date, and rejected ABC after assessment
Askarany and Yazdifar (2012)	ABC has been implemented and accepted, and ABC has been introduced on a trial basis	Discussions have not taken place regarding ABC introduction, a decision has been taken not to introduce ABC, and some consideration is given to ABC introduction

[a] Some studies used more than one definition for ABC adoption and non-adoption.

2.2.2 The cost system sophistication approach

The concept of CSS has been used recently by Abernethy et al. (2001), Drury and Tayles (2005), Al-Omiri and Drury (2007), Brierley (2007), Brierley (2008b), and Schoute (2009). The proponents of CSS dismissed the approach of dividing the types of cost systems between ABC adopters and non-adopters and instead view a cost system as a continuum that fluctuates from a simple to a highly-sophisticated design based on different dimensions of the cost assignment procedures - mainly the number of cost pools and cost drivers.

The concept of CSS has been supported by field studies that compare the cost system implementation across different companies. Abernethy et al. (2001) conducted five case studies in Australia and found that the level of CSS varies across companies based on the number and type of cost pools and second-stage cost drivers. They proposed that several relationships exist between different factors based on the concept of CSS.

Similarly, Brierley (2008b) interviewed 55 management accountants working in the UK manufacturing industry to define the concept of CSS from a practical point of view. Interestingly, the first and most commonly used definition was the assignment of overhead costs in terms of the number and type of cost pools and second-stage cost drivers. These findings appear to reinforce the view that cost system design can be better captured and measured by the sophistication level of the overhead assignment process rather than general statements about ABC adopters vs. non-adopters.

Figure 2.1 below shows the different dimensions that classify the level of CSS. These studies argue that CSS fluctuates according to the degree of complexity associated with these dimensions. They view the cost system as a continuum that ranges from a simple system to a highly-sophisticated one. At one end of the continuum, a cost system with no overhead assignment process (e.g. variable and direct costing), or with one cost pool and cost driver, is deemed as having the least sophisticated design.

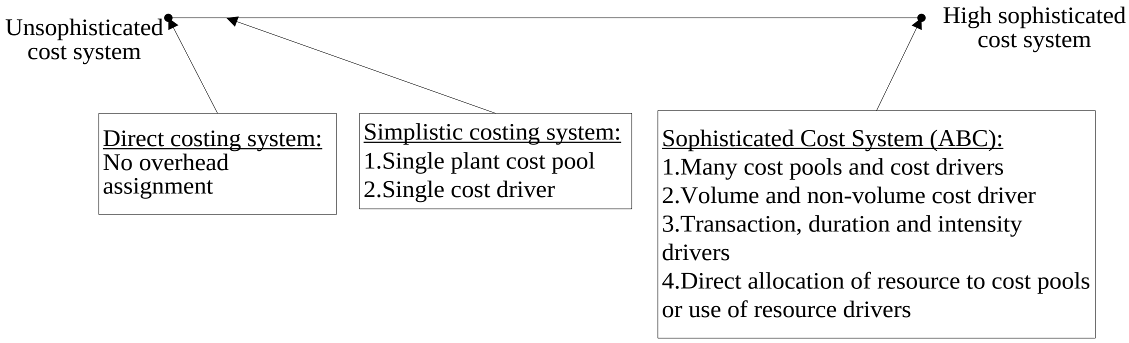

Figure 2.1: Dimensions of cost system sophistication (Al-Omiri and Drury, 2007).

At the other end of the continuum, a cost system is considered the most highly-sophisticated design when it uses: (1) a high number of activity-based cost pools; (2) volume and non-volume second-stage cost drivers; (3) cause-and-effect resource drivers; and (4) transaction, duration, and intensity cost drivers. Along this continuum, a cost system (be it ABC or a traditional cost system) can be located at any point, based on the nature of the cost drivers, the number of cost pools, the different types of second-stage cost drivers, and the resource drivers used in the cost system design. Nonetheless, a precise order or ranking for cost systems over a sophistication continuum becomes problematic due to the different combinations of the different number of the CSS's dimensions, such as the case when companies use many cost pools and a limited number of cost drivers while other companies use a limited number of cost pools and many different types of cost drivers (Al-Omiri and Drury, 2007). To overcome this, the previous research used different strategies, such as examining each dimension of CSS separately (Al-Omiri and Drury, 2007; Brierley, 2007), creating a 15-point sophistication scale based on the number of cost pools and the number of cost drivers (Drury and Tayles, 2005), or employing a composite measure by averaging the standardised scores for each dimension of CSS (Schoute, 2009).

The first dimension is the number of cost pools, which represents an important aspect of CSS, as this makes it possible to identify the number of departments or activities within a company. The traditional absorption cost system relies on responsibility cost pools, referred to as cost centres, which normally represent departments, while cost pools in ABC resemble the activities within departments and can be a unit, batch, product, or facility activity. Drury and Tayles (2005) and Brierley (2008b) argue that, as the number of responsibility cost centres increases, the traditional cost system will be able to capture the complexity of the production process, as each cost centre will represent a separate stage of the process. In contrast to the responsibility cost centres, an ABC system with many activity cost pools will achieve a more accurate measurement of the overhead costs than would a traditional cost system, since it supplies detailed cost information about the activities within and across different departments. Drury and Tayles (2005) state that, in a situation where there are many products (1) necessitating the use of different types of production and service processes, and (2) consuming a different quantity of resources within these processes, the use of many cost pools, each of which resembles a separate process, can capture the variation in resource consumption. Therefore, increasing the number of cost pools is assumed to move the level of sophistication of the cost system from left to right, as shown in Figure 2.1 (Abernethy et al., 2001; Drury and Tayles, 2005; Al-Omiri and Drury, 2007).

After identifying the number of cost pools, a sophisticated cost system can rely on the dimension of either directly allocating costs to cost pools, or applying cause-and-effect resource drivers for the purpose of estimating the usage of resources by activities rather than relying on arbitrary resource bases (Drury and Tayles, 2005; Al-Omiri and Drury, 2007). These procedures can be utilised in both the traditional cost system and ABC system, but the main difference resides in the use of many activity cost pools by the latter to obtain a clearer picture of the resources consumed by different activities (Drury and Tayles, 2000).

The third dimension of CSS is the number of different types of cost drivers in the second stage of the two-stage overhead allocation process. Cost drivers assign the costs from the cost pools to the cost object, thereby measuring the cost object's consumption of resources (Cooper, 1988a, 1988b, 1989a). As the cost system includes different types of cost drivers (volume, batch, and product sustaining cost drivers), the accuracy of assigning overhead costs to cost objects can increase (Brierley, 2008b). The use of non-volume cost drivers (e.g. the number of purchase orders) will establish cause-and-effect traceability of the overhead costs consumed by products in relation to different activities. An important feature of highly sophisticated cost systems is their reliance on cause-and-effect-cost drivers to connect the supply of resources within each cost pool to the demand for resources by the cost objects (Drury and Tayles, 2005). Similar to the cost pools, increasing the number of second-stage cost drivers is assumed to increase the level of CSS, as each level of activity cost pool or group of activities (unit, batch, and product sustaining activities) can have proper cause-and-effect cost drivers.

The last dimension is the nature of cost drivers consisting of transaction, duration and intensity drivers (Drury and Tayles, 2005; Al-Omiri and Drury, 2007). Transaction cost drivers count the number of occurrence of activities when they are performed (Kaplan and Cooper, 1998). Duration drivers are more sophisticated than transaction cost drivers because they measure the time required to conduct an activity (Kaplan and Cooper, 1998). The intensity drivers are the most sophisticated cost drivers because they directly measure the consumption of resources each time an activity is conducted (Kaplan and Cooper, 1998).

Based on the above four dimensions, Drury and Tayles (2005) and Al-Omiri and Drury (2007) argued that a highly sophisticated cost system, which is located at the far end of the right side of Figure 2.1, resembles a sophisticated ABC system when it includes: (1) a significant number of activity cost pools; (2) the use of resource drivers or direct charging to assign costs to cost pools; (3) a reliance on many different types of second-stage cost drivers; and (4) the utilisation of intensity drivers. Having provided the dimensions that constitute CSS, the following section will discuss the research articles that examine the concept of CSS and their findings.

2.2.2.1 Abernethy et al. (2001)

Abernethy et al. (2001) studied the effect of product diversity, cost structure and advanced manufacturing technologies (AMTs) on CSS. The data were collected from five Australian manufacturing sites. The study evaluated the level of CSS based on where it is located on a continuum, represented by three dimensions, namely the number of cost pools, the type and the number of cost drivers. Three sites had simple traditional cost systems with no more than three responsibility cost centres and one volume cost driver as well as low product diversity, low to moderate overhead costs and dedicated inflexible production equipment. The management of the three sites were satisfied with the cost information and did not need a sophisticated cost system because of the low production complexity, low product diversity and low-to-moderate overhead costs.

Further, the fourth site had high product diversity due to the production of many different types of customised products in various sizes, shapes and batch volumes. Nonetheless, the company had not implemented a sophisticated ABC system but instead used a sophisticated traditional cost system with many cost pools and two volume cost drivers. The management were highly satisfied with the cost information supplied by the cost system. The study attributed this to the investment in flexible AMTs that: (1) enable the rapid production of customised products by facilitating changes in products or volume; and (2) reduce overhead costs related to batch and product-sustaining activities as well as indirect labour. The study concluded that investing in a sophisticated ABC system with volume and non-volume cost drivers for batch and product-sustaining activities will not increase the accuracy of the cost information when there is an investment in flexible AMTs.

Finally, the fifth site used a simple cost system (two cost pools and one-unit volume driver) but had high manufacturing overhead costs that were related to indirect labour costs. It also had great product diversity but did not invest in flexible AMTs to manage product and volume changes; therefore, the batch-level activities (e.g. machine setup) and product-sustaining activities (e.g. product design and material composition) became vast and diverse. Consequently, the simple cost system led to the misallocation of overhead costs, resulting in wrong decisions, such as mispricing and weak operational control. The study argued that a highly sophisticated cost system, namely an ABC system, with activity cost pools and volume and non-volume cost drivers, should be implemented to control and correct the misallocation of overhead costs.

2.2.2.2 Drury and Tayles (2005)

Drury and Tayles (2005) used a composite measure that combines the number of cost pools and the number of different types of second-stage cost drivers as measurements of CSS. The study empirically surveyed manufacturing and non-manufacturing UK companies and reported that a high level of CSS is more likely to be used in large organisations and in the service and financial industry's sectors, because the former had significant resources and multiple activities, and the latter is expected to have high overhead costs compared to manufacturing and retail companies. Product diversity and product customisation were also found to significantly increase and decrease CSS, respectively. Finally, the study could not find any significant impact of cost structure, competition and decision-making on CSS.

2.2.2.3 Al-Omiri and Drury (2007)

Al-Omiri and Drury (2007) used two dimensions of CSS (the number of cost pools and cost drivers, respectively) to examine the factors influencing CSS levels. The study also used two dichotomous variables, namely ABC adopter vs. non-adopter and direct vs. absorption costing systems. A survey questionnaire was distributed to 1,000 UK firms and 176 usable responses were received. The study found that size, financial and service sector, the importance of cost information and competition had a positive impact on the number of cost pools, the number of cost drivers and ABC adoption. While the study also found that the extent of using innovative MA techniques led to the adoption of an ABC system, innovative MA techniques did not have any relationship with the remaining dependent variables. Furthermore, the study reported that the size and importance of the cost information influenced the adoption of an absorption cost system compared to a direct cost system. Finally, ABC systems based on ABC adoption vs. non-adoption were found to be more likely to operate in an environment characterised by JIT/lean production practices, but such an environment was not significantly associated with the number of cost pools and cost drivers, respectively.

2.2.2.4 Brierley (2007)

Brierley (2007) used a survey questionnaire to study the influence of competition, product customisation, the percentage of manufacturing overhead costs, the size of the business unit and the importance of product costs in selling price decisions on the number of cost pools and cost drivers. The only variables affecting CSS were the size of the operating units and the manufacturing overhead percentage. Because no significant association was detected between any of the independent factors and the number of cost drivers, Brierley (2007) changed the research focus from direct to mediation relationship, in which the cost pools were expected to mediate the relationship between the contextual factors and the number of cost drivers. Brierley justified the mediation approach based on the premise that increasing the number of cost pools to control the different activities within organisations may lead management accountants to consider increasing the number of cost drivers in order to accurately assign overhead costs from the cost pools to the cost objects. The study found that the size and percentage of manufacturing overhead costs positively but weakly influence the number of cost drivers through the number of cost pools.

2.2.2.5 Brierley (2008b)

Based on interviews with 55 management accountants in manufacturing companies, Brierley (2008b) investigated the sophistication of the cost system from a practical perspective. The study identified three definitions of CSS that emerged from the field study. The most commonly-used definition was the assignment of overhead costs that was provided 12 times by management accountants. This corresponds to the definition of CSS outlined in Figure 2.1 above. The number of cost pools and second-stage cost drivers, respectively, was considered the most important dimension for defining the level of sophistication of cost systems over a continuum that ranges from a simple cost system design (namely a direct cost system) to a highly-sophisticated one (Brierley, 2008b).

2.2.2.6 Schoute (2009)

Schoute (2009) examined the interaction effect between CSS and the purpose of cost systems (product planning vs. cost management) on the effectiveness of the cost system, measured by the intensity of use and the level of satisfaction, each of which is reflected by a single item measure. The study argued that the purpose of using cost systems for product planning is that this does not require high CSS, as is the case for cost management, because the latter requires a more sophisticated cost system in order to understand the causes of the costs associated with different processes. Hence, unsophisticated cost systems would be positively associated with effectiveness, if used for product planning. Otherwise, such a relationship would be negative for highly sophisticated cost systems. Alternatively, highly-sophisticated (simple) cost systems that are used for cost management should be positively (negatively) associated with effectiveness. The statistical results confirmed the developed hypotheses.

2.2.3 Critical evaluation of cost system design literature

The approaches, namely ABC adoption vs. non-adoption and CSS, that explore the contents of the cost system and its antecedent factors, have been presented. A closer look at this literature reveals several common limitations that require further research. These limitations are related to: (1) the concept of cost systems; (2) the omission of the role of management accountants as a facilitating factor; (3) the simplistic approach to examining AMTs, cost structure and product diversity; (4) the methodological limitations, particularly for research that investigates the role of competition, business strategy and product diversity; and (5) the absence of investigation into the efficacy of cost systems for assessing the claimed superiority of the cost system design. Table 2.2 and Table 2.3 compare a number of cost system studies to highlight the above limitations. The following sub-sections will discuss each of these limitations in turn.

Table 2.2: Comparison of CSS studies in terms of the antecedents and consequences of cost systems.

Cost system sophistication studies								
Study	**Research & Analysis methods**	**Antecedents variables**						**Consequences variables**
		Product diversity	**Competition**	**Cost structure**	**AMT**	**Business strategy**	**Role of accountant**	
Drury and Tayles (2005)	• Questionnaire • Multivariate regression method	• Variation in consumption of support overhead cost	• Competition for major products • Price competition	• Indirect costs divided by the total manufacturing and non-manufacturing costs	Not examined	Not examined	Not examined	Not examined
Al-Omiri and Drury (2007)	• Questionnaire • Multivariate regression method	• Diversity of product line • Diversity of process • Difference in volume • Cost of support department for each product line	• Increase in competition over the last 10 years for products • Intensity of competition from competitors • Price competition. • The intensity of competition in the market	• Indirect costs as a percentage of total costs	Not examined	Not examined	Not examined	Not examined
Brierley (2007)	• Questionnaire • Multivariate regression analysis	• Product customisation • Uniqueness/standardisation of the product	• Competition for the major products • Competition over the next two years	• Manufacturing overhead cost to total manufacturing costs	Not examined	Not examined	Not examined	Not examined
Schoute (2009)	• Questionnaire • Multivariate regression analysis	Not examined	Not examined	Not examined	Not examined	Not examined	Not examined	• The intensity of use of the cost system. • The level of satisfaction of the cost system.

Table 2.3: Comparison of ABC studies in terms of the antecedents and consequences of cost systems.

A sample of ABC adoption vs. non-adoption studies								
Study	**Research & Analysis methods**	**Antecedents variables**						**Consequences variables**
		Product diversity	**Competition**	**Cost structure**	**AMT**	**Business strategy**	**Role of accountant**	
Bjørnenak (1997)	• Questionnaire • Bivariate analysis methods	• Number of product variants • Degree of customised production	• The sale percentage being exported • The number of competitors	• Overhead costs divided by the total direct labour and overhead costs	Not examined	Not examined	Not examined	Not examined
Nguyen and Brooks (1997)	• Questionnaire • Bivariate analysis methods	• Facility flexibility • Product-volume variation • Product-complexity variation • Changes in product and designs	• The intensity of competition	• Overhead costs divided by total manufacturing costs	Not examined	Not examined	Not examined	Not examined
Krumwiede (1998)	• Questionnaire • Multivariate regression method	• Diversity of product line • Diversity of process • Difference in volume • Cost of support department for each product line.	Not examined	Not examined	Not examined	Not examined	Not examined	Not examined
Malmi (1999)	• Questionnaire • Bivariate analysis methods	• Number of product	• The sale percentage being exported • The change in competition	• Overhead costs divided by total capital costs	Not examined	• Two statements each of which describes the type of strategy (cost leadership, differentiation)	Not examined	Not examined
Clarke et al. (1999)	• Questionnaire • Bivariate analysis methods	• Number of product lines	Not examined	• Manufacturing overhead as a percentage of total costs	Not examined	Not examined	Not examined	Not examined
Groot (1999)	• Questionnaire • Bivariate analysis method	• Number of products • Number of product line • Number of packaging line	Not examined	• Overhead costs divided by the total manufacturing costs	Not examined	Not examined	Not examined	Not examined
Brown et al. (2004)	• Questionnaire • Multivariate regression method	• Diversity of product line • Diversity of process • Difference in volume • Cost of support department for each product line	Not examined	• Overhead costs divided by the total of direct labour and overhead costs	Not examined	Not examined	Not examined	Not examined

Table 2.4–Continued.

A sample of ABC adoption vs. non-adoption studies								
Study	**Research & Analysis methods**	**Antecedents variables**						**Consequences variables**
		Product diversity	**Competition**	**Cost structure**	**AMT**	**Business strategy**	**Role of accountant**	
Schoute (2011)	• Questionnaire • Multivariate regression analysis	• Number of products • Product physical size • Product complexity • Batch size	Not examined	Not examined	• The extent of usage of nine AMTs technology	Not examined	Not examined	Not examined
Bhimani et al. (2005)	• Questionnaire • Multivariate regression analysis	Not examined	Not examined	Not examined	Not examined	• Three statements each of which describes the type of strategy (prospectors, defenders, analysers)	Not examined	Not examined
Hoque (2000)	• Questionnaire • Bivariate and multivariate regression analysis	Not examined	Not examined	Not examined	• The extent of usage of automation	Not examined	Not examined	Not examined
Askarany et al. (2007)	• Questionnaire • Bivariate analysis method	Not examined	Not examined	Not examined	• Technological changes in manufacturing practices	Not examined	Not examined	Not examined

2.2.3.1 The definition of the cost system

A plethora of studies has focused on one type of cost system, namely the ABC system, to investigate its different aspects, such as ABC diffusion in practice, and the reasons for ABC system adoption (Gosselin, 2006; Al-Omiri and Drury, 2007; Askarany and Yazdifar, 2012). The classification of the different types of cost system as either ABC adopter or non-adopter, based on a dichotomous variable, represents the focus for the majority of cost system studies (Drury and Tayles, 2005; Al-Omiri and Drury, 2007). It is contended that this approach relies on too narrow a definition to capture the different characteristics of cost system design for three main reasons.

First, and most importantly, the approach of ABC adoption and non-adoption does not indicate in the first place why certain companies opt to design a highly sophisticated cost system, while other companies choose a less sophisticated or simple cost system. Drury and Tayles (2005) indicate that ABC systems can range from a simple design with a few aggregated activity cost pools and cost drivers, to a highly-sophisticated design with many activity cost pools and cost drivers. For example, Cooper and Turney (1990) conducted a field study and found that one company used a simple ABC design with only two non-volume cost drivers. Thus, it is difficult to differentiate between the different cost system designs, especially the simple vs. sophisticated ABC design, based on a measure confined to ABC adoption vs. non-adoption (Drury and Tayles, 2005; Al-Omiri and Drury, 2007).

Second, this definition makes it difficult to conclude whether or not the contingent factors, such as product diversity and competition, are important when implementing an ABC system (Drury and Tayles, 2005; Al-Omiri and Drury, 2007). The inclusion of different phenomena under the title of ABC adopter does not reflect the actual use of ABC systems nor indicates any differences in ABC system designs, as reported by the companies. As a result, Brierley (2011) questions the results reported by previous studies due to the lack of a shared definition regarding what constitutes ABC adoption. Such speculation was investigated based on a sensitivity analysis to compare the applicability of ten different definitions of ABC adoption and assess the degree to which various factors (competition, product diversity, size, etc.) have a consistent effect across these definitions. The first definition consists of only those companies using ABC, while the remaining definitions consist of different experiences of ABC, such as currently using ABC plus the intention/plan to use ABC. The study found that the most appropriate definition of ABC adoption is only those companies which are currently using ABC.

Finally, a misunderstanding from a practical point of view regarding the concept of ABC systems has been reported by several scholars (Dugdale and Jones, 1997; Abernethy et al., 2001). For example, Abernethy et al. (2001) provided field-based evidence about the respondents' misunderstanding of ABC. They found that the management at one of the business units implemented a sophisticated traditional cost system with many cost pools and two volume cost drivers, yet still claimed this to be an ABC system. This finding may indicate that some companies may not be aware of what an ABC system is.

Due to the reasons mentioned above, several studies dismiss the ABC adoption and non-adoption approach and focus mainly on the characteristics of cost systems in terms of the overhead cost assignment procedures to reflect the cost system design in terms of sophistication. This is because: (1) these characteristics are the most important features that have been illustrated by the proponents of ABC systems as differentiating between the different types of cost system (Kaplan and Cooper, 1998); and (2) the ambiguity of the concept of ABC from a practical point of view, makes ABC systems subject to different interpretations. Empirical evidence from field study research has also reinforced the importance of CSS, as practitioners considered overhead assignment procedures based on the number of cost pool and cost drivers to be the most relevant definition for determining a cost system's level of sophistication (Brierley, 2008b). Therefore, this research will use the number of cost pools and cost drivers to investigate the content of cost systems regarding sophistication, as well as assessing the antecedents and consequences of CSS.

The dimensions of cost pools and second-stage cost drivers have been importantly emphasised to reflect the level of sophistication of the cost system, as these were verified based on field studies (Abernethy et al., 2001; Brierley, 2008b) and can be reliably obtained from questionnaire respondents with less confusion compared to ABC adoption vs. non-adoption measures (Drury and Tayles, 2005; Al-Omiri and Drury, 2007). The remaining dimensions of CSS, namely resource drivers vs. direct charging and the nature of cost drivers (e.g. intensity drivers), were empirically dismissed from the survey of CSS studies. Al-Omiri and Drury (2007) contend that practitioners may be unable to provide accurate answers about these two dimensions, so their inclusion may affect the reliability of the questionnaire results. In fact, Brierley (2008b) found that none of the 55 management accountants interviewed was able to distinguish between transaction, duration and intensity drivers.

Finally, while the proponents of the concept of CSS assume that a higher number of cost pools and cost drivers will enable the cost system to provide detailed cost information, this assumption has not been empirically verified. By mathematically simulating the consequences of cost systems, Feltham (1977) reported that a cost system that provides disaggregated cost information is more beneficial to decision-makers than one that aggregates cost information (e.g. aggregates all types of labour costs into one cost pool). Pizzini (2006) revealed empirical evidence from a survey questionnaire distributed to US hospitals that a highly-functional cost system, displayed by the ability to provide detailed cost information about different cost objects, was significantly correlated with the use of a large number of cost drivers. For that reason, in addition to the dimensions of cost pools and cost drivers, the present thesis also uses the ability of cost systems to provide detailed cost information as a third measurement of CSS: to (1) assess the degree to which CSS supplies detailed cost information; and (2) enhance confidence in the statistical results when the results of the antecedents and consequences of CSS, as measured by the cost pools and/or cost drivers, are in line with those obtained from the ability of cost systems to supply detailed cost information.

2.2.3.2 The role of management accountants

One limitation associated with prior survey cost system research, is the failure to verify the role of management accountants as an antecedent factor for the adoption of innovative, sophisticated cost systems (Cooper et al., 1992b; Argyris and Kaplan, 1994; Anderson, 1995; Friedman and Lyne, 1997; Innes et al., 1998; Chenhall and Langfield-Smith, 1999; Liu and Pan, 2007; Fadzil and Rababah, 2012). Table 2.2 and Table 2.3 show the different factors that have, and have not been, examined by CSS and ABC studies respectively, which show that the role of management accountants has been neglected by prior survey cost system studies.

The role of management accountants has been described variously, as shown in Table 2.4. On the one hand, “bookkeepers” and “bean counters” represent examples of the passive role of management accountants in the sense that accountants lack involvement and interaction with the companies’ different managers and mainly focus on the provision of detailed historical and financial information (Mouritsen, 1996; Friedman and Lyne, 1997; Emsley, 2005; Jack and Kholeif, 2008). On the other hand, "service aid", "consultant" and "business partner" have been designated to reflect the active role of accountants, which encompasses: (1) active participation in the operational as well as strategic decision-making processes; (2) the provision of MA information to other non-accounting business managers; and (3) working directly with non-accountant managers, such as operational managers (Hopper, 1980; Siegel, 2000; Emsley, 2005; Byrne and Pierce, 2007; Langfield-Smith, 2008; Maas and Matějka, 2009).

Table 2.4: Categories of management accountant's role.

Prior studies	Categorisation of the management accountant's role
Hopper (1980)	Bookkeeper vs. service aid
Siegel (2000)	Business partner
Gibson (2002)	Bean counter vs. business partner
Pierce and O'Dea (2003)	Business partner
Emsley (2005)	Business unit orientation vs. functional (accounting) orientation
Burns and Baldvinsdottir (2007)	Scorekeeping role vs. consultancy role
Byrne and Pierce (2007)	Business partnership
Maas and Matějka (2009)	Local responsibility vs. functional responsibility
Lambert and Sponem (2012)	Discrete role, safeguarding role, partner role, omnipotent role
Wolf et al. (2015)	Business partner role

While previous survey cost system research did not address the role of management accountants, the present study argues that investigating the degree to which business-oriented management accountants compared to traditional accounting management accountants is associated with the use of sophisticated cost systems is important due to two reasons.

First, the proponents of the ABC system have shown that the implementation of complex cost systems requires the existence of facilitator factors in order for such systems to be successfully implemented and continuously used by different members of the organisation, such as top management support, team cohesion, resource adequacy, and evaluation and compensation (Anderson, 1995; Shields, 1995; McGowan and Klammer, 1997; Maiga and Jacobs, 2007; Pike et al., 2011). Nonetheless, these studies did not examine the characteristic of the human factor "role of management accountants" that can impact the design of the cost system. Given the assumption that management accountants are the main custodian of MAS and cost systems, they can hinder or facilitate the adoption of sophisticated cost systems as well as other change initiative projects (Cooper et al., 1992b; Johnston et al., 2002; Emsley, 2005).

Confirming that a sophisticated cost system needs business-oriented management accountants, as opposed to more traditional management accountants, will add to the cost system literature a new, important facilitator factor that should be considered, especially by practitioners, in order to explore the kind of management accountants' characteristics needed to successfully facilitate the development and continuous use of complex projects such as sophisticated cost systems. In addition, finding a significant result between the role of management accountants and CSS may indicate that prior research provides only a partial picture of the most important facilitator factors that focus mainly on organisational factors, such as top management support and adequacy of resources, while neglecting the role of management accountants (Anderson, 1995; Shields, 1995; McGowan and Klammer, 1997; Maiga and Jacobs, 2007).

Second, our knowledge of the importance of the accountants' role in regard to the design and implementation of cost systems emanated from conceptual and qualitative field studies (Cooper and Turney, 1990; Argyris and Kaplan, 1994; Friedman and Lyne, 1997; Chenhall and Langfield-Smith, 1999; Johnston et al., 2002). These studies provided valuable knowledge about the type of accountants needed in order to have a wellfunctioning cost system in place, but such knowledge is difficult to generalise due to the limited number of sites examined by these studies (Shields, 1995; Brierley, 2014). Uncovering a significant relationship between the role of management accountants and CSS, by means of a large-scale survey questionnaire, will help to generalise the research findings and consequently improve our confidence about the importance of the role of management accountants for sophisticated cost systems.

2.2.3.3 The moderation role of advanced manufacturing technologies

During the 1980s, the proponents of ABC systems highlighted the most important types of business environment changes that would entail the use of sophisticated cost systems. These include the acceleration of overhead costs, the production of diverse, customised products, and the advent of AMTs. Nonetheless, more than 25 years since these arguments first appeared, we still lack conclusive evidence about the effect of AMTs, product diversity and cost structure on cost system design. Despite the fact that scant literature has reported significant associations between product diversity and cost system design (Krumwiede, 1998; Malmi, 1999; Drury and Tayles, 2005; Schoute, 2011), as well as between cost structure and cost system design (Bjørnenak, 1997; Brierley, 2007), the majority of studies found that the cost system is not significantly affected by the level of product diversity (Nguyen and Brooks, 1997; Clarke et al., 1999; Baird et al., 2004; Brown et al., 2004; Al-Omiri and Drury, 2007; Brierley, 2007, 2008a; Charaf and Bescos, 2013), nor the cost structure (Nguyen and Brooks, 1997; Clarke et al., 1999; Groot, 1999; Brown et al., 2004; Drury and Tayles, 2005; Al-Omiri and Drury, 2007; Brierley, 2008a; Pokorná, 2015). Abernethy et al. (2001) argue that prior research relies on a simplistic assumption by investigating the direct effect of these factors on cost system design. Similarly, Davila and Wouters (2006) recognise that there exists mixed empirical evidence regarding the association between AMTs and the level of sophistication of cost systems, but conclude that a sophisticated cost system is more likely to be irrelevant to modern manufacturing technologies based on a review of prior research results.

Recent limited empirical evidence shows that AMTs decrease the need to implement a highly sophisticated cost system with many activity cost pools and volume and non-volume cost drivers (Abernethy et al., 2001; Schoute, 2011). This is due to the ability of AMTs to facilitate the production of diverse products and allow rapid product and volume changes while simultaneously reducing indirect labour, batch, and product-sustaining costs as well as production complexity (Abernethy et al., 2001). Schoute (2011) revealed empirical evidence that high AMTs reduce the effect of product diversity on ABC adoption. As a result, the current study argues that the inconsistent results regarding the effect of cost structure and product diversity on cost system design may be due to neglecting the role of AMTs in moderating the effect of cost structure and product diversity on the cost system. This research will take Schoute's (2011) study one step further by investigating, not only the moderating role of AMTs in the product diversity-CSS relationship, but also the extent to which AMTs moderate the cost structure-CSS relationship. Confirmation of the moderating role of AMTs would offer essential knowledge due to the following three reasons:

First, finding a significant moderating role of AMTs might reveal important empirical evidence that can explain the reasons for the mixed results regarding the effect of cost structure and product diversity on cost system design. More specifically, it can point to the possibility that the classical direct model used by prior research is an insufficient approach to providing more understanding and a more complete picture of the circumstances under which the phenomenon of "cost system design" had been studied.

Second, it can also increase our confidence in the research findings reported by Abernethy et al. (2001) and Schoute (2011), because these are the only studies that consider the moderation role of AMTs. The former relied on a qualitative field study consisting of only five sites, while the latter represents the only empirical survey study to provide evidence in supplying some understanding of the role of AMTs in the product diversity-cost system design relationship (see Table 2.2 and Table 2.3 above).

Finally, investigating the conditional effect of cost structure and product diversity on cost system design, based on the moderating role of AMTs, can highlight the different strategies whereby companies can resolve the issues of high product diversity and high overheads by either investing in AMTs to facilitate and reduce the product diversity and overhead costs, respectively, or investing in a highly-sophisticated ABC system to avoid product distortion.

2.2.3.4 Methodological limitations

A key limitation undermining the provision of informed conclusive evidence regarding the effect of competition, product diversity, and business strategy is the methodological issues associated with many prior cost system studies. These problems are related to the measurement of the antecedents of cost systems, the statistical analysis used, the reliance on one source for the data collection, and the small sample examined.

In MA research, many constructs are theoretical and abstract in nature, and so cannot be directly observed. Instead, they are measured indirectly through the use of a number of items that can reflect and approximate the domain of the research constructs under consideration (Smith and Langfield-Smith, 2004; Bisbe et al., 2007). Unfortunately, most of prior research attempted to measure competition, product diversity and business strategy by using only a single or few measures that failed to reflect the scope of these constructs (Table 2.2 and Table 2.3 above compares the different measurements used by prior research as well as the statistical methods).

Regarding competition, all of the studies used either a single (Nguyen and Brooks, 1997) or a few item measures that do not reflect the different dimensions of competition (Bjørnenak, 1997; Malmi, 1999; Drury and Tayles, 2005; Al-Omiri and Drury, 2007; Brierley, 2007). For example, Drury and Tayles (2005) focused only on the major product and price competition, while Brierley (2007) used major product competition and expected future competition. Similarly, the ABC studies used no more than two dimensions for competition, including sales percentages being exported and number of competitors (Bjørnenak, 1997), sales percentages being exported and the change in competition (Malmi, 1999), and competition intensity (Nguyen and Brooks, 1997).

Similarly, product diversity was treated narrowly in many studies. One group of prior studies investigated no more than two dimensions of product diversity, each of which was examined in isolation of the others (Bjørnenak, 1997; Nguyen and Brooks, 1997; Clarke et al., 1999; Groot, 1999; Malmi, 1999; Drury and Tayles, 2005). For example, the number of products, the number of product lines, and variations in the consumption of overhead costs by products were used to reflect the level of product diversity by Malmi (1999), Clarke et al. (1999), and Drury and Tayles (2005), respectively. Another group of studies operationalised a summed scale of no more than four dimensions of product diversity (Krumwiede, 1998; Brown et al., 2004; Al-Omiri and Drury, 2007; Brierley, 2007; Charaf and Bescos, 2013; Al-Sayed and Dugdale, 2016). For example, Brierley (2007) used a summed scale that only captures the level of product standardisation and customisation, while the remaining studies focus on volume diversity, product line diversity, support diversity and process diversity (Krumwiede, 1998; Brown et al., 2004; Al-Omiri and Drury, 2007; Charaf and Bescos, 2013; Al-Sayed and Dugdale, 2016).

Some business strategy-cost system studies also did not differ from the studies investigating product diversity and competition due to the use of a single statement describing the typology of each type of business strategy, such as cost leadership strategy vs. differentiation strategy (Gosselin, 1997; Malmi, 1999; Bhimani et al., 2005).

It has been argued that competition, product diversity and business strategy are multifaceted concepts (Cooper, 1988b; Mia and Clarke, 1999; Hoque, 2011). For example, the intensity of the competition may emanate from different environmental elements, such as raw materials, parts and equipment, price, marketing, product quality and variety, new product development and technological changes in the industry (Khandwalla, 1972; Libby and Waterhouse, 1996; Mia and Clarke, 1999; Hoque et al., 2001; Chong et al., 2005; Hoque, 2011). For example, in a highly competitive environment, product designers may be encouraged to design a product that consumes fewer costs to reduce the cost of the product and so gain a competitive advantage. As a result, the cost system design may be impacted by the product design competition, as firms may seek a sophisticated ABC system with non-volume cost drivers that could direct the product designer's attention towards evaluating different cost options.

Similarly, prior literature contends that product diversity can arise for a number of reasons, including diversity related to the volume, size, process, materials, product lines, the products themselves, and setup, respectively, which collectively and jointly cause simple cost systems to produce highly-distorted cost information (Kaplan, 1984; Cooper, 1988a, 1988b, 1989a; Estrin et al., 1994). Frey and Gordon (1999) also revealed empirical evidence, based on exploratory factor analysis, that cost leadership and differentiation can consist of multiple dimensions, each consisting of different indicators. For example, cost leadership can include the use of technologies to develop low-cost product design, with the objective of being the lowest-cost producers in the industry and seeking cost advantages from all resources, while a differentiation strategy can maintain different dimensions, such as the uniqueness of the product, the development of brand awareness and technological improvement.

Further, given the fact that these theoretical constructs are abstract concepts lacking direct observation and measurement, they are more likely to be open to measurement errors because the constructs' items do not always perfectly represent the abstract constructs (Smith and Langfield-Smith, 2004; Byrne, 2010; Hair et al., 2010; Kline, 2011).[5] To date, all prior research that investigates the antecedents of cost system design relied on statistical methods, namely bivariate methods (Nguyen and Brooks, 1997; Booth and Giacobbe, 1998; Clarke et al., 1999; Groot, 1999; Malmi, 1999; Cohen et al., 2005; Askarany et al., 2007; Pokorná, 2015) or multivariate regression methods, as shown in Table 2.2 and Table 2.3 (e.g. Gosselin, 1997; Krumwiede, 1998; Hoque, 2000; Baird et al., 2004; Brown et al., 2004; Drury and Tayles, 2005; Al-Omiri and Drury, 2007; Brierley, 2007, 2008a; Kallunki and Silvola, 2008; Askarany et al., 2012; Phan et al., 2014; Al-Sayed and Dugdale, 2016).[6] Nonetheless, neither approach controls for the effect of measurement errors associated with the theoretical constructs on the regression coefficients (Smith and Langfield-Smith, 2004). Instead, the reliability estimation is reported separately and is not aggregated into the regression model (ibid).

As a result of ignoring the inclusion of measurement errors when using the bivariate and multivariate regression methods, the regression model can lead researchers to miss

[5] A measurement error can be defined as "the degree to which the observed values are not representative of the "true" values" (Hair et al., 2010, p. 29). It arises from different sources, including the inability of the respondents to supply accurate information, the imprecision of the measurement instrument and the difficulty of accurately capturing all aspects of the abstract theoretical construct (ibid).

[6] While bivariate methods show the association between two variables only, multivariate regression methods address the effect of multiple variables on the dependent variable simultaneously.

significant relationships or detect erroneous significant relationships between the examined constructs in cases when the reliability of the constructs is low (Smith and Langfield-Smith, 2004; Blanthorne et al., 2006). Hence, there is a risk that researchers may produce significant research findings that are not reliably verified during statistical analysis. This issue is exacerbated when researchers also rely on only one source of data collection, as is the case with most survey cost system studies, without considering different sources to improve confidence in the research findings, as well as supplying possible explanations for the insignificant results (Chenhall, 2003; Modell, 2005; Brierley, 2014; Ittner, 2014). The use of a small sample is another issue that is associated with cost system studies (Pizzini, 2006) that can lead to the regression model being insufficiently sensitive to detect significant relationships, even though such relationships might exist within the population from which the sample is drawn (Hair et al., 2010). For example, while Frey and Gordon (1999) and Elhamma and Zhang (2013) could not find a relationship between ABC and business strategy, their sample contained only 11 and 8 ABC users, respectively, due to the low sample size employed (n = 62).

To overcome some of the methodological limitations associated with prior research, the present study applies several methodological procedures. First, it relies on multiple items to provide a concurrent estimate of the measurement of various dimensions of the constructs. For competition, it will use six dimensions that include competition regarding raw materials, parts and equipment, new product development, marketing and advertising, product quality, product variety and pricing (Hoque et al., 2001; Hoque, 2011). Similarly, for product diversity, it will focus on diversity regarding volume, product line, department support, process, the number of products, and product size, as these have been identified by the proponents of ABC systems to cause product distortion. The business strategy will also be measured by six different items adopted from Frey and

Gordon (1999), as discussed earlier.

Second, MA scholars have advocated the use of structural equation modeling (SEM) to overcome the limitations of bivariate and multivariate statistical analysis (Shields, 1997; Shields and Shields, 1998; Chenhall, 2003; Smith and Langfield-Smith, 2004). In particular, SEM has the ability to examine simultaneously different equation models and control for the measurement errors associated with theoretical variables, thereby adjusting the regression coefficients of the independent variables and dependent variables based on the estimation of the measurement errors (Blanthorne et al., 2006; Hair et al., 2010; Bollen, 2011).[7] Finally, unlike prior cost system research (e.g. Gosselin, 1997; Krumwiede, 1998; Hoque, 2000; Baird et al., 2004; Brown et al., 2004; Drury and Tayles, 2005; Al-Omiri and Drury, 2007; Brierley, 2007, 2008a; Kallunki and Silvola, 2008; Askarany et al., 2012; Phan et al., 2014; Al-Sayed and Dugdale, 2016), this study utilises mixed methods research in the form of an explanatory sequential design, consisting of two different data collection phases. The first phase includes the acquisition and analysis of quantitative data via a survey questionnaire distributed to a large number of manufacturing companies, followed by a second phase for collecting and analysing the qualitative data by means of a field interview. Such a methodology can improve the validity and credibility of the quantitative results when the qualitative findings converge with the quantitative results (Chenhall, 2003; Modell, 2005; Brierley, 2014; Ittner, 2014).

2.2.3.5 The consequences of the cost system

Another critical limitation associated with the studies that examine the effect of contingent factors on ABC adoption and the CSS related studies is the absence of any criterion variable for assessing the claimed superiority of ABC or CSS (Shim, 1996;

[7] Further details on SEM will be provided in chapter 4.

Bjørnenak, 1997; Gosselin, 1997; Nguyen and Brooks, 1997; Booth and Giacobbe, 1998; Krumwiede, 1998; Clarke et al., 1999; Malmi, 1999; Hoque, 2000; Baird et al., 2004; Brown et al., 2004; Bhimani et al., 2005; Drury and Tayles, 2005; Brierley, 2008a; Askarany et al., 2012; Phan et al., 2014; Al-Sayed and Dugdale, 2016). These studies adopted the selection approach of contingency theory, where it is assumed that all organisations are in equilibrium, and so any differences in performance cannot be recognised because only the best performers can survive (Ittner and Larcker, 2001; Chenhall and Chapman, 2006; Otley, 2016). Therefore, it is assumed that all existing companies, given their environmental characteristics, are optimising their cost system, whether it is simple or sophisticated in nature. Scholars argue that it is implausible to believe that all organisations achieve an alignment between their context and management control systems (MCS), so a measure of effectiveness should be included to assess the MCS differences between companies (Ittner and Larcker, 2001; Chenhall and Chapman, 2006; Otley, 2016). Case studies have also shown that dysfunctional cost systems do exist and can weaken the relevance of cost information for decision-making, and so, ultimately, the profitability (Abernethy et al., 2001). Therefore, companies in a disequilibrium state can exist and be observed.

The use of outcomes variables, such as profitability, innovation and employee satisfaction, can help "to explain the success or failure of organizations" (Donaldson, 2001, p. 6). This research, thus, will extend the previous research by examining not only the factors that influence CSS, but also the extent to which CSS is associated with improvements in product planning, cost management, and so, ultimately, organisational performance. More specifically, the mediation approach of contingency theory is adopted by the current study in order to undertake a simultaneous holistic examination of the antecedents and consequences of the cost system. The MAS research has recently adopted the mediation approach to investigate the antecedents and implications of MAS (e.g. Baines and Langfield-Smith, 2003; Gerdin, 2005; Widener, 2007; Cadez and Guilding, 2008; Hoque, 2011; Fullerton et al., 2014).[8]

2.3 Cost system purposes

Organisations make several types of decisions when they establish a cost system (Feltham, 1977). The varieties of decisions for which cost information is used represent the central argument behind the main criticism of the use of traditional, simple cost systems (Johnson and Kaplan, 1987; Cooper and Kaplan, 1988a, 1988b; Cooper et al., 1992a; Kaplan and Cooper, 1998). Many different decisions can be erroneously made based on inaccurate cost information extracted from traditional simple cost systems in a business environment that includes, but are not limited to, high product diversity and high overhead costs (Cooper and Kaplan, 1988a, 1988b; Cooper and Kaplan, 1991b). A sophisticated cost system with activity cost pools and volume and non-volume cost drivers is expected to improve the effectiveness of various decisions because it is generally accepted that such systems can supply detailed, accurate cost information that can increase the probability of making the right decisions, especially when time is limited (Cooper, 1989c; Kaplan and Cooper, 1998; Drury and Tayles, 2006).

The literature points to two general types of cost information usage, namely product planning, and cost management (Swenson, 1995; Kaplan and Cooper, 1998; Chenhall, 2004; Tillema, 2005; Schoute, 2009).[9] The following sub-sections will discuss product

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[8] Further discussion of contingency theory and its types will be presented in chapter 3.

[9] The literature employs various terminology to describe a group of decisions. For example, Swenson (1995) used 'strategic decisions' to describe the use of ABC cost information for sourcing, product pricing and mix, and customer profitability analysis, and 'operational decisions' for process improvement, product and process design, and performance measurement. Similarly, Kaplan and Cooper (1998) referred to 'strategic activity-based management (ABM)' to include product pricing and mix, product design and development, customer profitability analysis, customer relationship, and product range, and 'operational ABM' to include performance measurement, activity management, process re-engineering, and total quality. On the other hand, Chenhall (2004) used the term 'product planning' to include pricing, range of

planning and cost management.

2.3.1 Product planning purpose

Product planning decisions refer to a range of different strategic decisions that benefit from the product costing process to assign indirect costs to various cost objects. The cost objects can be a product, a product line, a customer, a distribution channel, or a brand (Kaplan and Cooper, 1998). The product planning decisions rely on accuracy in assigning overhead costs to cost objects, which represent the basis for pricing a product, evaluating a product mix, output, design, sourcing and managing customer relationships (Turney, 1991; Partridge and Perren, 1998).

Simple cost systems can lead to product-cost subsidisation when companies produce a diverse range of products, and subsequently contribute poorly to product planning decisions (Cooper and Kaplan, 1988a). As a result of inaccurate product costs, many management decisions, including the product price, mix, output, design, sourcing and customer profitability that rely on cost information, will be affected dramatically (Cooper and Kaplan, 1991b; Kaplan and Cooper, 1998). For example, the over-costed products will be either over-priced or display a low contribution margin, while the under-costed products will be either under-priced or display a high contribution margin (Shank and Govindarajan, 1993). Similarly, the customer profitability analysis will be unreliable since it relies on the sales and costs associated with the distorted product costs that are

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products, output of products, new product development and design, and customer and profitability analysis and 'cost management' for cost reduction and modeling, re-engineering and improvement, budgeting, and performance measurement. Similarly, Schoute (2009) referred to 'product planning' as including stock valuation, customer profitability analysis, and product pricing, and employed 'cost management' to encompass cost modelling, performance measurement, and cost reduction. In line with Chenhall (2004) and Schoute (2009), the current study uses 'product planning' and 'cost management' to distinguish between the different types of cost system purposes, because both studies used exploratory factor analysis to empirically measure the underlying dimensions of different decisions, and found that two dimensions (namely product planning and cost management) underlie the usage of cost systems for different decision areas.

tracked to each customer.

In contrast, a sophisticated cost system, like an ABC system can enhance the profitability of products, services and customers by directing the demand for activities away from unprofitable, costly usage towards more profitable usage (Kaplan and Cooper, 1998; Drury and Tayles, 2006). Therefore, this will establish a link between resources, activities, cost drivers and cost objects, independently of the number of units produced. Thus, ABC system reports more accurate product costs for different cost objects and consequently improves profitability through the provision of accurate costs for pricing, outsourcing, customer profitability and product output and range. This can be done by shifting the mix of resources to the most profitable products and customers by decreasing the quantity of resources consumed by unprofitable products and customers through the use of relevant cost drivers (Cooper and Kaplan, 1991b).

Companies can also use a sophisticated cost system with non-volume cost drivers to influence future costs at the product design and development stages. Prior research indicates that about 80% of the product costs during its life cycle are determined during the design phase, making it difficult to alter these costs once the design of the product is completed (Berliner and Brimson, 1988; Kaplan and Cooper, 1998). The awareness of cost drivers will help designers to evaluate alternative options during the design phase, such as common versus new parts, complex versus simple production processes, and existing versus new vendors (Kaplan and Cooper, 1998).

2.3.2 Cost management purpose

The introduction of ABC systems during the late 1980s aimed to enhance the accuracy of product costing and product planning decisions (Turney, 1991; Gupta and Galloway, 2003; Gosselin, 2006; Innes and Kouhy, 2011; Drury, 2015). Nonetheless, the analysis of resources, activities and cost drivers made possible by ABC systems opened up the opportunity for early ABC adopters to discover that ABC systems cannot only serve product planning decisions, but also different cost management applications (Partridge and Perren, 1998; Drury, 2015).

Sophisticated cost systems can offer a process horizontal view, aimed at providing operational information about why activities occur and the accomplishment of the work within activities (Turney, 1991). This is done by determining the cost drivers that measure the effort and work supplied to perform an activity and evaluating the results of activities through performance measurement (Turney, 1991). Each activity can have multiple cost drivers and performance measures that differ from other activities. Typical performance measures include the quality and efficiency of the work done and the time required to perform the work within an activity. On the other hand, the cost pools of the traditional cost systems mirror the organisational structure regarding departments, and thus lack the ability to provide information about the activities that cross departmental boundaries or operational performance measures with regard to non-financial information (Berliner and Brimson, 1988; Tsai, 1998). The traditional cost systems mainly focused on financial performance measures and variance analysis at the aggregate level, and reflect ex-post facto information which does not provide information about the real cause of any deviation from the performance targets (Shank and Govindarajan, 1993).

Additionally, the analysis of activities can also be used for other cost management applications. For example, the process view provides an opportunity to engage in organisational and process re-engineering by mapping the flow of the work as a series of activity chains based on the time required to perform the activity and its location (Mitchell, 1994). This analysis will highlight the complexity and duplication of work, leading management actions to re-engineer, simplify or eliminate these activities. Similarly, cost reduction can be optimised by categorising the activities into value-added and non-value-added, thus providing a basis for reducing or eliminating non-value-added activities (Innes and Mitchell, 1995).

A sophisticated cost system that is designed to focus on the processes of the activities also provides a link between resources, activities, cost drivers, and products, thereby providing a basis for setting a dynamic activity-based budget (ABB) rather than a static one that is department-focused and adjusted based on a plus/minus share of the previous year's spending pattern (Kaplan and Cooper, 1998; Hansen et al., 2003). The ABB converts the estimated production and sales volume by product into an activities requirement using activity cost drivers, and then determines the level of resources required to perform the activities using resource cost drivers (Hansen et al., 2003). Prior to critically reviewing the literature of cost system purposes in section 2.4.4, the next section reviews the cost system-performance literature.

2.4 Cost system and performance

The literature that examines the association between the cost system and organisational performance represents the most recent research, stemming from the early 2000s (Gordon and Silvester, 1999; Kennedy and Affleck-Graves, 2001; Cagwin and Bouwman, 2002; Ittner et al., 2002; Maiga and Jacobs, 2003, 2007, 2008; Pizzini, 2006; Banker et al., 2008; Xiao et al., 2011; Krumwiede and Charles, 2014; Laitinen, 2014; Maiga et al., 2014; Pokorná, 2016). Figure 2.2 represents an early development model for how a sophisticated cost system, namely an ABC system can improve the profitability of an organisation, and so, ultimately, the shareholder value, by enhancing the strategic and operational decisions regarding performance (Ward and Patel, 1990). Nonetheless, the scope of strategic decisions (product planning) and operational decisions (cost management) have been expanded to include a variety of decisions pertaining to product planning and cost management, as discussed in the previous section (Turney, 1991; Bhimani and Pigott, 1992; Innes and Mitchell, 1995; Swenson, 1995; Partridge and Perren, 1998; Ittner et al., 2002; Stevens, 2004; Maiga and Jacobs, 2008).

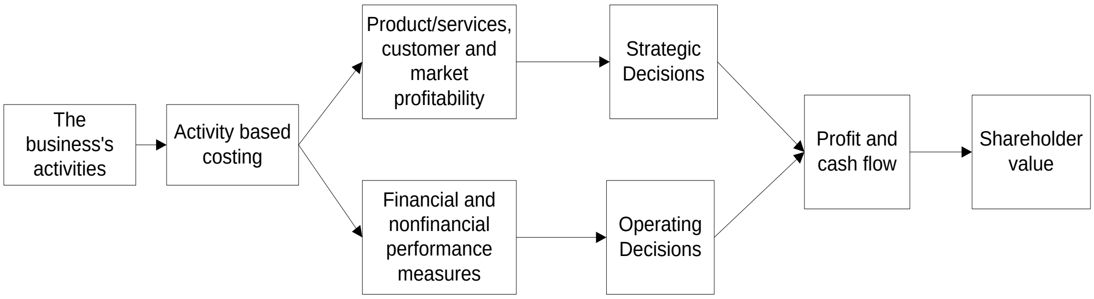

Figure 2.2: The link between ABC and profitability (adapted from Ward and Patel, 1990).

The activity analysis of the organisational processes and operations, the identification of resource consumption, and the accurate assignment of costs to cost objects represent important aspects of a sophisticated cost system that can influence several decisions related to product planning and cost management. The reliance on incorrect cost information can jeopardise the quality and efficacy of product planning and cost management, ultimately lowering organisational performance (Cooper and Kaplan, 1991b; Kaplan and Cooper, 1998; Maiga and Jacobs, 2008). For example, Abernethy et al. (2001) found that one of the companies in their study experienced low profitability because of the use of a simple cost system. More specifically, the company erroneously priced their products based on incorrect cost information, resulting in “a loss of orders for their high-volume products and a lowering of overall profitability margins” (Abernethy et al., 2001, p. 271).

On the other hand, Narayanan and Sarkar (2002) used a field study to investigate the benefits of ABC implementation in a US company that started an ABC implementation project in 1996. Different data collection methods were used, including statistical analysis of objective data prior to and after ABC implementation, interviews, and reviews of the company's internal reports. The activity analysis helped the managers to identify redundant and non-value-added activities which were then subjected to redesign or elimination. For example, the top 20 activities costed the firm about 87% of their total costs. Of these activities, a group of non-value-added activities consumed about $4.9 million that were subject to elimination and process improvement, which consequently led to considerable cost savings

The majority of the survey cost system-performance studies tended to focus on ABC systems (Pizzini, 2006). While these studies did not elaborate on or examine the level of sophistication of ABC systems, they considered ABC systems to be far superior to the traditional volume and direct cost systems, based on the assumption that ABC incorporates many activity cost pools and volume and non-volume cost drivers that improve different decisions and areas related to product planning and cost management, but without asserting or examining this assumption (Gordon and Silvester, 1999; Kennedy and Affleck-Graves, 2001; Cagwin and Bouwman, 2002; Ittner et al., 2002; Maiga and Jacobs, 2003, 2007, 2008; Pizzini, 2006; Banker et al., 2008; Xiao et al., 2011; Krumwiede and Charles, 2014; Maiga et al., 2014; Pokorná, 2016). However, the types of relationship between cost systems and performance can generally be classified into different groups, including the direct approach, the interaction (moderation) approach, and the mediation approach. Each of these will now be explained and discussed in sections 2.4.1, 2.4.2, and 2.4.3.

2.4.1 The direct approach

The direct approach explores only the direct main effect of the cost system on performance (Chenhall, 2003; Luft and Shields, 2003). It does not show the mechanism of how or under which conditions the cost system may influence organisational performance. For example, Gordon and Silvester (1999) employed an event approach to examine the effect of the announcement of ABC adoption by US firms on the stock market reaction. The findings indicated that there was no significant market return between ABC firms and non-ABC firms. In contrast, Kennedy and Affleck-Graves (2001) used an event study approach to compare the performance of 37 ABC firms with non-ABC firms that were publicly listed on the London Stock Exchange. A questionnaire survey was used to identify ABC firms (with their adoption date) and non-ABC firms. The results showed that the ABC firms significantly outperformed the non-ABC firms by 27% over the three years following ABC implementation. However, Pokorná (2016) employed a survey questionnaire to identify Czech ABC and non-ABC firms, using the Albertina database to collect financial performance up to 5 years prior to and post-ABC implementation. One hundred and twenty ABC firms were compared to 428 non-ABC firms based on the return on assets (ROA). The findings indicated that the ABC firms had not outperformed the non-ABC firms following the implementation of an ABC system.

Unlike previous ABC studies, Pizzini (2006) focused on the functionality of the cost system rather than the ABC system. The study argued that a cost system that is capable of supplying more details about cost information is considered to be highly-functional. Using objective financial measures, the study found that the ability of cost systems to supply detailed cost data was significantly and positively associated with the operating margin and cash flow ($p < 0.01$).[10]

2.4.2 The interaction approach

Researchers who studied the association between cost system and performance anticipated that better performance can be generated from the conditions that moderate the association between the cost system and performance. Such investigations reveal under which circumstances ABC can be financially beneficial. Examples of the examined circumstances include, but are not limited to, the balanced scorecard (Maiga and Jacobs, 2003), information technologies (IT) (Maiga et al., 2014), other initiatives (e.g. total quality management) and complex production environments (Cagwin and Bouwman, 2002). The following literature will reflect the different types of circumstances that have been examined in prior research.

Frey and Gordon (1999) examined under which business strategy (differentiation vs. cost leadership) ABC can influence performance, as well as the direct impact of ABC on organisational performance. The study reported that the ABC users outperformed the non-ABC users. Additionally, the association between ABC and improved ROI was found to be more significant and positive among those following product differentiation strategies than those following leadership strategies.

Similar to Frey and Gordon (1999), Krumwiede and Charles (2014) examined the relationship between customer service (CS) and low price (LP) strategies, ABC, and financial performance. Based on a questionnaire completed by members of the Institute of Management Accountants (IMA), the results showed that high performance was recognised when ABC was used by firms that emphasised a strong commitment towards

[10] Pizzini (2006) also used the system approach of contingency theory to examine the simultaneous effect of multiple contingent factors on the functionality of the cost system to obtain a benchmark model to examine the extent to which the degree of functionality of the cost system is associated with performance.

CS strategy. The study also found that their interaction positively influenced performance. In contrast, ABC was positively associated with performance in high LP strategy firms, but their interaction, based on a moderated regression analysis, was insignificant. Cagwin and Bouwman (2002) focused on the interaction between ABC systems and many contextual factors. The results of the survey showed an insignificant direct association between the use of ABC and organisational performance. In contrast, the study found a positive, significant association between improved ROI and the interaction of ABC with production complexity, other initiatives (e.g. JIT, computer integrated manufacturing, value chain analysis), and the importance of cost information.

The impact of ABC and the balanced scorecard on performance have also been studied. Maiga and Jacobs (2003) investigated the direct and interaction effects of ABC and the balanced scorecard on performance. The results revealed that greater performance, as reflected by customer satisfaction and product quality, was realised due to the joint use of ABC with all dimensions of the balanced scorecard. Additionally, the margin on sales had been improved due to the interaction between ABC and all dimensions of the balanced scorecard, except for the internal business process. In another study, Maiga et al. (2014) contend that superior financial performance is more likely to be high under the concurrent use of ABC with IT rather than under their individual effects. The results demonstrated that their simple, isolated effects on performance were insignificant, but that their interaction positively improved performance due to the quality and availability of cost information supplied by the IT for ABC activities and cost drivers' identification process. Nonetheless, Xiao et al. (2011) revealed empirical evidence that IT did not moderate the relationship between ABC and non-financial performance (e.g. customer satisfaction).

2.4.3 The mediation approach

In contrast to the previous approach, several studies adopted the mediation approach to uncover the mechanisms of how cost systems influence financial and/or operational performance through an intermediate variable that transmitted the effect of the cost system to the financial and/or operational performance.

Based on a cross-sectional sample of US manufacturing companies, Ittner et al. (2002) found that the extensive use of ABC is not associated with improved return on net plant assets (ROA). Nonetheless, there was a direct positive link between the extensive use of ABC and significant improvements in finished products' first pass quality and higher plant-level quality, a significant decrease in manufacturing cycle time, and an indirect positive link between ABC use and manufacturing cost reduction via increases in quality and decreases in manufacturing cycle time. [11]

Similar to Ittner et al. (2002), Maiga and Jacobs (2008) also examined the association between ABC use and improved plant-level operational performances, namely quality, cost, and cycle time, and the extent to which these operational performances intervene between ABC and profitability. The study found that ABC itself does not have any direct impact on plant performance. Instead, the scope of ABC use, as measured by the number of functions, significantly improved the plant costs, quality, and cycle time, which subsequently improved the plant performance.

Unlike previous studies, Banker et al. (2008) focused on the mediating role of world-class manufacturing (WCM) capabilities between ABC implementation and plant-level

[11] Ittner et al. (2002) also used the system approach of contingency theory to examine the fit between ABC use and performance. Using this approach, the study found a weak relationship between ABC and financial performance based on the contingent fit between ABC and different plant factors including advanced manufacturing practices, the type of production, product volume, mix and new product introduction.

operational performance. Operational performance was captured by measuring the changes in quality (first pass quality yield), time (production lead time and cycle time), and cost (manufacturing cost) over the preceding five years. Finally, the mediating variable of WCM capability consists of JIT, pull system, total quality management (TQM), formal continuous process improvement, self-directed teams and competitive benchmarking. The study found that ABC directly influenced the adoption of WCM practices. Also, ABC positively and significantly improved operational performance when such improvement was mediated by capabilities provided by WCM practices. No direct significant relationship was found between ABC and operational performance.

While previous studies focused on ABC systems, Laitinen (2014) examined the effects of changes in the cost and pricing systems on financial performance. It was expected that changes in the cost system would have a positive impact on financial performance through the mediator role of pricing. The study found a significant, positive relationship between changes in cost systems and pricing systems, while changes in the pricing systems were negatively associated with performance at the 10% level. Cost system changes have a positive but insignificant influence on financial performance through pricing.

2.4.4 Critical evaluation of the cost system purposes and the cost system-performance literature

In previous sections, the outcomes of the cost system have been reviewed from two perspectives, namely the purposes of the cost system and the cost system-performance association. The purpose of the cost system literature (section 2.3) and cost system-performance literature (section 2.4) have been addressed mainly by ABC studies rather than CSS studies (Drury and Tayles, 2005; Brierley, 2007, 2008a). A closer look at these two streams of literature reveals several limitations.

First, no study to date has revealed any empirical evidence, whether via ABC or CSS studies, regarding the extent to which product planning and cost management can mediate the relationship between the cost system and organisational performance. It is argued that the ultimate aim in designing a cost system with activity cost pools and different volume and non-volume cost drivers is to direct the managerial actions towards better decision-making, such as pricing, cost reduction, and performance measures which in turn increases the organisation's profitability (Cooper and Kaplan, 1991b; Kennedy and Affleck-Graves, 2001; Cagwin and Bouwman, 2002; Ittner et al., 2002; Maiga and Jacobs, 2008; Xiao et al., 2011; Krumwiede and Charles, 2014). For example, Cooper and Kaplan (1991b, p. 130) stated that "ABC has emerged as a tremendously useful guide to management action that can translate directly into higher profits".

Most of the previous cost system-performance literature has focused on either the direct impact of the cost system on performance, or the interaction effect of ABC systems and other moderator variables on performance. Nonetheless, many studies have not found a direct link between the cost system and performance (Cagwin and Bouwman, 2002; Ittner et al., 2002; Maiga and Jacobs, 2003, 2008; Cagwin and Barker, 2006; Banker et al., 2008; Xiao et al., 2011; Pokorná, 2016). Despite the knowledge that can be obtained from investigating the direct and interaction effects of the cost system on performance, researchers argue that the relationship between the cost system and performance can be better understood by highlighting the variables that transform the effect of the cost system on performance, which reflect the mechanisms between the cost system and performance (Kennedy and Affleck-Graves, 2001; Banker et al., 2008; Maiga and Jacobs, 2008; Laitinen, 2014).

To date, only two studies have made a concerted effort to examine the single areas of either product planning or cost management as mediators between the cost system and performance (Maiga and Jacobs, 2008; Laitinen, 2014). However, these studies only show a partial picture because neither covers both product planning and cost management (see section 2.4).

To make a stronger statement regarding the superiority of cost systems in regard to financial benefits for organisations, there is an urgent need to investigate and compare the extent to which product planning and cost management transform the effect of CSS on performance. The importance of examining the mediator role of product planning and cost management rests on the fact that previous survey research has not empirically covered these two areas and that such an examination by the present study can extend the theory of the cost system-performance association, as each of these areas requires different cost information and a different approach to improving the profitability of the organisation. From this perspective, the result regarding the mediation role of product planning and cost management between CSS and performance can direct academics and practitioners' attention to those areas (product planning and/or cost management) that are most likely to benefit from a sophisticated cost system and positively contribute to the profitability of the organisation.

A second limitation is that most of the cost system literature did not differentiate between product planning and cost management when examining the relationship between the cost system and different decisions/purposes. Instead, each decision was examined separately and in isolation from other decisions (Shields, 1995; Swenson, 1995; Foster and Swenson, 1997; McGowan, 1998; Anderson and Young, 1999; Groot, 1999; Innes et al., 2000; Byrne et al., 2009; Pike et al., 2011; Abu-Mansor et al., 2012). Therefore, these studies do not allow for tracing the full potential impact of cost systems on the concepts of product planning and cost management, as reflected by a group of related decisions rather than single, isolated measures. Distinguishing between product planning and cost management, each of which is exhibited by a group of related decisions, is critical in order to scrutinise the extent to which a highly sophisticated cost system can improve product planning and/or cost management. This is because Kaplan and Cooper (1998) contend that an ABC system for product planning purposes may need fewer activity analyses than one that is used for cost management purposes. The authors argued that "[t]he designs of an ABC system can vary, depending on the intended benefits. Strategic systems may require relatively few activities (typically 20-60), while operational […] systems often require several hundred activities to provide a finer view of the processes that underlie production and customer services" (Kaplan and Cooper, 1998, p. 138). Schoute (2009) argued that a cost system is less likely to be able to simultaneously support both product planning and cost management purposes due to the different levels of sophistication required for each type of purpose (see section 2.2.2.6 for more information about Schoute's (2009) study). Therefore, the full potential of the impact of CSS for improving product planning and/or cost management remains to be tested through rigorous studies to evaluate whether a highly sophisticated cost system with many pools and cost drivers is able to support both product planning and cost management.

Furthermore, the majority of the cost system literature focused on an ABC sample alone, without comparing ABC to the traditional cost systems in order to scrutinise its acclaimed superiority over these (Shields, 1995; Swenson, 1995; Foster and Swenson, 1997; McGowan, 1998; Anderson and Young, 1999; Innes et al., 2000; Chenhall, 2004; Byrne et al., 2009; Pike et al., 2011; Abu-Mansor et al., 2012). Pizzini (2006) also argues that the results regarding the efficacy of ABC were modest, and many of these studies relied on a small sample. For example, Swenson (1995) and Chenhall (2004) investigated the efficacy of ABC systems based on a sample consisting of 60 and 64 participants, respectively.

A further limitation is the methodological approach employed to measure ABC by the ABC-performance studies. These studies defined the construct of ABC differently. For example, some researchers used a single question about the extensive use (Ittner et al., 2002) or extensive implementation of ABC (Banker et al., 2008; Maiga et al., 2014). As a result, these studies did not validate the respondents' claims about whether they actually implemented and used ABC systems; nor did they state the criteria for defining the extensive use or implementation of an ABC system.

Other studies defined the cost system differently by using multiple measures of ABC usage, such as the use of ABC by different departments, the purpose of ABC, the integration of ABC with strategic and performance evaluation (Cagwin and Bouwman, 2002; Maiga and Jacobs, 2008; Lee et al., 2010; Xiao et al., 2011), the adoption stages of ABC systems, such as considering, rejecting and use (Pokorná, 2016), the stages of ABC use, which included value chain analysis, ABC, and activity-based management (ABM) (Krumwiede and Charles, 2014), and ABC implementation factors, such as top management support (Maiga and Jacobs, 2003).

It was pointed out in section 2.2.3.1 that relying on a mere statement of ABC adoption is problematic. For example, these studies did not validate or consider the level of sophistication of ABC. It was argued in section 2.2.2 that cost systems, including ABC systems, can range from a simple to a sophisticated level, based on how many cost pools and cost drivers are incorporated into the cost system design. The ABC-performance studies treated ABC users/respondents as if they were using a homogenised ABC system, even though ABC systems can range from a simple design with few activity cost pools and drivers to a sophisticated design with many activity cost pools and cost drivers. Thus, using the number of cost pools and cost drivers as a measurement of CSS, which includes both ABC systems and traditional cost systems, can be considered a rigorous approach to reflect the degree to which the cost system in terms of sophistication can influence the improvement in product planning and cost management, and so, ultimately, organisational performance.

Finally, based on the above discussion, as well as the critical evaluation of cost system design literature regarding the contingent factors of CSS (section 2.2.3), this research aims to contribute to the literature on cost systems by adopting the mediation approach of contingency theory and examining simultaneously the influence of the antecedent factors on the level of CSS, which in turn is hypothesised to influence product planning and cost management decisions, and so, ultimately, the organisational performance (Gerdin and Greve, 2004). The mediation approach has provided insightful knowledge in the contingency-based MA research, as it can show simultaneously how MAS is affected by contingent factors combined with an exhibition of the mechanisms that link MAS to performance (e.g. Chong and Chong, 1997; Lau and Lim, 2002; Baines and Langfield-Smith, 2003; Hoque, 2004, 2011; Gerdin, 2005; Naranjo-Gil and Hartmann, 2006; Widener, 2007; Cadez and Guilding, 2008; Kallunki et al., 2011; Fullerton et al., 2014).

2.5 Chapter summary

The conceptual and empirical literature on cost systems has been presented from two perspectives. These include the ABC adoption and non-adoption approach, and the CSS approach. We have seen how the ABC adoption approach has dominated the cost system literature. Nonetheless, several limitations have been highlighted that entail further research based on the concept of CSS to uncover the antecedents and consequences of the level of sophistication of the cost system. Also, the purposes of cost systems have been discussed, which include product planning and cost management. It was indicated that these purposes were considered important outcomes of the cost system, affecting many different decisions and control areas. Finally, the literature that focused on the association between cost systems and performance was reviewed from various approaches, including the direct approach, the interaction approach, and, finally, the mediation approach. The limitations of previous literature have been highlighted, which reflect the urgent need for further research to investigate the contingent factors that influence the level of CSS, and the extent to which product planning and cost management mediate the CSS-performance association. With these limitations in mind, the next chapter will present a discussion of the contingency theory, the proposed research model, and the development of the research hypothesis.

Chapter 3: Theoretical Framework and Hypotheses Development

3.1 Introduction

In the previous chapter, three streams of literature were discussed, including cost system design, the purpose of cost systems, and the cost system-performance association. The objective of this chapter is to develop a theoretical model that links the antecedent factors to cost system sophistication (CSS) and clarifies the mechanisms whereby CSS influences performance through its contribution to product planning and cost management which, in turn, are expected to impact on performance. This chapter is organised as follows. In the next section, a brief introduction to contingency theory will be presented. Section 3.2.1 will discuss the different types of contingency fits, while section 3.2.2 will present the main criticism raised against contingency theory. Section 3.3 outlines the theoretical research model, while section 3.4 addresses the development of the research hypotheses that link together the research constructs of the theoretical model as well as the literature supporting the research hypotheses. The last section will summarise the information presented in this chapter.

3.2 Contingency theory

Contingency theory is one of the theoretical lenses that is often used in management accounting (MA) research to explain the various relationships between the different elements of the organisation, MA design, and outcomes (Hall, 2016; Hopper and Bui, 2016; Otley, 2016). It has also been used in different fields, including marketing (Chung et al., 2012), operations management (Flynn et al., 2010), human resource management (Datta et al., 2005), and strategic management (Hoetker and Mellewigt, 2009). It was developed in the organisational design field during the 1960s by a host of scholars like Burns and Stalker (1961) and Woodward (1965), who elaborated on the design of organisational structure, given the conditions in the environment and type of technologies used. During the 1970s, MA scholars introduced contingency theory in the realm of MA to examine a limited number of contingency factors, namely organisational structure and competition, in relation to management control systems (MCS) (Hopwood, 1972; Khandwalla, 1972; Otley, 1978). The contingency theory of the MA research has been expanded to include other contingency variables, like size, technology, and strategy (Chenhall, 2003).

Contingency theory asserts that there is no optimal design for organisational characteristics (e.g. structure) and systems (e.g. management accounting system) that can be applied universally to every organisation, but that such characteristics and systems should match the external (e.g. competition) and internal (e.g. size) requirements of the context in which the organisation operates in order to achieve effective outcomes (Otley, 1980, 2016; Fisher, 1998; Chenhall, 2003; Gerdin and Greve, 2004). This class of framework differs from the universalistic theories which affirm that there is only "one best way" to manage organisational characteristics in the sense that organisational performance is maximised when organisations maximise their characteristics, such as specialisation (Fisher, 1995; Donaldson, 2001, p. 3). Alternatively, contingency theory adopts a different view, asserting that there is no one optimal design or particular level of organisational characteristics, such as organisational structure or management accounting system (MAS), that can be applied equally across different contexts and consequently maximise organisational effectiveness (Drazin and Ven de Van 1985; Donaldson, 2001; Gerdin and Greve, 2004). Rather, the optimal design of the organisational structure or MAS depends on the context, and firms that fail to align their structure or MAS to the context experience a decline in performance due to the absence of fit (Donaldson, 2001; Gerdin and Greve, 2004). Therefore, the notions of fit represent important aspects of contingency theory (Gerdin and Greve, 2004; Chenhall and Chapman, 2006; Otley, 2016). The following section will discuss the various forms of fit that have been advanced and used in MA research.

3.2.1 Form of fit under contingency theory

Various notions of fit have been advanced by different scholars in various fields. In the organisational design literature, Drazin and Ven de Van (1985) elaborate on three types of fit, namely selection, interaction, and system fit. Venkatraman (1989) also discusses six types of fit, which include fit as moderation, mediation, gestalts, profile deviation, matching, and co-variation. Each type of fit leads to a different meaning of contingency theory as well as the anticipated empirical results. This is due to how fits are theoretically developed and statistically analysed (Drazin and Ven de Van 1985; Venkatraman, 1989).

Gerdin and Greve (2004) elaborate on the different types of fit as well as the various types of statistical analysis techniques that have been used in MA research. They provide a classification of fit that is driven by different schools of thought, particularly by combining the contingency research under one general framework. For example, Gerdin and Greve (2004) include the mediation perspective discussed by Venkatraman (1989) and the selection and interaction perspectives discussed by Drazin and Ven de Van (1985) under one general paradigm, namely the Cartesian perspective, with the aim of encouraging accounting researchers to be aware of the potential conflicts between the different types of fit and their required statistical analysis methods. The following paragraphs will discuss the contingency framework and their form of fits, as explained by Gerdin and Greve (2004).[12]

[12] While the literature of MAS consists of different review articles of the contingency MA research, this study relied on Gerdin and Greve (2004) because it introduces different types of fit from different fields as well as discussing the statistical analysis associated with each type of fit. This includes the mediation perspective, which represents one of the foundations of this study.

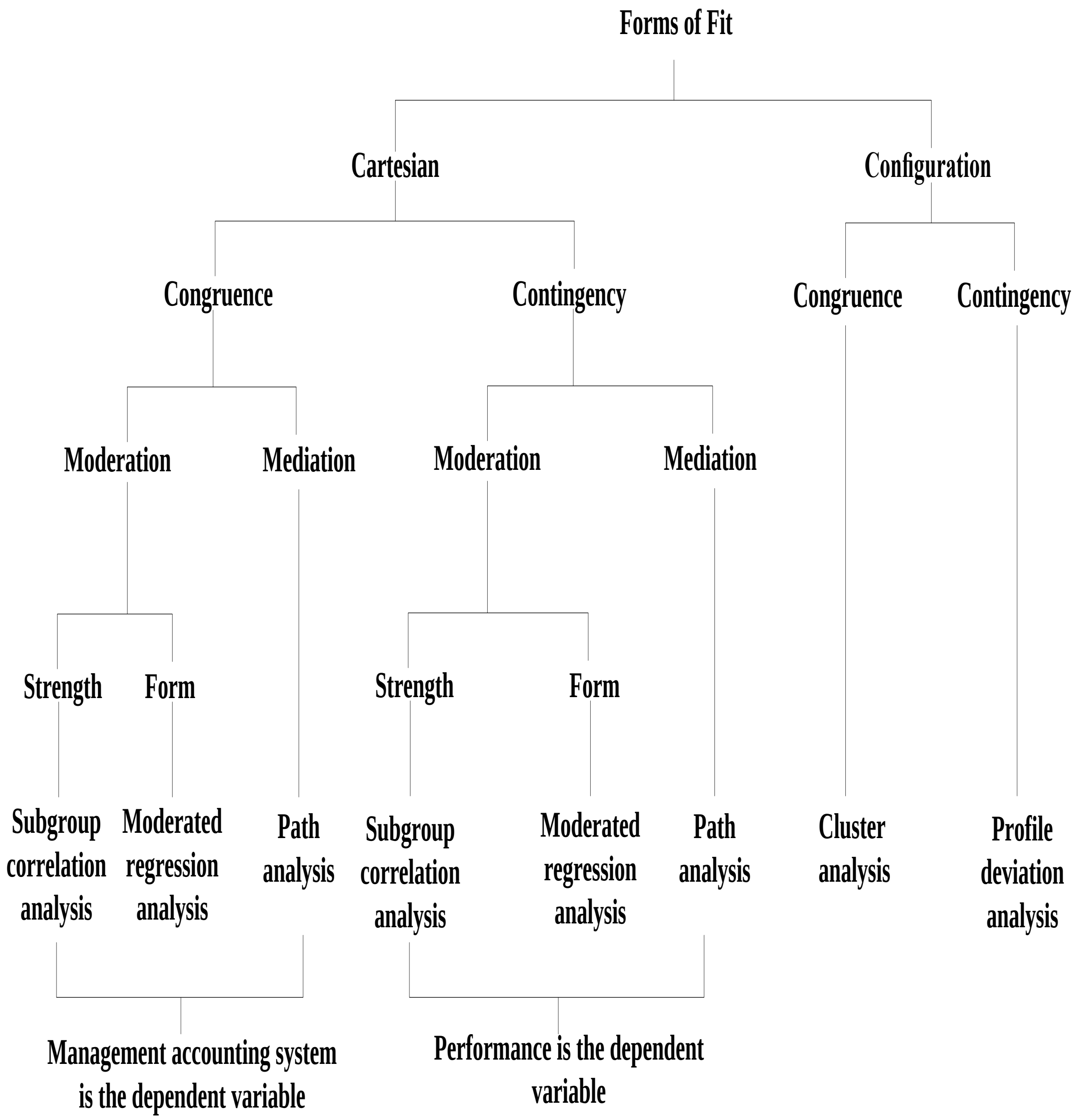

Figure 3.1: Framework of the different forms of contingency fit (adopted from Gerdin and Greve, 2004, p. 304).

Figure 3.1 above shows the classification of contingency fit. At the top level, Gerdin and Greve (2004) distinguish between two conflicting paradigms, namely the configuration and the Cartesian paradigm. The advocates of configuration argue that there are only a few states of fits that can be regained from a misfit state through the mechanism of quantum jumps from one state to another (Gerdin and Greve, 2004). The configuration approach of fit takes a holistic view, regarding fit as the internal consistency between multiple contingencies variables and structural elements (Drazin and Ven de Van 1985;

Gerdin and Greve, 2004). More specifically, fit can only be understood and investigated when many contingency variables and organisational structure elements are investigated simultaneously to show the different states of fit. The profile deviation analysis can examine simultaneous contingent factors and MCS with organisational performance. In this approach, researchers need to identify, either theoretically or empirically through regression analysis, the ideal profile (i.e., score) for a combination of contingent factors and MCS that is expected to represent a fit (Drazin and Ven de Van 1985; Govindarajan, 1988; Chenhall and Chapman, 2006). Then, the identified ideal profile is compared with the actual one to measure the distance between them (e.g. zero represent a fit while other scores represent a misfit) in order to examine the impact of the distance on performance.

In contrast, the Cartesian form of fit adopts a reductionist and molecular view by assuming that firms consist of several elements that can be investigated separately, and that fit can be regained by making continuous and incremental changes (Drazin and Ven de Van 1985; Gerdin and Greve, 2004). Unlike the configuration paradigm, the Cartesian paradigm focusses on investigating the effect of single contingency elements on single elements of structure or MAS, and how such a relationship can influence performance (Drazin and Ven de Van 1985; Gerdin and Greve, 2004). The configuration paradigm is rarely used in MA research while the Cartesian paradigm is the mainstream of contingency MA research (Gerdin and Greve, 2004; Chenhall and Chapman, 2006).

At the second level, Gerdin and Greve (2004) also differentiated between congruence and contingency. The congruence approach adopts the natural selection postulates that fit is the outcome of the ability of surviving firms continuously to adapt to the context while firms lacking adaptation ability will fail (Drazin and Ven de Van 1985; Gerdin and Greve, 2004). Under this type of contingency approach, the researcher's goal is to explore the nature of the relationship between the contingency variables and structure without considering performance, since it is assumed that surviving firms, given their context, are at optimal performance (Gerdin and Greve, 2004). In this regard, outcomes variables, such as performance, are not examined; instead, MAS is depicted as the dependent variable.

In contrast, the advocates of the contingency approach argue that, while some firms are moving closer to the optimal alignment between context and structure, other firms may not have achieved this yet (Drazin and Ven de Van 1985; Gerdin and Greve, 2004). This assumption allows researchers to expect both high- and low-performing firms to coexist at any point in time, as a consequence of their degree of success in combining the context and structure (Gerdin and Greve, 2004; Chenhall and Chapman, 2006). Thus, this perspective emphasises the importance of including outcomes variables, such as performance, as dependent variables in order to evaluate the degree of alignment between elements of the context and the organisational structure (Gerdin and Greve, 2004; Chenhall and Chapman, 2006).

At the third level of the Cartesian paradigm, relationships can be investigated using moderation or mediation analysis. Figure 3.2 below shows the moderation approach. The mode of moderation fit aims to examine the extent to which the effect of an independent variable on a dependent variable is conditioned by the value of a third variable, known as a moderator (Shields and Shields, 1998; Luft and Shields, 2003). In addition, moderation relationships can be modelled to evaluate either the strength or the form of the relationship (Gerdin and Greve, 2004; Chenhall and Chapman, 2006). The strength relationship aims to compare and test the “predictive ability” of the independent variable over the dependent variable, often across different levels of the moderator (e.g. a high competition group vs.

a low competition group) (Gerdin and Greve, 2004; Chenhall and Chapman, 2006). Alternatively, the form of relationship examines how the moderator variable affects the value of the slope of the association between the independent variable and dependent variable (Gerdin and Greve, 2004; Chenhall and Chapman, 2006). This examination is usually depicted by multiplying the independent variable and moderator variable to produce an interaction term that reflects different combinations of the values of these two variables, which can be then examined with the outcome variable (Luft and Shields, 2003; Chenhall and Chapman, 2006). Moderation can be used under the congruence or contingency of the Cartesian paradigm, depending on whether the dependent variable is the MAS or performance.

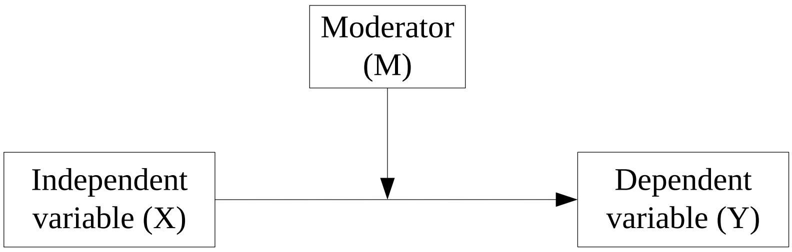

Figure 3.2: The moderation approach.

In contrast to the moderation approach, mediation models have a different meaning for fit, as shown in Figure 3.3. The mediation approach only shows the causal paths between the independent, mediator and outcomes variables to examine the direct and indirect relationships between them (Shields and Shields, 1998; Luft and Shields, 2003). The mediation form of fit is established when the impact of the independent variable (X) on the dependent variable (Y) operates through the mediator variable (M) (Gerdin and Greve, 2004). Similar to moderation, mediation can be applied under the congruence and contingency of the Cartesian paradigm, depending on whether the dependent variable is the MAS or performance.

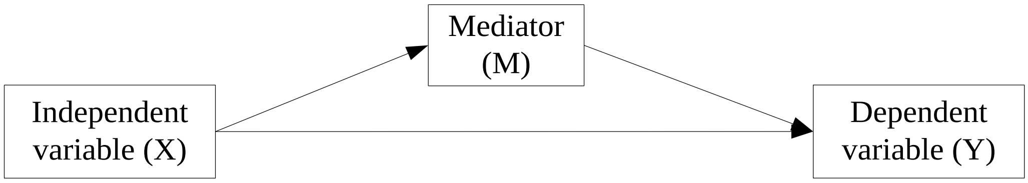

Figure 3.3: The mediation approach.

Further, Gerdin and Greve (2004) briefly discussed a third approach under the Cartesian/congruence approach, which is the direct model, as shown in Figure 3.4. Under this type of approach, fit exists when the independent variables (e.g. competition) have a significant effect on the dependent variable (e.g. MAS). Performance analysis is excluded under this approach because it is assumed that only the best performing firms survive. This approach represents the majority of research that examines the relationship between contingency variables and cost system design, whether measured by ABC adoption vs. non-adoption, or the level of CSS (Shim, 1996; Bjørnenak, 1997; Gosselin, 1997; Nguyen and Brooks, 1997; Booth and Giacobbe, 1998; Krumwiede, 1998; Clarke et al., 1999; Malmi, 1999; Hoque, 2000; Baird et al., 2004; Brown et al., 2004; Bhimani et al., 2005; Drury and Tayles, 2005; Al-Omiri and Drury, 2007; Brierley, 2007, 2008a; Askarany et al., 2012; Phan et al., 2014; Al-Sayed and Dugdale, 2016). Having discussed the different types of fit used in MAS, the following section will present the main criticisms of the contingency theory.

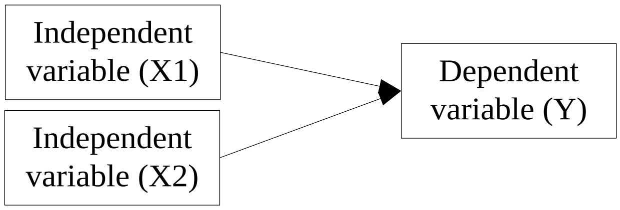

Figure 3.4: The direct approach.

3.2.2 Criticism of contingency theory

While contingency theory has been widely used in MA research, it has been subject to criticism in several ways. First, the congruence perspective has been criticised by organisational and MA scholars (Ittner and Larcker, 2001; Gerdin and Greve, 2004; Chenhall and Chapman, 2006; Otley, 2016). This perspective adopts the natural selection postulate, which excludes outcomes variables from the analysis of the contingency variable-MAS association, because it assumes that surviving firms tend to be at optimal performance due to their ability to adapt to the environment (Gerdin and Greve, 2004; Chenhall and Chapman, 2006). This postulate implies that companies make the best choices in order to optimise the MAS that best suits their context (Gerdin and Greve, 2004; Chenhall and Chapman, 2006). Based on this assumption, it will be impossible to identify a company that has not optimised its MAS and aligned with its context, as it will not have survived. In other words, the existence of a firm implicitly proves that it has aligned its MAS and practices with its internal and external contingent elements, so examining the outcome variables, such as performance, becomes irrelevant.

As mentioned above, the congruence perspective dominates the literature on cost system research. These studies focus completely on examining the influence of one or more contingent variable on the cost system by implicitly assuming that all companies, given their context, are optimising their cost system design, be it simple or sophisticated in nature. Therefore, they exclude outcomes, such as performance and decision-making from their studies, assuming that surviving firms are at optimal outcomes.

Nonetheless, scholars indicate that firms can experience a misfit and continue to exist for a prolonged period of time even though their performance deteriorates (Donaldson, 2001; Hall, 2016). Therefore, it is implausible to assume that a misfit company will not continue to exist or cannot be observed (Ittner and Larcker, 2001; Chenhall and Chapman, 2006; Otley, 2016). In addition, Ittner and Larcker (2001) and Otley (2016) argue that the notion that surviving firms are optimising all the time with respect to accounting practices is irrational and unrealistic in the real world. Ittner and Larcker (2001), therefore, suggest that "people learn to make good decisions and that organizations adapt by experimentation and imitation, so there is at least 'fossil evidence' available for testing theories" (Milgrom and Roberts, 1992 as cited in Ittner and Larcker, 2001, p 399). In this regard, companies can experience a discrepancy between their contextual environment and accounting systems, which they may eliminate by the process of learning, experimentation, or imitation.

Another debate within contingency theory is whether the mediation approach belongs to this theory or not. Burkert et al. (2014) argued that the mediation perspective does not form part of contingency theory. They contended that mediation does not show the different states of fit and misfit between context and MAS. For example, if a theory predicts that high/low values of contingency variable and MAS are expected to achieve high performance, the mediation perspective cannot prove such a relationship because it cannot show the misfit states, such as whether a low value of context with a high value of MAS will reduce performance. However, this can be considered a limitation of the mediation perspective, as Venkatraman (1989) argued that the mediation is less precise, based on his comparison of the specificity of fit between mediation and moderation. He stated that "[l]ike moderation, this [mediation] perspective is anchored with respect to a particular criterion variable. However, the functional form of fit is, viewed simply as indirect effects, **less precise** than the moderation perspective (strength, form, quadratic effects, etc.)" (Venkatraman, 1989, p. 429). Based on this, the mediation fit cannot explore the different states of fit and misfit. Alternatively, it depicts fit as a mechanism whereby a mediator variable is caused by the independent variable and causes variation in the outcome variable (Venkatraman, 1989; Hartmann and Moers, 1999; Gerdin and Greve, 2004).

Despite the debate about the mediation perspective, Hall (2016, p. 63) used the term "contingency-based research" instead of "contingency theory" to differentiate between "contingency approach to MA research and the precise theory(ies) mobilised in a particular study". In this regard, the researcher indicates that contingency-based MA research "seeks to understand how the operation and effects of management accounting practices are not 'universal'— they depend on the different contexts within which those practices operate" (Hall, 2016, p. 63). Therefore, Hall argues for the relevance of using different theories, such as psychology, in contingency-based MA research as well as the appropriateness of using moderation and mediation analysis to test different relationships in contingency-based MA research. The mediation perspective has been used widely in contingency-based MA research to explain different relationships. For example, Otley (2016) reviewed contingency MA research, including studies that incorporate mediation analysis, and classified contingency MA research, based on the complexity of the analysis into three levels, which include the mediation model (e.g. Chong and Chong, 1997; Lau and Lim, 2002; Baines and Langfield-Smith, 2003; Hoque, 2004, 2011; Gerdin, 2005; Naranjo-Gil and Hartmann, 2006; Widener, 2007; Cadez and Guilding, 2008; Kallunki et al., 2011; Fullerton et al., 2014).

3.3 Theoretical research model

It is recommended that a theory should be provided at the beginning of a study in order to provide a theoretical foundation that can help the researcher determine the nature of the research literature, the research questions, the type of methodology used to collect the required data, the analysis procedures and interpretation of the research findings (Creswell and Plano Clark, 2011). Several theories have been used in MA and cost system research, such as contingency theory, new institutional sociology (NIS), and old institutional economics (OIE) (Powell and DiMaggio, 1991; Burns and Scapens, 2000; Soin et al., 2002; Luft and Shields, 2003; Al-Omiri and Drury, 2007). While institutional theories (e.g. NIS and OLE) have been useful for explaining the changes or lack of changes of the cost system within organisations using in-depth single case studies (see Soin et al., 2002; Yazdifar et al., 2008), they are not appropriate for the current study, due to the fact that they do not allow for the collection of sufficient data from a large number of companies in order to investigate the extent of the variability of the cost system practices among a large number of companies, which is necessary to achieve the research aims. Instead, contingency theory is adopted to act as a theoretical foundation for the current study to inform the interpretation of the research findings, because it recognises the role of fit to explain the effect of the external and internal factors of the organisational business environment on the design of the cost system, in addition to using the organisational performance as an outcome variable to assess the functionality of MAS and cost systems (Chenhall, 2003; Gerdin and Greve, 2004). Thus, this research argues that contingency theory can provide a conceptual framework that is in line with the research questions and objectives, one which entails the use of a research methodology that can permit the research findings to be generalised statistically to the research population.

Fisher (1995, p. 24) suggests that “[t]he ultimate goal of contingent control research should be to develop and test a comprehensive model that includes multiple control systems, multiple contingent variables, and multiple outcome variables”. Additionally, several case studies have shown the appropriateness of contingency theory for MAS sophistication (Tillema, 2005) as well as CSS (Abernethy et al., 2001). For example, Tillema (2005, p. 102) suggests that "the appropriateness of using sophisticated techniques may depend on the circumstances in which these techniques are being used. This would give rise to the need to adopt a contingency theory perspective". Therefore, this research is motivated to construct a holistic model that links contingency factors to CSS, as well as linking CSS to organisational performance through the mediation role of product planning and cost management. Figure 3.5 below depicts the research model.

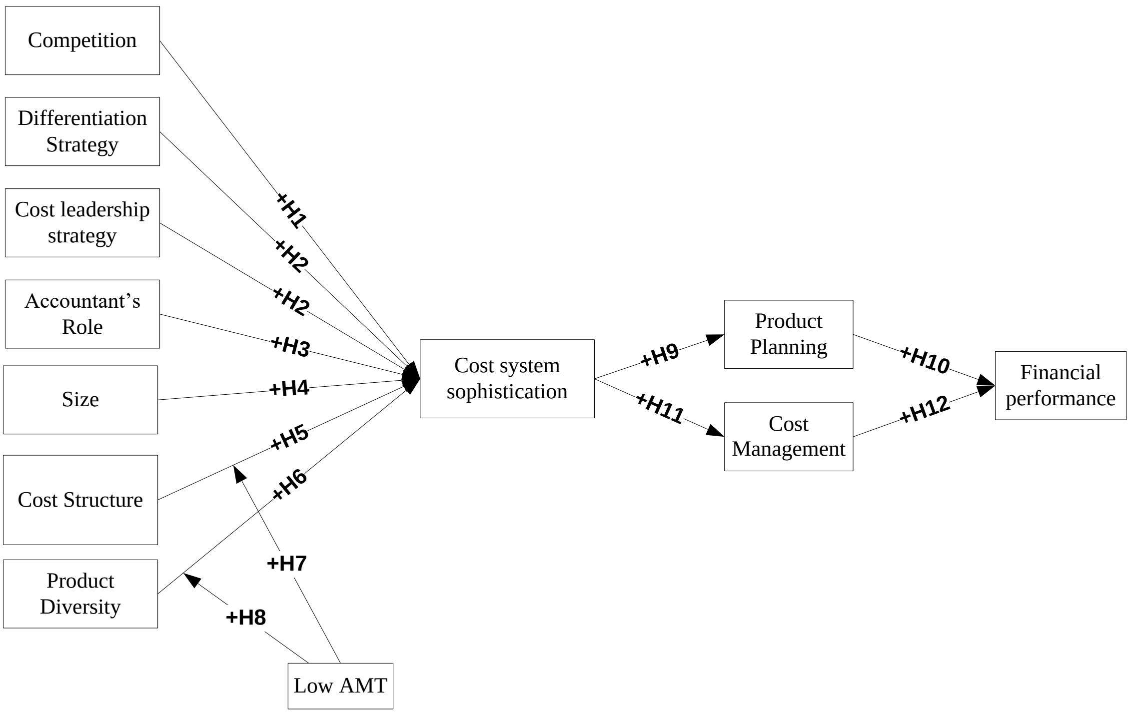

Figure 3.5: Research model of the antecedents and consequences of CSS.

The research model draws on three streams of cost system literature, the first of which is reviewed to identify the most important contingent factors that can influence the level of CSS (Shim, 1996; Bjørnenak, 1997; Gosselin, 1997; Nguyen and Brooks, 1997; Booth and Giacobbe, 1998; Krumwiede, 1998; Clarke et al., 1999; Malmi, 1999; Hoque, 2000; Baird et al., 2004; Brown et al., 2004; Bhimani et al., 2005; Drury and Tayles, 2005; Al-Omiri and Drury, 2007; Brierley, 2008a; Askarany et al., 2012; Phan et al., 2014; Al-Sayed and Dugdale, 2016). Based on this stream of literature, it is expected that competition, the role of management accountants, business strategy (differentiation and cost leadership strategy), size, cost structure, and product diversity can positively influence CSS (H1-H6). In addition, this research also investigates the extent to which the role of AMTs moderate the relationships between the cost structure and CSS, and product diversity and CSS (H7-H8).

These seven contingency factors were chosen because, while they represent the most important factors that can influence the design of a cost system, they lack conclusive empirical evidence due to the theoretical and methodological issues in prior research (as presented in sections 1.3 and 2.2.3).[13] There are other important factors that were excluded from the investigated research model because their inclusion would have increased the length of the questionnaire and consequently may have reduced the response rate. For example, industry type can influence the design of the cost system because it is argued that companies with discrete production facilities may not use sophisticated cost systems when compared to those with continuous production processes because the former relies on make-to-order production, which increases the levels of uncertainty and consequently makes it more difficult to handle sophisticated cost systems (Krumwiede, 1998; Ittner et al., 2002).[14]

Additionally, it draws on a second stream of literature that examine the success of ABC systems in terms of decision-making related to product planning and cost management (Innes and Mitchell, 1995; Shields, 1995; Swenson, 1995; Foster and Swenson, 1997; Anderson and Young, 1999; Innes et al., 2000; Cotton et al., 2003; Cohen et al., 2005; Baird et al., 2007; Maiga and Jacobs, 2007; Nassar et al., 2009). While many of these

[13] Justification for these contingent factors will be discussed in the following section.
[14] There are other new contingent factors that were reported in chapter 7 as these were uncovered from the field interview.

studies focused mainly on ABC users alone, they provided empirical evidence that ABC success was associated with many individual areas of product planning and cost management. Therefore, this research attempts to examine the extent to which CSS can influence product planning and cost management applications (H9 and H11).

Finally, it draws on a third stream of literature that mainly focused on examining the relationship between cost system and performance (Frey and Gordon, 1999; Kennedy and Affleck-Graves, 2001; Cagwin and Bouwman, 2002; Ittner et al., 2002; Maiga and Jacobs, 2003, 2008; Cagwin and Barker, 2006; Banker et al., 2008; Xiao et al., 2011; Krumwiede and Charles, 2014; Pokorná, 2016). Many of these studies could not detect a direct link between ABC system and performance (Gordon and Silvester, 1999; Cagwin and Bouwman, 2002; Ittner et al., 2002; Maiga and Jacobs, 2003, 2008; Cagwin and Barker, 2006; Banker et al., 2008; Xiao et al., 2011; Pokorná, 2016). The failure to find a link between cost system and organisational performance may suggest that this relationship should be understood as an indirect link caused by the cost system's contribution to product planning and cost management which, in turn, is expected to positively influence organisational performance (H10 and H12). The following section outlines the literature that supports the hypotheses development, in the order mentioned above.

3.4 Research hypotheses development

3.4.1 Competition and cost system sophistication

Different changes in the external environment, namely the deregulation of the market, the expectation of consumers, and the move from local to global competition, have increased the competition, which heightens the competitive environment (Otley, 1994; Mia and Clarke, 1999; Hoque et al., 2001; Baines and Langfield-Smith, 2003). The rapid rise of the competitive environment has motivated companies to seek a superior, sophisticated cost system design that can supply accurate cost information for planning and operational decisions as well as avoid the cost of errors associated with such decisions (Cooper, 1988b; Bjørnenak, 1997; Nguyen and Brooks, 1997). The cost of errors occurs when the cost system supplies incorrect cost information, resulting in wrong decisions, which can weaken the competitive position of organisations in their markets, such as through continuing to sell unprofitable products and ceasing producing profitable ones (Cooper, 1988b).

In a highly-competitive environment, Cooper (1988b) highlights that a simple cost system can lead to poor product decisions regarding aggressively selling unprofitable products, over-costing high-volume ones and under-costing low volume ones. In this case, there would be a high possibility that competitors may have a chance to pursue products that were incorrectly over-priced due to the arbitrary measurement of costs (Malmi, 1999; Drury and Tayles, 2005; Pavlatos and Paggios, 2009). Many other decisions, such as resource forecasting, outsourcing and product design, can also be affected by the arbitrary measurement of costs (Innes and Mitchell, 1997; Anderson and Sedatole, 1998; Kaplan and Cooper, 1998; Gunasekaran, 1999; Wouters et al., 2005). For example, in a highly-competitive environment, product designers may be encouraged to design a product that can consume fewer costs to reduce the cost of the product and so gain a competitive advantage. In this case, an unsophisticated cost system with limited volume cost drivers, such as labour hours, may direct product designers towards focusing on labour cost savings while ignoring overhead costs. However, this strategy may not reduce the cost of the products when the labour costs represent only a small fraction of the total costs, while overhead costs represent a large percentage of these costs. Therefore, a sophisticated non-volume-base cost system is capable of providing details and accurate cost information by linking resource costs to the activities that cause them and then allocating these costs to products based on cause-and-effect cost drivers.[15] This, in turn, can enhance the position of organisations that facing high competition, by increasing the accuracy of their decision-making and subsequently decreasing the cost of errors (Mishra and Vaysman, 2001; Sheu and Pan, 2009).

Empirical evidence shows conflicting findings regarding the effect of competition on the choice of cost system. For example, Bjørnenak (1997), Cohen et al. (2005), and Brierley (2008a) found that competition was not associated with ABC adoption, while Drury and Tayles (2005) and Brierley (2007) found no association between competition and CSS level. On the other hand, Malmi (1999) found that competition significantly led to ABC adoption, while Al-Omiri and Drury (2007) found competition to be significantly associated with CSS level. These conflicting results may be attributed to the measurement of the competition, which neither captures nor accounts for the different dimensions of competition, as mentioned in section 2.2.4.4 of chapter two. More specifically, Drury and Tayles (2005, p. 78) and Brierley (2011, p. 246) argue that the non-significant association between competition and cost system design, as reported by previous studies, is due to the measurement of competition, which was based on one or two questions that cannot capture the different dimensions of competition, and does not provide adequate construct validity. In MA research, competition is perceived to exist in different dimensions, such as material competition and product design competition (Mia and Clarke, 1999; Hoque, 2011). For example, Mia and Clarke (1999) found empirical evidence that competition is a multifaceted construct that requires the use of different dimensions to capture its full scope. The study found that competition is positively related to MAS use. Therefore,

[15] The concept of sophisticated non-volume-based cost systems is used in this chapter to refer to sophisticated ABC systems.

further research is needed to re-examine the association between the role of competition, as measured by different dimensions, and CSS level. Thus, the following hypothesis will be tested:

H1: The level of competition is positively related to cost system sophistication.

3.4.2 Business strategy and cost system sophistication

The business strategy adopted by the business unit outlines their future goals and objectives as well as how the top management aims to compete against competitors in their industry (Hambrick, 1983; Shank and Govindarajan, 1993; Langfield-Smith, 1997). Various scholars have advanced different classifications of business strategies. Miles and Snow (1978) describe three types of successful business strategy, namely prospectors, analysers, and defenders, while Porter (1980) differentiates between differentiation, focus, and cost leadership. Prior research has suggested that insignificant differences exist between these classifications, such that they can generally be viewed as a continuum, with defenders/cost leaders at one end, and prospectors/differentiators at the other (Miller, 1987; Ittner et al., 1997; Abernethy and Lillis, 2001; Abdel-Kader and Luther, 2008; Jarrar and Smith, 2014). Nonetheless, the developers of these strategic models contend that organisational characteristics, such as structure and MAS, are expected to differ across these types of strategies (Miles and Snow, 1978; Porter, 1980; Gerdin and Greve, 2004).

Defenders/cost leaders operate in a fairly stable market environment that is characterised by disengagement from market/product development, low uncertainty and strong production economies of scale to improve the efficiency of the operations (Miles and Snow, 1978; Porter, 1980; Govindarajan, 1986; Frey and Gordon, 1999). It is also expected that these business units will produce a narrow range of standardised, high-volume products, thereby resulting in low product diversity (Govindarajan, 1986; Gosselin, 1997; Bhimani et al., 2005). Consequently, it could be argued that unsophisticated cost systems are more likely to be relevant to defenders/cost leaders, since they produce a limited number of standardised products which are not expected to lead to high product cost distortion through cross-product subsidisation (Gosselin, 1997; Bhimani et al., 2005; Pavlatos, 2010). However, several researchers have argued that defenders/cost leaders may require sophisticated non-volume-based cost systems to identify the activities that can be eliminated or reduced in order to achieve cost savings and thus enable these companies to bring the cost of their operations down lower than that of their competitors (Chenhall and Langfield-Smith, 1998; Malmi, 1999; Drury and Tayles, 2005).

In contrast to defenders/cost leaders, prospectors/differentiators operate in a relatively uncertain environment and compete by initiating changes in their industry by searching for new opportunities in the market and introducing new innovative products that constitute attributes that are valued by customers (Miles et al., 1978; Porter, 1980). They seek uniqueness by quickly and flexibly adapting to the changing needs of customers, and producing a wide range of customised products that are superior in terms of design, quality, and brand image (Gosselin, 1997; Bhimani et al., 2005; Ward et al., 2007; Kennedy and Widener, 2008). Since prospectors/differentiators face high uncertain tasks and many options in their environment, which require a relatively large information-processing capacity, sophisticated non-volume-based cost systems can support these firms by providing broad-based information that can highlight new strategic priorities (Gosselin, 1997; Bhimani et al., 2005; Jarrar and Smith, 2014).

In addition, given that prospectors/differentiators produce a wide variety of customised products to meet their different customers' needs, a sophisticated non-volume-based cost system is more relevant in this environment in order to accurately measure the overhead consumption demanded by different products (Gosselin, 1997; Kaplan and Cooper, 1998; Bhimani et al., 2005; Pavlatos, 2010).

Malmi (1999) argued that ABC systems are more appropriate for enabling cost leaders to improve the cost effectiveness by providing accurate cost information to control costs and price products accurately. The study did not find a link between ABC and cost leadership strategy. Moreover, Frey and Gordon (1999) found that business strategy in terms of cost leadership and differentiation has no influence on ABC adoption, but that ABC improved performance in companies following a differentiation strategy but not in cost leadership. Based on data drawn from 161 Canadian manufacturing firms, Gosselin (1997) provided evidence that prospectors adopted activity management (AM), which included ABC, more than defenders. Nevertheless, given the importance of the contingency role of business strategy in determining MAS design (Chenhall, 2003; Gerdin and Greve, 2004), the empirical evidence of the implications of business strategy for cost system design: (1) mainly focused on one aspect of cost system design, namely "ABC"; (2) was often hampered by a small sample size that included very few ABC users (Frey and Gordon, 1999; Elhamma and Zhang, 2013); (3) was based on a single item as the measurement for business strategy, which does not reflect the different dimensions of business strategy (Gosselin, 1997; Malmi, 1999; Bhimani et al., 2005); and (4) produced modest results (Gosselin, 1997). Examining the association between business strategy and cost system based on a large sample, with a focus on new attributes that reflect the sophistication level of the cost system, will increase our knowledge about the most important attributes of a sophisticated cost system that are required by the type of business strategy. Therefore, the following hypothesis will be tested:

H2: Firms pursuing a differentiation strategy are more likely to implement highly sophisticated cost systems than those pursuing a cost leadership strategy.

3.4.3 Role of management accountants and cost system sophistication

Academics emphasise the importance of management accountants' role in supporting the decision-making process and adopting innovative and sophisticated MA techniques, such as ABC, target costing, and balanced scorecard that provide broad scope information that can strengthen the competitive advantages of modern organisations (Kaplan, 1986a; Johnson and Kaplan, 1987; Friedman and Lyne, 1997; Abernethy and Lillis, 2001; Emsley, 2005; Hartmann and Maas, 2011). Different classifications have been advanced to reflect the characteristics of the management accountants' role. On the one hand, the terms "bookkeeper", "bean counter", and "watchdog" have been advanced to describe the passive role of management accountants (Hopper, 1980; Mouritsen, 1996; Emsley, 2005; Burns and Baldvinsdottir, 2007; Hagel, 2015). In this role, it has been argued that management accountants lack involvement and interaction with the companies' different managers and mainly focus on providing detailed historical and financial information that does not support the strategic position of modern organisations (Hopper, 1980; Mouritsen, 1996; Emsley, 2005; Burns and Baldvinsdottir, 2007; Hagel, 2015).

In contrast, "service aid", "consulting ", "business orientation" or "business partner" have been designated to reflect the active role of management accountants (Hopper, 1980; Siegel, 2000; Emsley, 2005; Byrne and Pierce, 2007; Langfield-Smith, 2008; Maas and Matějka, 2009). This role encompasses the active participation of management accountants in the operational as well as strategic decision-making processes, the provision of MA information for other non-accounting business managers, and the orientation towards teamwork with non-accountant managers, such as operational managers, which subsequently enables management accountants to understand the process and improve the cost management information (Hopper, 1980; Siegel, 2000; Emsley, 2005; Byrne and Pierce, 2007; Langfield-Smith, 2008; Maas and Matějka, 2009).

In support of the above argument, Johnston et al. (2002) conducted a field study of six UK case studies and identified several factors that represent the prerequisites for the successful involvement of management accountants in radical process change initiatives, including a strong knowledge of the business processes and operations, flexibility, teamwork skills, strong communication, interpersonal skills, and well-developed, automated computerised accounting systems to free management accountants from traditional accounting tasks. It could be argued that these factors are also important for management accountants' involvement in developing ABC systems since scholars have viewed ABC implementation as a change project that can radically modify the organisational operations and activities, and overhead allocation process (Argyris and Kaplan, 1994; Estrin et al., 1994; Kaplan and Cooper, 1998).

Designing and implementing a sophisticated non-volume-based cost system demands that management accountants be released from traditional accounting tasks. This is due to the fact that such a system is costly and requires a lot of work (Anderson, 1995; Gunasekaran and Sarhadi, 1998; Innes et al., 1998; Kaplan and Cooper, 1998; Pizzini, 2006) in terms of: (1) understanding the organisational activities that cross departmental boundaries; (2) identifying and collecting costs for each activity cost pool; (3) identifying the appropriate cost drivers that match the cost pool overhead costs; and (4) training and educating users on how to use the new system (Cooper and Kaplan, 1991a; Innes et al., 1998; Kaplan and Cooper, 1998). For example, case studies have documented that replacing traditional cost systems with ABC systems is a complex process that can take several years to finalise

(Anderson, 1995; Chenhall and Langfield-Smith, 1999).

Estrin et al. (1994, p. 40) also argue that the “implementation of ABC requires a complex, comprehensive, process that is costly and time-consuming”. In this regard, management accountants with extensive business knowledge will be keener to provide insights that can tailor the design of the new system towards integrating the requirements of different departments, including the production, marketing and purchasing departments (Cadez and Guilding, 2008). In contrast, management accountants who possess an accounting orientation will be less knowledgeable about the business activities and the sort of information that is important for non-accounting departments, and thus may be insufficiently skilled to design innovative systems that can address the needs of different users (Emsley, 2005).

Johnston et al. (2002) interviewed operational managers to investigate the role of management accountants in change projects. The study found that management accountants “who worked closely with operations managers in process change appear to be non-traditional accountants, who act as facilitators” (Johnston et al., 2002, p. 1336). In contrast, management accountants, who did not positively contribute to the change project were regarded by the operational managers as lacking the required skills and knowledge for the change projects and focused on “preventing things from happening” (Johnston et al., 2002, p. 1331). On the other hand, based on eight case studies, Cooper et al. (1992b) showed that the companies that implemented ABC systems experienced difficulties due to organisational and behavioural factors, and, above all, the fact that the ownership of the ABC system design was controlled by the accounting employees.

In addition, management accountants with business knowledge spend much of their time out of the accounting function and alongside different managers, so consequently they become more accustomed to the types of decisions that non-accounting managers make (Merz and Hardy, 1993; Argyris and Kaplan, 1994; Clarke et al., 1999; Emsley, 2005; Scapens, 2006; Cadez and Guilding, 2008). This entails management accountants being trusted by senior managers when advocating the development of new systems (Emsley, 2005). In this regard, they can demonstrate and justify the benefits and costs of the new cost system to the managers and convince them about the value of investing in such a system (Argyris and Kaplan, 1994). Chenhall and Langfield-Smith (1999, p. 41) conducted three case studies and revealed evidence that the management accountants who were found to possess distinctive communication skills and the ability to jointly work with operational managers were the ones who triggered the idea of ABC adoption and facilitated the design and implementation of ABC systems.

Based on the above discussion, as well as the importance of examining the role of management accountants (see section 2.2.3.2 of chapter 2), the following hypothesis will be tested:

H3: The business unit orientation of management accountants is positively related to cost system sophistication.

3.4.4 Size and cost system sophistication

Organisational size represents one of the most important contingency factors in MA research (Chenhall, 2003). As companies grow in size, the more benefits can be recognised in terms of greater human and financial resources, efficiency improvement and labour specialisation (Glancey, 1998; Chenhall, 2003; Doğan, 2013). The higher knowledge and resources in terms of finance and humans that are available to larger rather than smaller firms are considered to be an advantage with regard to experimenting with sophisticated non-volume-based cost systems (Parker and Lettes, 1991; Nguyen and

Brooks, 1997; Booth and Giacobbe, 1998; Krumwiede, 1998; Groot, 1999; Al-Omiri and Drury, 2007). This is because implementing and operating a sophisticated cost system like ABC is considered costly because it requires the involvement of a heterogeneous team, external consultation, cost drivers and activity analysis, extensive training and high-quality IT (Krumwiede, 1998; Liu and Pan, 2007; Nassar et al., 2009; Pike et al., 2011; Fadzil and Rababah, 2012).

Furthermore, larger organisations are expected to have a greater diversity and complexity of activities and resources (King et al., 2010), implying that they possess a diverse range of products and customers (Drury and Tayles, 2005). This necessitates the use of highly-sophisticated non-volume-based cost systems in order to accurately measure the consumption of resources by different products (Drury and Tayles, 2005).

Many other studies also found the adoption and implementation of ABC systems to be positively associated with larger firms (Drury and Tayles, 1994; Lukka and Granlund, 1996; Krumwiede, 1998; Clarke et al., 1999; Groot, 1999; Malmi, 1999; Baird et al., 2004; Brown et al., 2004). Al-Omiri and Drury (2007) found that size is positively associated with sophisticated cost systems, as measured by the number of cost pools and cost drivers, while Brierley (2007) found that size was only associated with the number of cost pools. Thus, this study will test the following hypothesis:

H4: Size is positively related to cost system sophistication.

3.4.5 Cost structure and cost system sophistication

Lukka and Granlund (1996) indicated that a company’s cost structure represents an important factor that affects the type of costing methods used by companies. Both simple and sophisticated cost systems can easily and accurately trace direct costs to the cost objects (Drury and Tayles, 2005; Al-Omiri and Drury, 2007). In contrast, the proportion of overhead costs to total costs has become an important factor that can influence the functionality of the cost system (Abernethy et al., 2001; Chan and Suk-Yee Lee, 2003; Pizzini, 2006). Relying on a traditional, simple cost system in a business environment, in which the proportion of overhead costs is large, will lead to cross-subsidising between products, thus negatively affecting the quality of the decision-making (Cooper and Kaplan, 1988a; Bjørnenak, 1997; Al-Sayed and Dugdale, 2016).

A possible remedy for decreasing the amount of distortion in the cost information provided by the traditional simple cost system is to adopt a sophisticated non-volume-based cost system like an ABC system. By emphasising the activity analysis, a sophisticated non-volume-based cost system will depict the overhead costs into unit, batch, and product-sustaining level activities, each of which can have its own cost drivers, thus allowing firms to track the diverse overhead consumption of different activities by products (Cooper and Kaplan, 1988b; Kaplan and Cooper, 1998). This enables the provision of accurate cost information to make the right decisions, such as shifting the demand for activities from unprofitable products to profitable ones.

Empirical evidence from European countries indicates in general that material costs are the highest costs followed by overhead costs, with labour costs being the lowest (Brierley et al., 2001). In the US, Miller and Vollmann (1985) advocated the use of activity analysis, as they observed that the percentage of overhead costs in American industry has increased from about 48% to 72% from 1855 to 1975. While it is well-established, both theoretically and logically, that increases in overhead costs necessitate increases in the number of cost pools and cost drivers to measure overhead costs accurately, prior research tends not to find any effect of cost structure on ABC adoption or CSS (Nguyen and Brooks, 1997; Clarke et al., 1999; Groot, 1999; Brown et al., 2004; Drury and Tayles, 2005; Al-Omiri and Drury, 2007; Brierley, 2008a; Pokorná, 2015). Nevertheless, the possible reasons outlined in prior research may preclude the detection of such relationships, including: (1) the low number of ABC users in certain prior research samples (Nguyen and Brooks, 1997; Clarke et al., 1999; Groot, 1999; Brown et al., 2004; Brierley, 2008a); (2) the fact that some of the previous research relied on a small sample, which can lack the power to detect such relationships (Nguyen and Brooks, 1997); and (3) the heterogeneity of the sample used by some of prior research, which included both manufacturing and service companies (Brown et al., 2004; Drury and Tayles, 2005; Al-Omiri and Drury, 2007).[16] Given the importance of cost structure for cost system design and the limitations associated with prior research, the following hypothesis will be tested:[17]

H5: The level of indirect costs is positively related to cost system sophistication.

3.4.6 Product diversity and cost system sophistication

Seeking to fulfil customers' desires by producing different, customised products, so-called product diversity, has become one of the strategies that companies pursue (Bjørnenak, 1997; Langfield-Smith, 2006; Ward et al., 2007). Typically, product diversity appears in situations where companies produce different products that consume different proportions of the activity resources (Cooper, 1989a).

Greater product diversity has become an extra problem in product cost estimation, leading to the traditional simple cost system being ineffective for measuring product costs

[16] It is argued that the service sector is more diverse and consists of service outputs that are difficult to define compared to the manufacturing sector, so the sector-related market can obfuscate the examination of the relationships between different variables and ABC system adoption (Clarke et al., 1999; Groot, 1999; Brierley et al., 2008).

[17] It is critical to examine the effect of cost structure on CSS in order to assess the extent to which the former has a direct or moderation effect. The moderation effect will be investigated through the role of AMTs in moderating the cost structure-CSS association, as will be explained in more detail in section 3.4.7.

accurately (Banker et al., 2008; Ismail and Mahmoud, 2012; Maiga et al., 2014). The implication of this is that a simple cost system with volume cost drivers will cause significant product cost distortion by over-costing standardised high-volume products and under-costing customised low-volume ones. This is because customised low volume products will require a small portion of volume activities, such as direct labour, but require a considerable number of non-volume activities, such as material movement, quality control and inspection, the number of machine setups, and shipping.

In contrast, standardised high-volume products will require a large quantity of direct labour but few non-volume activities, such as machine setup, shipping, and material movement. A sophisticated non-volume-based cost system with many cost pools, each representing a separate activity, will reduce the diversity of the activity processes within each cost pool (Cooper and Kaplan, 1991b; Kaplan and Cooper, 1998; Drury and Tayles, 2005; Al-Omiri and Drury, 2007; Brierley, 2007). It also uses volume and non-volume cost drivers that correspond to the nature of the activity cost pool. Therefore, it will be able to accurately assign overhead costs to products and thus improve the accuracy of the product costs (Drury and Tayles, 2005; Al-Omiri and Drury, 2007; Brierley, 2007).

While product diversity is a multifaceted concept, prior research approaches it narrowly (Bjørnenak, 1997; Groot, 1999; Malmi, 1999; Drury and Tayles, 2005). Malmi (1999) found a significant relationship between the number of products and ABC adoption, while Bjørnenak (1997) found that ABC firms tended to have more product variants than non-ABC firms, but unexpectedly found that the latter had more customised products than the former. However, these studies do not approach product diversity in its entirety, but instead examined each dimension of product diversity in isolation.

In contrast, using a composite measure for volume diversity, support diversity, process diversity, and product line diversity, Krumwiede (1998) found that product diversity was significantly associated with ABC adoption. However, using Krumwiede (1998)'s measurement of product diversity, subsequent research could not find any relationship between product diversity and ABC systems (Brown et al., 2004; Charaf and Bescos, 2013; Al-Sayed and Dugdale, 2016), and between product diversity and CSS (Al-Omiri and Drury, 2007). While many of survey studies could not find a relationship between product diversity and cost system design, case studies showed that product diversity is one of the factors that can influence the cost system design (Anderson, 1995; Kaplan and Cooper, 1998; Narayanan and Sarkar, 2002). Nonetheless, the results reported by survey studies were subject to a number of limitations. These limitations include: (1) the reliance on a sample that includes a low number of ABC users, which may lack the power to uncover a relationship between product diversity and ABC adoption (Nguyen and Brooks, 1997; Groot, 1999; Charaf and Bescos, 2013); (2) the use of single or few measures that do not reflect the different aspects of product diversity (Bjørnenak, 1997; Clarke et al., 1999; Groot, 1999; Malmi, 1999; Drury and Tayles, 2005; Brierley, 2008a); (3) the use of a small sample that may lack the power to detect such a relationship (Bjørnenak, 1997; Nguyen and Brooks, 1997; Groot, 1999; Charaf and Bescos, 2013); and (4) surveying both the manufacturing and service industries where each industry has totally different outputs (Brown et al., 2004; Al-Omiri and Drury, 2007; Charaf and Bescos, 2013). Because of these limitations, further research is needed to examine the relationship between product diversity and CSS with a consideration to use a large, homogenised sample (UK manufacturing companies) and rely on multiple measures to capture the different aspects of product diversity in order to overcome the limitations associated with prior studies. Therefore, the following hypothesis will be tested in this research:

H6: The level of product diversity is positively related to cost system sophistication.

3.4.7 Advanced manufacturing technology and cost system sophistication

AMTs involve the use of manufacturing applications and computers to control and automate the production process flexibly and efficiently, and to allow the seamless integration of different production functions and activity processes (Boyer, 1998; Chung and Swink, 2009; Spanos and Voudouris, 2009; Khanchanapong et al., 2014). Activities related to product design and development, inventory control, engineering, and production processes can be automated (Isa and Foong, 2005). AMTs include many different types of technology, such as computer-aided design (CAD), computer-aided manufacturing (CAM), flexible manufacturing systems (FMS), and automated material handling systems. A plethora of intangible and tangible AMTs' benefits are well-recognised. These include: (1) a reduction in direct labour costs, scrap rework activities, and machine setup activities; (2) improvements in product modification design by reducing the time required to design the product to meet the demand for customisation; and (3) high flexibility and efficiency in terms of producing a wide variety of customised products within shorter manufacturing lead times and with different batch sizes (Kaplan, 1986b; Berliner and Brimson, 1988; Swamidass and Kotha, 1998; Tracey et al., 1999; Boyer and Pagell, 2000; Kotha and Swamidass, 2000; Khanchanapong et al., 2014).

The implication of AMTs for cost system design is mixed. More specifically, there are two views that conceptually and empirically govern the AMTs-cost system association in prior research. First, one view is that a sophisticated non-volume-based cost system like ABC should be used in an AMT environment. This is because AMTs facilitate the strategy of producing many different types of customised products to the customers' specifications, resulting in high product diversity (Tracey et al., 1999; Hoque, 2000; Isa and Foong, 2005; Askarany et al., 2007; Mat and Smith, 2014). It is also claimed that

AMTs can change the cost composition by dramatically decreasing the proportion of direct labour costs and increasing many of the overhead costs, such as computer operators and technicians, supervisors and maintenance people, software programmers, and machine and operations engineers (Berliner and Brimson, 1988; Sriram, 1995; Hoque, 2000; Koltai et al., 2000; Isa and Foong, 2005). Consequently, simple volume cost systems, especially those using labour hours as an allocation method, will distort the product costs, as many of the activities associated with AMTs become non-volume-driven due to the production of many customised products with different batch sizes to the customers' specifications (Cooper and Kaplan, 1988b, 1991b).

Besides automation, firms place greater emphasis on non-financial performance measures to control and monitor the effectiveness and efficiency of their production operations (Kaplan, 1989; Baines and Langfield-Smith, 2003; Abdel-Maksoud et al., 2005). These include, but are not limited to, material quality, inspection, rework, scrap work, waste, inventory level, machine maintenance and utilisation, procurement, production, and delivery time (Kaplan, 1989; Gosse, 1993; Baines and Langfield-Smith, 2003; Choe, 2004; Ismail and Isa, 2011; Khanchanapong et al., 2014). A traditional volume cost system supplies financial information that does not support or monitor the efficiency and effectiveness of the AMTs' production environment (Kaplan, 1986b; Cooper and Kaplan, 1991a). It evaluates production performance mostly in terms of material, labour and machine hour variances at an aggregate departmental level rather than activity level (Gosse, 1993). Thus, the cause of any unfavourable variance is hardly detectable due to the numerous activities that exist in the production departments (Shank and Govindarajan, 1993).

Based on the above argument, some studies hypothesise that the use of AMTs will lead companies to redesign their traditional cost systems and adopt sophisticated MA techniques, including ABC systems (Hoque, 2000; Baines and Langfield-Smith, 2003; Isa and Foong, 2005; Mat and Smith, 2014). Based on empirical data from New Zealand, Hoque (2000) found that the automation brought about by AMTs was positively associated with ABC system adoption. Similar findings based on questionnaire data from manufacturing companies were reported by Askarany et al. (2007).

The second view postulates that a sophisticated ABC system is not required in a manufacturing environment that is characterised by the high usage of AMTs (Abernethy et al., 2001; Schoute, 2011) since, while AMTs increase the flexibility to produce many customised products to customers' specifications, they also reduce the batch and product sustaining level costs and shift these from the batch and product sustaining level to the facility level that cannot be traced to a particular product (Abernethy et al., 2001; Schoute, 2011). Based on five case studies, Abernethy et al. (2001) found that sophisticated volume cost systems with many cost pools and two volume cost drivers, namely labour and machine hours, provided accurate cost information as a result of using AMTs, which reduced and transformed much of the direct labour and overhead costs associated with the batch and product-sustaining level costs to facility-sustaining costs. Schoute (2011) found that high product diversity positively influenced ABC system adoption at the low level of AMTs and reduced the need for ABC systems at the high level of AMTs.

In addition, it is anticipated that increases in manufacturing indirect costs will stimulate companies to implement sophisticated non-volume-based cost systems with a greater number of cost pools and volume and non-volume cost drivers (Cooper, 1988b; Kaplan and Cooper, 1998; Drury and Tayles, 2005; Al-Omiri and Drury, 2007), but such a system may not be required in modern manufacturing technology environments since modern technologies are capable of reducing the indirect manufacturing costs and are considered an alternative source of various types of information, including cost information (Davila and Wouters, 2006). Using a large-scale questionnaire distributed to US and UK manufacturing companies, Swamidass and Winch (2002) reported that the UK companies were able to reduce their manufacturing costs by 13%, while the US companies experienced an 11% reduction in their manufacturing costs due to the use of AMTs. Tu et al. (2011) also investigated the effect of automation brought by AMTs' implementation on manufacturing operational performance, as measured by cost, flexibility, quality, delivery, and innovation. The study found that AMTs led to significant improvements in operational performance. The cost performance was measured by several items, some of which reflect different types of direct and indirect costs, namely reductions in costs related to materials, production, inventory, product unit and labour costs. Other studies also supplied empirical evidence that flexible, integrated AMTs enhanced firms' competitive advantage by reducing the manufacturing costs and improving the product mix flexibility and product volume flexibility (Boyer, 1998; Narasimhan and Das, 1999; Das and Narasimhan, 2001; Raymond, 2005; Raymond and St-Pierre, 2005; Khanchanapong et al., 2014).

Given the empirical evidence from quantitative and qualitative studies that AMTs can (1) manage and mitigate the effect of product diversity on cost system design (Abernethy et al., 2001; Schoute, 2011); and (2) reduce manufacturing costs (Chen and Adam, 1991; Boyer, 1998; Narasimhan and Das, 1999; Das and Narasimhan, 2001; Raymond, 2005; Raymond and St-Pierre, 2005; Khanchanapong et al., 2014), the current study will examine the moderating role of AMTs between the cost structure-CSS and product diversity-CSS associations. Such an examination becomes necessary in order to verify the circumstances under which product diversity and cost structure can influence CSS, and shed some light on the reasons behind the respective non-significant effects of product diversity on CSS (Bjørnenak, 1997; Nguyen and Brooks, 1997; Clarke et al., 1999; Groot, 1999; Brown et al., 2004; Brierley, 2008a; Al-Sayed and Dugdale, 2016) and cost structure on ABC systems (Nguyen and Brooks, 1997; Clarke et al., 1999; Groot, 1999; Brown et al., 2004; Al-Omiri and Drury, 2007; Brierley, 2008a; Pokorná, 2015), since these studies relied solely on the direct causal model. These insignificant findings suggest that the relationship between product diversity and ABC systems, and cost structure and ABC systems, may not be direct but rather vary according to the extent of AMTs usage (Abernethy et al., 2001; Schoute, 2011). Therefore, the following two moderation hypotheses will be tested:[18]

H7: AMTs will moderate the impact of overhead costs on cost system sophistication such that at low AMTs the relationship will be more positive and stronger rather than at high AMTs.

H8: AMTs will moderate the impact of product diversity on cost system sophistication such that at low AMTs the relationship will be more positive and stronger rather than at high AMTs.[19]

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[18] The theoretical argument behind the moderating role of AMTs in the cost structure-CSS and product diversity-CSS associations implies that AMTs (the moderator) are theoretically related to the independent variables (product diversity and cost structure) and/or the dependent variable, so a bivariate association between the moderator and independent variables and/or a bivariate association between the moderator and dependent variable may exist. The prior literature argues that the moderator should not be associated with the independent variables: otherwise, a mediation perspective is more likely to be relevant in situations when the moderator is associated with the independent variables and/or the dependent variable (Sharma et al., 1981; Shields and Shields, 1998). Nevertheless, from a contingency theory perspective, Donaldson (2001) asserts that a bivariate association between the contingency variable (moderator) and the organisational characteristics (organisational structure) can exist. This is attributed to the process of adaptation, referred to as "selection forces", experienced by organisations, "providing a commonality across the diverse structural contingency theories", resulting in a bivariate association between the contingency and organisational characteristics (Donaldson, 2001, p. 9).

[19] H7 and H8 investigate the moderation effect of AMTs on the relationship between overhead cost and cost system sophistication and the relationship between product diversity and cost system sophistication using sub-group analysis. On the other hand, H5 and H6 only investigate the direct effect of cost structure

3.4.8 Cost system sophistication, product planning and performance

Prior research indicates that sophisticated non-volume-based cost systems are critical for improving the strategic benefits of product planning decisions due to their ability to relate overhead costs to the activity level rather than responsibility cost pools, and the use of multiple- and non-volume cost drivers that can realistically reflect the cost behaviour for each type/group of activity (Cooper and Kaplan, 1991b; Cooper et al., 1992a; Swenson, 1995; Anderson and Young, 1999; Drury and Tayles, 2006; Al-Omiri and Drury, 2007). This can enable companies to estimate the actual consumption of joint resources by different products and consequently obtain more detailed cost information about different cost objects (e.g. products, customers) that can improve product planning decisions, and so, ultimately, performance (Cooper and Kaplan, 1991b; Shank and Govindarajan, 1993; Swenson, 1995; Chenhall, 2004; Pizzini, 2006).

Further, many product planning decisions are strategic in nature, such as pricing and outsourcing, and so require a long-term analysis regarding their consequences for organisational profitability (Kaplan, 1988; Innes and Mitchell, 1995; Innes et al., 1998; Tayles and Drury, 2001; Drury, 2015; Nielsen et al., 2015). The profitability analysis of different decisions can benefit from the hierarchical activity analysis of sophisticated non-volume-based cost systems because it assigns those resources to their relevant activities (e.g. batch and product-sustaining activity costs), which are expected to be become variable in the long-term and fluctuate according to the demand placed on them by cost objects (Cooper and Kaplan, 1991b; Innes et al., 1998; Drury and Tayles, 2006). Thus, decision-makers can have plausible cost behaviours that can improve the accuracy of cost information due to knowing the relevant, incremental costs that can be extracted to drive

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and product diversity on the cost system sophistication without considering the sub-group analysis of the role of AMTs.

the cost analysis used in product planning decisions (Cooper and Kaplan, 1991b; Kaplan and Cooper, 1998). In contrast, a simple cost system that uses only volume cost drivers that are irrelevant to the non-unit-level activities and aggregates these activities as "a lump sum of fixed costs" can undermine the relevance of cost information for profitability analysis (Drury and Tayles, 2006, p. 409).

Regarding pricing strategy, it is argued that sophisticated non-volume-based cost systems are necessary for setting accurate prices, especially cost-plus pricing, when standardised and customised products are produced simultaneously in the same facility (Cooper and Kaplan, 1991b; Turney, 1991; Kaplan and Cooper, 1998; Drury and Tayles, 2006). Accurate cost information about different products will allow the management to avoid overpricing standardised, large volume products that consume few non-volume activities, and underpricing customised, low volume products that consume more non-volume transactions (Shank and Govindarajan, 1993). Thus, companies can increase their profitability by increasing the price of customised products to compensate for the high costs, and reduce the prices of standardised large volume products to a competitive level (Cooper and Kaplan, 1991b; Estrin et al., 1994).

Additionally, sophisticated non-volume-based cost systems can provide accurate cost information about product-sustaining activities that are dedicated to individual products, such as product parts and specifications, special tooling and testing, and the technical support required for individual products. This information, in turn, can increase the designers' knowledge about the costs of different design options in order to develop products that consume fewer overhead costs and hence reduce the volume of cost drivers, which in turn can improve profitability (Innes and Mitchell, 1997; Anderson and Sedatole, 1998; Kaplan and Cooper, 1998; Gunasekaran, 1999). Field and experimentation studies have empirically illustrated how the provision of non-volume cost drivers by ABC systems, and the provision of detailed cost information have helped product designers to consider cost-conscious decisions during the product design process (Cooper and Turney, 1990; Booker et al., 2007).

The scope of usefulness of sophisticated non-volume-based cost systems can also support customer profitability analysis, outsourcing, and product output decisions (Cooper et al., 1992a; Malmi et al., 2004; Stapleton et al., 2004). The list of activities related to overhead costs can enable the identification of profitable and non-profitable customers through tracking how their orders influence the supply of production resources (Cooper and Kaplan, 1991a; Cooper and Kaplan, 1991b). These activities can also be expanded to include marketing, selling, administration, and technical support costs, which can be tracked to individual customers or distribution channels using appropriate cost drivers, rather than arbitrarily allocating costs based on sales revenue (Estrin et al., 1994; Guilding and McManus, 2002; Van Raaij et al., 2003; Stapleton et al., 2004).

Based on a survey sent to UK companies, Innes et al. (2000) provided evidence that the success of ABC was significantly associated with the success rating of pricing, new product design, customer profitability analysis, and product output. Other studies also reported an association between ABC and different applications, including pricing, customer profitability analysis, inventory valuation, new product design and outsourcing (Innes and Mitchell, 1995; Swenson, 1995; Cotton et al., 2003; Abu-Mansor et al., 2012).

Cagwin and Bouwman (2002) found the direct effect of the importance of cost information, as well as its interaction with ABC use, positively influenced financial performance. ABC use was measured by the use of ABC within organisational functions and applications, including pricing, customer profitability analysis, outsourcing, performance measurement, and budgeting.

Focusing on 56 business units that adopted an ABC system, Chenhall (2004) reported that ABC's usefulness regarding pricing, product range and output, new product design, and customer profitability analysis was found to be associated with the success measure of overall financial benefits. Lee et al. (2010) also revealed evidence that the extent of ABC usage exhibited by organisational functions and applications, including pricing, product mix, performance measurement, customer profitability, budgeting and outsourcing decisions, influence organisational performance. Based on the above argument, the following two hypotheses will be tested:

H9: Cost system sophistication is positively related to improved product planning decisions

H10: The impact of cost system sophistication on business unit performance is positively mediated by product planning decisions

3.4.9 Cost system sophistication, cost management and performance

Surveys and case studies have shown that the use of sophisticated non-volume-based cost systems, namely ABC systems, improves not only the product planning decisions, but also different applications of cost management (Shields, 1995; Anderson and Young, 1999; Block and Carr, 1999; Narayanan and Sarkar, 2002; Pike et al., 2011).

It is argued that a sophisticated non-volume-based cost system can improve profitably through supporting process re-engineering and cost reduction initiatives (Herath and Gupta, 2005; Cagwin and Barker, 2006; Maiga and Jacobs, 2008). It highlights valued-added activities that deserve more attention to increase their efficiency (Turney, 1991; Innes and Mitchell, 1995; Herath and Gupta, 2005). It also uncovers non-value-added activities that can be re-engineered, eliminated, or simplified, leading to cost savings that can improve profitability (Turney, 1991; Innes and Mitchell, 1995; Herath and Gupta, 2005; Maiga and Jacobs, 2008).

Regarding performance measures, the identification of activities and their volume and non-volume cost drivers can provide financial and non-financial information to enable managers to measure, analyse, and monitor the effectiveness and efficiency of the activity performance (Turney, 1991; Shields, 1995; Kaplan and Cooper, 1998; Ittner, 1999; Banker et al., 2008; James and Elmezughi, 2010). It is argued that financial performance measures may be insufficient to improve profitability because they ignore important aspects of manufacturing operations (Ittner et al., 2003; Maiga and Jacobs, 2003; Kelly, 2007). Alternatively, financial measures should be supplemented with non-financial performance measures that can improve performance by monitoring the critical operational activities that add value to the customer (Scott and Tiessen, 1999; Baines and Langfield-Smith, 2003; Kelly, 2007; Maiga and Jacobs, 2008).

In terms of budgeting, a cost system with many hierarchical activity cost pools and different types of cost drivers can improve the planning process regarding setting dynamic, realistic budgeting (Mitchell, 2005). This is done by converting the forecast products and sales mix and volume into activity requirements by using cost drivers and then estimating the resources that should be supplied to meet the required level of the activities using resource drivers. Generating budgets based on ABC concepts avoids the need to estimate the unnecessary resources because it balances the operational requirements by matching the resources to the requirements of the activities (Kaplan and Cooper, 1998; Hansen et al., 2003; Stevens, 2004). In this regard, Hansen (2011) argued that the main features of activity-based budgeting are improved resource capacity forecasting and utilisation, and greater flexibility for companies to plan for unexpected events (e.g. hiring more labour due to high product orders).

In favour of the above argument, Shields (1995) found that ABC success was significantly correlated with performance measurement, product costing, re-engineering, and activity analysis. Similarly, Innes and Mitchell (1995) surveyed UK companies and found that ABC success was more positively associated with cost management applications than product planning decisions. The strongest ABC associations were with cost reduction and budgeting. Other survey and case study research also reported that ABC systems supported different applications, including budgeting, performance measures, cost reduction and process re-engineering (Swenson, 1995; Innes et al., 1998; Anderson and Young, 1999; Goldsby and Closs, 2000; Innes et al., 2000; Narayanan and Sarkar, 2002; Cotton et al., 2003; Pike et al., 2011; Abu-Mansor et al., 2012).

In addition, one might not expect the existence of sophisticated non-volume-based cost systems to improve profitability unless their analyses and findings direct the decision-makers to take actions, such as cost reduction actions that lead to cost-saving, thereby enhancing profitability (Cooper and Kaplan, 1991b; Cagwin and Bouwman, 2002; Narayanan and Sarkar, 2002). For example, Kaplan and Cooper (1998) argued that the benefits of ABC systems will not be realised unless the information obtained from them is integrated into firms' budgeting processes. Cagwin and Barker (2006) reported empirical evidence that firms that were involved in business process re-engineering received a higher financial return, as measured by return on assets (ROA), compared with those that were not. Maiga and Jacobs (2008) argued that ABC will not have a direct effect on financial performance but that its effect will materialise through cost reductions and quality and cycle time performance measures that would improve due to the reliable cost information being supplied by the ABC system. The study confirmed such relationships, where ABC use enabled cost reductions and improved quality and cycle time performance, which were, in turn, associated with improved profitability.

Based on a survey distributed to Australian manufacturing companies, Baines and Langfield-Smith (2003) found that advanced accounting practices, including ABC and benchmarking, positively affected non-financial accounting information, which, in turn, improved organisational performance. Kallunki et al. (2011) reported similar results. Agbejule and Saarikoski (2006) argue that managers place a greater reliance on specific cost information that can improve their understanding regarding the business process and activities and consequently enhance their participation in budgeting. Along this same line, the study established that budgeting participation improves managerial performance when managers have a high knowledge of cost management. Further, Uyar and Kuzey (2016) found that the extent of budget use, including flexible and long-term budgeting, positively affected organisational performance, while Elhamma (2015) also reported that firms that placed more emphasis on budgeting evaluation enjoyed higher performance. Therefore, the following hypotheses will be tested:

H11: Cost system sophistication is positively related to improved cost management applications

H12: The impact of cost system sophistication on business unit performance is positively mediated by cost management

3.5 Chapter summary

In this chapter, contingency theory, which underpins much of the MAS and cost system literature, has been discussed, including the various forms of fit as well as the main criticism of contingency theory. Based on this discussion, it was decided that this research would adopt two streams of contingency fit, namely mediation and moderation that represent the foundation of the theoretical research model. Consequently, 12 hypotheses have been developed. These include six contingent factors that are expected directly and positively to influence the level of CSS. These are: competition, business strategy, the role of management accountants, size, cost structure, and product diversity. The role of AMTs in moderating the relationship between product diversity and CSS, as well as cost structure and CSS, has also been presented. Finally, the theoretical model generates four further hypotheses that link CSS to product planning and cost management and ultimately the business unit performance.

Chapter 4: Research Methodology and Methods

4.1 Introduction

The previous chapter presented the theoretical framework as well as the research hypotheses. The current chapter aims to present the research methodology and methods that can achieve the current research objectives. This chapter contains four further sections. Section 4.2 briefly presents the different research paradigms, coupled with a discussion of the research paradigm underpinning the current study. Section 4.3 covers the different types of research strategy. The mixed method strategy is discussed along with the research methods that are used to collect the required data. More specifically, section 4.3.1 presents the justification for using mixed methods, which is followed by section 4.3.2 that elaborates on the survey questionnaire instrument employed. Next, section 4.3.3 discusses the interview method and its application in the current study for the qualitative data collection. The last section contains the chapter summary.

4.2 Research paradigms

A research paradigm, known as a worldview, can be defined as "a set of interrelated assumptions about the social world which provides a philosophical and conceptual framework for the organized study of that world" (Filstead, 1979, as cited in Ponterotto, 2005, p.127). Paradigms can be viewed as lying on an objective-subjective continuum with two opposite extremes, namely positivism and interpretivism (Saunders et al., 2009; Wahyuni, 2012; Collis and Hussey, 2014). In between these, different paradigms can be located over the objective-subjective continuum, hinged on several dimensions, including the ontological and epistemological assumptions (Morgan and Smircich, 1980). The ontological assumption guides our beliefs about the nature of reality, while the epistemological assumption describes how a researcher can acquire valid knowledge associated with the ontological position adopted by a researcher (Collis and Hussey, 2014). Adopting one of these paradigms is contended to implicate the choice of methodological approach as well as the selection of the research instruments, tools, and methods (Ryan et al., 2002; Saunders et al., 2009; Collis and Hussey, 2014). The main differences between these paradigms, as well as the features of positivism and interpretivism, are respectively presented in Table 4.1 and Table 4.2 below.

Table 4.1: Typology of the assumptions on a continuum of paradigms.

	Positivism ◄				► Interpretivism	
Ontological assumption	Reality as a concrete structure	Reality as a concrete process	Reality as a contextual field of information	Reality as a realm of symbolic discourse	Reality as a social construction	Reality as a projection of human imagination
Epistemological stance	To construct a positivistic science	To construct system, process, change	To map contexts	To understand patterns of symbolic discourse	To understand how social reality is created	To obtain phenomenological insight, revelation

Source: Collis and Hussey (2014, p. 49)

Table 4.2: Features of the two paradigms.

Positivism tends to:	Interpretivism tends to:
• Use large samples	• Use small samples
• Have an artificial location	• Have a natural location
• Be concerned with hypothesis testing	• Be concerned with generating theories
• Produce precise, objective, quantitative data	• Produce 'rich', subjective, qualitative data
• Produce results with high reliability but low validity	• Produce findings with low reliability but high validity
• Allow results to be generalised from the sample to the population	• Allow findings to be generalised from one setting to another, similar setting

Source: Collis and Hussey (2014, p. 50)

4.2.1 Positivism

Under positivism, the reality of the external world has a concrete, real structure, as in physics and chemistry, which is basically "out there", independent of the researcher, and can be explored and discovered (Gioia and Pitre, 1990; Collis and Hussey, 2014; Creswell, 2014). The regularities and relationships that govern a phenomenon are the primary concerns for researchers under this paradigm to generalise these regularities (Ryan et al., 2002). This entails objective, measurable observation of reality by natural science methods to acquire knowledge, and involves separating the observer from the phenomenon under observation (Kholeif, 2011). New theory is rarely generated under this paradigm (Gioia and Pitre, 1990).

Researchers seek to build theory by engaging in deductive reasoning by reviewing and specifying the literature that guides the hypotheses development, including selecting the variables that researchers seek to examine (Gioia and Pitre, 1990). The developed hypotheses can provide a new direction that extends prior theory or present an examination of different competing relationships, thereby providing different explanations of the phenomenon under study (Gioia and Pitre, 1990).

While positivism relies on deductive reasoning and quantitative methods, it can involve an element of qualitative methods (Creswell, 2014) for different purposes, such as theory development (Modell, 2005) and theory revision (Bryman and Bell, 2011). The deductive approach involves the move from the general to the particular (Collis and Hussey, 2014) and incorporates six different stages, namely: (1) theory; (2) hypotheses; (3) data collection; (4) results; (5) confirmation/rejection of the hypotheses; and (6) revision of the theory (Bryman and Bell, 2011; Collis and Hussey, 2014).

4.2.2 Interpretivism

In contrast to positivism, interpretivism sees reality as an outcome of humans' intersubjective experience that can be understood from an individual point of view (Gioia and Pitre, 1990; Collis and Hussey, 2014; Creswell, 2014). It approaches the social world based on how people symbolically and socially perceive it, and hence focuses on the perceptions and meanings attached by the individuals inhibiting the social world to things or objects (Danture, 2011; Creswell, 2014). Knowledge can be obtained through interaction and dialogue between the researchers and the participants (Ponterotto, 2005).

Inductive reasoning characterises the interpretive paradigm (Collis and Hussey, 2014). To investigate a phenomenon, researchers attempt to avoid using theories at the beginning of their investigation to generate theory as a final product of their investigation to explain the phenomenon under investigation (Creswell, 2014). Alternatively, theoretical lenses borrowed from the existing social theories (e.g. actor network theory) and literature can be used as sensitising devices to understand the processes, structure, and people related to the phenomenon under investigation (Danture, 2011; Creswell, 2014). Qualitative data, which reflect and maintain the unique representations of the perceptions and meanings of the informants, are collected and analysed to establish the building blocks of the broad patterns, theories, themes, and categories (Gioia and Pitre, 1990; Creswell, 2014).

4.2.3 The classification of this research

The current study proposes a theoretical model with hypotheses, derived from the prior cost system literature and defined by a set of variables, the associations of which will be tested to permit statistical generalisation and explanation about cost system sophistication (CSS) levels (Ryan et al., 2002). Therefore, the current research assumes an ontological objectivist position. Nonetheless, it takes reality to be a concurrent process, where the assumptions about the existence of stable relationships that govern reality as a concrete structure are relaxed and replaced by the assumption that reality exists within contingent relationships that detail how things are changing (Ryan et al., 2002). The concurrent process of reality transfers the cost system from a closed system view, which is rooted in the objective facts of universal laws (as in physics and chemistry) to an open system view that is characterised by evolving processes and changes over time regarding its context (ibid).

The ontological assumption of the current research assumes that the cost system design can change from a simple to sophisticated one according to contingent elements, which characterise the internal and external contextual environments of organisations, and that differences in cost system design can influence performance based on the fact that cost systems contribute to product planning and cost management. In line with the ontological assumption of this research, the epistemological stance is also located toward the objectivist position, which gives emphasis to independence, value-free, an unbiased position resulting in a deductive strategy, theory verification, and a formal language format in terms of a passive rather than a personal voice (Collis and Hussey, 2014).

4.3 Research strategy: mixed method design

Research strategies are general plans that guide how the research questions will be answered and include the execution of procedures and research methods to collect, analyse, interpret, and report the data (Saunders et al., 2009; Bryman and Bell, 2011; Creswell and Plano Clark, 2011). Naturally, the choice of research design follows the type of research paradigm adopted by the researcher, the kind of questions under investigation, and the time and resources available for the research (Saunders et al., 2009). Creswell (2014) classified research strategies into three realms, namely quantitative, qualitative and mixed methods, as presented in Table 4.3.

Table 4.3: Alternative research strategies.

Quantitative	Qualitative	Mixed methods
• Experimental designs • Non-experimental designs (e.g. survey)	• Case study • Phenomenology • Grounded theory • Ethnographies	• Convergent • Explanatory sequential • Exploratory sequential • Transformative, embedded, or multiphase

Source: Creswell (2014, p. 12)

Some of the above strategies are located toward the positivism paradigm and deductive approach, such as the survey, while others are better suited to the interpretivist paradigm and inductive approach, such as the case study (Saunders et al., 2009; Collis and Hussey, 2014). Nonetheless, their use is not necessarily mutually exclusive (Saunders et al., 2009). For example, exploratory case studies can be utilised for positivistic research to generate new hypotheses for subsequent large-scale survey testing, while explanatory case studies can be used for interpretive research to understand and explain the research topic and consequently generate theories that can explain the individual case (Ryan et al., 2002).

Each type of research strategy is unique and has its strengths and weaknesses (Saunders et al., 2009). Nonetheless, a combination of research strategies from the quantitative and qualitative approaches is argued to strengthen research findings and overcome any possible validity threats arising from the bias associated with using a single strategy (Abernethy et al., 1999; Modell, 2005; Brierley, 2014). Currently, several typologies for mixed method designs have been advanced to reflect the different combinations of quantitative and qualitative strategies (Morgan, 1998; Tashakkori and Teddlie, 2003; Saunders et al., 2009; Creswell and Plano Clark, 2011). Creswell and Plano Clark (2011), in their book, present 15 different classifications of mixed methods design, as advanced by various scholars from different fields. They, however, elaborate in more detail on six types of mixed methods designs, namely: (1) convergent parallel design; (2) explanatory sequential design; (3) exploratory sequential design; (4) embedded design; (5) transformative design; and (6) multiphase design. The selection of a particular mixed methods strategy is driven by different aspects, including the research questions, the level of interaction between the quantitative and qualitative phases, priorities, timing and integration decisions (Creswell and Plano Clark, 2011).

This study uses an explanatory sequential design. It consists of two sequential phases, as shown in Figure 4.1.[20] The first phase consists of the collection and analysis of

[20] The opposite of explanatory sequential design is the exploratory sequential design in which the researchers start with a qualitative phase followed by a quantitative phase.

quantitative data to address the research questions statistically, which receives more weight and priority compared to the second qualitative phase (Creswell and Plano Clark, 2011). The second phase is the qualitative phase which was developed based on the results of the first step to collect and analyse qualitative data. Each phase is collected separately, analysed and then reported (Creswell and Plano Clark, 2011). Nevertheless, the qualitative data should be acquired from the same individuals who participated in the quantitative phase, or from the same sample of questionnaire targets in order to meet the objective of this design that emphasises the exploration of the statistical results in depth (Creswell, 2014).

The explanatory sequential design is more applicable for a study with a prior theory, as it can specify the relevant variables to be examined during the first quantitative phase, as well as the availability of the quantitative instrument for measuring the research variables (Creswell and Plano Clark, 2011; Brierley, 2014). The main objectives in incorporating the qualitative phase, after the quantitative phase, include: (1) to aid the interpretation of any unexpected results produced by the first phase; (2) to provide explanations of the relationships between the variables; and/or (3) to identify new predictors that were not covered during the first phase (Creswell and Plano Clark, 2011). The next section will present the justification for using the explanatory sequential design and how it can contribute to the current study.

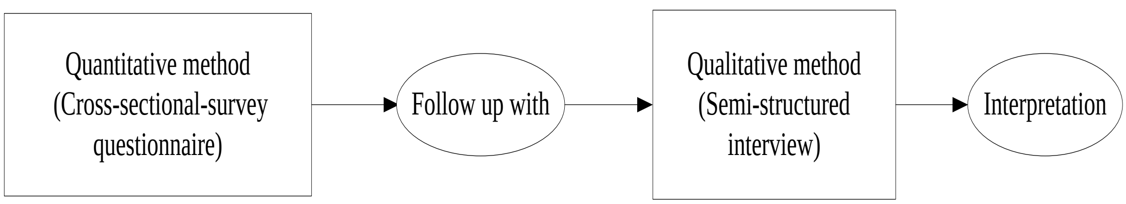

Figure 4.1: The explanatory sequential design strategy.

4.3.1 The justification for using the explanatory sequential design strategy

It was mentioned above that the field of mixed methods research has developed different types of mixed methods strategies, each with a different purpose. Among these is the explanatory sequential design strategy, which is relevant to the current study for two reasons.

First, the explanatory sequential design is suitable for this research due to the existence of prior research in terms of theory and the mechanisms for specifying the variables that can influence the cost system design as well as its effect on product planning, cost management, and so, ultimately, organisational performance. The literature outlined in chapters two and three provided conceptual and empirical background information to develop and justify the research model and hypotheses, respectively.

The second reason pertains to the fact that the reliance on a single method may be insufficient to provide an in-depth understanding of the antecedents and consequences of CSS. Recently, scholars in the field of MA, have advocated the use of multiple methods to collect quantitative and qualitative data to overcome the limitations associated with using a single method (Birnberg et al., 1990; Lillis and Mundy, 2005; Modell, 2005; Ittner, 2014). Brierley (2014) identifies three limitations associated with a pure quantitative strategy that can be overcome by the mixed methods approach. These include: (1) a quantitative strategy tends to omit important variables from the research model which can be captured and covered by using a qualitative strategy to generate new theory; (2) quantitative conceptual models that are built on prior findings from the quantitative literature may not incorporate the target subject's understanding into the research model; and (3) the generalised quantitative findings may not be applied equally to some of the researched subjects. Similarly, Brierley (2014) points out three inherited issues related to a qualitative strategy that can be overcome by using a combined quantitative and qualitative strategy. In particular, qualitative methods: (1) may not be applicable to testing prior theory and hypotheses due to the difficulties associated with these methods; (2) can be influenced by the investigator's personal bias; and (3) rely on a small sample size, resulting in difficulty generalising the research findings to other subjects.

The use of a qualitative method can contribute to the current study by providing the necessary explanations about the non-significant results of the quantitative phase (Ittner and Larcker, 1997; Creswell and Plano Clark, 2011; Brierley, 2014). This allows the researcher to explain the mechanisms behind such relationships, which may lead to theory refinement in terms of disconfirming, re-specifying, or refining the existing variables and their relationships (Lillis and Mundy, 2005; Creswell and Plano Clark, 2011; Brierley, 2014). Moreover, seeking the participants' views improves the interpretation of the significant quantitative results concerning their credibility and validity by identifying the reasons and mechanisms that support such relationships (Modell, 2005; Brierley, 2014; Ittner, 2014). This can be enhanced when the quantitative results confirm the proposed hypotheses and converge with the qualitative results within the target empirical settings (Modell, 2005; Ittner, 2014). Finally, the use of mixed methods provides contextual information regarding the inclusion of possible new contextual factors that have not been covered by previous research (Saunders et al., 2009; Creswell and Plano Clark, 2011; Brierley, 2014; Ittner, 2014). Using qualitative data in the second phase of the mixed methods design can open the door to exploring other variables that have not been covered by the current study but are considered important from the point of view of the practitioners. Findings new variables can refine the research model for subsequent statistical testing in future studies.

To implement the explanatory sequential design, this research aims to acquire and analyse quantitative data using a cross-sectional survey questionnaire in the first phase, followed by the collection and analysis of qualitative data using the interview method in the second phase. The following sections will discuss the survey questionnaire and how it is used and operationalised in this study, followed by a section devoted to the process and implementation of the field interviews.

4.3.2 Cross-sectional survey questionnaire

The questionnaire is the most widely used method in survey MA research (Van der Stede et al., 2005) as well as the social sciences (Roberts, 1999; Saunders et al., 2009). The questionnaire can be defined as "a method for collecting primary data in which a sample of respondents are asked a list of carefully structured questions chosen after considerable testing, with a view to eliciting reliable responses" (Collis and Hussey, 2014, p. 343).

It can be either cross-sectional or longitudinal in nature. A cross-sectional survey aims to collect data about the subject matter at one point in time, while a longitudinal survey examines the same phenomenon at several time intervals with the same respondents (Van der Stede et al., 2005; Saunders et al., 2009). A cross-sectional rather than a longitudinal survey was chosen for the current study due to: (1) the existence of sound theoretical literature that can specify the direction of the associations between the different variables (see chapters 2 and 3); and (2) the possibility that the initial respondents to the longitudinal survey may not participate again or may not have the time to engage in the same survey at a later stage (Saunders et al., 2009), leading to an incomplete data set.

The questionnaire can also be conducted by post, telephone, face-to-face or the internet (Saunders et al., 2009). The postal questionnaire was chosen because all of the companies included in the sample have an available postal address, as supplied by different databases. Moreover, the postal questionnaire is more suitable, since it gives the survey respondents greater freedom and privacy to complete the questionnaire at their convenience (Collis and Hussey, 2014) and thus is free from interviewers' bias, which may arise in the case of face-to-face or telephone questionnaires (Roberts, 1999). The online questionnaire was also used concurrently with the postal questionnaire. The use of a postal questionnaire, combined with an online questionnaire, offers more advantages in terms of reducing costs, accelerating the collection of more responses within a short time, and improving the response rate by giving the respondents more choices (Dillman et al., 2014). The online questionnaire was also designed to mirror the design of the postal questionnaire. The covering letter that accompanied the paper questionnaire informed the respondents that they complete either the paper or online version of the questionnaire (see Appendix 5). The following sub-sections will discuss the process of designing the questionnaire format and questions, determining the population and individual respondents, distributing the questionnaire, the achieved response rate, response bias, common method bias, and finally the questionnaire data analysis.

4.3.2.1 Questionnaire format and layout

Developing a well-designed questionnaire involves a great amount of care in order to achieve a satisfactory response rate as well as valid and reliable data (Dillman et al., 2014), since a cross-sectional questionnaire will gather data from the sample only once (Van der Stede et al., 2005; Saunders et al., 2009). Nonetheless, there are important recommendations that can facilitate a user-friendly questionnaire which can improve the response rate, data validity, data reliability and also reduce response errors. The questionnaire employed by the current study incorporated the recommendations of the "Tailored Design Method" (Dillman et al., 2014) as well as other recommendations (e.g. Saunders et al., 2009). The following recommendations were included in the questionnaire design:

1. The questionnaire was printed on A-3 size paper (11.7″ x 16.5″) to form an A-4 booklet-style questionnaire to make it easier for the respondents to use.
2. The questionnaire's front cover page included the following: (1) a clear title of the research study; (2) a short description directing the respondents on how to complete the questionnaire; and (3) the return postal address for the questionnaire (in this case, Sheffield University Management School's address).
3. The back cover of the questionnaire included: (1) open-ended questions to give the survey respondents the opportunity to write comments about the research topic; (2) a promise to supply a copy of the study results on request; and (3) a request for an interview.
4. Clear, easy transitional or instruction words were used.
5. Closed-ended questions were mainly incorporated into the questionnaire, which offer more advantages in terms of taking less time to answer, easiness, and comparability.
6. A five-point rating scale was consistently used across the questionnaire.
7. The matrix or grid format style was consistently used for the majority of the questions to record the responses, make them easier for the participants to read, and to save space.
8. The first question was the easiest in terms of the required time to answer it, because it is a categorical question that asked the respondents to specify which of three types of cost system their organisation used.
9. Sensitive questions like sales and percentages of material costs were located at the end of the questionnaire.
10. All questions were designed to appear only on one page, never across two pages.
11. Similar questions were grouped under one section to make it easier for the respondents to retrieve the required information regarding these.
12. A respondent tracking number was printed on the cover of each questionnaire as well as the covering letter to facilitate follow-up reminders.

4.3.2.2 The pilot questionnaire

Pre-testing a questionnaire instrument is a necessary step, especially since cross-sectional questionnaire data are only collectible once from the survey participants (Bryman and Bell, 2011; Dillman et al., 2014). The current study selected 20 manufacturing companies located in Yorkshire from the Online-Financial Analysis Made Easy (FAME) database for the pilot testing stage. Appendix 2 presents the pilot questionnaire. It consisted of 10 pages and 16 questions about the variables under investigation, but was reduced to 8 pages and 15 questions following the pilot test. The pilot questionnaire was tested by conducting four sequential stages which were undertaken at fortnightly intervals:

1. An advance letter was sent on 19 January 2015 to inform the potential participants about the objective of the pilot questionnaire and informing them that a copy of the questionnaire would be sent to them in a fortnight's time.
2. A first postal pilot questionnaire was sent out on 2 February 2015, along with a covering letter and a stamped addressed return envelope.
3. A follow-up letter with a questionnaire and a stamped addressed return envelope was sent out on 16 February 2015.
4. A second reminder with a questionnaire and a stamped addressed return envelope was also sent on 2 March 2015 (see Appendix 3 for all letters accompanying the pilot questionnaire).

Of the 20 companies, only four returned the questionnaire, yielding a 20% response rate. The questionnaires were answered completely by the respondents but no substantial comments were supplied about the questionnaire design. In parallel with the pilot testing stage of the questionnaire, the researcher was able to conduct an interview on 12 January 2015 with a financial director from a UK manufacturing company, who was introduced to the researcher by a private contact. Important feedback and observations were gained from the interview, which helped the present study to modify the pilot questionnaire. This included modifying the management accountants' role question which was considered to be too long and to consume a lot of time to complete. The original question consisted of six sub-questions. This was changed to a semantic differential scale format based on bipolar rating scales (Saunders et al., 2009). Each bipolar scale was designed to anchor/capture each sub-question of the original question's six questions.

Moreover, the advanced manufacturing technologies (AMTs) question was considered more technical. Thus, it was decided to change the AMTs question from technical concepts and focus instead on the flexibility of manufacturing technologies. Another comment related to targeting companies with at least £20 million sales, as many of the research questions may be inapplicable to small firms which may lack a formal cost system and/or clear, written objectives. The final version of the questionnaire is presented in Appendix 4.

4.3.2.3 Covering letter

The covering letter accompanying the questionnaire can convey important information to the respondents, such as the importance of their participation and the research objectives. As a result, the appearance and content of the covering letter can improve the participants' awareness of the importance of the research topic (Saunders et al., 2009; Dillman et al., 2014). The letter used the Sheffield University Management School's official letterhead and was printed on a single page. Its content included sufficient, clear information about: (1) the purpose of the study and the importance of their participation; (2) the means whereby the participants were identified and selected; (3) the confidentiality of their names, firm identity and responses; (4) the names of the supervisory team; (5) the contact information of the researcher in case they preferred to complete the online version of the questionnaire, or required any information/clarification; and (6) the researcher's signature. A copy of the covering letter is included in Appendix 5.

4.3.2.4 Final questionnaire questions

The final version of the questionnaire consisted of 15 questions related to the variables of interests and separated into three sections. Question A1 was a categorical question that was adapted from Krumwiede (1998) and Maiga and Jacobs (2008) to classify cost systems into three types: the direct cost system, the traditional absorption cost system, and the ABC system. The respondents were provided with a clear description of the content of each type of cost system. Following Al-Omiri and Drury (2007) and Brierley (2007), open-ended questions relating to the number of cost pools (question A2) and second-stage cost drivers (question A3) that measured the assignment of overhead costs to cost objects were included.

Question A4 was adapted from Pizzini (2006) and modified to suit the context of manufacturing companies. Pizzini (2006) contended that a highly-functional cost system has the attribute of supplying detailed cost information about the different level of cost objects, such as the payer level and patient level. In a manufacturing context, it is argued that a sophisticated cost system can supply detailed cost information about different cost objects, namely the product, batch, product line, department, customer, distribution channel, supplier and brand (Cooper and Kaplan, 1991b; Kaplan and Cooper, 1998). Therefore, question A4 sought to ascertain whether the cost system had the ability to supply detailed cost information for eight different cost objects (e.g. product, batch, product line). The responses to each item of A4 were gathered using a five-point Likert scale, ranging from 1 (not at all) to 5 (excellent).

Section B included one question (B1) about the management accountants' role, which consisted of six items adapted from Emsley (2005). Emsley developed the measure to capture the extent to which management accountants had a more business unit orientation compared to an accounting orientation. Responses that scored higher for business unit orientation reflected the active role of management accountants, such as giving more priority to work for the business units and more reports being supplied to the business unit managers (Emsley, 2005). The responses to each of the five items were gathered using a five-point semantic differential scale.

Section C aimed to obtain information about the business unit and its environment. Question C1 measured the level of competition over six different dimensions, where items a, c, d, e, and f were adopted from Hoque (2011) and item b was derived from Mia and Clarke (1999). The respondents were asked to rate the level of competition on a five-point Likert scale, ranging from 1 (not at all) to 5 (to a great extent).

The level of product diversity experienced by a business unit over the past three years was measured via question C2, which consisted of six items. Items a, c, d, and e were taken from Krumwiede (1998), focusing on diversity regarding the product line, the processes, volume, and support services, respectively. Two further items, b (the diversity of the products within each product line) and f (the diversity of the physical size of the product), were adapted from Schoute (2011).

For the business strategy construct, the measurement (C3 a, b, c, d, e) was adopted from Frey and Gordon (1999) while item f was self-developed to mirror item e but for a unique product design in a differentiation strategy. Thus, differentiation and cost leadership strategy were measured by three items each, with a high score indicating a strong emphasis on the corresponding strategy, and low values reflecting the reverse. All of the items for questions C2 and C3 were based on a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree).

Cost structure was measured by two questions (C4 and C8). C4 was self-developed to measure the increase in indirect costs experienced by the business units over the last three years, based on a five-point Likert scale ranging from 1 (not at all to) to 5 (to a great extent). The six items of C4 were based on the description of overhead costs provided by Miller and Vollmann (1985, p. 148). Question C8 asked the respondents to state the percentage of direct material costs, direct labour costs, manufacturing overhead costs, and non-manufacturing overhead costs to the total cost structure of the business unit (adopted from Brierley, 2007).

Information about improvements in product planning and cost management (C5) was obtained by asking the respondents to rate the improvements within 11 decision, control, and operational areas over the past three years. These 11 areas were adopted from previous research (Innes and Mitchell, 1995; Chenhall, 2004; Brierley et al., 2006; Schoute, 2009). The scale measurement of C5 consisted of a 6-point Likert scale, ranging from 0 (do not make this decision) and 1 (no improvement) to 5 (very high improvement).

The most commonly used outcome variable in contingency MA research is financial performance, because it is a widely-used measure in most companies (Otley, 2016). Therefore, four perceptual measures (C6) were operationalised to capture the improvement in business unit profitability over the past three years (derived from Maiga and Jacobs, 2008; Maiga et al., 2014). Return on sales (ROS), market share, sales on assets and return on assets (ROA) were the indicators used for financial performance; each indicator was measured on a five-point Likert scale ranging from 1 (no improvement) to 5 (very high improvement).

Four indicators from the instrument developed by Tracey et al. (1999) were adopted to measure AMTs (C7 a, b, c, and d). The remaining item in this question was self-formulated to capture the overall use of AMTs by the business units. All of the items were measured using a five-point Likert scale, ranging from 1 (not at all to) to 5 (to a great extent).

Two further questions captured the size of the business units. C9 asked the respondents to state the approximate number of employees, while C10 captured the approximate annual sales of the business unit in the last year (Al-Omiri and Drury, 2007; Brierley, 2007). The last page of the questionnaire included (1) an open-ended question seeking the respondents' views of antecedent and consequences of the cost system; (2) an offer for the respondents to receive the results of the survey; and (3) an interview request.

4.3.2.5 Research population and sampling

Bryman and Bell (2011, p. 182) define a research population as "the universe of units from which the sample is to be selected". It consists of a group of elements (e.g. individuals, objects, nations), the characteristics of which the survey aims to investigate (Van der Stede et al., 2005). The target population should be precisely defined to draw a survey sample that represents the characteristics of the population (Roberts, 1999).

Given the aims of the current study, the research population consists of medium- and large-scale UK manufacturing business units (≥£20 million sales and ≥50 employees).[21] Simons (1991) argues that medium and large companies have similar accounting systems, such as budgeting, cost systems, and human resources. Small-size companies were excluded because they are more likely to lack sufficient resources to invest in sophisticated management accounting systems (MAS) and so may be unable to provide relevant data for the research constructs under investigation (Drury and Tayles, 2005; Al-Omiri and Drury, 2007; Abdel-Kader and Luther, 2008).

In order to find information about the survey population, the current research used the online-Financial Analysis Made Easy (FAME) database, which covers more than 9

[21] Several studies used the 50 employee's criterion to differentiate small-size companies from medium- and large-size ones (Hertenstein and Platt, 2000; Baird et al., 2004; Schoute, 2009; Pokorná, 2016).

million active and inactive companies in the UK and Ireland (FAME, 2017). It has also been used and accepted in prior survey cost and MA research (Abdel-Kader and Dugdale, 1998; Alkaraan and Northcott, 2006; Al-Omiri and Drury, 2007; Abdel-Kader and Luther, 2008; Al-Sayed and Dugdale, 2016). Several criteria, as presented in Table 4.4 below, were used to determine and filter the number of companies that would suit the current study's research objectives.

Table 4.4: The population frame criteria.

Criteria	Number of companies
1. Including active companies only.[a]	149,932
2. Including companies located in England, Scotland, and Wales only.	130,758
3. Including companies with independence indicators A, B, C, and D only.[b]	116,581
4. Including companies with sale revenues ≥ £20 million only.	22,009
5. Including companies with ≥ 50 employees.	16,980
6. Including all manufacturing sectors.[c]	3,155
7. Including companies whose main activity includes reference to "manufacturing" or "producing".	2,453
8. Excluding companies with no production site in the UK.	2,442
9. Excluding companies that refused to participate in the questionnaire during the process of contacting them to obtain the name of the management accountants prior to the administration of the questionnaire (see section 4.3.2.6 below for more information about contacting the companies).	2,407
10. Excluding companies with the same registered office address.	1,957

Each criterion led to a reduction in the number of companies. Thus, the number next to each criterion shows the number of companies that remained after the criterion was applied.

[a]Abdel-Kader and Luther (2008) used the active, independence and location criteria in their UK survey questionnaire. Tayles and Drury (1994) also used the trading activities description to include companies with reference to producing and manufacturing (criterion 7 in Table 4.4)

[b]These indicators represent different ownership percentages controlled by a third party. This allowed the inclusion of distinct business units that form part of large, divisionalised companies but these distinct business units are considered, for reporting purposes, as a single legal entity (Tayles and Drury, 1994, p. 2).

[c]Certain sectors of the food industry, namely fruit and vegetables, were excluded due to the fact that some of them engaged in importing rather than producing activities. This was found when the researcher went through some of these companies' websites to identify their email addresses, which were not reported in the FAME database. Also, printers and producers from the media industry were excluded due to the large number of these compared to the other types of industry.

These criteria resulted in a population consisting of 1,957 manufacturing companies. While prior research relied on sampling techniques to select representative units from the population, this research surveyed the whole 1,957 population rather than selecting a sample from it, for three reasons. First, large samples can produce more confidence in the statistical results compared to a small sample that is associated with insensitivity and difficulty in detecting relationships (Hair et al., 2010). Second, structural equation modeling (SEM) analysis requires a large sample, especially a complex research model with more than seven constructs, as is the case in the present study (Hair et al., 2010; Kline, 2011). Therefore, it was decided to survey the whole population (1,957) rather than selecting a sample that might yield a low number of responses and so jeopardise the achievement of the research objectives. Appendix 6 shows the types of manufacturing industries that were included in the population.

4.3.2.6 Choice of respondents and unit of analysis

A survey should be directed to the most knowledgeable practitioners who can provide relevant information regarding the survey questions (Dillman et al., 2014). Prior management accounting (MA) studies considered management accountants are the main cost system practitioners who are in the best position to answer MA surveys because they can provide relevant information about the MAS and practices (Drury and Tayles, 2005; Al-Omiri and Drury, 2007; Brierley, 2007, 2008b; Abdel-Kader and Luther, 2008). For this reason, the survey questionnaire targets management accountants as the potential respondents. Nonetheless, it was difficult for the current study to identify the names of the management accountants from external databases, such as the FAME database, because these do not report the names of the company employees. As an alternative plan, the current study emailed the 1,957 companies, using the email addresses reported on either the FAME database or their website, requesting the names of their management accountants. Out of the 1,957 companies, only 44 supplied the name(s) of the individuals who were in the best position to answer the questionnaire. Therefore, 44 of the 1,957 questionnaires included the names of the individuals provided by these companies, while the remaining questionnaires were directed to "the attention of the management accountant".

Finally, the questionnaire's front cover page includes a request for the questionnaire respondents to answer the questionnaire from the perspective of the business units within which they worked, such as an autonomous company, a division of a divisionalised company, a manufacturing site within a division of a divisionalised company. The focus on the business unit was due to the fact that many large companies may have different business units (e.g. divisions), each of which may have different types of cost system and different levels of contextual variables, such as high or low product diversity (Drury and Tayles, 2005; Al-Omiri and Drury, 2007). For example, the field study conducted by Abernethy et al. (2001) (see chapter 2) showed that different divisions belonging to the same company had different levels of CSS, product diversity, and AMTs. Furthermore, the choice of business units is in line with previous MA and cost system studies (Frey and Gordon, 1999; Mia and Clarke, 1999; Chenhall, 2003; Drury and Tayles, 2005; Abdel-Kader and Luther, 2008).

4.3.2.7 Questionnaire administration and response rate

Once the questionnaire had been pilot tested and modified, and the target population had been identified, the questionnaires were printed to be distributed to the 1,957 UK manufacturing companies. 1,913 questionnaires were addressed as being for the attention of the management accountant, while 44 were addressed to named individuals. Each target participant received a copy of the questionnaire, a stamped addressed reply envelope and a covering letter at three triweekly intervals:

1. Monday 11 May 2015: the questionnaire with a covering letter and stamped addressed envelope were dispatched to the target population.

2. Monday 1 June 2015: a first reminder, which included a questionnaire, a covering letter and a stamped addressed envelope, was sent to each non-respondent.
3. Monday 22 June 2015: a second reminder, which included a questionnaire, a covering letter and a stamped addressed envelope, was sent to each non-respondent.

To improve the response rate, telephone calls were made to encourage non-respondents to participate in the questionnaire. Therefore, 440 questionnaires were received. Of these responses, 39 questionnaires were not usable for several reasons, as shown in Table 4.5. Therefore, the final sample of usable responses consisted of 401 questionnaires, which yielded a 20.5% effective response rate. The response rate of the current study is comparable with other MA and cost systems surveys undertaken in the UK: 19.6% (Abdel-Kader and Luther, 2008), 19.6% (Al-Omiri and Drury, 2007), and 11% (Al-Sayed and Dugdale, 2016). Further, 97 companies refused to participate in the survey for different known reasons, as presented in Table 4.6 below. The average (median) work experience of the participants in their current position is 7.19 (5) years.

Table 4.5: Analysis of the questionnaire responses.

	N	Total
Unusable questionnaires		
1. Questionnaires had missing values ≥ 10%.	15	
2. Questionnaires had inconsistent answers for pools and drivers.[a]	12	
3. Respondents did not answer all of the cost system questions.	10	
4. Respondents did not engage in answering the questionnaire.[b]	2	39
Usable questionnaire		
1. Questionnaires received prior to the first reminder.	129	
2. Questionnaire received after the first reminder.	135	
3. Questionnaire received after the second reminder.	137	401
		440

[a] Inconsistent answers included cases where the cost drivers are greatly larger than the cost pools.
[b] These respondents provided similar answers for the research constructs.

Table 4.6: List of reasons for not participating in the survey.

	N
Company policy	30
Not a manufacturing company	16
Busy	15
Questionnaire questions are irrelevant to the respondents' business	13
No reason	9
Closed or in the process of closing/selling the business	6
Overseas manufacturing facilities	5
The required person to complete the questionnaire is not available	3
Total	97

4.3.2.8 Non-response bias

To generalise the results of the questionnaire analysis, it is important to ensure that the data collected from the respondents are representative of the target population. Non-response bias can occur when some of the members, who declined to participate, cannot provide the required data or cannot be contacted, or systemically differ in terms of characteristics from the questionnaire respondents (Collis and Hussey, 2014).

Several methods have been proposed to test non-response bias (Armstrong and Overton, 1977). Non-response bias can be tested by comparing known values of the population, such as sales, age and income, to those of the survey respondents, and any significant differences between them indicate response bias (Armstrong and Overton, 1977). However, this method is not applicable in this research, even though the FAME database contains known values, such as sales, number of employees, and assets about the surveyed population, because the information reported by the FAME database often concerns the firm's level while our research focus is the business unit level (Al-Omiri and Drury, 2007). A common difference was also detected by the present study for some respondents between the sales and number of employees disclosed on the questionnaire and those reported on the FAME database (see also Al-Omiri and Drury, 2007).

Another method that can test non-response bias is the wave method. It compares the characteristics of early respondents to late ones, and any significant differences between them points to the possibility of bias (Armstrong and Overton, 1977). In this method, it is argued that late respondents are more likely to resemble the characteristics of non-respondents because the former would not have responded to the questionnaire had they not received the final reminder from the researcher (ibid). The wave method is widely used in the management accounting literature (Drury and Tayles, 2005; Al-Omiri and Drury, 2007; Brierley, 2007; Abdel-Kader and Luther, 2008; Al-Sayed and Dugdale, 2016).

The current study employed the wave method and conducted different tests to compare early respondents (n = 129) with late ones (n = 137). The chi-square test reveals no difference between early and late respondents in terms of industry type $\chi^2 = 7.08$, *p value* = 0.71 and type of cost system $\chi^2 = 0.78$, *p value* = 0.67. An independent sample t-test was also used to examine whether any difference exists between early and late respondents regarding the variables under consideration (see Appendix 7). The results suggested that no significance difference exists between the two groups except for AMTs (*p value* = 0.048) and the percentage of manufacturing overhead costs type (*p value* = 0.012). It is difficult to explain this difference, given the fact that the remaining tests between the two groups are insignificant as well, and the wave method is a surrogate method that treats late respondents as equally as non-respondents.

4.3.2.9 Common method bias

Common method bias is the spurious variance associated with the measurement method, such as the scale type of questions and response format, rather than the research constructs (Podsakoff et al., 2003; Hult et al., 2006). It arises from the characteristics of the question and/or when the answers to the questions that are related to the independent and dependent variables are provided by the same person (Podsakoff et al., 2003; Hult et al., 2006). Harman's single factors test is one of the widely-used approaches for checking for common method bias using the exploratory factor analysis (EFA) technique (Podsakoff et al., 2003). Using this approach, the EFA analysis showed that an unrotated solution with 16-factors with an eigenvalue > 1 emerged, where the first factor only explained 13%. This result suggested that common method bias may not be an issue for the current study because of the absence of a single factor and the low variance explained by the first factor.

4.3.2.10 Questionnaire data analysis: structural equation modeling

Structural Equation Modeling (SEM) is one of the most important multivariate statistical analysis methods that has arisen in the social sciences for complex theory testing and/or development (Hair et al., 2010; Schumacker and Lomax, 2012). The label 'SEM' does not designate a particular type of statistical technique, but rather refers to a combination of analysis procedures, including factor analysis, multiple regression, and canonical correlation (Tabachnick and Fidell, 2001; Smith and Langfield-Smith, 2004; Hair et al., 2010; Kline, 2011). According to Henri (2007), SEM is "a set of multivariate techniques that allow for the simultaneous study of the relationship between directly observable and/or unmeasured latent variables, while incorporating potential measurement errors". SEM is principally concerned with the analysis of the covariance structure. Different estimation techniques are available in SEM to estimate the parameters. These include maximum likelihood estimation (MLE), weighted least squares, generalised least squares, and asymptotically distribution free estimation (Byrne, 2010; Hair et al., 2010; Kline, 2011). These estimation techniques vary regarding their efficiency and effectiveness due to the size of the sample and the normality of the data. However, MLE is the most common estimation technique used because it is robust even when multivariate normality is not met (Olsson et al., 2000; Olsson et al., 2004; Savalei, 2008). The following section will outline the main advantages of SEM before discussing the two components of SEM, namely the measurement model and the structure model.

4.3.2.10.1 Advantages of structural equation modeling

SEM is different from the older generations of multivariate techniques (Hair et al., 2010; Kline, 2011). First, the main feature of SEM is its ability to include latent constructs or factors into the analysis as well as the observed variables constituting the latent constructs (Byrne, 2010; Hair et al., 2010; Kline, 2011). A latent construct (e.g. business strategy, competition) is a hypothesised theoretical and abstract concept that cannot be observed or measured directly (Byrne, 2010; Hair et al., 2010). Thus, multiple indicators, manifest or observed variables, which can be collected via a survey questionnaire or observation, are used to reflect and measure indirectly the latent construct (Byrne, 2010; Hair et al., 2010; Kline, 2011). Nonetheless, latent constructs are exposed to measurement errors that arise from the inability of indicators variables to account for a large share of the variance within the latent construct (Byrne, 2010; Hair et al., 2010; Kline, 2011). The old multivariate techniques generation can neither address nor correct the measurement errors associated with the examined variables, and thus can lead to biased findings (Byrne, 2010; Hair et al., 2010; Kline, 2011). In contrast, SEM explicitly addresses the measurement errors for indicators variables and corrects the coefficient estimates of the hypothesised relationship, based on the measurement errors associated with the indicators of the latent construct (Byrne, 2010; Hair et al., 2010; Kline, 2011). Therefore, it can verify and examine the measurement properties of constructs indicators as well as the theoretical relationships between different constructs simultaneously in one model.

Another advantage of SEM is that it can examine simultaneously a series of relationships, whereas a latent dependent construct on one relationship can be treated as a latent independent construct in a subsequent relationship (Byrne, 2010; Hair et al., 2010; Kline, 2011). SEM can be perceived as a technique that combines the advantages of two procedures, namely factor analysis and path analysis (Hair et al., 2010).

4.3.2.10.2 The measurement model

The measurement model aims to evaluate the relationships between observed variables or indicators and latent constructs. More specifically, confirmatory factor analysis (CFA) is used to assess the measurement property of the research model and verify the pattern of the indicators-constructs relationships (Byrne, 2010; Hair et al., 2010; Kline, 2011). It also evaluates the validity, reliability and dimensionality of the research constructs (Hair et al., 2010).

Unlike exploratory factor analysis, CFA requires the researcher to specify the latent constructs, the indicators of each latent construct, the errors of the indicators, and the correlation between all of the latent constructs, based on prior theory (Byrne, 2010; Hair et al., 2010; Kline, 2011). Once the measurement model has been specified, the collected data are used to examine the extent to which the hypothesised model fits the data. In this regard, the covariance matrix that is estimated from the sample data is compared to the covariance matrix estimated for the theoretically specified model. If a small difference exists between them, the theoretical model fits the sample data well (Byrne, 2010; Hair et al., 2010; Kline, 2011). In contrast, a large difference between them will lead to a poor model that requires re-specification and modification based on statistical and theoretical reasoning (Byrne, 2010; Hair et al., 2010; Kline, 2011).

Different types of fitness indices have been developed to evaluate the degree of goodness of the overall fit of the specified research model. These indices fall into three categories: (1) absolute fit indices; (2) incremental fit indices; and (3) parsimony fit indices (Byrne, 2010; Hair et al., 2010; Kline, 2011). Absolute fit indices assess the degree to which the specified model can fit or reproduce the sample data and explain the proportion of the observed covariance within the data (Byrne, 2010; Hair et al., 2010; Kline, 2011). Chi-square, normed Chi-square, and root mean square error of approximation (RMSEA) are common indices that belong to the absolute fit category.

The incremental fit indices, known as comparative fit indices, evaluate the relative fit improvement of the specified model in comparison to a baseline model that includes completely uncorrelated indicators (Byrne, 2010; Hair et al., 2010; Kline, 2011). The most common incremental fit indices are the comparative fit index (CFI), incremental fit index (IFI), and normed fit index (NFI).

Parsimony fit indices are the final category which aims to compare the specified model to several competing models by evaluating the fit of these models based on their complexity (Byrne, 2010; Hair et al., 2010; Kline, 2011). Given two different models that can similarly fit the same data, parsimony fit indices would favour the simpler model with fewer estimated, parameters and penalise a complex model with a higher number of estimated parameters. Table 4.7 presents the fitness indices along with the acceptable values that reflect a good fit measurement model.

Once a measurement model with acceptable fit indices has been achieved, the researchers move to the next step, during which the reliability and validity of the measurement model are evaluated (Hair et al., 2010). The reliability of the research measures can be evaluated by assessing the internal consistency, namely the Cronbach's alpha and composite reliability (Hair et al., 2010). Validity, on the other hand, can be assessed by discriminant validity and convergent validity (Hair et al., 2010). Further explanation about the concepts of reliability and validity, along with their acceptable values, will be discussed in chapter five.

Table 4.7: Types of fitness indices.

Fitness indices	Minimum acceptable level
Absolute fit indices:	
1. Chi-square (χ^2)	$p \geq 0.05$
2. Root mean square error of approximation (RMSEA)	≤ 0.08
3. Normed Chi-square (χ^2/degree of freedom)	≤ 3.0
Incremental fit indices:	
1. Comparative fit index (CFI)	≥ 0.90
2. Incremental fit index (IFI)	≥ 0.90
Parsimony fit indices:	
1. Adjusted goodness-of-fit index (AGFI)	≥ 0.80
2. Parsimony normed fit index (PNFI)	≥ 0.50

Source (Chau, 1997; Tabachnick and Fidell, 2001; Meyers et al., 2006; Byrne, 2010; Hair et al., 2010)

4.3.2.10.3 The structural model

Specifying a good fit measurement model is a critical step when conducting a structural model. The structural model allows the specification of the path regressions from the independent constructs to the dependent constructs in order to test the direct and/or indirect hypothesised relationships (Hair et al., 2010). This model is labelled a complete or full model because it consists of the measurement model as well as the structural model (Byrne, 2010). Unlike R^2 in multiple regression, which evaluates the overall fit of the model, goodness-of-fit (GOF) indices, as mentioned above, are also used to assess the structural model, which contains the links between the indicators and latent constructs, and also the links among the latent constructs themselves (Hair et al., 2010). Nonetheless, the fit of the structural model can be worse than the achieved fit of the measurement model because the latent constructs are allowed to be correlated with each other in the measurement model, but many of these correlations are constrained to having a zero value, meaning that no correlation is estimated (Hair et al., 2010).

Finally, the significance of the path coefficients (*p value*) represents a way to accept or reject the hypothesised associations in the structural model (Hair et al., 2010). The critical ratio (C.R.) accounts for the test statistic, which functions as a z-statistic, calculated by the division of the unstandardised regression coefficients over the standard error coefficients (Byrne, 2010).

4.3.3 The interview method

Over the years, the business environment has witnessed drastic changes. The complexity of this environment and greater importance attributed to the accounting role have led to growth in the use of qualitative methods in the accounting research field (Moll et al., 2006). This is due to the ability of qualitative methods to supply fresh and contextual insights about how accounting interrelates and interacts with its environments (Moll et al., 2006). The interview method is the most common and important data collection method in qualitative research (Myers and Newman, 2007; Qu and Dumay, 2011), which can be used for all types of qualitative research, both interpretive and positivist (Myers and Newman, 2007).

Kvale (1983, p. 174) defines the interview method as "an interview, whose purpose is to gather descriptions of the life-world of the interviewee with respect to the interpretation of the meaning of the described phenomena." Interviews can be classified based on their level of formality and structure into three types, namely structured, semi-structured and unstructured interviews (Myers and Newman, 2007; Saunders et al., 2009; Qu and Dumay, 2011). Structured interviews, known as a standardised interview, consist of a set of pre-determined questions that allow only for generating a fixed number of response categories (Myers and Newman, 2007; Saunders et al., 2009; Qu and Dumay, 2011). In the structured interview, there is no place for improvisation and the analysis is straightforward, involving quantifying and organising the findings (Myers and Newman, 2007; Qu and Dumay, 2011).

In contrast, the unstructured interview is the least standardised and formal type and is suitable for understanding the research area under study in depth from the interviewees' point of view (Saunders et al., 2009; Qu and Dumay, 2011). There is no pre-planned list of questions in the unstructured interview but, rather, the interviewers rely on general questions with more emphasis on improvisation to explore the beliefs, events and behaviours related to the topic area (Saunders et al., 2009; Qu and Dumay, 2011). Between structured and unstructured interviews lies the semi-structured interview. It involves pre-arranged questioning based on identified themes that cover the topic area, as well as interposed probes aimed at eliciting more answers (Saunders et al., 2009; Qu and Dumay, 2011).

Furthermore, the breadth and depth of the information collected by the interview method depend on the qualitative research strategy used by the researcher. Case study and field study are the most popular qualitative strategies used in management accounting research (Birnberg et al., 1990; Lillis and Mundy, 2005; Modell, 2005).[22] Researchers use the case study to provide an in-depth understanding of the phenomenon under study. Normally, it involves extensive data collection but it is limited to an individual case or site (Moll et al., 2006). Nonetheless, a case study approach can involve a small number of multiple sites (e.g. business units) for the purpose of increasing the breadth of the investigation, but not at the expense of losing the in-depth analysis of the case studies (Lillis and Mundy,

[22] There are other qualitative strategies such as ethnography, but these are uncommon in the accounting field (Moll et al., 2006).

2005).

In contrast to the case study, field study involves multiple site investigations, which normally tend to be large in number (Moll et al., 2006). While a field study lacks in-depth investigation, it has more breadth of inquiry than multiple case studies, which improves the generalisability of the findings by observing and comparing the research area over many sites (Lillis and Mundy, 2005; Moll et al., 2006). According to Lillis and Mundy (2005, p. 120), a field study is more appropriate for theory refinement "where there is significant extant theory but doubt or disagreement about either the nature of the constructs on which the theory is built, the relations among these constructs, or their empirical interpretation".

Based on the above discussion, the current study employs a field study strategy and semi-structured interview method to: (1) to provide what Lillis and Mundy (2005, p. 120) refer to as "empirical interpretation" of the results obtained from quantitative method phase; and (2) to explore other potential factors that may implicate the design of CSS (Brierley, 2014). The field study, which is incorporated in the qualitative phase of the mixed methods sequential explanatory design strategy and conducted after the completion of the first quantitative phase, aims to provide sufficient breadth of investigation, which can enable the current study to collect data about the similarities between the concepts and characteristics of the antecedent factors and consequences of CSS.

4.3.3.1 The interview guide

Developing an interview guide is an important aspect for conducting an interview and guiding the conversation (Richards, 1996; Berry, 2002; King, 2004a; Myers and Newman, 2007). One of the benefits of the interview guide is to limit the bias that is associated with the interview method during the conversation (Lillis, 1999). This is done by designing an interview guide that ensures a comprehensive and consistent coverage of the research themes for each interview and reduces interviewer intrusion based on predetermined neutral questions and probes (Lillis, 1999). The interview guide used in the current study (see Appendix 8) was designed to ensure the consistent and complete coverage of the research themes and questions for each interview. First, the first section of the interview guide questions was developed based on the results of the quantitative data to explore the reasons and mechanisms behind the significant and non-significant effects of the antecedents and consequences of CSS.

The second section of the interview guide was designed to seek the interviewees' perspectives regarding the potentiality of other factors that seem important when designing a sophisticated cost system (Saunders et al., 2009; Creswell and Plano Clark, 2011; Brierley, 2014). In this section, open-ended questions are employed to give the interviewees an opportunity to discuss any potential relevant contextual factors that should be included within the research model. The second strategy involves the use of closed-ended questions to focus particularly on the sustainability practices existing within the interviewees' companies and the degree to which these companies implement sophisticated cost systems in response to such practices. Sustainability represents a relatively new area of business research (Bennett et al., 2011). There is also increased recognition of the important role of MA in supporting companies proactively to emphasise sustainability in their business context (Sarkis et al., 2006; Ferreira et al., 2010; Henri and Journeault, 2010; Bennett et al., 2011; Henri et al., 2014; Henri et al., 2016), but such important contextual elements have been neglected by prior ABC and CSS research.

The term sustainability can be defined as "economic activity that meets the needs of the present generation without compromising the ability of future generations to meet their needs, and is based upon economic, social, and environmental components" (Sarkis et al., 2006, p. 751). A sustainable organisation should not only consider its economic performance and stakeholders' interests, but the environment and social dimensions of sustainability should also be effectively managed (Sarkis et al., 2006; Bennett et al., 2011). The environmental aspect of sustainability represents the major focus of the interview guide with the aim of uncovering the extent to which companies adopt a proactive environmental strategy that can actually address environmental issues (Banerjee, 2002; Perego and Hartmann, 2009). It is argued that such a strategy requires a refined cost system, such as an ABC system, to uncover the hidden environmental costs and track them to the activities and cost objectives associated with them, rather than aggregating costs into a general cost pool that can undermine and hide relevant critical information concerning environmental costs (Ditz et al., 1995; Bennett and James, 1998; Sarkis et al., 2006; Henri et al., 2014). As a result, a number of questions are formulated to investigate cost accounting procedures concerning the activity cost pools and cost drivers devoted to measuring and tracking environmental costs, such as waste, emissions, and recycling to investigate whether CSS is impacted by the environmental aspect of sustainability.

4.3.3.2 Interviewee recruitment

The last page of the questionnaire included a request for a face-to-face interview and the contact information of the respondents (see Appendix 4). Fifty-four questionnaire respondents provided their contact information. Once the quantitative analysis had been completed and the results were available, the researcher contacted the 54 respondents during March 2016. Of the contacted 54 questionnaire respondents, 11 respondents accepted to be interviewed by the researcher and the remaining questionnaire respondents did not respond to the email requests sent by the researcher or were too busy to attend an interview.[23] The gap between receiving the respondent's questionnaire and conducting the interview was six months because the process of the quantitative analysis, the preparation of the interviews guide and the process of contacting the interviewees took six months. This is in line with the objectives of the explanatory mixed methods design, where the researcher dedicates the resources and time to collect and analyse quantitative data during the first phase of the explanatory mixed methods design, and then proceeds to the second qualitative phase based on the results of the first phase. The first interview took place on 10 March 2016 and the final one on 29 April 2016. Nine interviews were conducted face-to-face and two were held over the phone. Most of the interviewees were financial directors, managers, or controllers, and the interviews ranged from 40 minutes to 141 minutes in length, with an average time of 113 minutes. All interviews were tape-recorded and later transcribed. Table 4.8 presents the interviewees' information.

4.3.3.3 The interview analysis

There are many approaches whereby qualitative data can be analysed. Examples of qualitative analysis approaches are content, thematic, grounded theory, discourse, and narrative analysis (Nadin and Cassell, 2004; Braun and Clarke, 2006; Saunders et al., 2009). The choice of analysis method should follow the philosophical assumptions underpinning the research study (Willig, 2013). Some of the qualitative analysis methods are highly deductive, formalised, and structured, while others are inductive and less-structured (Saunders et al., 2009).

[23] It should be noted that further interviews were excluded from the analysis. For example, two interviews were excluded because these were conducted with individuals who did not participate in the questionnaire. For example, one commercial accountant had been directed to attend the interview by the financial director who had completed the questionnaire and a management accountant attended the interview because of the absence of the financial director who had completed the questionnaire.

Table 4.8: Interview sample.

Code	Type of business	Interviewee position	Interview type	Interview duration (in minutes)	Gender
A	Manufacture of aerospace fasteners	Cost accountant	Face-to-face interview	109	Male
B	Manufacture and decoration of bottle closures	Financial controller	Phone interview	113	Male
C	Production of wine	Financial director	Face-to-face interview	97	Male
D	Manufacture of cheese products	Financial director	Phone interview	40	Male
E	Manufacture of paint products	Financial director	Face-to-face interview	129	Female
F	Preparation and spinning of textile fibres	Financial director	Face-to-face interview	136	Male
G	Manufacture of meat substitute products	Financial controller	Face-to-face interview	122	Male
H	Manufacture of chocolate and other confectionery products	Financial director	Face-to-face interview	115	Male
I	Manufacture of paper	Financial manager	Face-to-face interview	112	Male
J	Manufacture of electronic coating thickness gauges	Manufacturing accountant	Face-to-face interview	127	Male
K	Manufacture of specialist medical and industrial equipment	Financial manager	Face-to-face interview	141	Male

Thematic analysis is an approach for finding, analysing, organising, and reporting the themes within the whole data set to highlight the commonality and differences across the interviewees (Braun and Clarke, 2006; King and Horrocks, 2010). It is more flexible because it can suit different types of research, including positivist and interpretivist research and can also be applied deductively and inductively (Braun and Clarke, 2006; King and Horrocks, 2010; Willig, 2013).

Thematic analysis can be geared towards positivist and deductive research when the research emphasises the semantic or explicit surface meaning of the data across cases based on a pre-determined framework (Braun and Clarke, 2006; King and Horrocks, 2010; Willig, 2013). Therefore, it was used in the current study to analyse the qualitative data due to the nature of this research which is in line with the hypothesis testing and deductive approach. The present study approached the thematic analysis with pre-defined statements and categories from the quantitative analysis phase (e.g. psychometric-based measures, like competition, product diversity and business strategy) and the literature review.

There are different ways of conducting thematic analysis, including template analysis (King, 2004b; King and Horrocks, 2010), data matrices (Nadin and Cassell, 2004; King and Horrocks, 2010), and thematic network (Attride-Stirling, 2001). The interviews were analysed using data matrices because this is more appropriate in situations where the aim of the research is to compare different sites, groups, and organisations and when the research study lacks the time to engage in line-by-line coding and analysis (Nadin and Cassell, 2004; King and Horrocks, 2010). This method aims to present a visual matrix by tabularising the unit of analysis (sites, individuals) against the main characteristics, concepts, or themes related to the research questions (Nadin and Cassell, 2004; King and Horrocks, 2010).

The following steps reflect the data analysis process. All of the interviews were tape-recorded, then transcribed verbatim by a professional transcription service. The accuracy of each transcribed interview was verified by listening to the audio and comparing it to the transcribed text. Eleven data matrices were created in a Word document, each of which represents an overarching or global, theme, such as competition, product diversity, or accountant role. All of the transcribed texts were read once without any attempt to engage in any coding process, to become familiar with the text. The next step involved highlighting text that was relevant to the themes under study to define the descriptive codes. Once the relevant texts had been highlighted, they were labelled with short explanatory phrases. All of the relevant texts with their descriptive codes were moved to their corresponding data matrices. Each site or interviewee was allocated to a row and each column was denoted by a single descriptive code, where texts were inserted inside the matrix. The final stage involved the interpretation process by attaching meaning to the codes. This was done by grouping the descriptive codes that share a common meaning and creating an interpretive code that can reflect them.

4.4 Chapter summary

The current chapter discussed the research paradigms, philosophical assumptions, and research strategy. The present study adopted the positivism paradigm that frames the current research and the mixed methods strategy to examine the research data. It also identified and discussed the data collection methods and justified the appropriateness of employing a cross-sectional questionnaire and interview method to collect the empirical data to achieve the research objectives.

Chapter 5: Data Description and Measurement Model Analysis

5.1 Introduction

The objectives of this chapter are to: (1) clean and prepare the data collected from the cross-sectional questionnaire; (2) empirically describe the research constructs under consideration; (3) assess the fit of the research measurement model through confirmatory factor analysis (CFA); and (4) establish the reliability and validity of the research constructs of interest. Section 5.2 presents the preliminary data screening procedures. These include the treatment of missing data and the identification and treatment of outliers and non-normal observations. The third section will provide general descriptive statistics for the main factors, along with their indicators, that will be examined in the CFA. This section is divided into three sub-sections: cost system sophistication (CSS), antecedent factors, and finally, outcome factors. The fourth section of this chapter is dedicated to testing the theoretical measurement model based on the CFA. The fifth and sixth sections aim to establish the reliability and validity of the measurement instrument, respectively. After establishing the reliability and validity of the measurement scale, a multicollinearity analysis of the independent factors will be presented in section 5.7. Finally, a summary of chapter five will be presented at the end.

5.2 Preliminary data screening procedures

5.2.1 Missing data analysis

Missing data occur when the questionnaire respondents provide no answer to one or more of the questionnaire questions (Hair et al., 2010). The literature differentiates between two types of missing data: ignorable and non-ignorable (Vriens and Melton, 2002; Hair et al., 2010; Kline, 2011). Ignorable missing data occur in a non-systematic and random way across the data set due to the research design, the design of the data collection instrument, or accidental reasons (Vriens and Melton, 2002; Hair et al., 2010; Kline, 2011).

In contrast, non-ignorable missing data occur in a systematic way due to known reasons, such as errors in the data entry process, or unknown reasons that directly pertain to the respondents, such as a refusal to answer sensitive questions or a lack of knowledge about certain questions (Vriens and Melton, 2002; Hair et al., 2010; Kline, 2011). The existence of this class of missing data in the data set can impede the generalisability of the results of the questionnaire (Byrne, 2010).

When the amount and pattern of missing data occur randomly, researchers can opt to use various imputation methods to estimate the values of the missing data (Tabachnick and Fidell, 2001; Byrne, 2010; Hair et al., 2010; Kline, 2011). In contrast, estimating systematic missing data requires special remedies (Tabachnick and Fidell, 2001; Byrne, 2010; Hair et al., 2010; Kline, 2011). Little's MCAR test can be used to uncover the pattern and the magnitude of missing data. Scholars recommend using Little's MCAR test to determine whether missing data are completely missing at random (Hair et al., 2010; Kline, 2011). Little's MCAR test compares the actual scattering of the missing data to the situation where the missing data are hypothesised to be completely randomly distributed (Hair et al., 2010). In this case, a non-significance difference between the actual and hypothesised missing data demonstrates that the data are missing completely at random (Hair et al., 2010). Little's MCAR test for sample data collected by the current study revealed χ^2 = 2440.197, *df* = 2454, *p* = 0.575. This implies the absence of any systematic pattern of missing data and the data are more likely to be missing completely at random.

In addition, Hair et al. (2010) and Byrne (2010) recommend that less than 10% of missing data should be considered a random pattern. Table 5.1 reports the total percentage of missing values (0.689%), which is far below the 10% level. Therefore, the researcher can choose various methods for estimating the missing values (Tabachnick and Fidell, 2001; Byrne, 2010; Hair et al., 2010; Kline, 2011). The single regression method is used in the current study to estimate the value of the missing data, which is more informative and superior for estimating missing data than pairwise deletion, listwise deletion, and mean substitution, because it considers all of the available information in the data set during the estimation process (Vriens and Melton, 2002; Sawilowsky, 2007; Kline, 2011; Babu et al., 2014). This method is built into the Statistical Package for the Social Sciences (SPSS) and estimates the missing values of the variables using the remaining completed variables in the data set as predictors of the variables with missing data based on a regression equation (Vriens and Melton, 2002; Sawilowsky, 2007; Kline, 2011; Babu et al., 2014). Therefore, this method treats the variables that contain missing data as dependent variables which are predicted by the remaining variables with complete data (Vriens and Melton, 2002; Sawilowsky, 2007; Kline, 2011; Babu et al., 2014).

Table 5.1: Summary of the missing values.

	Complete data		Incomplete data	
	N	%	N	%
Values	26,682	99.31%	185	0.689%
Cases	324	80.80%	77	19.20%
Variables	28	41.79%	39	58.21%

5.2.2 Outliers and normality analysis

Outliers are cases where influential data have extreme values that differ from the remaining cases (Byrne, 2010). Their presence can lead to biased estimates of survey results, which require either deletion or remedies to reduce their effects (Hair et al., 2010; Kline, 2011). It is recommended that outliers should be retainable and remediable, as they can represent a special segment of the population and their deletion will reduce the sample size (Tabachnick and Fidell, 2001; Hair et al., 2010; Kline, 2011). Outliers can be detected by converting the value of each observation into a z-score, and any value above ±3 is deemed an outlier (Kline, 2011). Therefore, observations with a z-score larger than ±3 were remedied based on the winsorization method. According to Sheskin (2003, p. 404), winsorization "involves replacing a fixed number of extreme scores [outliers] with the score that is closest to them in the tail of the distribution in which they occur". Observations pertaining to the number of cost pools, the number of cost drivers, the number of employees, and manufacturing overhead costs as a percentage of the total costs have some outlier cases and thus were winsorized.

Normality refers to the extent to which the sample data follow a normal distribution and it is also affected by the existence of outlier cases (Hair et al., 2010; Kline, 2011). Skewness and kurtosis were relied upon to examine the normality of the sample (Hair et al., 2010; Kline, 2011). While skewness influences the mean estimation, kurtosis tends to impact on the covariance and variance analysis (Byrne, 2010). Given the fact that SEM relies on covariance analysis, the kurtosis index is a critical concern in SEM analysis (Byrne, 2010).

Kline (2011) suggests that a value greater than ±3 and ±7 for skewness and kurtosis, respectively, demonstrates a violation of normality. The descriptive analysis (see section 5.3 below) showed that the skewness and kurtosis values of the questionnaire's questions were less than the threshold values.

5.3 Descriptive statistics

5.3.1 Descriptive statistics for cost system sophistication

Question A1 asks the respondents to report the type of cost system used for purposes of decision-making and control. As reported in Table 5.2, the first dominant cost system method used by UK manufacturing companies is traditional absorption costing systems

(57.6%), followed by the direct cost system method (36.9%). The table also shows that only 22 (5.5%) manufacturing companies use ABC systems, which is similar to the adoption rates reported by Drury and Tayles (1994) and Brierley (2011), as shown in Table 5.3. Nonetheless, the ABC adoption rate revealed by this study is lower than the rates disclosed by Innes and Mitchell (1995), Innes et al. (2000), Drury and Tayles (2005), and Al-Omiri and Drury (2007), despite the fact that the sample for this study is much larger than that for the remaining studies. The discrepancy in adoption rate can be attributed to the fact that these studies surveyed both service and manufacturing companies, while this research focuses only on manufacturing companies. Prior research revealed empirical evidence that the adoption rate of ABC systems is higher in the service companies, particularly in the financial and commercial sectors, compared to manufacturing companies, because the former has higher indirect costs and fewer direct costs compared to the latter (Innes et al., 2000; Drury and Tayles, 2005; Al-Omiri and Drury, 2007). In addition, Kaplan and Cooper (1998) argue that manufacturing companies may not need ABC systems as much as non-manufacturing companies because the former has high direct costs, which represent a larger portion of the manufacturing costs that can be directly traceable to individual products.

Table 5.2: Descriptive statistics for the cost system types.

	Frequency	Percent
Direct costing systems	148	36.9
Traditional absorption costing systems	231	57.6
Activity-based costing (ABC) systems	22	5.5
Total	401	100

Table 5.4 presents the tabulated statistics for the number of cost pools (Question A2) set against the number of cost drivers (Question A3) to show the level of sophistication of

Table 5.3: Summary of the ABC adoption rate reported by some UK studies.

Authors	Country	Population	ABC adoption Rate
Drury and Tayles (1994)	UK	Manufacturing industry	4%
Innes and Mitchell (1995)	UK	Manufacturing and non-manufacturing industry	19.5%
Innes et al. (2000)	UK	Manufacturing and non-manufacturing industry	17.5%
Drury and Tayles (2005)	UK	Manufacturing and non-manufacturing industry	15%
Al-Omiri and Drury (2007)	UK	Manufacturing and non-manufacturing industry	29%
Brierley (2011)	UK	Manufacturing industry	3.5%

the cost system used by the survey respondents.[24] The shaded area in the lower right side of Table 5.4 indicates that 54 companies use sophisticated cost systems with 11 or more cost pools and four or more cost drivers. Of these 54 companies, seven are ABC users while the remainders use traditional absorption cost systems. The remaining ABC users use between 2 and 20 cost pools and between 1 and 9 cost drivers. This is lower than Kaplan and Cooper's (1998, p.102) suggestion that a simple ABC system should include 30-50 cost pools and many cost drivers to provide accurate cost information. However, the current study showed that the UK manufacturing companies tended to have a range of ABC systems, fluctuating from a simple to a highly-sophisticated design. In the UK, Drury and Tayles (2005, p. 71) found that UK manufacturing and non-manufacturing companies had a significantly low number of cost pools and cost drivers compared to Kaplan and Cooper's (1998, p.102) recommendation. More specifically, they reported that only 33 out of the 170 companies had developed sophisticated cost systems with more than 11 cost pools and 4 cost drivers. Of these 33 companies, 27 had implemented

[24] Direct cost system users were asked to skip questions A2 and A3 on the questionnaire because they do not use cost pools or cost drivers for overhead cost assignment (Al-Omiri and Drury, 2007). Thus, the cross-tabulation table only includes 253 respondents who use traditional absorption cost systems and ABC systems.

Table 5.4: Tabulated statistics: number of cost pools set against the number of cost drivers.

		Number of different types of cost drivers															
		1		2		3		4		5		6		7-10		>10	
		N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Number of cost pools	1 (N=12)	10	(4.0)	2	(0.8)												
	2-4 (N=41)	11	(4.3)	22	(8.7)	4	(1.6)	2	(0.8)	2	(0.8)						
	5-10 (N=95)	20	(7.9)	23	(9.1)	14	(5.5)	10	(4.0)	13	(5.1)	3	(1.2)	10	(4.0)	2	(0.8)
	11-20 (N=57)	11	(4.3)	11	(4.3)	12	(4.7)	5	(2.0)	6	(2.4)	5	(2.0)	4	(1.6)	3	(1.2)
	21-30 (N=24)	5	(2.0)			3	(1.2)	3	(1.2)	7	(2.8)	3	(1.2)			3	(1.2)
	31-50 (N=13)			3	(1.2)			1	(0.4)	2	(0.8)			4	(1.6)	3	(1.2)
	>50 (N=11)			6	(2.4)					1	(0.4)			1	(0.4)	3	(1.2)
Total (n = 253)		57	(22.5)	67	(26.5)	33	(13.0)	21	(8.3)	31	(12.3)	11	(4.3)	19	(7.5)	14	(5.5)

an ABC system. The shaded area in the top left-hand corner of the table also shows that 106 companies used cost systems with a number of cost pools and cost drivers less than 11 and 4, respectively. The remaining respondents in the unshaded area can be located between those with a simple cost system, and those with a sophisticated cost system.

Question A4 was used to capture the extent to which the cost accounting system provides detailed data for analysing costs at eight different levels of cost object. Table 5.5 reports the descriptive statistics for question A4, which is labelled a "detailed cost system", as well as the number of cost pools and cost drivers. The mean score for cost pools is 8, while the mean score for cost drivers is 2.24.[25] Brierley (2007) surveyed UK manufacturing companies and found the average score for the number of cost pools and cost drivers to be 9 and 1.6, respectively. Further, the mean score of the detailed cost system construct is 3.14, which suggests that many companies consider their cost system, on average, to be an "adequate" system for providing detailed cost information for analysis at different levels.

In addition, the three measures, which include the number of cost pools, the number of cost drivers, and the detailed cost system, were subject to correlation analysis in order to examine the degree of consistency in terms of the strength, direction, and significance between several measures of a construct (Hair et al., 2010). Before conducting the correlation, the eight cost objects of the detailed cost system construct were subject to factor analysis in order to uncover the dimensionality of detailed cost system construct (see Table 5.9 for the result of the factor analysis in section 5.4.2.1 below). The results showed that the product, batch, product line and department levels were loaded onto one

[25] The direct cost system users (N=148) were coded zero for both the number of cost pools and cost drivers (Al-Omiri and Drury, 2007), thereby reducing the mean value for cost pools and drivers across the whole sample.

factor, which was labelled "internal cost objects". The remaining cost objects, which include the customer, supplier, brand and distribution channel levels, were loaded onto another factor, which was named "external cost objects".

Table 5.6 presents the correlation analysis for the different measures of CSS. The results show that the number of cost pools and the number of cost drivers share a strong mutual relationship ($r = 0.599$, $p < 0.01$). Drury and Tayles (2005) also found a significant correlation between the number of cost pools and the number of cost drivers ($r = 0.501$, $p < 0.01$). Furthermore, the internal cost objects' factor of the detailed cost system has a significant, low correlation with the number of pools and the number of cost drivers, while the external cost objects have no association with either the cost pools or the drivers. The low correlation results reported by the present study indicate that the detailed cost system construct does not fully reflect the element of sophistication as measured by the cost pools and cost drivers.

Table 5.5: Descriptive statistics of the cost system measures.

	Mean	Std. Deviation	Skewness	Kurtosis
A2. Number of cost pools	8.070	10.689	1.685	2.197
A3. Number of cost drivers	2.240	2.720	1.450	1.491
A4. Detailed cost system	3.140	0.770	0.010	–0.370
CS_1: Product level	3.820	0.929	–0.606	0.013
CS_2: Batch level	2.950	1.283	–0.207	–1.100
CS_3: Product line level	3.530	1.031	–0.628	0.071
CS_4: Department level	3.440	1.135	–0.616	–0.252
CS_5: Customer level	3.330	1.180	–0.442	–0.575
CS_6: Supplier level	2.700	1.266	0.053	–1.092
CS_7: Brand level	2.720	1.368	–0.021	–1.365
CS_8: Distribution channel level	2.610	1.321	0.145	–1.203

Table 5.6: Correlation of cost system measures.

	1	**2**	**3**	**4**
1 Number of cost pools	1			
2 Number of cost drivers	0.599**	1		
3 Internal cost objects	0.113*	0.114*	1	
4 External cost objects	0.009	0.032	0.481**	1

**Correlation is significant at the 0.01 level (two-tailed).
*Correlation is significant at the 0.05 level (two-tailed).

5.3.2 Descriptive statistics for the antecedent factors

The descriptive statistics for the antecedent factors and the corresponding indicators are reported in Table 5.7 to Table 5.13. These include: competition, the role of management accountants, product diversity, cost leadership strategy, differentiation strategy, cost structure, advanced manufacturing technologies (AMTs), and size of business unit.

Table 5.7 presents the descriptive statistics for competition. The results demonstrate that UK manufacturing companies tend to face relatively high competition on average (3.18). Brierley (2007) found that the UK manufacturing companies faced high competition (4.344). The Norwegian study conducted by Bjørnenak (1997) showed that the mean score for competition was 3.083 for ABC adopters and 3.348 for non-ABC adopters.

Table 5.7: Descriptive statistics for competition.

	Mean	Std. Deviation	Skewness	Kurtosis
C1. Competition	3.18	0.680	–0.334	0.220
COM_1: Raw materials, parts and equipment competition	2.63	1.024	0.262	–0.490
COM_2: New product development competition	3.22	1.132	–0.346	–0.696
COM_3: Promotion, advertising, and selling and distribution competition	2.61	1.134	0.207	–0.844
COM_4: Variety of products competition	2.99	1.036	–0.08	–0.442
COM_5: Quality of products competition	3.56	1.068	–0.457	–0.442
COM_6: Price competition	4.08	0.988	–0.984	0.564

As shown in Table 5.8 below, the mean score for the management accountants' role is 2.82, which is higher than that (1.95) reported by Emsley (2005), who surveyed the role of management accountants in Irish companies. Furthermore, more than half of the indicators reported in the table have mean scores that fall slightly below the midpoint between the accounting orientation and business unit orientation. This shows that, on average, UK management accountants consider that they focus on the importance of their responsibilities and lean slightly towards the requirements of the accounting function rather than the business unit's requirements.

Table 5.8: Descriptive statistics for the role of management accountants.

	Mean	Std. Deviation	Skewness	Kurtosis
B1. Role of management accountant	2.82	0.779	0.155	–0.497
ACC_1: The extent management accountants' work is determined by the needs of the accounting function and managers of the business unit	2.95	0.897	–0.084	–0.152
ACC_2: Amount of the working day spent with staff from the accounting function and the business unit	2.68	0.918	0.287	–0.392
ACC_3: The extent of the management accountants' responsibilities for reporting to the accounting function and the business unit	2.53	1.444	0.431	–1.145
ACC_4: The extent to which the management accountants conceive their role to be part of the accounting function or the business unit	2.92	1.059	–0.051	–0.491
ACC_5: The extent to which the performance of management accountants' work is determined by the accounting function and the business unit	2.93	0.986	–0.011	–0.269
ACC_6: The order in which management accountants deal with simultaneous requests from both the accounting function and the business unit	2.90	0.879	0.004	0.219

In addition, the respondents also seemed to provide neutral answers (neither agree nor disagree) about the level of their product diversity (3.30 out of 5), as shown in Table 5.9 below. In the US, Krumwiede (1998) revealed empirical evidence that manufacturing companies tended to have about an average level of product diversity. Similarly, Brierley (2007) showed that the UK manufacturing companies also tended to have an average level of product diversity (3.058).[26]

Table 5.9: Descriptive statistics for product diversity.

	Mean	Std. Deviation	Skewness	Kurtosis
C2. Product diversity	3.30	0.699	–0.350	0.125
PD_1: Diversity of product lines	3.28	1.127	–0.455	–0.774
PD_2: Diversity of product within each product line	3.02	1.095	–0.057	–0.962
PD_3: Diversity of design, manufacture and distribution processes	2.75	1.145	0.269	–0.887
PD_4: Diversity in volume (lot sizes) of products	3.77	1.058	–0.856	0.042
PD_5: Diversity of support departments for each product line	2.98	1.127	–0.034	–1.037
PD_6: Diversity of products' physical size	4.03	1.024	–1.305	1.441

Table 5.10: Descriptive statistics for business strategy.

	Mean	Std. Deviation	Skewness	Kurtosis
C3. Differentiation strategy	3.68	0.768	–0.329	–0.208
DIFF1: Seeking to maintain brand identification, rather than compete mainly on price	3.77	0.988	–0.750	0.247
DIFF2: Seeking to be unique in our industry and find buyers that are willing to pay a premium price for that uniqueness	3.70	1.000	–0.480	–0.444
DIFF3: Investing in technology to develop unique product designs	3.56	1.009	–0.301	–0.671
C3. Cost leadership strategy	3.34	0.681	0.090	–0.077
CL1: Our objective is to be the lowest cost producer	2.82	1.138	0.163	–0.931
CL2: Reaping cost advantages from all sources	3.77	0.813	–0.656	0.690
CL3: Investing in technology to develop low-cost product designs	3.43	0.930	–0.354	–0.411

Additionally, Table 5.10 above reports a descriptive analysis of the differentiation and cost leadership strategies. It appears from this table that the sample business units tend to adopt a differentiation strategy slightly more than a cost leadership strategy, as the former

[26] Krumwiede (1998) used a seven-point Likert scale while Brierley (2007), together with the current study, used a five-point Likert scale to measure product diversity.

has a higher mean (3.68) compared to the latter (3.34). Chenhall and Langfield-Smith (1998) surveyed Australian manufacturing companies and disclosed that the mean score for product differentiation was 5.52, while cost leaders tended to have a mean of 3.50.[27]

Table 5.11: Descriptive statistics for cost structure.

	Mean	Std. Deviation	Skewness	Kurtosis
C4. Cost structure: Increases in overhead costs in the past three years in:	2.75	0.585	–0.155	0.769
CSTR_1: Indirect labour costs	2.85	0.810	0.034	0.578
CSTR_2: General and administrative costs	2.61	0.871	–0.040	–0.061
CSTR_3: Facilities and equipment costs	2.90	0.821	0.060	0.115
CSTR_4: Engineering costs	2.99	0.889	–0.143	0.009
CSTR_5: Material overhead costs for the procurement and movement of materials	2.61	0.833	–0.003	–0.341
CSTR_6: Material overhead costs for raw materials, components, assembly and finished products	2.57	0.817	–0.021	–0.382
C8. Cost structure: Manufacturing overhead costs as a percentage of the total costs	14.30	7.574	0.538	–0.477

Regarding cost structure, this was measured by two questions on the questionnaire (C4) and (C8). C4 asked the respondents to specify the extent to which they faced an increase in indirect costs during the last three years for six items. As Table 5.11 above shows, the UK sample companies in this study, on average, experienced only a slight increase in indirect costs (2.75) as well as for all six indicators of scale.

In addition, C8 aimed to measure the percentage of manufacturing overhead costs to the total cost structure which also included direct material costs, direct labour costs, and non-manufacturing overhead costs. The mean score for the manufacturing overheads percentage is 14.30% which is slightly higher than that for indirect manufacturing costs

[27] Chenhall and Langfield-Smith (1998) used a seven-point Likert scale

(10.3%) reported by Al-Omiri and Drury (2007), but lower than that for manufacturing overhead costs (21.11%) revealed by Brierley (2011).[28]

Table 5.12 shows the descriptive analysis for the AMTs' construct. On average, the surveyed UK manufacturing companies tend to use AMTs to a limited extent (2.64). Hoque (2000) surveyed the extent to which AMTs, as measured by the level of automation, was adopted by New Zealand companies, and found that these companies tended to implement AMTs to some extent (3.65).

Table 5.12: Descriptive statistics for advanced manufacturing technologies.

	Mean	Std. Deviation	Skewness	Kurtosis
C7. Advanced manufacturing technologies	2.64	0.924	0.212	–0.557
AMT1: Applying computer-enhanced technology to improve the flexibility of manufacturing	2.64	1.095	0.192	–0.630
AMT2: Utilising production technology that is among the most flexible in the industry	2.58	1.100	0.193	–0.770
AMT3: Incorporating real-time process control into our production systems	2.54	1.176	0.259	–0.854
AMT4: Reorganising our facilities as necessary to increase our manufacturing flexibility	3.14	1.080	–0.208	–0.471
AMT5: Using AMTs in the production process	2.32	1.182	0.451	–0.851

Finally, the descriptive statistics for the business unit size, as measured by the number of employees, are reported in Table 5.13. The UK manufacturing companies, on average, tended to have 334 employees. The Australian study by Hoque (2011) showed that the manufacturing companies, on average, had 1,168 employees, while Brierley (2007) found that the mean score for employee numbers in the UK manufacturing companies was 371.

[28] Al-Omiri and Drury (2007) reported a mean score of 10.3 for manufacturing companies alone, but the mean score for the total indirect costs for the whole sample, which include manufacturing and non-manufacturing companies, was 30.9.

The number of employees has been considered a reliable indicator of organisational size (Chenhall and Langfield-Smith, 1998; Baird et al., 2004; Schoute, 2009; Askarany et al., 2012). Therefore, the number of employees is used to measure organisational size rather than sales revenue because the latter is more exposed to year-to-year variations (Askarany and Smith, 2008).

Table 5.13: Descriptive statistics for business unit size.

	Mean	Std. Deviation	Skewness	Kurtosis
C9. Size of the business unit				
Number of employees	334.85	293.841	1.874	2.776

5.3.3 Descriptive statistics for the outcomes variables

One of the research objectives is to test the impact of CSS on improvements in product planning, cost management, and, ultimately, business unit performance. Table 5.14 presents the descriptive statistics for product planning and cost management. The respondent companies experienced a greater improvement in cost management compared to product planning, as the former had a higher mean (3.15) compared to the latter (2.73). In relation to their indicators, the table showed that cost management indicators are also higher than the product planning indicators. The UK companies tend to perceive the highest improvement to be in performance measurement, followed by cost reduction and budgeting. This might indicate that the UK companies' sample in this study attributed greater weight and focus to operational activities in order to reap more benefits compared to product planning areas, such as pricing and outsourcing decisions. The American study reported by Cagwin and Bouwman (2002) found that the most frequently used application by ABC users was cost reduction (4.37), followed by product cost (4.13), budgeting (3.78), and performance measurement (3.76), while pricing (3.65) and outsourcing decisions (3.46) were the least frequently used decisions.

Table 5.14: Descriptive statistics for product planning and cost management.

	Mean	Std. Deviation	Skewness	Kurtosis
C5. Product planning	2.73	0.845	–0.857	0.769
PP1: Product pricing decisions	2.83	1.220	–0.913	0.226
PP2: New product design decisions	2.81	1.296	–0.857	0.075
PP3: Product range decisions	2.69	1.272	–0.773	–0.099
PP4: Outsourcing decisions	2.15	1.359	–0.211	–0.993
PP5: Product output decisions	2.68	1.236	–0.821	0.140
PP6: Customer profitability analysis	3.05	1.360	–0.679	–0.224
PP7: Stock valuation	2.90	1.124	–0.376	–0.215
C5. Cost management	3.15	0.815	–0.873	1.790
CM1: Cost reduction decisions	3.22	0.982	–0.717	0.98
CM2: Budgeting	3.19	1.014	–0.628	0.595
CM3: Performance measurement	3.33	1.094	–0.808	0.73
CM4: Process reengineering and improvement	2.87	1.199	–0.588	0.102

The business unit performance was measured by four indicators, as shown in Table 5.15. The analysis showed that UK manufacturing companies were able to attain an average improvement, with a mean score of 2.91 out of 5. Maiga and Jacobs (2008) found that the US manufacturing companies tended to maintain slightly higher performance (5.364 out of 7) compared to our own findings.

Table 5.15: Descriptive statistics for business unit performance.

	Mean	Std. Deviation	Skewness	Kurtosis
C6. Business unit performance	2.91	0.907	–0.371	–0.440
PERF1: Market share	2.89	1.052	–0.381	–0.573
PERF2: Return on sales	2.97	1.135	–0.291	–0.767
PERF3: Sales on assets	2.83	1.056	–0.251	–0.681
PERF4: Return on net assets	2.94	1.061	–0.271	–0.544

5.4 The measurement model: confirmatory factor analysis

It was pointed out in chapter four that CFA was used to assess the measurement property of the research constructs items. CFA consists of the factors that account for the variation in a number of indicators (Kline, 2011; Brown, 2015). These factors are the latent constructs, which directly influence the indicators by accounting for the degree of correlation between them (Kline, 2011; Brown, 2015). The direct influence of constructs on their indicators is statistically estimated and called factor loadings (Kline, 2011). These factor loadings can be interpreted as regression coefficients, presented in the form of standardised and unstandardised values (Kline, 2011). In addition, CFA statistically estimates the errors or residuals associated with each indicator or the factors when they are considered dependent factors (Hair et al., 2010). The error terms for the indicators show the amount of unexplained variance by the factor (ibid). Part of the unexplained variance is attributable to measurement errors. CFA produces several statistical estimates that can evaluate and diagnose the CFA model. These include the standardised regression weights, the modification indices, and the goodness-of-fit indices.

As mentioned above, the standardised regression weights represent the regression paths from the latent factors to their corresponding indicators. The size of the standardised regression weights (factor loading) represents an important aspect when evaluating the measurement model. Factor loadings should be statistically significant, with a critical ratio (C. R.) > ±1.96 and a standardised loading > 0.50, which indicates that more explanation and variation are accounted for by the latent construct (Byrne, 2010; Hair et al., 2010). In the case of a single item, such as the age, size, cost pool or cost driver, as is the case in this research, this should not be considered nor interpreted in the same way as factors because they represent one item only (Kline, 2011; Brown, 2015). However, they should be included in CFA in order to estimate their correlation with other latent factors in order to avoid specification errors (Kline, 2011, p. 24; Brown, 2015). For the latent constructs, a minimum of two indicators should be used, "which is required for identification" (Byrne, 2010; Kline, 2011, p. 114).

The modification indices, on the other hand, show the potential cross-loading for all non-specified relationships in the measurement model, such as specifying a correlation between errors or freeing up a single path that has not been accounted for initially (Byrne, 2010; Hair et al., 2010). This can aid researchers to improve the model fit by showing the amount of improvement within it, if the offending indicators have been freed to load on another factor, or deleted. Modification indices with a value greater than |4.0| are recommended for potential consideration.

In relation to the goodness-of-fit indices, it was mentioned in chapter four that fitness indices are the most important criteria for showing the degree of the goodness or badness of the measurement model. Different indices have been discussed, including Chi-square (χ^2, $p \geq 0.05$), root mean square error of approximation (RMSEA ≤ 0.08), normed Chi-square (χ^2/degree of freedom ≤ 3.0), comparative fit index (CFI ≥ 0.90), incremental fit index (IFI ≥ 0.90), adjusted goodness-of-fit index (AGFI ≥ 0.80), and parsimony normed fit index (PNFI ≥ 0.50). This research will rely on the RMSEA and CFI indices to evaluate the measurement model because these are the most informative indices and the least sensitive to the effect of sample size (Fan et al., 1999; Tabachnick and Fidell, 2001; MacKenzie et al., 2005; Byrne, 2010; Hair et al., 2010). MacKenzie et al. (2005, p. 717) argued that RMSEA and CFI are "the most sensitive goodness-of-fit indices at detecting measurement model misspecification". Thus, when the measurement model of this study produces RMSEA with a value less than 0.08 and CFI with a value greater than 0.90, the measurement model will be deemed to be a good-fit model. The Chi-square (χ^2) will also be reported but not relied upon because it is expected to be statistically significant when the sample size exceeds 200 cases and/or the model contains > 30 indicators (Tabachnick and Fidell, 2001; Byrne, 2010; Hair et al., 2010; Kline, 2011).

Finally, SEM is a statistical technique that commonly requires a large sample size. Hair et al. (2010) suggested that a minimum sample size of 200 may be sufficient to apply the maximum likelihood estimation method for SEM. Other scholars rely upon Bentler and Chou's (1987, p. 91) rule, which points to the ratio of five respondents per free parameter, "especially when there are many indicators of latent variables". The sample size for the current study is 401, which meets the requirement of N >200 but the measurement model of this research contain 225 parameters to be estimated, which fails to meet the 5:1 rule of thumb suggested by Bentler and Chou (1987). In order to reduce the number of estimated parameters to comply more closely with the 5:1 rule of thumb, this research used the parcelling strategy. Further discussion about the use of parcelling will be presented in section 5.4.2 below. Having provided the statistical criteria for evaluating the measurement model under the CFA approach, the following section will examine the CFA measurement model for the current study.

5.4.1 Validating the CFA measurement model

The Analysis of a Moment Structures (AMOS) software is used in the current study to examine the measurement model. Figure 5.1 shows the latent factors, the indicators of the latent factors, the single variables, and the standardised factor loadings of the indicators. The maximum likelihood estimation (MLE) was used to estimate the measurement parameters. Each latent factor was specified, together with its indicators. The result of the CFA measurement model showed that the theoretical measurement produced unacceptable fit indices because these failed to meet some of the criteria or requirements for the cut-off values, as reported in Table 5.16. This indicates that the model requires modification in order to improve the model fit. Nonetheless, all of the indicators were loaded significantly ($p < 0.01$) onto their factors, with CR > 4, as shown in Table 5.17.

Several reasons can be outlined to explain the unacceptable fit indices. First, the model is complex, with 62 indicators and 225 estimated parameters, including factor loading, factor and error variance, and covariance, and it also contains a large degree of freedom (df = 1728). This can lead to model instability in terms of factor solutions (Schumacker and Lomax, 2012, p. 184).

Second, the modification indices showed a large covariance between a different pair of indicator errors, mostly from the same latent constructs. Finally, some indicators had a standardised loading of < 0.50, which indicates that less explanation and variation are accounted for by the latent construct (Byrne, 2010; Hair et al., 2010). In order to reduce the number of items of the latent factors and improve the standardised loading and model fit, the parcelling strategy was used, which is a common strategy in SEM (Kline, 2011; Little et al., 2013). The following section will present a discussion about the operationalisation of the parcelling strategy adopted by the current study.

Table 5.16: The CFA measurement model fitness indices.

Fitness indices	Requirement	Fitness indices values	Results
Chi-square (χ^2)	$p \geq 0.05$	$\chi^2 = 3442.997$, $p \leq 0.000$	Not satisfied
Df	> 0	df = 1728	Satisfied
RMSEA	≤ 0.08	RMSEA = 0.05	Satisfied
CFI	≥ 0.90	CFI = 0.80	Not satisfied
IFI	≥ 0.90	IFI = 0.80	Not satisfied
Normed Chi-square (χ^2/df)	≤ 3.0	χ^2/df = 1.99	Satisfied
AGFI	≥ 0.80	AGFI = 0.74	Not satisfied
PNFI	≥ 0.50	PNFI = 0.61	Satisfied

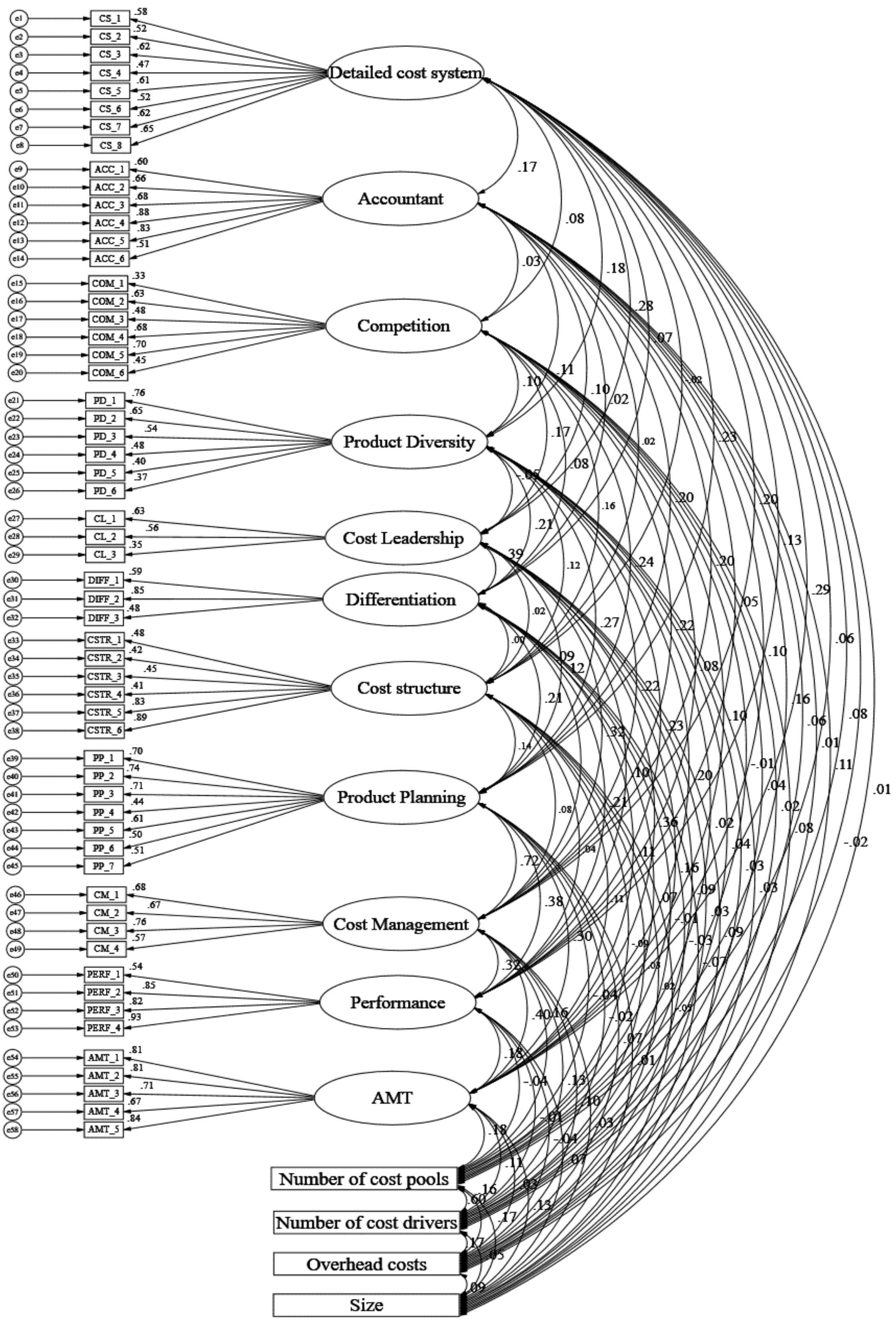

Figure 5.1: The CFA measurement model.

Table 5.17: The regression weights.

			Unstandardised regression Weights	S.E.	C.R.	P	Standardised regression weights
CS_1	←	Detailed cost system	1.00				0.58
CS_2	←	Detailed cost system	1.25	0.15	8.15	***	0.52
CS_3	←	Detailed cost system	1.20	0.13	9.23	***	0.62
CS_4	←	Detailed cost system	0.99	0.13	7.49	***	0.47
CS_5	←	Detailed cost system	1.35	0.15	9.14	***	0.61
CS_6	←	Detailed cost system	1.22	0.15	8.11	***	0.52
CS_7	←	Detailed cost system	1.57	0.17	9.16	***	0.62
CS_8	←	Detailed cost system	1.61	0.17	9.52	***	0.65
ACC_1	←	Accountant	1.00				0.60
ACC_2	←	Accountant	1.11	0.10	10.71	***	0.66
ACC_3	←	Accountant	1.81	0.16	11.00	***	0.68
ACC_4	←	Accountant	1.71	0.13	12.90	***	0.88
ACC_5	←	Accountant	1.51	0.12	12.54	***	0.83
ACC_6	←	Accountant	0.82	0.09	8.71	***	0.51
COM_1	←	Competition	1.00				0.33
COM_2	←	Competition	2.12	0.39	5.44	***	0.63
COM_3	←	Competition	1.62	0.32	5.03	***	0.48
COM_4	←	Competition	2.09	0.38	5.53	***	0.68
COM_5	←	Competition	2.22	0.40	5.56	***	0.70
COM_6	←	Competition	1.33	0.27	4.92	***	0.45
PD_1	←	Product Diversity	1.00				0.76
PD_2	←	Product Diversity	0.83	0.08	10.23	***	0.65
PD_3	←	Product Diversity	0.73	0.08	8.94	***	0.54
PD_4	←	Product Diversity	0.59	0.07	7.99	***	0.48
PD_5	←	Product Diversity	0.52	0.08	6.73	***	0.40
PD_6	←	Product Diversity	0.44	0.07	6.33	***	0.37
CL_1	←	Cost Leadership	1.00				0.63
CL_2	←	Cost Leadership	0.63	0.10	6.66	***	0.56
CL_3	←	Cost Leadership	0.45	0.09	4.99	***	0.35
DIFF_1	←	Differentiation	1.00				0.59
DIFF_2	←	Differentiation	1.45	0.17	8.33	***	0.85
DIFF_3	←	Differentiation	0.82	0.11	7.55	***	0.48
CSTR_1	←	Cost structure	1.00				0.48
CSTR_2	←	Cost structure	0.94	0.14	6.49	***	0.42
CSTR_3	←	Cost structure	0.95	0.14	6.83	***	0.45
CSTR_4	←	Cost structure	0.94	0.15	6.43	***	0.41
CSTR_5	←	Cost structure	1.79	0.19	9.32	***	0.83
CSTR_6	←	Cost structure	1.88	0.20	9.37	***	0.89
PP_1	←	Product Planning	1.00				0.70
PP_2	←	Product Planning	1.13	0.09	13.00	***	0.74
PP_3	←	Product Planning	1.06	0.08	12.52	***	0.71
PP_4	←	Product Planning	0.71	0.09	8.06	***	0.44
PP_5	←	Product Planning	0.88	0.08	10.84	***	0.61
PP_6	←	Product Planning	0.80	0.09	9.12	***	0.50
PP_7	←	Product Planning	0.66	0.07	9.13	***	0.51
CM_1	←	Cost Management	1.00				0.68
CM_2	←	Cost Management	1.02	0.09	11.19	***	0.67
CM_3	←	Cost Management	1.24	0.10	12.22	***	0.76
CM_4	←	Cost Management	1.03	0.11	9.80	***	0.57
PERF_1	←	Performance	1.00				0.54
PERF_2	←	Performance	1.72	0.15	11.29	***	0.85
PERF_3	←	Performance	1.54	0.14	11.08	***	0.82
PERF_4	←	Performance	1.76	0.15	11.63	***	0.93
AMT_1	←	AMT	1.00				0.81
AMT_2	←	AMT	1.01	0.06	17.68	***	0.81
AMT_3	←	AMT	0.94	0.06	14.96	***	0.71
AMT_4	←	AMT	0.82	0.06	14.04	***	0.67
AMT_5	←	AMT	1.13	0.06	18.50	***	0.84

***p value < 0.001 (two-tailed).

Table 5.18: Modification indices.

			M.I.	Par Change
e7	↔	e8	76.04	0.53
e40	↔	e41	71.74	0.39
e3	↔	e1	69.65	0.28
e29	↔	e32	55.16	0.30
e34	↔	e33	45.67	0.20
e44	↔	e48	45.24	0.33
e44	↔	Cost Management	38.15	0.21
e36	↔	e33	37.90	0.18
e45	↔	Cost Management	36.77	0.17
e40	↔	Cost Management	32.71	–0.16
e34	↔	e35	31.43	0.17
e29	↔	AMT	29.87	0.20
e34	↔	e36	28.57	0.18
e5	↔	e44	27.98	0.31
e35	↔	e33	27.36	0.14
e16	↔	e40	25.71	0.23
e3	↔	e8	25.42	–0.23
e28	↔	e46	23.79	0.14
e8	↔	e1	23.46	–0.21
e32	↔	AMT	22.57	0.18
e41	↔	Cost Management	22.21	–0.13
e40	↔	e47	20.86	–0.18
e45	↔	e48	20.81	0.19

5.4.2 Parcelling strategy

Parcelling can be defined as the use of the average (sum) scores across two or more indicators (Kline, 2011). Parcelling has been used in different fields, including accounting (Cadez and Guilding, 2008), human resources (Aryee et al., 2004), operational management (Sila, 2007; Huang et al., 2008; Bou-Llusar et al., 2009), and marketing (Özturan et al., 2014).

There are several reasons why parcelling is a strongly warranted strategy for examining the relationships between latent factors. These include reducing the number of estimates parameters in SEM, decreasing the random errors, improving the ratio of communality to unique factor solution for each parcel, increasing communality, and improving the sample data’s normality (Landis et al., 2000; Little et al., 2002).

Before engaging in parcelling, it is important to verify the dimensionality of the indicators in order to determine the appropriate methods for forming the parcels. EFA is an approach that can determine the level of dimensionality of each construct (Hall et al., 1999; Little et al., 2002). When EFA produces a unidimensional factor solution, the researcher can choose any methods to form the parcels, as none of these methods would lead to a substantially different model fit (Landis et al., 2000; Little et al., 2002). These include, but are not limited to, random assignment (indicators are randomly assigned to parcels), the judgmental method (indicators with similar content questions are combined), or item-to-construct balance (the indicator with the highest factor loading is grouped with that with the lowest loading and so on until all indicators are paired together) (Landis et al., 2000; Little et al., 2002).

For multidimensional factor solutions for the latent constructs, Kishton and Widaman (1994) propose two methods. The internal consistency method aims to assign indicators from the same dimension randomly into parcels, so that each parcel will only contain indicators belonging to the same dimension. In contrast, the domain representative method assigns items randomly from different dimensions into parcels so that each parcel will contain indicators from different dimensions. Kishton and Widaman (1994) empirically compared the strength of the two methods and found several issues relating to the internal consistency method, including an unacceptable estimate of the parameters, and an unstable model solution (see Little et al., 2002). On the other hand, the domain representative method resulted in a stable model solution as well as acceptable parameter estimates. This method will lead to the creation of parcels that cover the broad aspects and domain of the latent construct (Burnette et al., 2009). Further, Landis et al. (2000) suggested that, for multidimensional constructs, the parcelling strategy should only be used in situations where there exists an equal number of indicators for each dimension in order to have representative parcels; otherwise, parcelling may affect the reliability of the measurement. They commented: “the resulting set of items should provide an adequate representation of the underlying construct dimensionality…[t]o the extent that one dimension was overrepresented, reliability would be expected to suffer” (Landis et al., 2000, pp. 190-191).

Based on the above discussion, the current study will use EFA as an initial step to uncover the dimensionality of each research construct. In particular, the principle component method with oblique rotation was used to extract the factors with eigenvalues greater than one (Hair et al., 2010; Field, 2013). The principle component method was selected due to its consideration of the total variance as well as unique and error variance, while oblique rotation was chosen because there are no theoretical reasons to assume that the dimensions of the latent construct are totally independent (Hair et al., 2010; Field, 2013). Three measures will also be relied upon to evaluate the validity of the factor analysis assumptions (Hair et al., 2010; Field, 2013). First, Kaiser-Meyer-Olkin’s (KMO) measure of sampling adequacy for the whole factor model, as well as the individual variables, will be used to evaluate the appropriateness of the factor solutions (Hair et al., 2010; Field, 2013). A value between 0.50 and 1 for both the whole model and each individual variable shows that the factor solution is acceptable. In contrast, a value <0.50 requires the deletion of the offensive variables from the factor analysis. Second, Bartlett's test of sphericity must be significant ($p < 0.001$), which can confirm that sufficient correlations exist between the variables (Hair et al., 2010; Field, 2013). Given the sample of the current study, a factor loading of a variable in excess of 0.30 is considered significant, but it will be a candidate for deletion in cases of the significant cross-loading of two or more factors, or loaded on unexpected factors that was not determined by the conceptual foundation of the study (e.g. Widener, 2007).

Further, the item-to-construct will be used to parcel the indicators when they load into one factor, as this method is considered a common parcelling method and can lead to equally balanced parcels with regard to discrimination and difficulty (Foley et al., 2002; Little et al., 2002; Gainey and Klaas, 2003; Elicker et al., 2006; Williams and O'Boyle, 2008; Diestel and Schmidt, 2011). For multidimensional factor solutions, the domain representative method will be relied upon to parcel the indicators for each sub-dimension randomly, because this can result in a stable estimate of the model parameters (Kishton and Widaman, 1994; Little et al., 2002; Williams and O'Boyle, 2008). Finally, both parcelling strategies will be used for constructs with 6 or more indicators, as these constructs lead to a large number of parameter estimates compared to constructs with fewer indicators (e.g. Diefendorff and Richard, 2003; Alge et al., 2006; Amiot et al., 2006; Brown et al., 2006; Henri, 2006; Bou-Llusar et al., 2009; Schmitz et al., 2014).

5.4.2.1 Factor analysis of detailed cost systems

The detailed cost system construct consists of eight cost object measures. To assess the dimensionality of the construct, they were initially factor analysed, as shown in Table 5.19. Two factors emerged with eigenvalues greater than one, which, in combination, explained 57% of the data variance. Further, no significant cross-loading greater than 0.30 is evident. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy for the whole model (0.79) and each individual variable is above 0.50, and Bartlett's test of sphericity ($p < 0.001$) showed that the EFA had sufficient correlations between the indicators (Hair et al., 2010; Field, 2013).

The first factor contained the internal cost objects while the second factor encompassed the external cost objects. Both factors have an equal number of indicators, which entail the use of the domain representative method (Landis et al., 2000; Little et al., 2002).

Therefore, four parcels were created, each containing the average score of two indicators that were randomly assigned to four parcels. Therefore, CS_8 and CS_2 were combined into one parcel (CS_P1), CS_7 and CS_4 were averaged into one parcel (CS_P2), CS_6 and CS_3 were included in another parcel (CS_P3), and CS5 and CS_1 were paired into one parcel (CS_P4).

Table 5.19: Factor analysis of detailed cost systems.

	Factor loading	
	1	2
CS_1: Product level	–0.093	**0.869**
CS_2: Batch level	0.061	**0.652**
CS_3: Product line level	–0.042	**0.866**
CS_4: Department level	0.189	**0.464**
CS_5: Customer level	**0.525**	0.270
CS_6: Supplier level	**0.670**	0.027
CS_7: Brand level	**0.841**	–0.062
CS_8: Distribution channel level	**0.879**	–0.051

Variance explained by the model = 56.78
Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy (whole model) = 0.79
Bartlett's test of sphericity (χ^2 = 887.042, df = 28, $p < 0.001$)

5.4.2.2 Factor analysis of the role of management accountants

The role of management accountants consists of six measures that were loaded significantly into one factor which had 57% variance, as shown in Table 5.20. Bartlett's Test of Sphericity ($p < 0.001$) and the KMO measure of sampling adequacy (0.852) showed an acceptable EFA model, and the KMO values for individual indicators were above 0.50 (Hair et al., 2010; Field, 2013).

Since the management accountants are a unidimensional construct, the item-to-construct method is used to parcel the six indicators so that the highest and lowest loading indicators are combined together into one parcel. This led to the creation of three parcels, each with an average score of two indicators. ACC_4 and ACC_6 were averaged into one parcel (ACC_P1), ACC_5 and ACC_1 were combined (ACC_P2), and finally, ACC_2 and ACC_3 were parcelled together (ACC_P3).

Table 5.20: Factor analysis of the management accountants' role.

	Factor loading
ACC_1: The extent management accountants' work is determined by the needs of the accounting function and managers of the business unit	**0.704**
ACC_2: Amount of the working day spent with staff from the accounting function and the business unit	**0.734**
ACC_3: The extent of the management accountants' responsibilities for reporting to the accounting function and the business unit	**0.739**
ACC_4: The extent to which the management accountants conceive their role to be part of the accounting function or the business unit	**0.872**
ACC_5: The extent to which the performance of management accountants' work is determined by the accounting function and the business unit	**0.853**
ACC_6: The order in which management accountants deal with simultaneous requests from both the accounting function and the business unit	**0.600**
Variance explained by the model = 57.17	
KMO measure of sampling adequacy (whole model) = 0.852	
Bartlett's test of sphericity (χ^2 = 984.81, df =15, p < 0.001)	

5.4.2.3 Factor analysis of competition

Competition was measured by six indicators that were loaded significantly onto a single factor, as shown in Table 5.21. Both Bartlett's test of sphericity ($p < 0.001$) and the KMO measure of sampling adequacy (0.746) and for each indicator (> 0.50) demonstrate an acceptable EFA model (Hair et al., 2010; Field, 2013). Also, the factor explained 42% of the variability of the competition. The item-to-construct method will be used to parcel the six indicators of competition, since it is a unidimensional construct. Three parcels were created, whereby the highest loading indicator was combined with the lowest one. COM_1 and COM_5 were included in one parcel (COM_P1), COM_4 and COM_6 were combined (COM_P2), and COM_2 and COM_3 were averaged into one parcel (COM_P3).

Table 5.21: Factor analysis of competition.

	Factor loading
COM_1: Raw materials, parts, and equipment competition	**0.437**
COM_2: New product development competition	**0.718**
COM_3: Promotion, advertising, and selling and distribution competition	**0.589**
COM_4: Variety of product competition	**0.747**
COM_5: Quality of product competition	**0.761**
COM_6: Price competition	**0.554**
Variance explained by the model = 41.654	
KMO measure of sampling adequacy (whole model) = 0.746	
Bartlett's test of sphericity (χ^2 = 432.175, df =15, p < 0.001)	

5.4.2.4 Factor analysis of product diversity

Six indicators were operationalised to measure the product diversity construct. EFA showed that product diversity is a unidimensional construct, where all indicators had significant loadings greater than 0.30 and explained 41% of the variance in the data, as presented in Table 5.22. The KMO measure of sampling adequacy is 0.744, the KMO values for each variable were above 0.50, and Bartlett's test of sphericity is significant ($p < 0.001$), thereby demonstrating that the data meet EFA assumptions. Again, the item-to-construct method is used to create three parcels, whereby high and low loading indicators were paired. The scores for PD_1 and PD_6, PD_2 and PD_5, and PD3 and PD_4 were, respectively, averaged into three parcels: PD_P1, PD_P2 and PD_P3.

Table 5.22: Factor analysis of product diversity.

	Factor loading
PD_1: Diversity of product lines	**0.763**
PD_2: Diversity of product within each product line	**0.676**
PD_3: Diversity of design, manufacture and distribution processes	**0.670**
PD_4: Diversity in volume (lot sizes) of products	**0.637**
PD_5: Diversity of support departments for each product line	**0.557**
PD_6: Diversity of products' physical size	**0.509**
Variance explained by the model = 41.043	
KMO measure of sampling adequacy = 0.744	
Bartlett's test of sphericity (χ^2 = 408.304, df = 15, $p < 0.001$)	

5.4.2.5 Factor analysis of business strategy

The indicators for the cost leadership and differentiation strategies were factor analysed together, as shown in Table 5.23. One indicator, "CL3: Investing in technology to develop low-cost product designs", was removed because it was loaded significantly onto two factors and had a KMO value equal to 0.480, which is less than 0.50. The remaining indicators were loaded significantly onto their corresponding business strategy, where factor one resembles the differentiation strategy, and factor two represents the cost leadership strategy. Both factors explain 65% of business strategy's variance and meet the recommended values for the KMO's measure of sampling adequacy for the whole model (0.637) and each variable (> 0.50), and the significance of Bartlett's test of sphericity ($p < 0.001$). Since the indicators were loaded onto the cost leadership and differentiation strategies, as specified by prior research (Frey and Gordon, 1999), and each strategy contains fewer than six indicators, no parcelling will be conducted for business strategy. The individual items will be included in the measurement model.

Table 5.23: Factor analysis of business strategy.

	Factor loading	
	1	2
CL1: Our objective is to be the lowest cost producer	–0.225	**0.732**
CL2: Reaping cost advantages from all sources	0.193	**0.907**
DIFF1: Seeking to maintain brand identification, rather than compete mainly on price	**0.770**	–0.008
DIFF2: Seeking to be unique in our industry and find buyers that are willing to pay a premium price for that uniqueness	**0.815**	–0.094
DIFF3: Investing in technology to develop unique product designs	**0.710**	0.133
Variance explained by the model = 64.479		
KMO of sampling adequacy = 0.637		
Bartlett's test of sphericity ($\chi^2 = 310.476$, df = 10, $p < 0.001$)		

5.4.2.6 Factor analysis of cost structure

Cost structure was developed for the purpose of this study (C4 on the questionnaire) to measure the extent of the increase in indirect costs for six different cost categories. The factor analysis of the six items revealed two factors, and the variance explained by the two factors accounted for 67% of the total. Each factor has a different number of indicators, whereby the first four indicators were loaded onto the first factor and the remaining two were loaded onto the second factor, as shown in Table 5.24. Thus, no parcelling strategy can be conducted for cost structure due to the unequal number of indicators (Landis et al., 2000).

It is also expected that the increased indirect costs would have a significant correlation with the manufacturing overhead costs as a percentage of total costs (C8 on the questionnaire) if they measure the same domain of cost structure construct. A Pearson's correlation was conducted between the two factors and the percentage of manufacturing overhead costs, as shown in Table 5.25. The results showed that an insignificant correlation exists between the two factors and the percentage of manufacturing overhead costs. This indicates that the developed measure of the increase in indirect costs fails to capture the percentage of manufacturing overhead costs. It was decided to exclude the two factors from the measurement and structural models, since they cannot be parcelled nor captured with the cost structure construct, as measured by the manufacturing overhead costs. Nonetheless, the percentage of manufacturing overhead costs will be used as a measurement of cost structure in line with the majority of prior cost system studies that use a single objective measure of cost structure.

Table 5.24: Factor analysis of cost structure.

	Factor loading	
	1	2
CSTR_1: Indirect labour costs	**0.743**	0.065
CSTR_2: General and administrative costs	**0.796**	–0.061
CSTR_3: Facilities and equipment costs	**0.676**	0.072
CSTR_4: Engineering costs	**0.753**	–0.047
CSTR_5: Material overhead costs for the procurement and movement of materials	–0.046	**0.965**
CSTR_6: Material overhead costs for raw materials, components, assembly and finished products	0.05	**0.913**

Variance explained by the model = 66.794
KMO measure of sampling adequacy = 0.744
Bartlett's test of sphericity (χ^2 = 774.92, df = 10, p < 0.001)

Table 5.25: Correlation matrix of cost structure measures.

	1	**2**	**3**
1. CSTR_factor_1	1		
2. CSTR_factor_2	0.452**	1	
3. Manufacturing overhead costs	0.017	0.012	1

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

5.4.2.7 Factor analysis of advanced manufacturing technologies

Table 5.26 presents the factor analysis results for advanced manufacturing technologies (AMTs). As shown in the table, one factor was extracted which accounted for 67% of the total variance. All indicators have significant loading and the factor solution has an acceptable level of sample adequacy (0.862) for the overall factor solution, and for each variable (> 0.50). Bartlett's test of sphericity (p < 0.001) indicates that a sufficient correlation exists between the indicators and the factor solution, thereby confirming the unidimensionality of the AMTs' construct. Since AMTs have five indicators, no parcelling strategy will be conducted for the AMTs' construct, and the five individual indicators will be validated in the CFA measurement model.

Table 5.26: Factor analysis of advanced manufacturing technologies.

	Factor loading
AMT1: Applying computer-enhanced technology to improve the flexibility of manufacturing	**0.838**
AMT2: Utilising production technology that is among the most flexible in the industry	**0.847**
AMT3: Incorporating real-time process control into our production systems	**0.787**
AMT4: Reorganising our facilities as necessary to increase our manufacturing flexibility	**0.761**
AMT5: Using AMTs in our production process	**0.867**
Variance explained by the model = 67.417	
KMO measure of sampling adequacy = 0.862	
Bartlett's test of sphericity (χ^2 = 1004.384, df = 10, p < 0.001)	

5.4.2.8 Factor analysis of product planning and cost management

The 11 indicators of product planning and cost management were factor analysed, resulting in the extraction of two factors. Two indicators were removed from the factor analysis because they were significantly cross-loaded on both factors of product planning and cost management.[29] These indicators were "PP1: Pricing decisions" and "CM4: Process reengineering and improvement". Additionally, two further indicators, namely "PP6: Customer profitability analysis" and "PP7: Stock valuation", loaded onto the cost management factor, were also eliminated, as prior research found these to be product planning indicators rather cost management indicators (Chenhall, 2004; Schoute, 2009). The remaining indicators were loaded onto their respective factors, as shown in Table 5.27. The first factor represents the product planning construct, while the second reflects the cost management construct. All of the indicators associated with each factor were

[29] Schoute (2009) also removed several items that were significantly cross-loaded onto the product planning and cost management factors.

loaded significantly onto that factor (> .30) and, in combination, explained 63% of the variance in the data. In addition, the KMO measure for the whole model (0.772) and for each variable (> 0.50), and Bartlett's test of sphericity, showed no violation of the minimum requirement for an acceptable factor solution. Finally, neither factor required any parcelling, since the number of indicators was less than six.

Table 5.27: Factor analysis of product planning and cost management.

	Factor loading	
	1	2
PP2: New product design decisions	**0.913**	–0.113
PP3: Product range decisions	**0.877**	–0.074
PP4: Outsourcing decisions	**0.512**	0.161
PP5: Product output decisions	**0.647**	0.182
CM1: Cost reduction decisions	0.092	**0.757**
CM2: Budgeting	–0.087	**0.871**
CM3: Performance measurement	0.032	**0.806**

Variance explained by the model = 62.885
KMO measure of sampling adequacy = 0.772
Bartlett's test of sphericity (χ^2 = 854.633, df = 21, p < 0.001)

5.4.2.9 Factor analysis of business unit performance

The business unit is the last construct, which consists of four indicators. Table 5.28 reflects the factor solution of the business unit performance. As the table shows, all of the indicators were loaded significantly onto one factor, which confirmed the unidimensionality of the business unit performance construct. The significance of the loadings ranged from 0.683 for "market share" to 0.916 for "return on net assets". Further, the total cumulative variance is 72%, while the KMO measure (0.778) and Bartlett's test of sphericity (p < 0.001) pointed to the fact that the factor lies within the acceptable range. Moreover, the KMO for each variable is above 0.50. Like the AMTs, product planning, and cost management constructs, business unit performance was not parcelled due to the low number of indicators. Alternatively, the individual indicators of business unit performance will be validated in the CFA measurement model in the next section.

Table 5.28: Factor analysis of business unit performance.

	Factor loading
PERF1: Market share	0.683
PERF2: Return on sales	0.888
PERF3: Sales on assets	0.879
PERF4: Return on net assets	0.916
Variance explained by the model = 71.674	
KMO measure of sampling adequacy = 0.778	
Bartlett's test of sphericity (χ^2 = 912.628, df = 6, p < 0.001)	

5.4.3 Validating the measurement model after the parcelling strategy

CFA was conducted to evaluate the measurement model after implementing the parcelling strategy described in the previous section. Figure 5.2 shows the CFA model.[30] The fitness indices for the whole measurement model are reported in Table 5.29. The overall fit of the measurement is acceptable, with Chi-square χ^2 = 847.61, df = 507 and p = 0.00, RMSEA of 0.04, Normed Chi-square (χ^2/df) of 1.67, CFI of 0.93, IFI of 0.94, AGFI of 0.87, and PNFI of 0.69. Table 5.30 also shows that all indicators were significantly loaded onto their respective factors and have standardised factor loadings greater than 0.50, except for "CL_2 = 0.49" which is marginally less than 0.50. Therefore, the current study believes that the measurement model fits the sample data, as the measurement model's fitness indices exceed the minimum requirements for an acceptable model fit.

Table 5.29: CFA's fitness indices.

Fitness indices	Requirement	Fitness indices values	Results
Chi-square (χ^2)	P ≥ 0.05	χ^2 = 847.61, $p \leq 0.00$	Not satisfied[a]
Df	> 0	df = 507	Satisfied
RMSEA	≤ 0.08	RMSEA = 0.04	Satisfied
CFI	≥ 0.90	CFI = 0.93	Satisfied
IFI	≥ 0.90	IFI= 0.94	Satisfied
Normed Chi-square (χ^2/df)	≤ 3.0	χ^2/df = 1.67	Satisfied
AGFI	≥ 0.80	AGFI = 0.87	Satisfied
PNFI	≥ 0.50	PNFI = 0.69	Satisfied

[a] The p value of the χ^2 is difficult to satisfy because χ^2 is sensitive to sample size when it exceeds 200 and when the number of indicators exceeds 30 (Tabachnick and Fidell, 2001; Byrne, 2010; Hair et al., 2010; Kline, 2011). The current sample size exceeds 200 and the number of indicators also exceeds 30.

[30] As a further refinement, DIFF_3, "Investing in technology to develop unique product designs", was removed from the measurement model due to its high covariance (modification indices = 25.66) with the AMTs' construct. This is due to the similarity of wording (Byrne, 2010) between DIFF_3 and the AMTs' measure, which can cause cross-loading. PP_4 was also deleted because it had a low standardised factor loading (0.41).

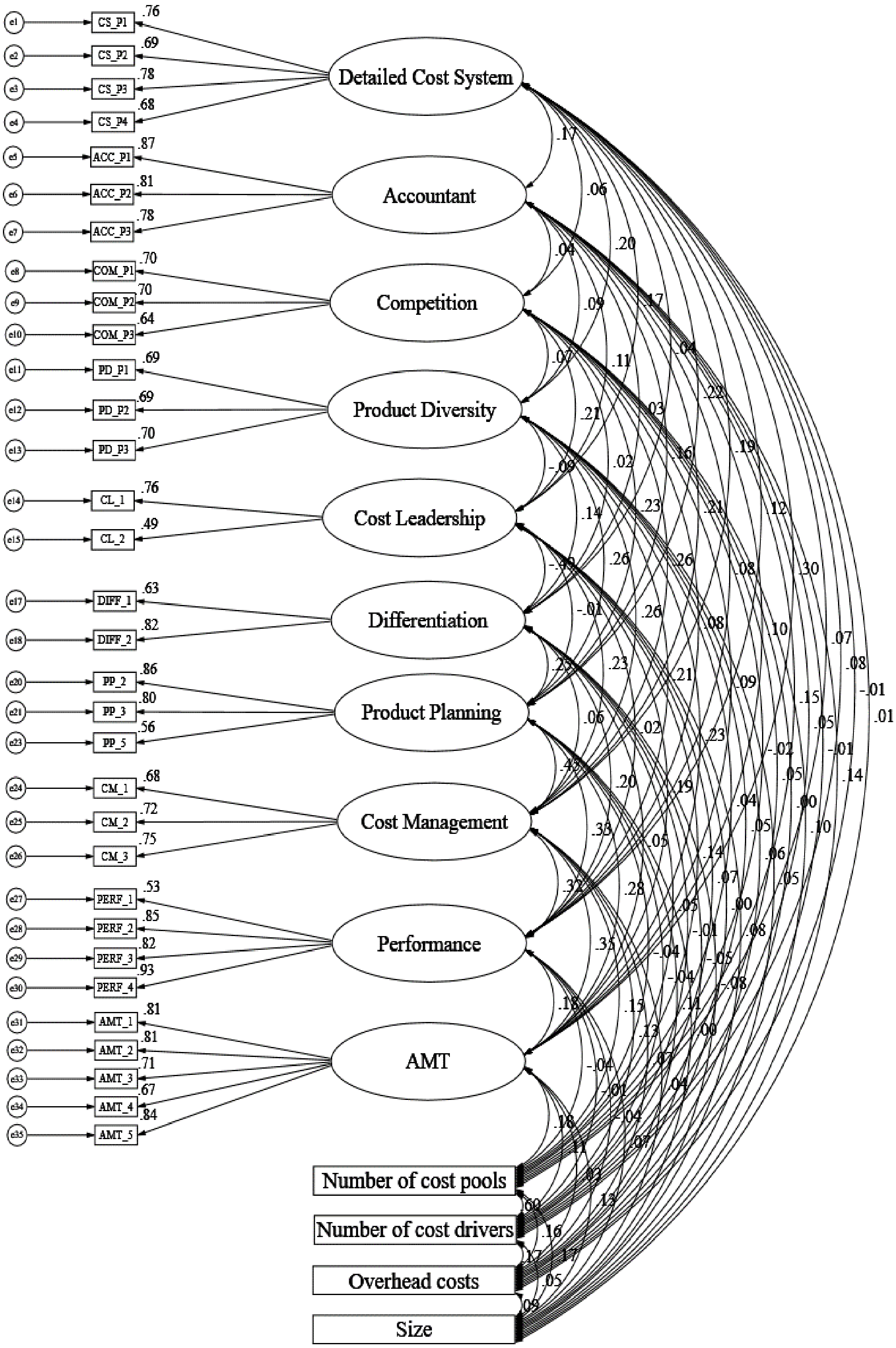

Figure 5.2: The CFA measurement model after the parcelling strategy has been implemented.

Table 5.30: The regression weights.

			Unstandardised regression weights	S.E.	C.R.	P	Standardised regression weights
CS_P1	←	Detailed cost system	1.00				0.76
CS_P2	←	Detailed cost system	0.87	0.07	12.57	***	0.69
CS_P3	←	Detailed cost system	0.88	0.06	13.75	***	0.78
CS_P4	←	Detailed cost system	0.76	0.06	12.3	***	0.68
ACC_P1	←	Accountant	1.00				0.87
ACC_P2	←	Accountant	0.93	0.05	17.03	***	0.81
ACC_P3	←	Accountant	1.11	0.07	16.62	***	0.78
COM_P1	←	Competition	1.00				0.70
COM_P2	←	Competition	1.01	0.11	9.29	***	0.70
COM_P3	←	Competition	1.04	0.11	9.17	***	0.64
PD_P1	←	Product diversity	1.00				0.69
PD_P2	←	Product diversity	1.00	0.10	9.7	***	0.69
PD_P3	←	Product diversity	1.06	0.11	9.73	***	0.70
CL_1	←	Cost leadership	1.00				0.76
CL_2	←	Cost leadership	0.47	0.08	5.69	***	0.49
DIFF_1	←	Differentiation	1.00				0.63
DIFF_2	←	Differentiation	1.32	0.19	7.1	***	0.82
PP_2	←	Product planning	1.00				0.86
PP_3	←	Product planning	0.91	0.06	14.54	***	0.80
PP_5	←	Product planning	0.62	0.06	10.72	***	0.56
CM_1	←	Cost management	1.00				0.68
CM_2	←	Cost management	1.09	0.10	11.08	***	0.72
CM_3	←	Cost management	1.22	0.11	11.24	***	0.75
PERF_1	←	Performance	1.00				0.53
PERF_2	←	Performance	1.72	0.15	11.28	***	0.85
PERF_3	←	Performance	1.54	0.14	11.07	***	0.82
PERF_4	←	Performance	1.76	0.15	11.62	***	0.93
AMT_1	←	AMT	1.00				0.81
AMT_2	←	AMT	1.01	0.06	17.63	***	0.81
AMT_3	←	AMT	0.95	0.06	14.95	***	0.71
AMT_4	←	AMT	0.82	0.06	13.98	***	0.67
AMT_5	←	AMT	1.13	0.06	18.49	***	0.84

*** p value < 0.000 (two-tailed).

5.5 Scale reliability

Reliability is concerned with the stability of the instrument measure across time, and the internal consistency between the multiple measurements of the construct (Hair et al., 2010; Collis and Hussey, 2014). Reliability can be established through the stability's test of the instrument measure and/or the internal consistency for a set of measures of the constructs (Hair et al., 2010; Collis and Hussey, 2014).

Stability refers to the ability of the measure to capture the same concept at different times from the same respondents. This can be achieved through test-retest reliability and requires the same instrument to be administered to several respondents at least twice, at different times (Hair et al., 2010). Nonetheless, this method is not applicable for this research because it will be difficult to convince the respondents to complete the same questionnaire twice.

Internal consistency is the second approach for evaluating reliability, and is the most common type in quantitative research (Hair et al., 2010; Field, 2013; Collis and Hussey, 2014). Cronbach's alpha is the most common measure for evaluating the scale reliability in terms of internal consistency (Hair et al., 2010; Collis and Hussey, 2014). In general, a Cronbach's alpha coefficient of 0.70 or more is deemed to be the lower-bound estimate for a reliable construct. However, the coefficient of the Cronbach's alpha is affected by the number of indicators, as it produces conservative estimates for constructs with a few indicators (Hair et al., 2010; Field, 2013). Given the sensitivity of the Cronbach's alpha to the number of indicators, a value as low as 0.60 (Hair et al., 2010) or 0.50 (Nunnally, 1978) is acceptable for constructs with a few indicators (Al-Omiri and Drury, 2007; Hair et al., 2010; Field, 2013). The composite reliability (CR) is another measure of internal consistency, which is analogous to the Cronbach's alpha, but considers the actual factor loadings of the indicators, as estimated using the CFA measurement model (Hair et al., 2010). CR of 0.70 is considered the minimum acceptable reliability estimate (Hair et al., 2010).

Table 5.31 reports the composite reliability as well as the Cronbach's alpha for the latent constructs. As the table shows, cost leadership has the lowest reliability ($\alpha = 0.522$ and CR = 0.569), while the reliability estimate of AMTs was the highest ($\alpha = 0.878$ and CR = 0.879). Also, most of the remaining constructs have a reliability estimate above 0.70, whereas the differentiation (α = 0.681 and CR = 0.693) is slightly less than 0.70. The reliability of cost leadership reported by the current study is similar to that reported by Pizzini (2006). Pizzini found that the cost leadership and product differentiation strategies had Cronbach's alphas of 0.52 and 0.56, respectively.

Table 5.31: The research constructs' reliability.

	No. of items	Cronbach's alpha	Composite reliability (CR)
Competition	3	0.718	0.721
Cost Leadership strategy	2	0.522	0.569
Differentiation strategy	2	0.681	0.693
Management accountants' role	3	0.853	0.861
Product Diversity	3	0.733	0.735
AMTs	5	0.878	0.879
Detailed cost system	4	0.815	0.819
Cost Management	3	0.759	0.760
Product Planning	3	0.776	0.790
Performance	4	0.864	0.870

5.6 Scale validity

After examining the reliability of the research constructs, the next step involves establishing the research validity. It highlights whether or not the indicators or measures that are devised for a concept actually represent the concept that they are expected to denote (Bryman and Bell, 2011; Collis and Hussey, 2014). Validity can be tested through content validity and construct validity.

5.6.1 Content validity

Content validity, also called face validity, addresses the degree to which the measures cover the content of a construct's concept (Hair et al., 2010; Collis and Hussey, 2014). This type of validity is verified based on judgmental assessment by relying on expert opinion about the content of the concepts or pre-testing with a subpopulation (Hair et al., 2010; Collis and Hussey, 2014). The content validity of the current research constructs was addressed through: (1) pre-testing the questionnaire instrument by surveying a sample of 20 companies regarding the questionnaire questions; and (2) interviewing a financial director from a UK manufacturing company about the research measures used to capture the research constructs (see section 4.3.2.2).

5.6.2 Construct validity

Construct validity tests the degree to which the results obtained from the operationalisation of the measures fit the theoretical concepts on which the tests are designed (Collis and Hussey, 2014). Construct validity can be assessed through convergent validity and discriminant validity (Hair et al., 2010; Collis and Hussey, 2014).

Convergent validity is the degree to which the indicators used to measure the specific constructs converge or share high common variance between them (Hair et al., 2010). Different techniques can verify the convergent validity (Hair et al., 2010; Collis and Hussey, 2014). However, researchers can rely on the significance and size of the standardised factor loading and the average variance extracted (AVE) produced by the CFA measurement model to evaluate the convergent validity (Hair et al., 2010). A significant factor loading with a standardised estimate equal to 0.50 or more, indicates a converged validity (Hair et al., 2010). Table 5.30 above shows that all of the indicators were loaded significantly onto their corresponding constructs and have standardised loading estimates above 0.50, except for indicator "CL_2 = 0.49", which is slightly below the recommended value.

In contrast, the AVE method estimates the convergent validity through calculating the mean squared of the indicators' standardised factor loadings (Hair et al., 2010). An AVE of 0.50 or more demonstrates high convergent validity, as it shows that more than half of the variation in the indicators can be explained by the latent construct, whereas the remaining proportion resembles the unexplained variance. The AVEs for the current research constructs are shown on the diagonal in Table 5.32. All constructs exceed the 0.50 AVE's rule of thumb, except for cost leadership (AVE = 0.409), competition (AVE = 0.463), and product diversity (AVE = 0.481). Therefore, a conservative interpretation of the results for these three latent constructs become important in evaluating their effect on CSS.

Table 5.32: Average variance extracted (AVE) and squared correlation.

	1	2	3	4	5	6	7	8	9	10
1 Cost leadership	**0.409**									
2 Detailed cost system	0.029	**0.531**								
3 Accountant	0.012	0.029	**0.674**							
4 Competition	0.044	0.004	0.002	**0.463**						
5 Product diversity	0.008	0.040	0.008	0.005	**0.481**					
6 Differentiation	0.240	0.002	0.001	0.000	0.020	**0.535**				
7 Product planning	0.000	0.048	0.026	0.053	0.068	0.063	**0.564**			
8 Cost management	0.053	0.036	0.044	0.068	0.068	0.004	0.203	**0.514**		
9 Performance	0.000	0.014	0.006	0.006	0.044	0.040	0.109	0.102	**0.635**	
10 AMTs	0.036	0.090	0.010	0.008	0.053	0.003	0.078	0.123	0.032	**0.594**

Values below the diagonal are squared correlations and the diagonal elements are the constructs' average variance extracted (AVE).

Discriminant validity evaluates how well the constructs are divergent and distinct from each other (Hair et al., 2010). It can be testified through the existence of high cross-loading which can lead to poor fit indices of the CFA model (Hair et al., 2010). The CFA of the current study shows no cross-loadings exist among the indicators, and the model fit indices are within acceptable criteria which demonstrate the convergent validity (see Table 5.29 above). Another method for addressing the discriminant validity is that the AVE for each construct should exceed the squared correlation coefficients between the specific construct and the other constructs (Hair et al., 2010). This is based on the assumption that a construct should account for more of the variance in its indicators than the amount it shares with other constructs (Hair et al., 2010). Table 5.32 above, presents the AVE of each construct, which appears on the diagonal, and the squared correlation estimates between each pair of constructs are presented below the diagonal. As the table shows, the AVE for each construct is greater than the squared pairwise correlation estimates among the constructs. Therefore, the results show that all of the constructs meet the required discriminant validity.

5.7 Multicollinearity

Multicollinearity is a phenomenon that arises when two or more separate independent variables measure the same concepts and have a high association (Hair et al., 2010; Kline, 2011). The existence of multicollinearity indicates that the predictive ability to define the effects of the variables diminishes "to levels that make estimation of their individual effects quite problematic" due to the decrease in their total explained variance (Hair et al., 2010, p. 201). One multivariate method for examining the level of multicollinearity among three or more variables is to estimate the squared multiple correlations (R^2) between each variable in the research model, and the remaining variables (Kline, 2011). This requires running several multiple regression models, each of which have a different variable as the criterion and the remaining variables as predictors. R^2 of 0.90 or higher for the analysed criterion variable indicates multicollinearity. Table 5.33 shows the R^2 for each variable, which points to the absence of multicollinearity among the research variables, given that the highest R^2 is 0.44 for the cost pools, which is far below the 0.90 value.

Table 5.33: Squared multiple correlation (R^2).

Criterion variable	R^2
Number of cost pools	0.44
Cost leadership	0.41
Number of cost drivers	0.38
Differentiation	0.37
Cost management	0.37
Product Planning	0.35
AMTs	0.23
Detailed Cost System	0.17
Product Diversity	0.16
Competition	0.15
Accountant	0.10
Size	0.09
Overhead costs	0.08

5.8 Chapter summary

Chapter five outlined the processes whereby the collected data were screened and remedied for missing values, outliers, and normality. The statistical descriptive statistics for the current study constructs in terms of their mean, standard deviation, skewness, and kurtosis were presented and discussed. The CFA measurement model was tested using SEM and then modified based on the parcelling strategy, which ultimately improved the measurement model. Finally, the research factors were diagnosed in terms of their reliability, validity, and multicollinearity.

Chapter 6: The Structural Model: Testing the Research Hypotheses

6.1 Introduction

The previous chapter outlined the procedures that were used to clean and prepare the data in order to evaluate the measurement model, which represents the first stage of the structural equation modeling (SEM). The evaluated measurement model yielded acceptable fit indices that allowed this research to proceed to testing the structural model. Therefore, the aim of this chapter is to examine the conceptual model and the related research hypotheses developed in chapter 3 by means of the structural model of SEM. The second section of this chapter will provide a short background about the organisations on whom the research hypotheses were tested. Section 6.3 will focus on testing the hypotheses related to the moderation role of advanced manufacturing technologies (AMTs) between cost structure and cost system sophistication (CSS) association, and product diversity and CSS association. Section 6.4 will present the analysis and results of the tests of the antecedent factors and consequences of CSS, as formulated in chapter 3. Section 6.5 summarises the results of the testing of the hypotheses. Finally, this chapter will end with a summary of its contents.

6.2 The structural model

It was discussed in chapter 4 how SEM consists of the measurement model and the structural model. The measurement model aims to evaluate the pattern of indicator relationships as well as the reliability, validity, and dimensionality of the research constructs (Byrne, 2010; Hair et al., 2010; Kline, 2011). The confirmatory factor analysis (CFA) in AMOS software was used to evaluate the measurement model of the current study, which yielded appropriate fit indices that permitted the testing of the theoretical model. As reported in section 5.4.3 of chapter 5, the fit indices obtained for the CFA stage showed that the Chi-square (χ^2) = 847.61, df = 507 and p = 0.00, root mean square error of approximation (RMSEA) of 0.04, Normed Chi-square (χ^2/df) of 1.67, comparative fit index (CFI of 0.93), incremental fit index (IFI) of 0.94, adjusted goodness-of-fit index (AGFI) of 0.87 and parsimony normed fit index (PNFI) of 0.69. As a result of the good-fit measurement model, the current study proceeded to the second stage, namely the structural model of SEM, to test the proposed hypotheses in order to confirm or reject the hypotheses. Table 6.1 presents the research questions with their related research hypotheses that will be tested in the structural model. The structural model of this study consists of two stages of hypotheses-testing.

The first stage will only examine the hypotheses related to the moderation role of AMTs (H7 and H8), as these require multiple group analysis, thereby splitting the sample into low and high AMTs groups (Hair et al., 2010). Prior research relied on this approach to test the moderation hypothesis based on multiple group analysis (Hult et al., 2004; Walsh et al., 2008; Burkert et al., 2011; Fullerton et al., 2013; Heinicke et al., 2016). This is because multiple group analysis in SEM will lead to a simultaneous examination of two models for the proposed hypothesis, which will be constrained in one model and unconstrained in the second one (Hair et al., 2010). Large differences between the two models, in terms of the chi-square ($\Delta\chi^2_{(1)} > 3.84$), will indicate a significant moderation (Hult et al., 2004; Walsh et al., 2008; Hair et al., 2010; Maiga et al., 2013). More discussion about the process of testing moderation will be presented in section 6.3 below.

The second stage will test the remaining hypotheses shown in Table 6.1 below (H1, H2, H3, H4, H5, H6, H9, H10, H11 and H12) because these hypotheses represent direct and mediation hypotheses that do not require multiple group analysis (Luft and Shields, 2003; Gerdin and Greve, 2004; Burkert et al., 2011; Fullerton et al., 2013). These hypotheses include the direct effect of antecedent factors on CSS, the direct effect of CSS on product planning and cost management, and so ultimately and indirectly, on business unit performance, using the whole sample as a single group. The next section will present the moderation analysis. This is followed by section 6.4 that is devoted to the direct and mediation analysis.

Table 6.1: Research hypotheses.

Research questions	No.	Hypotheses
Which contingent factors influence the sophistication level of a cost system?	H1	The level of competition is positively related to CSS.
	H2	Firms pursuing a differentiation strategy are more likely to implement highly sophisticated cost systems than those pursuing a cost leadership strategy.
	H3	The business unit orientation of management accountants is positively related to CSS.
	H4	Size is positively related to CSS.
	H5	The level of indirect costs is positively related to CSS.
	H6	The level of product diversity is positively related to CSS.
	H7	AMTs will moderate the impact of overhead costs on cost system sophistication, such that the relationship will be more positive and stronger at low AMTs than at high AMTs.
	H8	AMTs will moderate the impact of product diversity on cost system sophistication, such that the relationship will be more positive and stronger at low AMTs than at high AMTs.
Does CSS have an indirect impact on business unit performance through its role in product planning and cost management?	H9	CSS is positively related to improvements in product planning decisions.
	H10	The impact of CSS on business unit performance is positively mediated through product planning decisions.
	H11	CSS is positively related to improvements in cost management applications.
	H12	The impact of CSS on business unit performance is positively mediated through cost management.
CSS: cost system sophistication; AMTs: advanced manufacturing technologies.		

6.3 Testing the moderation hypotheses

Multiple group analysis within the context of an SEM framework is relied on to test the moderating role of AMTs between cost structure and CSS, and between product diversity and CSS. The objective of multiple group analysis is to compare the regression weight paths in the structural model across different groups (Byrne, 2010; Hair et al., 2010). Nonetheless, establishing a measurement invariance, also known as a measurement equivalence, based on the CFA technique, is a prerequisite before testing the moderation in the structural model (Hair et al., 2010; Kline, 2011). The primary objective of the measurement invariance is to reflect the extent to which the psychometric properties of the research constructs share the same meaning, structure, and parameters across different groups (Byrne, 2010; Hair et al., 2010). That is, the compared different groups should resemble similar characteristics in order to meaningfully interpret the structural model containing the examined constructs; otherwise, constructs bias can occur, which "implies that a test measures something different in one group than in another" (Kline, 2011, p. 252). To test the measurement invariance, the sample was first split at the median of the AMTs (median = 2.60) to create two groups that had either a "low" or "high" level of AMTs usage (Hair et al., 2010; Groen et al., 2012; Fullerton et al., 2013). This procedure resulted in 186 cases being classified as low AMTs users and 215 cases as high AMTs users, as shown in Table 6.2.

Table 6.2: Descriptive statistics of the AMTs' groups.

	AMTs for the whole sample	Low AMTs group	High AMTs group
Mean	2.64	1.83	3.35
Median	2.60	1.80	3.20
Count	401	186	215
SD	0.92	0.45	0.59

SD: Standard Deviation.

The AMTs invariance measurement test was conducted based on the guidelines outlined by Hair et al. (2010). The tested invariance measurement model includes only the variables and factors that were hypothesised to be affected by the moderation of AMTs. These include the product diversity factor, cost structure measured by manufacturing overhead costs, the number of cost pools, the number of cost drivers, and the detailed cost system factor. The invariance measurement test involves a sequential examination of different models. These include configural invariance, known as a reference or base model, followed by a metric invariance.[31] The configural invariance aims to estimate freely all parameters across the two groups with the same items, and should result in acceptable fit indices. The metric invariance model imposes equality constraints on the factor loadings of the latent constructs across the two groups to specify the degree to which these are equivalent. This step allows a comparison of the metric invariance model to the configural invariance model to detect any non-invariance within the model. A non-significant chi-square difference test ($\Delta\chi^2$) between the two models indicates that the measurement model concerning factor loadings is equivalent across the two groups.

Table 6.3 below shows the model fit indices for each invariance model and the chi-square difference test ($\Delta\chi^2$) for the comparisons between the configural and metric invariance models. The fit indices for the configural invariance model indicated that the measurement model or the reference model fits the data well (RMSEA = 0.03, CFA = 0.97). In addition, the comparison of the configural invariance model ($\chi^2_{(56)} = 81.01$, p = 0.02) with the metric invariance model ($\chi^2_{(63)} = 85.61$, p = 0.03) resulted in a non-significant chi-square ($\Delta\chi^2_{(7)} = 4.6$, p = 0.71). It can, thus, be concluded that the measurement model remains constant and equivalent across both the low and high AMTs groups.

Having established that the constructs were invariant across the low and high AMTs groups, the next and final stage involves testing the research hypotheses in the structural model of SEM. Like the invariance test, the structural model requires the estimation of unconstrained and constrained models to compare the differences in chi-square, and so

[31] In addition to the metric invariance, the multiple group analysis for the measurement invariance includes other types of parameter examination depending on the aim of the research hypotheses and normally includes scaler (variables' mean and intercepts), factor covariance, factor variance, and error terms variance. Since the aim of the current study is to examine the regression paths at a different level of the AMTs moderator, a metric invariance test, is sufficient to establish the measurement invariance for the moderation relationship (Sila, 2007, Hair et al., 2010).

detect whether a moderation exists (Hair et al., 2010). The unconstrained model is estimated whereby all of the structural coefficients are calculated freely for the two groups. In the unconstrained model, the particular structural coefficients of interest are constrained between the two groups. Significant moderation is indicated when the constrained coefficient significantly increases the chi-square, which reflects a worse-fit model compared to the unconstrained model. For one degree of freedom at the alpha of 0.05 level, the chi-square difference test ($\Delta\chi^2_{(1)}$) should be equal to or greater than 3.84 to indicate a significant moderation (Hult et al., 2004; Walsh et al., 2008; Maiga et al., 2013).

Table 6.3: Measurement invariance test for the moderating role of AMTs.

	Model fit measures					Model differences		
Model tested	χ^2	*df*	*p*	RMSEA	CFA	$\Delta\chi^2$	Δdf	*p*
Configural invariance	81.01	56	0.02	0.03	0.97	--	--	--
Metric invariance	85.61	63	0.03	0.03	0.98	4.60	7	0.71

Further, the structural coefficients of the two groups should be examined to evaluate whether they are theoretically consistent in terms of their sign's direction and significance to the theoretical hypotheses (Hair et al., 2010). The results of the moderation analysis are reported in Table 6.4 below. Three dependent variables were used to measure CSS, which included the number of cost pools, the number of cost drivers, and the detailed cost system.

6.3.1 The moderation of AMTs between cost structure and CSS

The AMTs are expected to moderate the relationship between the cost structure, as measured by the manufacturing overheads costs and CSS, so that a low usage of AMTs will lead to a positive, significant relationship between the overhead costs and CSS, as indicated by H7. The results reported in Table 6.4 indicate that this study did not find any

Table 6.4: The results of the moderation of AMTs.

Exogenous variables	Endogenous variables	Standardised coefficient (β) Low AMTs	High AMTs	Unconstrained model χ^2	df	RMSEA	CFA	Constrained model χ^2	df	RMSEA	CFA	Model differences $\Delta\chi^2$	Δdf	p
Overhead costs	Cost pools	0.10	0.19***	17.20	8	0.05	0.96	18.73	9	0.05	0.96	1.53	1	0.22
Product diversity	Cost pools	0.01	0.00	17.20	8	0.05	0.96	17.20	9	0.05	0.97	0.00	1	1.00
Overhead costs	Cost drivers	0.09	0.22***	20.51	8	0.06	0.95	22.44	9	0.06	0.95	1.93	1	0.16
Product diversity	Cost drivers	–0.06	0.08	20.51	8	0.06	0.95	21.77	9	0.06	0.95	1.26	1	0.26
Overhead costs	Detailed cost system	0.04	–0.08	43.17	36	0.02	0.99	44.42	37	0.02	0.99	1.25	1	0.26
Product diversity	Detailed cost system	0.17**	0.18**	43.17	36	0.02	0.99	43.21	37	0.02	0.99	0.04	1	0.84

**p ≤ 0.05 (one-tailed), ***p ≤ 0.01 (one-tailed) support that AMTs moderate the relationship between cost structure and CSS, as measured by the number of cost pools ($\Delta\chi^2_{(1)} = 1.53$, $p = 0.22$), number of cost drivers ($\Delta\chi^2_{(1)} = 1.93$, $p = 0.16$), and the detailed cost system ($\Delta\chi^2_{(1)} = 1.25$, $p = 0.26$). Therefore, H7 is rejected due to the non-significance of $\Delta\chi^2$. While this research failed to detect any significant moderation, the results showed that higher AMTs users tended to have slightly higher manufacturing overhead costs (mean = 14.40) compared to low AMTs users' manufacturing overhead costs (mean = 14.19).

6.3.2 The moderation of AMTs between product diversity and CSS

Like the effect of AMTs on the cost structure-CSS association, H8 stated that, at low AMTs usage, product diversity will have a positive and significant relationship with CSS. As shown in Table 6.4 above, the results of this study indicate that AMTs did not moderate the relationship between product diversity and the number of cost pools of CSS ($\Delta\chi^2_{(1)} = 0$, $p = 1.00$), the relationship between product diversity and the number of cost drivers of CSS ($\Delta\chi^2_{(1)} = 1.26$, $p = 0.26$), and the relationship between product diversity and a detailed cost system of CSS ($\Delta\chi^2_{(1)} = 0.04$, $p = 0.84$). Therefore, the results revealed by the current study do not support H8.

6.4 Testing the antecedents and consequences of the cost system sophistication hypotheses

The proposed research model of the current study argues that competition, business strategy, the role of management accountants, size, cost structure, and product diversity have positive and significant relationships with CSS. Furthermore, it is expected that CSS will have a direct positive effect on product planning and cost management as well as a positive indirect impact on business unit performance through the role of product planning and cost management in transforming the effects of CSS on business unit performance.

Further, given the fact that AMTs did not moderate the relationships between cost structure and CSS, and between product diversity and CSS (see sections 6.3.1 and 6.3.2 above), the AMTs' construct was included in the structural model to examine whether AMTs directly influence the level of sophistication of the cost system rather than being a moderator.

It was discussed in chapter 3 section 3.4.7 that some researchers contend that AMTs can directly influence cost system design, particularly the adoption of ABC systems. They argue that the AMTs' production environment can increase the overhead costs (Berliner and Brimson, 1988; Hoque, 2000), facilitate the production of customised products, which increases the level of product diversity (Tracey et al., 1999; Hoque, 2000; Isa and Foong, 2005; Askarany et al., 2007; Mat and Smith, 2014) and require non-financial performance measures, such as material quality and waste measures, to monitor the performance of activities (Kaplan, 1989; Baines and Langfield-Smith, 2003; Choe, 2004; Ismail and Isa, 2011; Khanchanapong et al., 2014). All of these combined to make the traditional cost systems incapable of coping with the AMTs' production environment and, instead, an ABC system has been advocated as allowing the accurate measurement of overhead costs and better monitoring of activity performance (Hoque, 2000; Baines and Langfield-Smith, 2003; Isa and Foong, 2005; Mat and Smith, 2014). Considering this, the current thesis will examine the extent to which AMTs can influence the level of sophistication of cost systems in order to ascertain whether AMTs require detailed cost information that can be supplied by sophisticated cost systems. The results of the AMTs' effect will be reported and interpreted at a two-tailed significance level, since no hypothesis was established in advance regarding their main direct effect on CSS. The remaining results for the contingency variables and the indirect effect of CSS on performance through product planning and cost management will be interpreted at the one-tailed significance level, since the direction of these hypotheses was stated in the conceptual model (Field, 2013).

Moreover, the mediation hypotheses will be analysed based on the bootstrapping method to bootstrap the indirect effect (Cheung and Lau, 2007; Hayes, 2009; Zhao et al., 2010; Hayes, 2013). Different approaches have been developed to test the mediation analysis, including the Sobel test (Sobel, 1982), the causal approach of Baron and Kenny (Baron and Kenny, 1986), and the bootstrapping method (Preacher and Hayes, 2004; Preacher and Hayes, 2008). Among these methods, the bootstrapping method is the most recent approach that has been developed because of advances in computing power and speed (Hayes, 2013). Bootstrapping is the preferred and superior method for estimating the indirect effect in mediation analysis compared to other methods due to its validity (MacKinnon et al., 2004; Preacher and Hayes, 2004; Hayes, 2009; MacKinnon et al., 2012; Hayes, 2013). According to Hayes (2009, p. 412), "simulation research shows that bootstrapping is one of the more valid and powerful methods for testing intervening variable effects…and, for this reason alone, it should be the method of choice". More specifically, the bootstrapping method avoids the limitations associated with the other mediation analysis methods. It statistically quantifies and tests the indirect effect, whereas Baron and Kenny (1986)'s method "neither formally quantifies the indirect effect nor requires any kind of inferential test about it" (Hayes, 2013, p. 167). The indirect effect is quantified by the product of parameters a and b¸ as shown in Figure 6.1 below. For this reason, statistical experts have advocated the use of the bootstrapping method over the causal approach of Baron and Kenny, since the former can provide statistical evidence about the significance of the indirect effect (Shrout and Bolger, 2002; Preacher and Hayes, 2004, 2008; Judd and Kenny, 2010; Zhao et al., 2010; MacKinnon et al., 2012; Hayes, 2013).

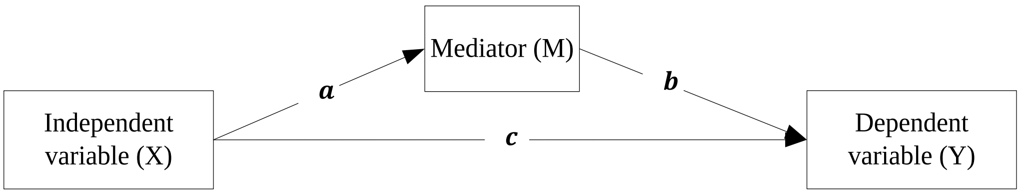

Figure 6.1: The mediation approach.

Furthermore, the causal approach of Baron and Kenny (Baron and Kenny, 1986) also suffers from three further limitations that led to the abandonment of this approach (see Hayes, 2013, p. 167). For example, the causal approach of Baron and Kenny requires that the independent variable (X) has a significant effect on the dependent variable (Y) in the absence of the mediator variable (M) (Baron and Kenny, 1986). This is referred to as the total effect.[32] Many statistical researchers argue that the significance of the total effect represents an unnecessary and flawed step, providing different reasons that undermine the plausibility of this condition (MacKinnon et al., 2000; Shrout and Bolger, 2002; Preacher and Hayes, 2004, 2008; Judd and Kenny, 2010; Zhao et al., 2010; MacKinnon et al., 2012; Hayes, 2013). For example, when multiple mediators exist with opposite signs and the same magnitude in terms of size, the total effect can be insignificant, as combining the effects of different mediators with different signs can cancel each other out (Hayes, 2013).

The second advantage of bootstrapping is related to its great ability to detect the indirect effect compared to the remaining methods (Shrout and Bolger, 2002; Preacher and Hayes, 2004, 2008; Judd and Kenny, 2010; Zhao et al., 2010; MacKinnon et al., 2012; Hayes, 2013). This is because bootstrapping is based on a resampling technique, which involves drawing a large number of repeated samples from the same data set in order to estimate the sampling distribution of the mediated effects (Hayes, 2009). For example, statistical

[32] The total effect is the sum of the direct and indirect effects (Hayes, 2013)

experts have argued, based on evidence from simulation studies, that the Sobel test has low power compared to the bootstrapping method and can lead to inaccurate estimates of the confidence intervals for the product of $a.b$ (MacKinnon et al., 2002; Preacher and Hayes, 2004, 2008; Judd and Kenny, 2010; Zhao et al., 2010; MacKinnon et al., 2012; Hayes, 2013). Therefore, the bootstrapping method is relied upon in this research, which uses 2,000 samples to estimate the mediation effect. The standardised bootstrapped coefficients of the total, direct and indirect effects and the significance levels will be reported to interpret the mediation results.[33]

Finally, bi-directional correlations between each pair of the exogenous constructs in both the measurement and structural models were considered in order to capture the shared variance between these constructs (Cole et al., 2007; Huang et al., 2008; Hair et al., 2010; Kline, 2011; Choo et al., 2015). According to Hair et al. (2010, p. 742), "if the measurement model estimates a path coefficient between constructs not involved in any hypothesis, then that parameter should also be estimated in the SEM model". A failure to include the correlations between each pair of exogenous constructs will lead to a poor model fit, specification error, and biased estimate of the model parameters (Cole et al., 2007; Kline, 2011; Choo et al., 2015).

The results of the main effects when CSS has been measured by the number of cost pools, the number of cost drivers, and detailed cost systems are reported in Table 6.5, Table 6.6, and Table 6.7 respectively. Figure 6.2, Figure 6.3, and Figure 6.4 below, show the structural model as measured by the number of cost pools, the number of cost drivers, and detailed cost systems, respectively. Finally, the results of the mediation analysis are

[33] Even though the direct effect of X (CSS for the current study) on Y (business performance) is not hypothesised in this research, it will be reported, as it forms part of the mediation analysis (Hayes, 2013, p. 90), and to explore whether CSS has a significant direct effect on performance.

reported in Table 6.8 for the mediator role of product planning, and in Table 6.11 for the mediator role of cost management.

6.4.1 Competition and cost system sophistication

The first hypothesis of the research model (H1) predicts a direct positive impact of competition on CSS. The results of the current study found no significant relationship between competition and CSS, whether measured by the number of cost pools, the number of cost drivers, or the detailed cost systems, as reported in Table 6.5, Table 6.6 and Table 6.7 below, respectively. Therefore, H1 is not supported.

6.4.2 Business strategy and cost system sophistication

The second hypothesis (H2) anticipates that the differentiation strategy will be more likely to be associated with a highly sophisticated cost system than a cost leadership strategy. The only variable of CSS that is positively and significantly affected by a differentiation strategy is the number of cost pools ($\beta = 0.143$, $p \leq 0.05$), as shown in Table 6.5. On the other hand, the results in Table 6.5 and Table 6.7 indicate that the cost leadership strategy is positively and significantly related to CSS, as measured by the number of cost pools ($\beta = 0.168$, $p \leq 0.05$), and the detailed cost systems ($\beta = 0.168$, $p \leq 0.05$). The value of the standardised coefficient (β) in SEM can be used to identify which exogenous variable has the larger effect on the dependent variable in order to draw a comparison between the different exogenous variables (Hoyle, 1995; Linneman, 2011).[34] Based on this criterion, H2 cannot be supported, as the standardised coefficient of the

[34] The standardised coefficient (β) is the standardisation of the original slopes because some variables (independent and depended variables) are measured based on different units of measurement (Linneman, 2011). Thus, the standardised coefficients (β) can be used "to compare and contrast the effects of multiple independent variables" (Kline, 2011; Linneman, 2011, p. 311). The standardised coefficients (β) of the effect of cost leadership and differentiation strategy on the number of cost pools are 0.168 and 0.143, respectively. Therefore, when cost leadership rises by one standard deviation, the number of cost pools rises by 0.168 standard deviations. On the other hand, when differentiation rises by one standard deviation, the number of cost pools rises by 0.143 standard deviations.

impact of cost leadership on CSS, whether measured by cost pools or detailed cost systems, is higher than the standardised coefficients of association between the differentiation strategy and CSS. The cost leadership strategy was also found positively and significantly to impact on two proxy measures of CSS, namely the number of cost pools and detailed cost systems, while the differentiation strategy was only related to the number of cost pools. Hence, H2 is not supported.

Table 6.5: The effects of the antecedents and consequences of CSS, as measured by cost pools.

Exogenous variables	Endogenous variables			
	Cost pools	Product planning	Cost management	Business unit performance
	Standardised coefficient (β)			
Competition	–0.080 (–1.316)			
Cost leadership	0.168 (1.951)**			
Differentiation	0.143 (1.961)***			
MAs	0.102 (1.914)**			
Size	0.133 (2.698)***			
Cost structure	0.149 (3.097)***			
Product diversity	–0.012 (–0.206)			
AMTs	0.123 (2.206)#			
Cost pools		–0.042 (–0.765)	0.143 (2.496)***	
Product planning				0.268 (4.461)***
Cost management				0.224 (3.640)***
R^2	0.112	0.002	0.020	0.121

χ^2 = 814.8, df = 397, p = 0.00, RMSEA = 0.05, CFI = 0.90, IFI = 0.91, χ^2/df = 2.05, AGFI, 0.85, PNFI = 0.71

Critical ratio in brackets.
*$p \leq 0.10$ (one-tailed), **$p \leq 0.05$ (one-tailed), ***$p \leq 0.01$ (one-tailed), # $p \leq 0.05$ (two-tailed).
AMTs: advanced manufacturing technologies.

Table 6.6: The effects of the antecedents and consequences of CSS, as measured by cost drivers.

	Endogenous variables			
Exogenous variables	Cost drivers	Product planning	Cost management	Business unit performance
	Standardised coefficient (β)			
Competition	0.024 (0.401)			
Cost leadership	0.058 (0.763)			
Differentiation	0.017 (0.237)			
MAs	0.032 (0.585)			
Size	0.009 (0.185)			
Cost structure	0.164 (3.311)***			
Product diversity	0.017 (0.279)			
AMTs	0.086 (1.529)			
Cost drivers		–0.038 (–0.690)	0.130 (2.263)***	
Product planning				0.268 (4.461)***
Cost management				0.226 (3.664)***
R^2	0.045	0.001	0.017	0.122
χ^2 = 812.4, df = 397, p = 0.00, RMSEA = 0.05, CFI = 0.90, IFI = 0.91, χ^2/df = 2.05, AGFI, 0.85, PNFI = 0.71				

Critical ratio in brackets
*$p \leq 0.10$ (one-tailed), **$p \leq 0.05$ (one-tailed), ***$p \leq 0.01$ (one-tailed).
AMTs: advanced manufacturing technologies.

Table 6.7: The effects of the antecedents and consequences of CSS, as measured by detailed cost system.

	Endogenous variables			
	Detailed cost system	Product planning	Cost management	Business unit performance
Exogenous variables	Standardised coefficient (β)			
Competition	0.011 (0.163)			
Cost leadership	0.168 (1.799)**			
Differentiation	0.093 (1.147)			
MAs	0.135 (2.331)***			
Size	–0.052 (–0.972)			
Cost structure	–0.012 (–0.237)			
Product diversity	0.158 (2.406)***			
AMTs	0.246 (3.986)#			
Detailed cost system		0.265 (4.381)***	0.245 (3.797)***	
Product planning				0.258 (4.331)***
Cost management				0.230 (3.716)***
R^2	0.172	0.070	0.060	0.127

χ^2 = 920.3, df = 489, p = 0.00, RMSEA = 0.05, CFI = 0.91, IFI = 0.91, χ^2/df = 1.88, AGFI, 0.85, PNFI = 0.73

Critical ratio in brackets.
*$p \leq 0.10$ (one-tailed), **$p \leq 0.05$ (one-tailed), ***$p \leq 0.01$ (one-tailed), # $p \leq 0.01$ (two-tailed).
AMTs: advanced manufacturing technologies.

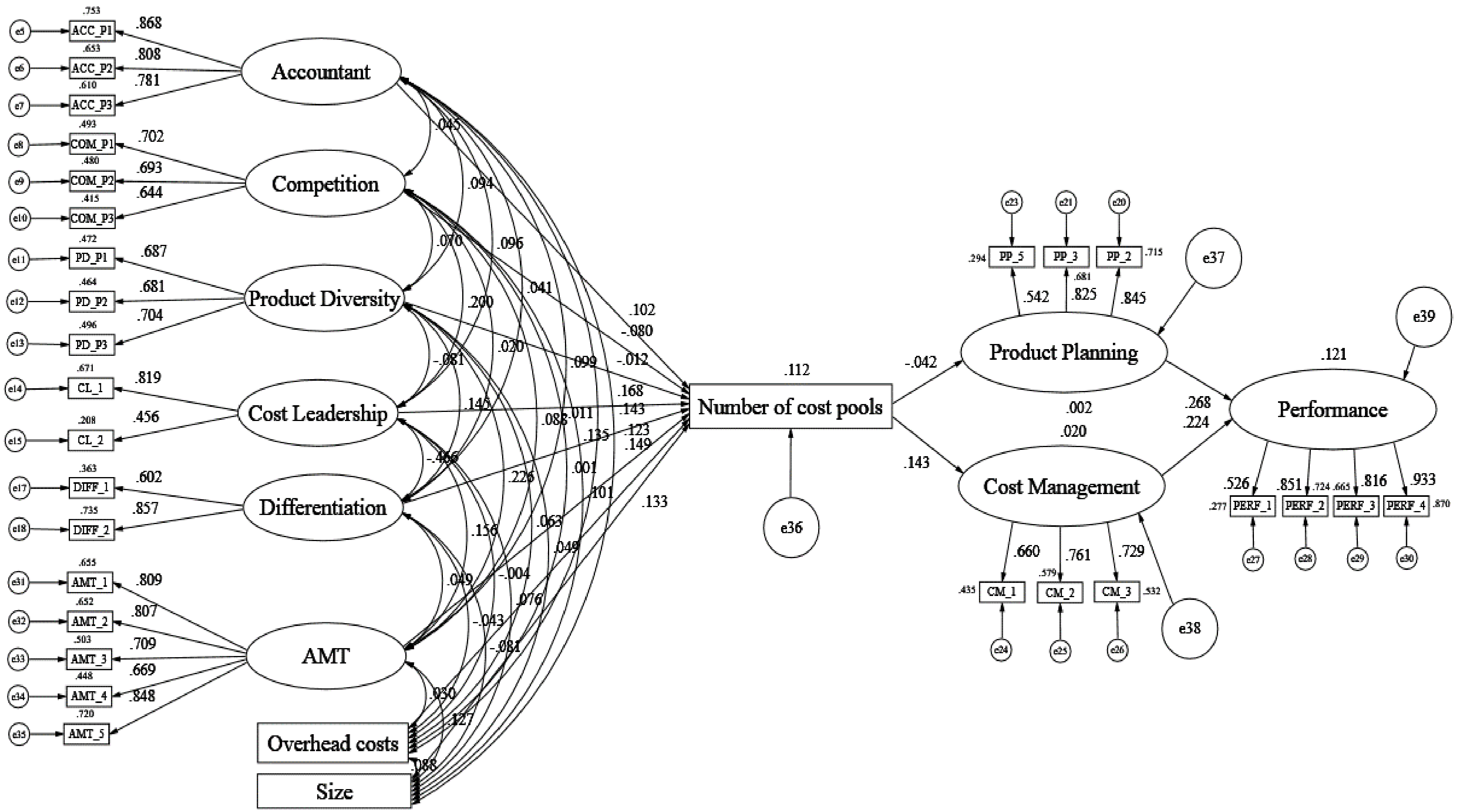

Figure 6.2: The effects of antecedents and consequences of CSS measured by cost pools.

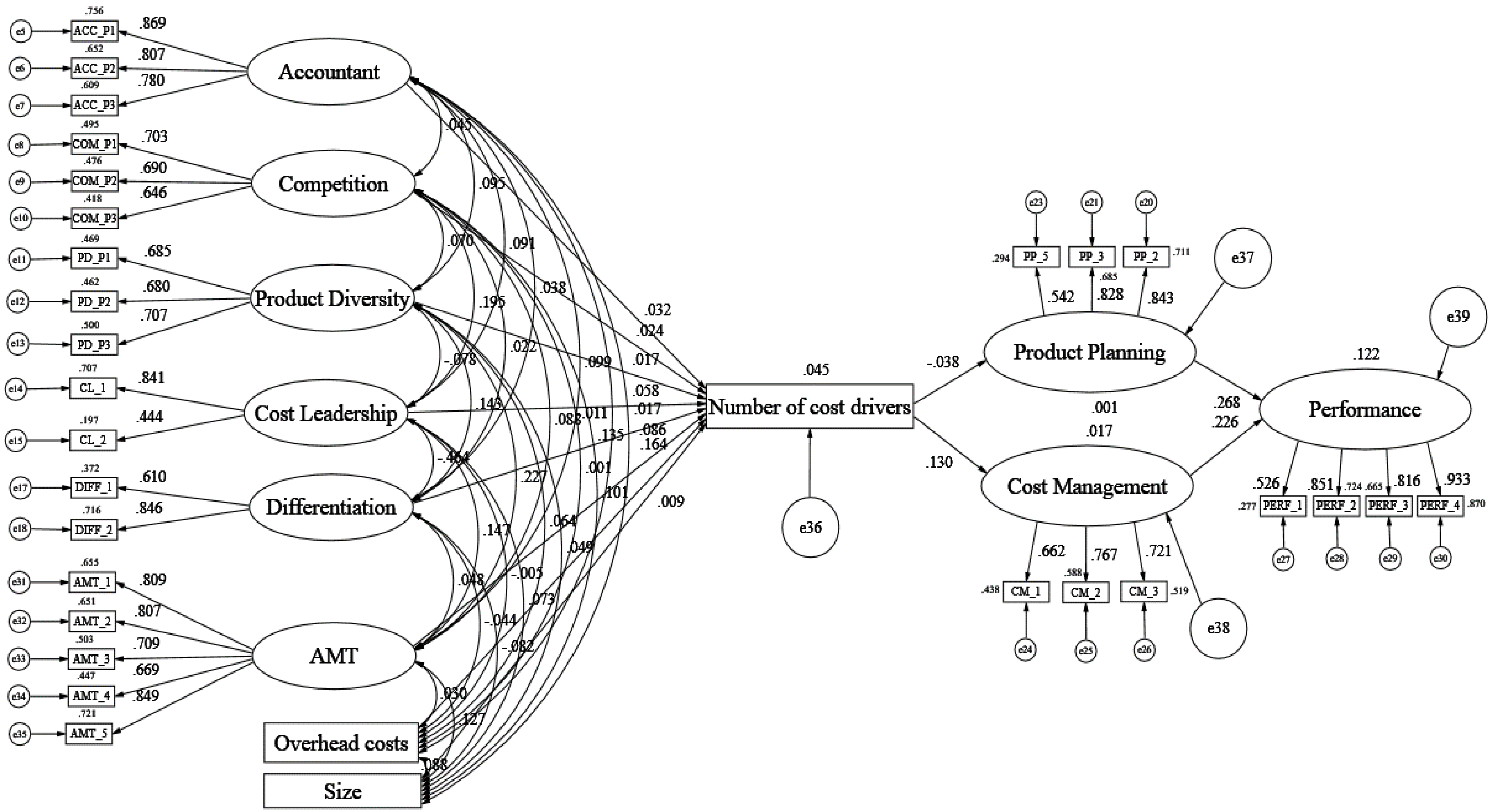

Figure 6.3: The effects of the antecedents and consequences of CSS, as measured by the cost drivers.

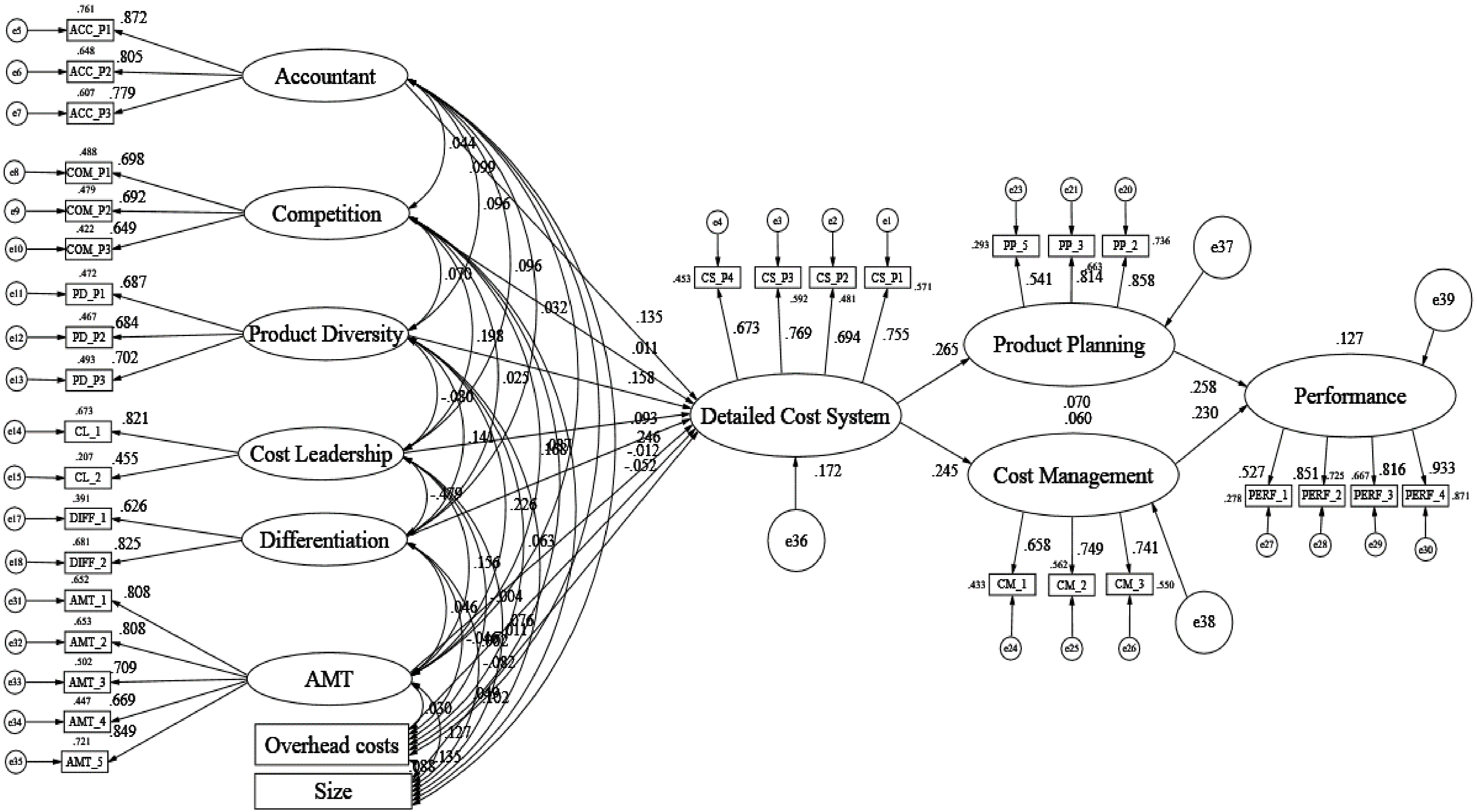

Figure 6.4: The effects of the antecedents and consequences of CSS, as measured by the detailed cost system.

6.4.3 The role of management accountants and cost system sophistication

Greater management accountants engagement in business activities compared to functional accounting activities is expected to have a direct positive association with CSS, as hypothesised in H3. The results in Table 6.5 and Table 6.7 show that management accountants are positively and significantly associated with CSS, as measured by the number of cost pools ($\beta = 0.102$, $p \leq 0.05$) and detailed cost systems ($\beta = 0.135$, $p \leq 0.01$), respectively. Nonetheless, management accountants had no significant relationship with CSS as measured by the number of cost drivers, as Table 6.6 shows. Given that the management accountants were positively and significantly associated with two measurements of CSS, namely cost pools and detailed cost systems, H3 is partially supported because no support was found for the number of cost drivers.

6.4.4 Size and cost system sophistication

As indicated in H4, organisational size is expected to be positively related to the use of sophisticated cost systems. The results of the analysis show that no significant relationship exists between size and CSS, whether measured by cost drivers or detailed cost systems, as reported in Table 6.6 and Table 6.7, respectively. Nonetheless, Table 6.5 shows that size does have a significant and positive impact on the use of sophisticated cost systems, as measured by the number of cost pools ($\beta = 0.133$, $p \leq 0.01$). Therefore, H4 is considered to be partially supported, since only one measurement of CSS was found to be related to size.

6.4.5 Cost structure and cost system sophistication

Hypothesis H5 states that companies experiencing high overhead costs will use sophisticated cost systems. Table 6.5 reveals a direct and positive association between overhead costs and CSS, as measured by the number of cost pools ($\beta = 0.149$, $p \leq 0.01$), and Table 6.6 also indicates that overhead costs are positively and significantly related to CSS, as measured by the number of different types of cost drivers ($\beta = 0.164$, $p \leq 0.01$). Collectively, these results partially support H5 because overhead costs had no relationship with CSS, as measured by detailed cost systems, as reported in Table 6.7.

6.4.6 Product diversity and cost system sophistication

High product diversity was hypothesised in H6 to positively increase the level of CSS used by producers with highly diverse products. The results point to the fact that product diversity has no association with CSS, as measured by the number of cost pools (see Table 6.5) and cost drivers (see Table 6.6), respectively. However, the coefficient for product diversity is positively and significantly associated with the detailed cost system construct ($\beta = 0.158$, $p \leq 0.01$). This finding supplies partial support for H6, since both the number of cost pools and the number of cost drivers were not associated with product diversity.

6.4.7 Advanced manufacturing technologies and cost system sophistication

It was hypothesised that the use of AMTs would moderate the relationships between cost structure and CSS, and between product diversity and CSS. Nonetheless, the analysis of AMTs' moderation found no support for the moderating role of AMTs, as reported in section 6.3. Alternatively, the current study explores the direct effect of AMTs on CSS to examine whether the former is directly related to the use of highly sophisticated cost systems. Table 6.5 contains the coefficient from the regression of CSS, as measured by cost pools on the AMTs' construct. The use of AMTs is positively and significantly associated with CSS, as measured by the cost pools ($\beta = 0.123$, $p \leq 0.05$, two-tailed). The use of AMTs is also found to have a positive and significant relationship with CSS, as measured by detailed cost systems ($\beta = 0.246$, $p \leq 0.01$, two-tailed), as depicted in Table 6.7 but has no relationship with CSS, as measured by the number of cost drivers, as shown in Table 6.6.

6.4.8 Cost system sophistication, product planning and performance

The relationships between CSS, product planning and business unit performance have been framed to investigate the direct effect of CSS on product planning and the indirect relationship between CSS and performance through the mediation role of product planning. As stated in H9, it is expected that CSS will be associated with improved product planning. The results in Table 6.5 and Table 6.6 reveal that CSS, as measured by the number of cost pools and the number of cost drivers, is not associated with improved product planning. Nonetheless, CSS, as measured by detailed cost systems, predicted improved product planning ($\beta = 0.265$, $p \leq 0.01$). Hence, H9 is partially supported, given that neither the number of cost pools nor the number of cost drivers was related to product planning. The results of the analysis also show that improved product planning is positively and significantly associated with business unit performance in the three structural models, each of which contain different measurements of CSS, as reported in Table 6.5 ($\beta = 0.268$, $p \leq 0.01$), Table 6.6 ($\beta = 0.268$, $p \leq 0.01$) and Table 6.7 ($\beta = 0.258$, $p \leq 0.01$).

Regarding the indirect effect, H10 specifies that product planning will positively mediate the relationship between CSS and business unit performance. The results of the mediation analysis are reported in Table 6.8 below. As shown in the table, neither the number of cost pools nor the number of cost drivers are indirectly related to business unit performance through improved product planning. The findings, however, indicate that product planning significantly and positively mediates the relationship between detailed cost systems and business unit performance ($p < .001$), and the indirect effect did not include zero between the lower and upper levels of the 95% confidence interval.[35] Therefore, the results partially support H10, since no mediation effect for the number of cost pools and the number of cost drivers was detected.

Table 6.8: Mediation of product planning between CSS and organisational performance.

	Organisational Performance							
	Total effect		Direct effects		Indirect effect			
	β	*P value*	B	*P value*	β	*P value*	LLCI[a]	ULCI[b]
Cost pools	–0.07	0.26	–0.06	0.33	–0.01[c]	0.4600[c]	–0.04	0.02
Cost drivers	–0.03	0.53	–0.02	0.65	–0.01[c]	0.4100[c]	–0.04	0.02
Detailed cost system	0.10	0.10	0.04	0.58	0.06	0.0002***	0.03	0.12

β coefficient reported in standardised value.
*p ≤ 0.10 (one-tailed), **p ≤ 0.05 (one-tailed), ***p ≤ 0.01 (one-tailed).
[a] Lower limit of bootstrapped 95% confidence interval.
[b] Upper limit of bootstrapped 95% confidence interval.
[c] It was expected that product planning would not mediate the relationships between cost pools and business unit performance, and between cost drivers and business unit performance because neither the cost pools nor the cost drivers had a main effect on product planning (see Table 6.5 and Table 6.6 above). Nonetheless, it was examined to explore the direct effect of these variables on business unit performance while examining the mediation effects.

To uncover whether product planning is considered to be a moderator rather than a mediator, multiple group analysis in AMOS is used to test the degree to which product planning moderates the relationship between CSS and business unit performance. Chenhall (2006) argued that testing separately the mediation and moderation can identify which one of them can provide a better explanation. This can increase the confidence of the research results. The sample was split at the median of product planning to obtain low and high product planning groups (see section 6.3 above for a discussion about the moderation analysis procedures based on a subgroup analysis). Table 6.9 indicates that the measurement constructs remained constant and equivalent across the two groups, as indicated by the non-significant chi-square difference test ($\Delta\chi^2_{(8)} = 8$, $p = 0.433$). This result allowed the testing of moderation in the structural model, the results of which are reported in Table 6.10 below. The Chi-square difference test ($\Delta\chi^2 < 3.84$, $p > 0.05$)

[35] If the lower interval is negative and the upper interval positive, it will be difficult to know the true sign of the true indirect effect in the population, since the indirect effect lies between the negative and positive intervals.

indicated that insignificant differences exist between the unconstrained and constrained models for each type of CSS measure. Therefore, it can be concluded that product planning does not moderate the relationship between CSS, as measured by the three methods of measurement, and business unit performance.

Table 6.9: Measurement invariance test for the moderating role of product planning.

	Model fit measures					Model differences		
Model Tested	χ^2	*Df*	*p*	RMSEA	CFA	$\Delta\chi^2$	Δdf	*p*
Configural invariance	98.35	62	0.00	0.04	0.98	--	--	--
Metric invariance	106.35	70	0.00	0.04	0.98	8.00	8	0.433

Table 6.10: The results of moderation for product planning.

		Standardised coefficient (β)		Model differences		
Exogenous variables	Endogenous variables	Low product planning	High product planning	$\Delta\chi^2$	Δdf	*p*
Cost pools	Performance	–0.09 (n.s)	0.03 (n.s)	1.17	1	0.279
Cost drivers	Performance	–0.03 (n.s)	0.04 (n.s)	0.47	1	0.493
Detailed cost system	Performance	0.05 (n.s)	0.10 (n.s)	0.28	1	0.597

n.s.: not significant.

6.4.9 Cost system sophistication, cost management and performance

The final hypotheses in the current study anticipates a positive direct association between CSS and cost management, and an indirect association between CSS and business unit performance through the role of cost management. Hypothesis H11 of the research model specifies a positive and direct relationship between CSS and improved cost management. This hypothesis is supported due to the significant results of regressing cost management on CSS, as measured by the number of cost pools ($\beta = 0.143$, $p \leq 0.01$), cost drivers ($\beta = 0.130$, $p \leq 0.01$), and detailed cost systems ($\beta = 0.245$, $p \leq 0.01$), as reported in Table 6.5, Table 6.6 and Table 6.7, respectively. These tables also show that cost management is positively and significantly associated with improved business performance at the 0.01 significance level.

Besides H11, H12 was formed to examine the mediating role of cost management between CSS and business unit performance. Collectively, the results shown in Table 6.11, below, indicate that cost management indeed positively mediates the relationship between CSS, as measured by the three methods, and business unit performance. The number of cost pools, the number of cost drivers, and detailed cost systems have significant indirect effects on performance at the 0.01 level. These indirect effects did not contain zero between the lower and the upper level of the 95% confidence intervals.

Table 6.11: Mediation of cost management between CSS and organisational performance.

	Organisational Performance							
	Total effect		Direct effects		Indirect effect			
	β	*P value*	β	*P value*	β	*P value*	LLCI[a]	ULCI[b]
Cost pools	–0.03	0.60	–0.07	0.24	0.04	0.0035***	0.01	0.07
Cost drivers	0.00	0.98	–0.03	0.53	0.03	0.0020***	0.01	0.06
Detailed cost system	0.08	0.17	0.03	0.61	0.05	0.0015***	0.02	0.10

β coefficient reported in standardised value.
*p ≤ 0.10 (one-tailed), **p ≤ 0.05 (one-tailed), ***p ≤ 0.01 (one-tailed).
[a] Lower limit of bootstrapped 95% confidence interval.
[b] Upper limit of bootstrapped 95% confidence interval.

Similar to the testing of the moderating role of product planning, the moderating role of cost management was tested to examine whether cost management can be a moderator. The median of the cost management construct was estimated to divide the sample into low and high cost management groups, respectively, in order to test the measurement invariance and then the moderation. Table 6.12 indicates that the research constructs of interest, which include business unit performance, detailed cost systems, the number of cost pools, and the different types of cost drivers, are equivalent across the two groups. Therefore, the current study can proceed to test moderation at the structural level of SEM. The results of this are reported in Table 6.13, which shows that the Chi-square difference tests ($\Delta\chi^2 < 3.84$, $p > 0.05$) are insignificant for the three measures of CSS. Thus, it can be stated that cost management does not moderate the relationship between CSS and business unit performance.

Table 6.12: Measurement invariance test for the moderating role of cost management.

	Model fit measures					Model differences		
Model Tested	χ^2	*df*	*p*	RMSEA	CFA	$\Delta\chi^2$	Δdf	*p*
Configural invariance	115.17	62	0.00	0.05	0.97	--	--	--
Metric invariance	127.6	70	0.00	0.05	0.96	12.43	8	0.133

Table 6.13: The results of the moderation of cost management.

		Standardised coefficient (β)		Model differences		
Exogenous variables	Endogenous variables	Low cost Management	High cost Management	$\Delta\chi^2$	Δdf	*p*
Cost pools	Performance	–0.09 (n.s)	–0.07 (n.s)	0.17	1	0.680
Cost drivers	Performance	0.07 (n.s)	–0.07 (n.s)	1.67	1	0.196
Detailed cost system	Performance	0.10 (n.s)	0.11 (n.s)	0.00	1	1.000

n.s = not significant

6.5 Summary of the research results

The current study examines several hypotheses pertaining to the antecedent factors and consequences of CSS. The method of a statistical hypothesis test based on SEM analysis is used statistically to decide whether to accept or reject the research hypotheses developed by the current study. In testing the level of CSS, three variables, capturing the number of cost pools, the number of cost drivers, and the ability of cost systems to provide detailed cost information, were relied on to derive a conclusion regarding supporting or rejecting the research hypotheses.

Table 6.14 summarises the results of the hypotheses testing as well as the research questions. Four hypotheses were rejected, including competition (H1), which was not a significant antecedent factor for the three dependent variables of CSS. A differentiation strategy was found significantly and positively to influence only the number of cost pools, while a cost leadership strategy was significant for the number of cost pools and detailed cost systems but not the number of cost drivers. Thus, H2 was rejected. In addition, the moderating role of AMTs between overhead costs and CSS, and between product diversity and CSS, was found to be insignificant, which led to the rejection of H7 and H8. Nonetheless, the study found that AMTs had a positive and significant direct effect on two variables of CSS, namely the number of cost pools and detailed cost systems.

The table also reveals that six hypotheses were partially supported.[36] The role of management accountants was found to be positively related to two variables of CSS, namely the number of cost pools and detailed cost systems (H3). Organisational size, as measured by the number of employees, was only significant for the number of cost pools (H4). The level of indirect costs, as measured by manufacturing overhead costs as a percentage of total costs, was found to affect the number of cost pools and number of cost drivers but not the detailed cost systems.

Moreover, the results indicate that product diversity positively and significantly influenced the detailed cost system variable (H6). Regarding product planning (H9 and H10), the analysis shows partial support whereas only the detailed cost system measure is associated with improved product planning (H9), and improved product planning mediates the relationship between CSS, as measured by detailed cost systems, and organisational performance (H10). Finally, the analysis also shows that all three measures of CSS had a direct, significant and positive effect on improved cost management (H11). The mediation analysis also showed that cost management, indeed, positively mediated the association between all three measures of CSS and organisational performance (H12).

[36] This research considers the effect of one variable on one or two of the three measures of CSS to be partially supported, which is a relatively conservative interpretation. It should be noted that some prior research, which used more than one measure for the dependent variable, considered the effect to be fully accepted, even though the significant relationship was found to be related to only one measure of the dependent variable but not the remaining measures (Nicolaou, 2003; Al-Omiri and Drury, 2007). For example, Al-Omiri and Drury (2007) accepted the effect of just-in-time (JIT)/lean production techniques and the extent of innovative MA techniques used on the level of CSS, despite the fact the JIT/lean production techniques and the extent of innovative MA techniques used were significantly related to one of the four measures of cost system sophistication level used by Al-Omiri and Drury (2007).

Table 6.14: Summary results of the hypotheses testing.

Research questions	Hypotheses	Results
Which contingent factors influence the sophistication level of a cost system?	**H1**: The level of competition is positively related to CSS.	Rejected
	H2: Firms pursuing a differentiation strategy are more likely to implement highly sophisticated cost systems than those pursuing a cost leadership strategy.	Rejected
	H3: The business unit orientation of management accountants is positively related to CSS.	Partial support
	H4: Size is positively related to CSS.	Partial support
	H5: The level of indirect costs is positively related to CSS.	Partial support
	H6: The level of product diversity is positively related to CSS.	Partial support
	H7: AMTs will moderate the impact of overhead costs on cost system sophistication, such that the relationship will be more positive and stronger at low AMTs than at high AMTs.	Rejected
	H8: AMTs will moderate the impact of product diversity on cost system sophistication, such that the relationship will be more positive and stronger at low AMTs than at high AMTs.	Rejected
Does CSS have an indirect impact on business unit performance through its role in product planning and cost management?	**H9**: CSS is positively related to improvement in product planning decisions.	Partial support
	H10: The impact of CSS on business unit performance is positively mediated through product planning decisions.	Partial support
	H11: CSS is positively related to improvement in cost management applications.	Supported
	H12: The impact of CSS on business unit performance is positively mediated through cost management.	Supported
CSS: cost system sophistication. AMTs: advanced manufacturing technologies.		

6.6 Chapter summary

Chapter 6 was dedicated to testing the research hypotheses that were developed in chapter 3. First, the moderation hypotheses of AMTs between cost structure and CSS and between product diversity and CSS were tested and reported. This was followed by testing the direct effect of the contingency variables on CSS, and the direct and indirect association between CSS, product planning, cost management, and business unit performance. The findings of these relationships were also reported. The findings of the research hypotheses testing reported in this chapter will be used in a qualitative field study that involves interviewing the questionnaire respondents who agreed to participate in an interview. A large part of these interviews will focus on the reasons behind the significant and insignificant results from the practitioners' point of view to offer explanations and improve our understanding of the statistical results that were found from the quantitative phase. The next chapter will present the results of the field study and interviews that were conducted with 11 operating units.

Chapter 7: Qualitative Findings: the Field Study

7.1 Introduction

The objective of this chapter is to present the qualitative findings obtained from the second phase of the explanatory sequential design as discussed in section 4.3 of chapter 4. The qualitative phase of the explanatory sequential design set out to achieve two objectives. The first objective was to explain the statistical results of the antecedent factors of cost system sophistication (CSS) and the consequences of CSS. The second objective of the qualitative phase was to explore possible new factors that can impact on the level of CSS. Section 7.2 provides brief background information about the interviewed operating units, after which section 7.3 is devoted mainly to the interview analysis results for the interviewees' perceptions regarding the statistical results of the quantitative phase. Section 7.4 provides the interview analysis results about potential factors that may be related to CSS. Finally, this chapter ends with a summary in section 7.5.

7.2 Background of the interviewees' companies

Table 7.1 presents general information about the interviewees' companies. The names of the companies were changed (e.g. company A, B, etc.) for the purpose of securing and maintaining confidentiality. Semi-structured interviews were conducted with 11 UK manufacturing companies which participated in the survey questionnaire and agreed to participate in the interview. As the table shows, the field study covers nine different industries, with the food industry representing the largest sector of interviewed companies. Moreover, none of the companies used ABC systems nor direct cost systems. Instead, the traditional absorption cost system is the only type used by the interviewed companies. Additionally, the average work experience of the participants in their current position is 7.55 years.

Table 7.1: General information about the interviewees.

Code	Type of business	Interviewee position	No. of years in current position	Gender
A	Manufacture of aerospace fasteners	Cost accountant	8 years	Male
B	Manufacture and decoration of bottle closures	Financial controller	3 years	Male
C	Production of wine	Financial director	8 years	Male
D	Manufacture of cheese products	Financial director	10 years	Male
E	Manufacture of paints products	Financial director	8 years	Female
F	Preparation and spinning of textile fibres	Operational director	3 years	Male
G	Manufacture of meat substitute products	Financial controller	1 year	Male
H	Manufacture of chocolate and other confectionery products	Financial director	4 years	Male
I	Manufacture of paper	Financial manager	26 years	Male
J	Manufacture of electronic coating thickness gauges	Manufacturing accountant	6 years	Male
K	Manufacture of specialist medical and industrial equipment	Financial manager	6 years	Male

7.3 Qualitative findings of the research model

The semi-structured interview questions were guided by the interview guide, which consisted of two sections (see Appendix 8).[37] The first section of the interview guide includes questions that were mainly devoted to the statistical results reported in chapter 6 and focused on "Why" and "How" questions to gain an understanding of, and explain, the significant and non-significant results found in the previous chapter.

As outlined in chapter 4, thematic analysis based on the data matrices style was used to

[37] The second section includes questions about potential new factors that can impact on CSS. The second section will be presented in section 7.4.

analyse the textual data (Braun and Clarke, 2006; King and Horrocks, 2010). The organisational size variable was excluded from the interview guide to save time and make it possible to focus on the interviewees' interpretations regarding the remaining constructs, explored through approximately 30 interview questions, and also to focus on exploring possible new factors of CSS, explored through approximately 15 interview questions (see Appendix 8 for the interview questions). In fact, some questions on the interview guide, especially the probing questions, were not asked during the interviews because the interviewees spent longer providing explanations about the antecedent factors of CSS, especially those that had no significant effect on CSS, namely product diversity and competition. For example, questions related to performance and the definitions of CSS were omitted. Therefore, the size variable was excluded during the interviews to allow more time to explore the remaining constructs and the exploratory questions in the second section of the interview guide. Similarly, business performance was not discussed, because interviewees spent longer than expected discussing the explanations for the antecedent factors of CSS, especially the product diversity construct, as they engaged in describing their product diversity in relation to CSS. Therefore, the researcher had to prioritise the remaining interview time to leave sufficient time for exploratory questions about possible new factors influencing CSS.

Finally, the reasons for the non-significant effect of business strategy, the role of management accountants, and the role of advanced manufacturing technologies (AMTs) on the number of cost drivers were combined into one section, namely the number of cost drivers (section 7.3.8 below). These constructs were found to influence the number of cost pools, but not the number of cost drivers. The reason for combining the explanations of the non-significant effect of these constructs on the number of cost drivers is that some researchers used similar and redundant explanations, while others did not provide specific explanations about the non-significant relationships, even though some of these interviewees were surprised by the result. Thus, it was decided to combine these explanations of the non-significance of business strategy, the role of management accountants, and the role of AMTs into a single section. The following sub-sections will present the interview results for the remaining constructs.

7.3.1 Competition

The quantitative analysis could not find any significant relationship between competition and CSS, as measured by the number of cost pools, the number of cost drivers, and the detailed cost system construct. This finding is unsurprising in light of the field study, because almost all of the interviewees believe that competition is not linked to CSS, for various different reasons.

One of the reasons is that competition was perceived as a completely external factor that is difficult to manage in relation to cost system design. The unavailability of cost information about competitors was mentioned by two interviewees as a possible reason for the irrelevance of competition to the cost system. Such information is maintained and controlled internally by companies, and it is hard for them to find out how their competitors built their cost system or how they estimate the cost of their products. Instead, companies place greater focus on collecting the available external information, such as the size of their competitors, the type of products their competitors produce, and their competitors' market share. They commented:

> I think the reason, is that it's very hard to get information about your competition, OK? You can't compare your costs, you can compare prices for similar products, but it's very hard to compare your costs. Businesses really then look at what they manufacture and think "What's the simplest way to manufacture it?" (Company D)

> Competition is an external thing and whether we have 20% of the market, 10% of the market or 40% of the market, it's not going to make much of a difference to the fact that I have a factory that can potentially make 100 million litres but I'm only perhaps

> selling 80 million litres today. It doesn't have an influence, your costs are built internally, you need to influence the internal factors, the external factors don't have an impact on you. (Company E)

Another reason pertaining to the nature of cost systems is their inflexibility to be modified to suit each event that takes place outside the organisation. It could be reasoned that, once the cost system has been developed and put in place, it may prove difficult to change in response to every change that occurs within the external environment because of the dynamic nature of competition that is frequently changing. Prior research also argues that the cost of completely changing the cost system can be significant (Datar and Gupta, 1994; Adams, 1996). The following quote was furnished by a manufacturing accountant who works for an electronic coating gauges company:

> Well…that makes perfect sense to me because you've got the history of a particular company, how it operates and if there's an increase and decrease in competition, in some cases it can't respond quickly enough to changes in its internal structures to the competition outside. (Company J)

Another thematic reason that was recognised among three operating units is the non-involvement of the accountants in the assessment of competitors' information. They indicated that different departments, namely the sales and marketing department and the purchasing department, are responsible for collecting and analysing information about competitors' product types, product price, geographical territory, and raw materials costs. Accountants do not possess detailed information about competitors, apart from the number of competitors in the market and the products that they sell. Part of their responsibility is to provide cost information to the marketing department for decision-making but they do not assess the competition. Most of the intelligence work regarding the competition is fed to the organisation through the sales and marketing department, including information about new products, prices, discounts, credit, and promotions, but it does not include any cost information about competitors. The following insightful comments were provided by a cost accountant and financial controller regarding how companies A and B regard their competitors, respectively.

> The competition information is held by the customer, sometimes negotiated with the sales team. Then the sales team will discuss with the plant, so because of this, the sales team, which is a group perspective, there's no real information from the customers on competition finding its way through to the plant level. (Company A)

> So, it’s a sort of team approach. Most of the intelligence relating to the competition probably comes from our sales people. So, it would be them who feed the information into that meeting. I don’t personally have any understanding. I know who our competitors are, I know the types of business they are, I know some of their products, but I won’t necessarily know what they’re doing from one week to the next. (Company B)

This lack of involvement of accountants in competitor assessment may be attributable to the organisational structure, characterised by the centralisation of responsibility for competition assessment at the group level (Company A), and a lack of knowledge among management accountants about competitors’ cost information (Company B). These reasons may have led to the isolation of the cost system to change in response to competition, as the accountants who oversee the cost system and the costs associated with the production processes play no role in competition assessment.

7.3.2 Business strategy

The statistical results for business strategy revealed that cost leadership influenced CSS, as measured by the number of cost pools and detailed cost system construct but not the number of cost drivers, while the differentiation strategy was found to be associated with the number of cost pools. A large group of seven interviewees argued that a cost leadership strategy is more likely to increase the level of CSS. The main reason provided by the interviewees is that this type of company generates a small margin from product sales and is always keen to reduce product costs. Further, they always maintain a cost-conscious orientation, and seek opportunities to engage in initiatives to reduce the cost of the organisational activities. Therefore, sophisticated cost systems can support low cost producers by providing detailed cost information about each type of activity and operation to direct the attention of the management towards non-value-added activities that need to be removed. These reasons led the interviewees to suggest that cost leadership strategy can influence CSS in the following ways:

> The cost leadership strategy will always require a higher, more sophisticated costing system, to be able to do the Kaizen costing, to be able to do the reduction exercises, you need to be able to focus on lean. (Company A)

> I suppose if that's what you're concentrating on, then you may well want to have as much detailed information as possible to ensure that individual products are profitable. It's absolutely critical to get everything exactly correct, otherwise, you could end up selling the products that don't make any money. (Company K)

On the other hand, two operating units disagreed with the view that cost leadership can influence CSS. For example, one operating unit indicated that developing and monitoring sophisticated cost systems will consume more resources and lead to high measurement costs, because an increase in the number of cost centres and cost drivers can require more tracking and monitoring. Cost leaders, thus, may avoid such systems because they operate in highly-sensitive cost environment and such systems can place a greater burden on the financial resources of the organisation and be costly to operate. This may indicate that companies may avoid implementing highly sophisticated cost systems like ABC systems because of the high costs associated with developing these.[38] The financial controller of company G stated:

> If you want to manage more and more cost centres and get into more and more detail that takes more resources. Companies are going to be particularly cautious about adding more, because that's adding more fixed overheads in order to do that analysis. I'd imagine that, if you're in a cost leadership strategy, the last thing you want to do is to put cost up front, and hope that that work will find something to reduce costs later down the track. (Company G)

Regarding the differentiation strategy, it was indicated by four operating units that companies that follow this strategy produce a range of different products, which adds

[38] The current study found the ABC system adoption rate is very low (22 users, yielding a 5.5% adoption rate), which might be explained partially by the level of resources available for firms to invest in such a costly system.

complexity to the production processes and operations because not all products undergo the same ones. Similarly, another group of two operating units associated the differentiation strategy with innovation, as differentiators provide a product that is considered unique and expensive in the market. In such an environment, the complexity of production might increase to produce unique and expensive products, as indicated by the interviewees. In turn, as the production and technological complexity increases, the requirement for sophisticated cost systems increases to measure the costs of the products appropriately.

Prior research contends that product diversity can determine the level of production complexity (Frey and Gordon, 1999; Malmi, 1999; Drury and Tayles, 2005; Al-Omiri and Drury, 2007). Producing products of different physical and volume sizes, which can also require more processes, operations and components, will increase the complexity of production and the number of the manufacturing and non-manufacturing activities (Frey and Gordon, 1999; Malmi, 1999; Drury and Tayles, 2005; Al-Omiri and Drury, 2007). These views, as well as the field interview findings, may indicate that the relationship between differentiation and CSS can be depicted as a type of mediation, whereas product diversity mediates the relationship between both variables.[39] The interviewees described the role of differentiation in relation to CSS as follows:

> I think probably for us the differentiation strategy has meant we make more complex products. They, therefore, go through a number of different processes and because they're going through more processes, and there's more component parts to them we would then try and allocate and split the cost centres up more because it's going through a more complicated production process. (Company B)

> If I want product differentiation it might have an influence on my costing because of the different types of products I want and you might be adding complexity into the

[39] This research failed to detect a significant relationship between product diversity and CSS, as measured by the number of cost pools and the number of cost drivers (see section 6.4.6 in chapter 6). Nonetheless, it is possible that the non-significant result for the relationship between product diversity and CSS, as measured by the number of cost pools and the number of cost drivers, is due to the measurement used by the current study to measure product diversity (see section 7.3.5 below).

> factory by doing that. It could also influence your manufacturing cost if it has an impact on it. (Company E)

7.3.3 The role of management accountants

The interviewees were asked about the significant statistical impact of the role of management accountants on CSS, as measured by the number of cost pools. The research finding was attributed to the engagement of management accountants in the production process to improve their understanding regarding the different activities and the resources that these consume. This engagement and understanding puts management accountants in a position to develop a sophisticated cost system, which would be more difficult to implement without a sound knowledge and understanding of the different parts of the organisation, especially the production processes. On the other hand, it was indicated that management accountants who focused on financial activities were less likely to understand the processes and thereby unable to develop a cost system. The following represents example of one of the interviewees' comments:

> If an accountant's just a financial accountant, you'll probably get a less sophisticated system because their understanding of the cost allocation is less. The process is when you've got someone who is very much in there, an accountant who's hands on and understands all of the processes, they're going to understand the variability in the processes. So, someone who actually gets in there and does what needs to be done, is going to have a more sophisticated system. (Company A)

The relationship between management accountants and CSS can also stem from the accountants' desire and responsibility to control the organisational operations and monitor the performance of other directors, as stated by three interviewees. The more cost centres created, the more management accountants can challenge other managers' overspending, which will ultimately lead to cost savings by directing other managers to use the organisational resources optimally. Two interviewees stated the following:

> Because accountants want it to be right. The more you break it down, the more you've got control it. (Company K)

> You need enough cost centres to understand what's going on in the company. The product may go through painting, finishing, and you may need all the cost centres to control them all separately. (Company I)

Management accountants who possess increased power within the organisation have been regarded as raising the profile of the importance of cost information for decision-making, and so they can advocate and support the development of a new cost system. Innes and Mitchell (1990) conducted a field study consisting of seven UK electronic companies and found that the lack of authority among accountants constrained their ability to propose changes to the accounting systems. Two interviewees expressed their views of the role of management accountants in the following ways:

> I think that the more influential the accountant's role, or the more senior the accountant is, the more sophisticated the cost system will be developed… If the accountant is seen as being more junior and not having as big an influence on the decision-making, then it's almost the same point… it may lead the accountant simplifying the cost system to make their life easier. It's not going to give such good decision making, but sometimes decisions are made without necessarily looking at the cost. (Company B)

> If the accountant is on the board of directors, then you're in a strong position to influence the organisation. (Company F)

7.3.4 Cost structure

Regarding cost structure, the study found that manufacturing overhead costs, as a percentage of the total costs, positively and significantly influenced CSS, as measured by the number of cost pools and the number of cost drivers. Almost all of the interviewees believed that increases in indirect costs could impact on CSS. The most frequently mentioned reason was the complexity of organisational activities that can increase the level of overhead costs, consequently leading to the adoption of sophisticated cost systems in order to track these costs, avoid misallocation, as well as uncover any overspending.

Further, in such an environment that is characterised by many different operations and support departments, it will be difficult to control the overhead costs-spending and establish accountability for other managers to control and monitor the use of organisational resources. Therefore, a sophisticated cost system can provide more visibility, as indicated by several interviewees with regard to how costs are spent and controlled:

> It could simply be that the business is more complex and that complexity is driving the overheads…I'd expect that if you've a higher percentage of your costs that has been properly allocated by your ABC method or whatever method, then I'd expect you to find a higher number of cost drivers, but it probably depends on the complexity of the business, so I'll expect the cost driver quantity to increase with the complexity. (Company G)

> If you've got just one big bucket of overhead costs, it's easier for that to get out of control than it is if you've got a smaller function of your costs. The more sophisticated you are, the more you're going to be able to see those fluctuations. If you've got a complicated cost structure, such as ours, we're able to report to the penny exactly what we've spent. (Company A)

Two further financial directors believed that such relationships are more likely to exist in specific industries, such as machinery and equipment and the automobile industry, because such industries engage heavily in producing complex products compared to other industries (e.g. the food and paper industries), which are characterised by simple operations. In these industries, the product passes through different departments, each of which oversees many different processes and operations. Therefore, the overhead costs are expected to be high, leading to companies implementing sophisticated cost systems in order to track and control these costs. Cadez and Guilding (2008) conducted follow-up interviews with their questionnaire respondents and reported that the applicability of strategic MA techniques was industry-specific. The financial directors said:

> I think it's industry-specific. I think you have to look at what the companies are... I found in heavy manufacturing, like when I was in the motor industry, they wanted a lot more cost centres. (Company H)

> I think it's got to be something to do with the industry. (Company I)

7.3.5 Product diversity

The interviewees were asked about the reasons behind the insignificant relationship between product diversity and CSS, as measured by the number of cost pools and the number of cost drivers. Even though they were surprised by the result, they were unable to furnish possible reasons for this insignificant relationship. Instead, they described how product diversity could affect CSS, mostly by reflecting on their production processes. They referred to different aspects of product diversity that can influence CSS, which have been mentioned in prior research (Cooper and Kaplan, 1988b; Cooper, 1988a, 1988b, 1989a, 1989b). These include production complexity, volume diversity, production line diversity, and size diversity. The following are examples where the interviewees disagreed with the statistical results:

> If a company only makes one type of product, it only goes through one process, then that is obviously going to have a very simple cost model, and conversely, where you have completely different types of products that go through different processes then that would seem to suggest that there would need to be a more complex cost system. (Company B)

> I think what happens is if you use different parts of your plant to make different products, then you do need to either have different cost centres or different ways of allocating those costs. I would expect there to be a lot of…cost drivers where there are a lot of products for the plant. (Company D)

Owing to the fact that the interviewees provided descriptions of their production processes and the type of products produced by their company, this research analysed the interview data by comparing what the participants stated during the interviews about product diversity to their answers about product diversity on the questionnaire. Table 7.2 below compares different aspects of the interviewed companies based on the information collected from the field study, while Table 7.3 below compares the answers of the questionnaire respondents regarding the six items of product diversity.

Based on the comparison analysis between the information reported in Table 7.2 and Table 7.3, this research argues that the ordinal scale used for product diversity on the questionnaire is not a sufficient surrogate measure for product diversity. Prior research found an inconsistent relationship between product diversity and ABC systems. Brown et al. (2004) attribute the mixed results regarding product diversity to the measurement of product diversity and ABC systems. This research argues that the ordinal scale of product diversity used in this study is too narrow in terms of the number of options to capture the magnitude or actual amount of product diversity. Instead, objective-scale variables that reflect product diversity in absolute terms should be used, for four dimensions of product diversity: (1) the diversity of the product line and product number; (2) the production complexity; (3) the volume diversity; and (4) the product's physical size. The following four sub-sections will discuss the aforementioned dimensions.[40]

Table 7.2: Summary of companies' cost systems and product variation from the field study.

Company	Product variation	Total number of cost centres	No. of production cost centres	Type of production	Second stage cost driver	Overhead costs allocation procedures
A	91,000	36	22	Batch.	Machine hours. Material weight. Number of batches. Percentage of manufacturing costs.	Manufacturing overhead costs are allocated to production cost centres using machine hours and material weight. The shipping, handling, facility engineering and quality are assigned to products based on the number of batches. Non-manufacturing overhead costs are allocated to products based on the percentage of total manufacturing costs.
B	1,000	59	26	Batch.	Machine hours.	Manufacturing and non-manufacturing overhead costs are allocated to manufacturing cost centres using machine hours.
C	390	28	5	Batch.	Volume per litre.	Manufacturing and non-manufacturing overhead costs are allocated to production cost centres based on product volume.
D	20	24	2	Continuous flow processing.	Throughput (unit per hour).	Manufacturing and non-manufacturing overhead costs are allocated to production cost centres based on resource drivers (number of people, tonnes, utility utilisation) and then to products based on the throughput rate.
E	6,000	NA	15	Batch.	Labour hours. No. of batch. Machine hours.	Manufacturing costs are allocated to product using machine hours, labour hours, and the number of batches.
F	450	12	11	Batch.	Machine hour No. of tonnes.	Manufacturing and non-manufacturing overhead costs are allocated to product using machine hours. Warehouse costs are assigned to products based on the number of tonnes.

[40] Item e in Table 7.3 represents one of the product diversity questions that was used in the questionnaire to measure the diversity of the support departments for product line. However, item e was excluded from the qualitative analysis because there was insufficient information from several interviewed companies regarding the different types of support departments.

Table: 7.2–continued

Company	Product variation	Total number of cost centres	No. of production cost centres	Type of production	Second stage cost driver	Overhead costs allocation procedures
G	100	12	10	Continuous flow processing.	Production hours per line. Total production hours.	Utility costs are allocated to products based on the production hours per line. Manufacturing overhead costs are allocated to products based on the total production hours. Non-manufacturing costs are not allocated to products.
H	200	11	8	Batch.	Number of tonnes.	Manufacturing and non-manufacturing costs are allocated to products using the number of tonnes.
I	1,000	8	1	Batch.	Machine hours. No. of tonnes.	Manufacturing and non-manufacturing overhead costs are allocated to products using machine hours. Packaging costs are allocated to products using the number of tonnes.
J	500	14	8	Assembly line.	Machine hours. Labour hours.	Manufacturing and non-manufacturing overhead costs are allocated to production cost centres.
K	300	22	12	Assembly line.	Labour hours.	Manufacturing and non-manufacturing overhead costs are allocated to production cost centres.

Table 7.3: Companies' answers to the product diversity questions on the questionnaire.

	Company										
Product diversity	A	B	C	D	E	F	G	H	I	J	k
a. Product lines are quite diverse.	3	4	3	2	3	4	4	4	5	4	4
b. The products within each product line are quite diverse.	2	4	3	2	3	2	2	3	5	4	2
c. Most products require different processes to design, manufacture, and distribute.	1	4	2	2	4	3	2	2	1	4	2
d. There are major differences in the volume (lot sizes) of products.	5	4	4	4	4	5	5	5	5	5	4
e. The costs of the support departments (e.g. engineering, purchasing, and marketing) differ for each product line.	3	4	3	3	2	2	4	3	1	4	4
f. Products are produced in different physical sizes.	5	4	4	2	5	5	3	5	5	5	4
Average scores for product diversity	3.17	4	3.17	2.50	3.50	3.50	3.33	3.67	3.67	4.33	3.33

7.3.5.1 The diversity of product lines and product numbers

Items a and b on the questionnaire measure the level of diversity of product lines and the diversity of the products within each product line. The research found that the ordinal scale of these items possibly led some companies to overstate or underestimate their answers to items a and b in Table 7.3, which may mean that these items are inadequate for measuring the diversity of the product line and product number because of the absence of objective benchmarks or standards that can help the respondents to reconcile or compare their product lines and product numbers to such a benchmark before answering items a and b. For example, company E and I are specialised in paint and paper production, respectively, and have similar characteristics because both companies' production process mainly focuses on the material mix used to produce the products. In these companies, once the material has been mixed and processed according to specific material-mix formula, the product is moved to the finished department, such as cutting in company I and filling and labelling in company E. Company E produces 6,000 paint products while company I produces about 1,000 paper products. Table 7.3 shows that company I extremely overstated items a and b, even though it had one production cost centre consisting of only four machines, two of which were identical. It should be noted that the average score for company I's product diversity is higher than that for company E as well as the majority of companies and it has the lowest number of cost centres. Similarly, company A underestimated items a and b despite the fact that they have about ten product lines and produce a large number of product variants (approximately 91,000). The interviewees described the number of product lines and the product numbers in their plants in the following ways:

> So, by the time you put in the one, two, three, four, five, six brands that you've got there, plus all the private label products that we do as well and times that by the different sizes that you have, we've got about 6,000 finished product codes. (Company E)

> Product lines, we would have one, two, three, four, five, six, seven, probably nine or ten…We've a total number of products in the region of about 91,000. (Company A)

Instead of an ordinal scale, objective scales of the variables, namely the number of product lines and product numbers produced in the plant, should be relied upon to capture accurate and objective answers from the respondents about the different types of product lines and product numbers. These objective measures can seek the absolute number of product lines and product numbers, which in turn can eliminate the possibility of the respondents overstating or underestimating their answers. Groot (1999) found that the number of product lines was significantly associated with ABC system adoption. Furthermore, Malmi (1999) found that the number of the products was positively and significantly related to ABC adoption.

7.3.5.2 Production complexity

Production complexity refers to the different types of processes and operations that products undergo. This theme was found in the field study, as the interviewees strongly emphasised it during their discussions of product diversity. The questionnaire-respondents' answers to item c in Table 7.3 were compared across the interviewed companies to capture the processes that products go through in terms of product design, manufacturing, and distribution. Item c does not reflect the complexity associated with the production process, for two reasons. First, item c combines three different types of processes into one question, namely the processes of product design, manufacturing, and distribution. Consequently, the combination of these different aspects into one question undermined the respondents' answers about the level of production complexity because some companies had low product design processes and high manufacturing processes.[41]

Second, it was found that, as the number of different types of operations that products undergo increases, companies increase the sophistication level of their cost system, especially the number of production cost centres, specifically to group similar costs for a

[41] Company A does not control their product design because their products are regulated by an aerospace fasteners organisation that specifies the design requirement for each type of aerospace fastener.

set of specific activities and operations into one pool. For example, company A indicated on the questionnaire that it has low diverse processes compared to other companies, even though the number of production processes and operations, cost pools, and cost drivers in company A are higher than in the majority of the remaining companies. It has five different departments, each of which has a different number of cost centres. For example, all fastener products have to go through the feeder department, which consists of a forging cost centre, a heating cost centre, and a secondary operation cost centre. Once the product has been prepared, it can move either to the low- or high-volume production departments, which consist of 17 cost centres, apportioned based on the thread diameter of the fasteners and type of product line.

Moreover, different types of painting processes and quality tests represent the last department that products pass through before being packed and shipped to customers. On the other hand, companies C, E, F G, H, I and J have low to moderate complex processes compared to company A, because the nature of their products requires a limited number of operations and therefore they have a low number of production cost centres and cost drivers even though their scores for item c, and their average scores, are higher than company A's score. For example, company C produces wine and its production processes mainly consist of four operations, namely fermentation, bottling, hygiene, and quality. They stated:

> For us, we have many, many, many, many processes. Each one of those processes is constantly being monitored and is constantly being shaved down. (Company A)

> It's basically manufacturing raw materials into an oven or a moulding shop and you come out with a chocolate bar. It's like making pizzas a lot. It's not sophisticated in that sense. You're not using high level engineering techniques. (Company H)

> Basically, we make every single paper the same. We start out with pulp, we add chemicals, we ship it down to the paper machine, and we dry it, we wrap it. That's it. (Company I)

Based on the above discussion, it might be suggested that an objective variable of the number of production processes that a product undergoes can capture the complexity of the production and the different processes and operations that are required for products. This scale can capture the production complexity aspect of product diversity in absolute terms rather than a series of ordered choices that can constrain the respondents' answers.

7.3.5.3 Volume diversity

Item d in Table 7.3 shows that all of the companies gave very similar answers regarding volume diversity, indicating that major differences exist in the volume of products produced by their plant even though they engage in different types of production processes, namely batch manufacturing, assembly line, and continuous flow. The field study found that the most critical element that influences the sophistication of cost systems, especially the number of cost centres, is the flexibility to produce different volumes that range from low- to high-volume. Company F is a mass producer of a very limited range of cheese products. The company invests in expensive machines that perform the same operations in order to produce the same products based on sale forecasts, and requires a minimum order size of product quantity when customers place an order. Therefore, the company does not largely engage in producing any customised products with different volume sizes. In contrast, a group of companies (company A and B) has dedicated production lines for customised products that are produced in small volumes, plus the main production lines that are used for large volume products. This strategy allows them to have high process flexibility to meet customer demand quickly and easily by changing the characteristics and quantity of the products produced.

Company E also produces customised products but mainly in low-volume because they lack the equipment and labour capacity which are necessary for establishing dedicated volume lines for different products. As a result, the number of volume lines could be a better reflective indicator of the extent to which the companies engage in producing major volumes of different products. When a company seeks high flexibility regarding their product volume and mix, they can devote more volume lines, equipped with different equipment, in order to respond to customer demand quickly and easily. The interviewees said:

> We're on a continuous process as the product's evolving. We're not manufacturing this in batches [emphasis added] so, as a result, what's most important for us is throughput rates. (Company D)

> The decoration [department] has quite a lot of different…Most of the closures that come out of these areas will be for expensive bottles, they're going to be gold or they'll be heavy, they'll look like a metal closure. They're much lower volume… We've got about eight cost centres in the assembly [department], each one tends to be used for only one type of product because it's a very bespoke item that has been designed specifically for usually quite a high-volume product. (Company B)

7.3.5.4 Product physical size

Item f measures the physical size of the products produced by companies. Table 7.3 shows that ten companies indicated that they have products that vary widely with regard to their physical size. Based on the field study, these companies produce a wide range of products of different physical sizes. For example, company E produces paint in three different physical sizes. Company C produces 130 different wine products in three different flavours and two bottle sizes. Similarly, company H manufactures a range of products in six different sizes. Company A customises its fastener products into 91,000 varieties based on the materials used, the fastener head style, the thread type, the strength, length, and height, and painting type. Again, an objective scale for the number of different product sizes produced by companies should be used to capture the variations between companies concerning the number of products of different physical sizes, because using a few ordered categories is too narrow and insufficient to reflect the actual variations between manufacturing companies. Appendix 9 shows the research questions that were developed based on the field study data to measure product diversity based on objective rather than ordinal measures.

7.3.6 Advanced manufacturing technologies

This study found that AMTs did not moderate the association between product diversity and CSS, and the association between cost structure and CSS. Instead, it was found that AMTs had a direct, and positive effect on the number of cost pools and the detailed cost system construct but not the number of cost drivers. Three different themes emerged from the interviews that shed light on the significant and positive direct relationship between AMTs and CSS, as reported in the quantitative phase.

The most frequently mentioned theme is the increase in indirect costs as a result of AMTs' implementation. It was indicated that AMTs can change the cost structure of the factory layout by shifting direct costs, especially labour costs, to capital and indirect costs, which subsequently increases the overhead costs. Therefore, the interviewees believe that a sophisticated cost system is needed in an AMTs environment in order to accurately capture the costs of different activities and allocate them to products, and so make better decisions, as well as evaluate the expected benefits from the costs incurred through AMTs' investment. One interviewee said:

> Higher technology tends to drive higher cost centres because the cost tends to be higher and people tend to want to control that cost better, because otherwise what'll happen is, if you make a lot of products and you don't understand your costs, you won't understand where you're making money or where you're losing money and therefore you won't make the correct decisions. (Company D)

Another group of four interviewees believed that the relationship between AMTs and CSS can stem from the production complexity caused by the high level of product diversity which can force companies to use advanced technologies and equipment in order to easily automate and handle the complex production processes and operations that are required by certain products. This can result, as stated by the interviewees, in using a sophisticated cost system to measure the different costs associated with different operations and processes. The interviewees expressed their views in the following ways:

> The reason you have an advanced manufacturing process is because you have a complex process. If you've got a complex process, you have a complex cost centre analysis…It's complexity that drives cost centres. (Company C)

> I think I'd expect that people invest a lot in AMT probably already in quite large cost pools, and they're expected to run diverse products, so you must be relatively advanced technologically. (Company G)

Lastly, it was understood from two operating units that AMTs can allow companies to easily collect cost information about the different activities undertaken on the factory floor. The revolution in the manufacturing technologies equipped with efficient and effective programmes, such as computerised systems for automating and handling the production equipment and remote data entry, have improved the availability of various information that is needed by sophisticated cost systems. Such technologies can reduce the measurement costs associated with the collection and processing of cost information, as much of this information will be more easily and accurately accessible from AMTs. This agrees with the theoretical argument of Koltai et al. (2000) that AMTs can improve the accuracy of on-line data collection and thus facilitate the collection of the required cost data for ABC systems. The financial manager of company K said:

> Because it would enable you to have the base data to be able to analyse the information better, and it may mean that you'd then break it down into further detail. You may have wanted to do it all the time, but not had the capability to do it, because you don't have the resources to actually analyse the information to that extent, but when you're getting the information from the computer-controlled machines, it does give you more information, and you may, as a consequence of that, want to separate that information out and analyse it better and split it down. (Company K)

7.3.7 Product planning and cost management

The quantitative study found that a sophisticated cost system, as measured by the three measures, is associated with improved cost management decisions. On the other hand, the analysis of this study revealed that CSS, as measured by the number of cost pools and the number of cost drivers, is not associated with improved product planning decisions, except for the detailed cost system construct. While the interviewees indicated that accurate cost information is important for product planning decisions, especially pricing, the interviewees felt that the CSS level is insufficient for influencing the improvement of product planning. Six interviewees referred to other factors both within and outside organisations that can shape the product planning decisions, which can downgrade the role of cost systems to being the sole provider of information for these decisions. The role of the marketing department, customers' tastes and demand, and competitors' actions have been identified as relevant factors influencing product planning decisions, especially new product design, range, and price.

Collecting and analysing information concerning these factors can be useful in servicing product planning decisions. For example, the marketing department of company H sells some products at an unprofitable price in order to satisfy the customer demand for a group of products rather than a single product. Similarly, company C produces and sells some unprofitable products in order to gain a market presence as well as market share. Both companies believed that abandoning these products, based on the cost information provided by the cost system alone, would increase the burden of overhead costs upon profitable products, thereby decreasing the overall profitability of the organisation.

For new product decisions, companies also rely on the ability of marketers to survey customers' tastes for new products and explore the functionality and quality of the competitors' products. For example, the financial controller of company B described how marketers engage in new product design with customers without considering cost information, while, in company E, cost information was initially considered for the profitability analysis of product planning decisions, but not as a determinant factor when making these decisions. The following statement reflects one of the interviewees' opinions about product planning decisions:

> There are things which affect product decisions, customers' requirements, gaps in the market, competitors – all those things are more effective in product decisions than cost centres or cost or product costs, the competitors might affect it, market conditions: what's happening out in the market, what's the latest thinking, technology, all those sort of things might affect products, but cost would only come into it once you've looked at what sort of product…you're interested in producing, then you can produce them for that price, that's when cost'd come into it. The market will determine what products you want to produce. (Company K)

Another reason that can be linked to the non-significant results regarding the association between CSS and product planning is the characteristics of the information required for product planning. Several interviewees indicated that product planning decisions require different information that is qualitative and future orientated. It could be argued that the nature of product planning decisions can lead companies to focus on information that is quantified in non-monetary terms and is forward-looking, which can help to estimate possible future events. Examples of this information include the size of, and the gap in, the market, competitor actions, demographic factors, technological advances, and consumer taste (Chenhall and Morris, 1986). The nature of this type of information may make it difficult for the cost system to measure accurately how this type of information can eventually impact on the profitability of products, especially when companies produce many different products and the cost system is mainly designed and used to quantify the organisational activities and events in monetary terms. The financial controller of company G said:

> Operation and control [decisions], you're talking more about things that are known, so more easy to make rational decisions about and these [product planning decisions] are rational but there's much more variables involved in them… such as, if you enter a new market, you can spend a lot of money on research and how to sell, or you might say don't spend much money because actually it has no return. However much research you do, there's a wide variability on that. (Company G)

Regarding the significant relationship between CSS and cost management, almost all of the interviewees agree with the results but offered different explanations for them. Five operating units believe that such a relationship stems from the ability of sophisticated cost systems to aid the process of controlling and coordinating the organisational activities and reflecting the managerial responsibilities in order to control their costs. It was also indicated that sophisticated cost systems help to monitor the performance of the different activities inside the organisation and guide managers regarding how well they and their sub-units are performing their activities. This is in line with the argument that increasing CSS can increase the visibility and transparency of costs, thereby enhancing the budgeting process for resource allocation, and monitoring the performance of each department by using different measures of efficiency and productivity for each cost pool (Kaplan and Cooper, 1998). One interviewee said:

> Because the more visibility you have of your costs, the more you're going to control them. I'd also argue, though, that actually it can only have a positive affect if it's managed and communicated and challenged. (Company E)

Finally, the remaining interviewees justified the relationship based on a number of reasons that can be grouped under one general theme, namely the nature of cost management. It was inferred from the examples and discussion provided by the interviewees that cost management requires operational knowledge about the flow of the activities and operations as well as their costs. In this regard, a sophisticated cost system can identify the drivers of each activity and provide cost information that serves as a benchmark or standard that can enable the managers to understand the implications of their actions, such as re-engineering the production processes in order to reduce the cost of the product. Also, it was indicated that cost management requires information that can be measured and analysed easily and directly by the cost system compared to that required for product planning decisions, which rely on non-cost information such as customer taste and competitors' actions.[42] The interviewees said:

> I think operational and control decisions are all about getting really into the detail. To get into the detail, you really want to understand: what is the true cost of running that department? What are the true drivers in there? What can I do to improve efficiency and effectiveness? (Company B)

> The operational and the control decisions are far more measurable as opposed to the product decisions which are more creative and more commercial whereas, for product design, you're having to decide more whether that product will sell. Will it be successful? Here [operational and control decisions], you've got direct measures. I can measure how long it takes you to clean that machine. I can measure how long it takes you to set that machine up. (Company F)

7.3.8 The number of cost drivers

This section aims to provide the possible reasons for the non-significance of the effect of business strategy (cost leadership and differentiation strategies), the role of management accountants, and AMTs on the number of cost drivers. These constructs were found to have a positive effect on the number of cost pools and the detailed cost construct but not the number of cost drivers.[43]

The non-significant findings regarding the effect of business strategy, the role of management accountants, and AMTs on the number of cost drivers could be attributed to two main reasons. The first reason is related to the complexity of the second-stage cost drivers. Four operating units referred to this reason. It was mentioned that increasing the number of second-stage cost drivers can make it difficult to monitor them, which requires much work. This may be due to the difficulty of identifying the overhead consumption for each group of products, the difficulty of explaining the nature of these cost drivers especially non-volume cost drivers to non-accountants, and the resources required, such as IT systems and personnel, to facilitate the assignment of different types of overhead

[42] The interviewer used the terms 'operational' and 'control decisions' rather than 'cost management' because the latter terms confused the interviewees during earlier interviews.

[43] It should be mentioned that the cost leadership strategy had a positive effect on the detailed cost system ($p \leq 0.05$ one-tailed), while the differentiation strategy has no influence over it.

costs to products using different types of cost drivers. The interviewees expressed the following views:

> I think that's because people understand cost centres a lot better. It's easier to visualize and I think, once you go beyond six or seven cost drivers, it's the most you can have I think. Three to four is a reasonable number, but even once you go beyond three to four and you start, definitely when you go beyond six or seven, it becomes too complicated. (Company D)

> In terms of the cost drivers, you could say that, if you've more cost drivers, it might give you better operational control decisions, but then you'd have to weigh that against efficiency, accuracy, the difficulty in some aspects of actually operating both systems to give you that. (Company K)

Another reason is the knowledge of management accountants about the different types of cost drivers. It was indicated that some management accountants may not know about the different types of cost driver, possibly because of their previous experience, which was gained through using traditional absorption cost systems that tend to rely on a few cost drivers. Drury and Tayles (1995) also argued that the wide use of limited volume cost drivers, especially labour hours, by many companies was because these cost drivers had been embedded and institutionalised in management thinking for a long time. This led to a state of inertia underpinning the management's thinking, making them reluctant to change this technique (Drury and Tayles, 1995). The widespread use of a limited number of cost drivers, especially labour hours, in many companies may have led the expertise of management accountants to be limited to a few cost drivers only and, consequently, precludes the use of many different volume and non-volume cost drivers. The following quotes reflect the interviewees' opinions:

> Probably, accountants are used to certain systems, and these systems have been very traditional, based on production hours or labour hours, and there's not been a lot of sophistication, so maybe accountants don't have a lot of experience in that area whereas cost pool people are more familiar with them, so they'll try and do that in more detail…It's become the standard way of doing it. (Company B)

7.4 Qualitative findings regarding the possible antecedents of CSS

The second objective of the field study is to explore the interviewees' opinions about possible new factors that had not been covered by this research so far, but were considered relevant for explaining the level of CSS. The second section of the interview guide was designed as open-ended, using "what" questions to explore the interviewees' perceptions about the new factors of CSS. As mentioned in chapter 4, the second section of the interview guide included a sub-section that aimed to uncover the level of sustainability practices used by the operating units and the extent to which such practices can influence the level of CSS. The following two sub-sections will present the field study results regarding possible factors that can influence CSS, namely information technology (IT) and top management awareness - as found from the field study. The third sub-section will be devoted to the sustainability findings.

7.4.1 Information technology

Information technology (IT) was mentioned by seven interviewees as a facilitating factor that should be included in the research model. In particular, enterprise resource planning (ERP) is considered an essential source by the interviewees for providing opportunities to increase CSS in terms of cost pools and cost drivers. The ERP system was introduced during the 1990s to replace the legacy systems, such as material requirement planning (MRP), because these lack the ability to integrate the different functions and activities within organisations into one central database (Jacobs and Weston, 2007). Fui-Hoon Nah et al. (2001, p. 285) define an ERP system as "a packaged business software system that enables a company to manage the efficient and effective use of resources (materials, human resources, finance, etc.) by providing a totally integrated solution for the organisation's information-processing needs".

Four operating units suggested that an ERP system is critical for increasing the number of cost drivers and cost pools. It was indicated that legacy IT systems do not connect the different activities and functionalities within the organisation, and they also lack the flexibility to create different cost drivers for different activities. On the other hand, they indicate that the integration brought by the ERP system increases the visibility of different activities within organisations and provides real-time information, thereby providing an opportunity for companies to increase the accuracy of the cost information collected for the different functions, business processes, and operations. A sophisticated cost system is also difficult to manage without an ERP system, because the latter can automate the business structure and processes. One interviewee said:

> If you've got this poor system of gathering your resource drivers, you've got this poor unconnected. You're going to get a disassociation between those joins and that disassociation which you're going to get incorrect; you've get a better chance of getting an incorrect cost accounting system…It's like our systems are being improved as computers and database signals improve. As that improves, our cost accounting system has developed further into a more complicated system. We didn't use to have these GAP systems [groups of autonomous production cost centres]. It used to be a simple factory overhead that they applied to everything. (Company A)

Three operating units also referred to the benefits of integrated IT systems that can allow companies to manage a sophisticated cost system. Sophisticated IT systems can reduce the measurement costs because they make a lot of the cost information visible and available in an electronic format, thereby eliminating the calculation barrier underpinning ABC systems (Cooper, 1988b). The interviewees recognised that IT systems improve the speed of data entry, provide timely and accurate information, and reduce the need for extensive accounting work. These attributes enable sophisticated cost systems to be maintained and updated regularly. The financial controller of company K stated:

> Because it enables you to quickly analyse the information…If you're doing all that manually, you wouldn't bother because the amount of work involved'd be too much, whereas with the ERP system you just key it into the system and it slots that one in there, slots that one in there, slots that one in there and just summarises them all up so it's an enabler for you to have lots of different cost centres. (Company K)

7.4.2 Top management awareness of the importance of cost information

Another factor that can trigger the development and implementation of sophisticated cost systems is top management awareness of the importance of cost information. This factor was justified and experienced by two operating units (companies B and J). In this regard, the top management plays a significant role in disseminating the importance of cost information, which can lead to the development of complex cost systems to meet the different needs of managers for different types of cost information. The responsibility for setting the organisational goals, strategic planning, and the allocation of organisational resources, which enable the implementation of sophisticated cost systems, lies with the top management (Shields, 1995; Al-Khadash and Feridun, 2006). Therefore, top directors who have little interest in using cost information for decision-making and controlling the activities of the organisation, may consider an unsophisticated cost system to be sufficient to point out the overall profitability of the organisation. Nonetheless, these companies are more likely to be exposed to cost distortion when they have a large portion of overhead costs and produce a different range of products that consume different activities costs and require different processes (Drury and Tayles, 2005; Al-Omiri and Drury, 2007; Brierley, 2008b). In this situation, management accountants should play an active role in increasing the top management's awareness of the importance of relying on accurate cost information to avoid making faulty decisions that may damage organisational performance. The financial controller of company B said:

> I think the senior management view can influence how complicated the cost system is. The good thing is, in this company here, various people are interested. Now that we can demonstrate the costs and how they're allocated, there's now a lot of buy-in from the senior management team. They're interested in what a product costs to make and how much profit we make on it. But there are some businesses where they just look at the overall profitability of the company and, as long as the company is profitable, they may not be interested in individual products. (Company B)

7.4.3 Sustainability

The field study focused on the sustainability practices undertaken by the interviewed companies to uncover the level of their proactive sustainability engagement to improve the quality of the environment and the society in which they operate, as well as the extent to which such practices influence the level of CSS. Having proactive engagement leads companies not only to protect the environment by complying with the environmental laws, but also to recognise the importance of environmental issues that can arise from product development and manufacturing as well as product distribution and consumption (Banerjee, 2002; Perego and Hartmann, 2009). This can also necessitate the development of a sophisticated cost system in the form of ABC to define, measure, and collect sustainable costs and allocate these to their specific production activities rather than the general overheads account (Sendroiu et al., 2006; Cãpusneanu, 2008; Jasch, 2009). Hence, the current study analysed the interviewed companies' experience of adopting a formal strategy to address environmental concerns as well as identifying the environmental costs associated with allocating them to their specific production activities and products.

The interviewees displayed an awareness of environmental costs, namely the input sources (material, water and energy) as well as non-product outputs (emissions, waste, and the treatment of waste). However, except for companies B, E, and G, the remaining companies monitor the environmental aspect of sustainability mainly with regard to compliance with laws and regulations. They lack a formal strategy for identifying and developing, for example, new processes that can minimise the impact of their environmental production costs, and also do not publish sustainability reports on their actions with regard to environmental protection. It was found that the actions taken by these companies were considered a response to the regulation requirements, and were based on the types of environmental resources that are used during the production process. For example, company A replaced paint containing chromate substance with a more environmentally-friendly material because of the restricted use of certain chemicals in production laid down by the European Union in 2008. Similarly, company F changed the dyeing process in order to obtain government permission to dye yarn in the factory. They stated:

> We have permits to run the dye house here and, as part of that permit, we've demonstrated that we're making the processes more environmentally-friendly. (Company F)

> We've a legal requirement under the food industry to ensure that all of our processes are auditable and traceable, so transparency and traceability, we have to provide that, we have to prove it. (Company H)

Companies B, E, and G are completely different to the other companies, as they proactively engage in developing new processes that can eliminate or reduce the environmental costs associated with production. For example, due to group demand, company B recently introduced several environmental initiatives, such as investing in new technologies to reduce CO_2 emissions, replacing solvent-based paint with water-based paint, and setting a target to reduce waste from 6% to 2%.

Similarly, company E engages proactively in sustainability practices by focusing on the social and environmental dimensions of sustainability as one of its strategic objectives to serve different stakeholders, namely their customers and society. The company has developed completely environmentally-friendly paint products, has formed a team to monitor and reduce the CO_2 emissions generated by their logistics and distribution, and completely eliminated their landfill activities. Company G has engaged in sustainability practices to increase their customers' awareness about the importance of their vegetarian meat-substitute products, which leave a smaller carbon footprint than meat production. Nonetheless, the company has invested in several projects to reduce the environmental impact of its production and distribution activities. These include reducing CO_2 emissions by switching from kerosene to cleaner fuel (e.g. natural gas), reusing their production water (which reduced their water consumption by 12% in 2015 compared to previous years), and investing in new packaging and logistics projects, which reduced their packaging materials, waste throughout the supply chain, and carbon footprint associated with logistics. For example, the financial controller of company B stated:

> We've a strategy, sustainable development that includes an environmental strategy. And it was established in 2011. It's a group policy, so it comes from our head office. We've had a number of initiatives. So, we've been going through a process of replacing all the lighting with LEDs throughout. We've a paint process which used to use almost completely solvent-based paint, so we've been gradually replacing the solvent-based paint with water-based. So, it's basically reducing solvents and gives off fewer emissions and is safer. It takes a while because obviously different paints can make the product different so it needs to go through customer approval. Our newest piece of machinery has got a carbon bed on it. So, it'll emit CO_2, but that carbon bed absorbs the carbon. So, that's to reduce the emissions of CO_2. And that has a cost because that bed needs to be renewed every six months.

Moreover, the field study could not find any evidence that the range of indirect environmental costs for companies affect the CSS. They manage the environmental costs at the business level rather than the activities and products that cause them. The companies provided different reasons why environmental costs do not influence CSS, which are discussed below.

7.4.3.1 The non-significant amount of environmental costs

The field study found that some companies believe that the percentage of environmental costs is low compared to other overhead costs, which means that it is not worth their effort to track these costs to the activities and products that cause them. They stated:

> We tend to generate waste minimally. The only waste we really generate is going to be oily contaminants and waste material, waste metal. We try not to turn round and say, okay, let's take the cost of disposing of nitric acid and allocate it to the process that uses it. Let's take the cost of oily sobs and allocate that to just the CNC machines. We try and drive it down as a business not specifically by area but, I suppose if it was significant, you'd cut it down. (Company A)

> [Be]cause it's so small…Although the company is environmentally aware-and seeks to make improvements, the effects of environmental costs on the level of sophistication is minimal. (Company J)

7.4.3.2 Lack of a requirement to link environmental costs to products

The majority of companies, as discussed above, monitor their environmental costs in response to the regulation requirements. However, they define and measure the sustainability costs at the business level but do not properly allocate them to the activities or products that cause them. A possible reason for this is that the companies do not face any pressure from external bodies about how they allocate costs to products. For example, accounting standards do not impose any criteria on manufacturing companies regarding the number and type of cost drivers that are used to assign indirect manufacturing costs between the inventory and the cost of goods sold. As a case in point, Company E follows better social and environmental sustainability practices. The company engages in several initiatives to improve the environment, such as projects to reduce their production and distribution-related environmental costs. However, the indirect environmental costs are not allocated to activities. The company monitors their environmental costs and reports these to different customers in order to obtain tender approval, and also to an Environment Agency to receive accreditation for their products. Bennett et al. (2011) argue that the scope of MA is expected to be limited when a company engages in environmental practices to reassure or influence important external stakeholders. The interviewees said:

> It’s part of the strategy but it’s not part of our costing process. It’s not something we’ve ever been asked for. It’s not cost information they were after, it was the non-financial type of data that was in there. They’re not interested in whether it costs us this or this, they’re interested in how many miles the supplier is doing to get its raw material to us here and how many miles it takes us to get from a raw material to an end consumer. That’s what they’re interested in, the whole carbon footprint area. (Company E)

> We've just never done it, I think. It's not something that we've done. We've used more of the measures like I described, waste to landfill, yield, that kind of thing. No, we've never used a costing system for it. (Company F)

7.4.3.3 The difficulty in tracking indirect environmental costs to cost objects

Direct environmental costs, such as solvent-based materials, can be traced easily to products because they are built into the bill for the material associated with these products. Similar to other types of manufacturing overheads costs, indirect environmental costs affect many different products, thereby making it difficult for many companies to allocate these to specific products. For example, several companies indicate that emissions and waste are difficult to track to production cost pools because of the lack of measurement that could correlate these costs to the factors that caused them. On the other hand, energy costs are considered by some companies easier to track to production cost centres and machines because of the availability of meter readings for machines that allow energy costs to be traced to the cost centres and allocated to the products. The energy costs within these companies were large compared to other overhead costs so, in turn, it had become necessary to control the former. The interviewees expressed their views in the following ways:

> Probably because it's not easy to do because environmental costs will not be regular costs, if you like. (Company K)

> Energy's our second largest cost after labour. As a result, we meter energy usage across key departments in order to ensure that the cost is properly allocated to cost centres and products...Environmental emissions are monitored but are not tracked by individual product or cost pool because of the difficulty of measuring them by area, and they're simply allocated across all products, depending on volume. (Company D)

7.5 Chapter summary

This chapter presented and discussed the qualitative findings based on the data collected from the field study that covered 11 different operating units operating across nine UK manufacturing industries. The interview results revealed that competition does not influence the CSS level. On the other hand, most of the interviewees appeared to support the impact of the management accountants' role, business strategy, cost structure, and AMTs on CSS. In addition, the participants disagreed with the quantitative result that product diversity does not have a significant relationship with CSS and provided different interpretations that reflected the connection between product diversity and CSS, such as volume diversity and size diversity. Moreover, this research attributed the non-significant result to issues that are associated with the measurement of product diversity employed here. This research, thus, proposed different measurements of product diversity to capture the level of product diversity in absolute rather than ordinal terms. In addition, the interviewees revealed that cost information produced by sophisticated cost systems is important, but not sufficient for improving product planning, as different internal and external contextual elements can reduce the importance of cost information for product planning. Alternatively, the interviewees cited different reasons that support the influence of CSS on cost management. Finally, the field study found that an ERP system and top management awareness were regarded as facilitating the adoption of sophisticated cost systems, but no evidence was found to support the relationship between sustainability practices and CSS.

Chapter 8: Discussion

8.1 Introduction

The aims of this thesis are to explain how a number of contingency factors influence the level of cost system sophistication (CSS) and the extent to which the CSS level affects organisational performance through the mediating roles of product planning and cost management. To achieve these aims, an explanatory sequential design strategy was implemented in this research to provide quantitative and qualitative empirical evidence about the antecedent factors and consequences of CSS. Having completed and presented the first and second phases of the explanatory sequential design in the previous two chapters, this chapter will discuss the quantitative and qualitative results. Table 8.1 below presents a summary of the developed hypotheses and the results of the statistical analysis. Section 8.2 will focus on discussing the effect of the antecedent factors on CSS and is mainly devoted to hypotheses H1-H8, as presented in Table 8.1. Section 8.3 is dedicated to the results of the effect of CSS on product planning, cost management, and so, ultimately, organisational performance. Hypotheses H9-H12 will be the main focus of section 8.3. Finally, section 8.4 will present a summary of the chapter.

8.2 Antecedents of cost system sophistication

The current section will discuss the quantitative and qualitative results obtained in chapters 6 and 7 regarding the associations between the research's contextual variables and the CSS level. More specifically, hypotheses H1-H8 will be the specific focus, as outlined in Table 8.1 below.

8.2.1 Competition and cost system sophistication

H1 anticipated a direct and positive association between competition and CSS. The statistical results reported in chapter 6 suggest that competition is unrelated to CSS.

Table 8.1: Summary results of the hypotheses testing.

Research questions	Hypotheses	Results
Which contingent factors influence the sophistication level of a cost system?	**H1**: The level of competition is positively related to CSS.	Rejected
	H2: Firms pursuing a differentiation strategy are more likely to implement highly sophisticated cost systems than those pursuing a cost leadership strategy.	Rejected
	H3: The business unit orientation of management accountants is positively related to CSS.	Partial support
	H4: Size is positively related to CSS.	Partial support
	H5: The level of indirect costs is positively related to CSS.	Partial support
	H6: The level of product diversity is positively related to CSS.	Partial support
	H7: AMTs will moderate the impact of overhead costs on cost system sophistication, such that the relationship will be more positive and stronger at low AMTs than at high AMTs.	Rejected
	H8: AMTs will moderate the impact of product diversity on cost system sophistication, such that the relationship will be more positive and stronger at low AMTs than at high AMTs.	Rejected
Does CSS have an indirect impact on business unit performance through its role in product planning and cost management?	**H9**: CSS is positively related to improvement in product planning decisions.	Partial support
	H10: The impact of CSS on business unit performance is positively mediated through product planning decisions.	Partial support
	H11: CSS is positively related to improvement in cost management applications.	Supported
	H12: The impact of CSS on business unit performance is positively mediated through cost management.	Supported
CSS: cost system sophistication. AMTs: advanced manufacturing technologies.		

It was argued that the non-significant competition-cost system association reported by prior research was possibly due to the measurement of competition, which was based on one or two questions that do not reflect the multiple dimensions of this factor (Mia and Clarke, 1999; Drury and Tayles, 2005; Brierley, 2011; Hoque, 2011). As a result, this research utilised six different dimensions of competition and three different measures of CSS, but none of them were influenced by competition. The research findings are in line with the majority of cost system studies, which reported no association between competition and cost system design, as measured by ABC adoption and non-adoption (Bjørnenak, 1997; Cohen et al., 2005; Brierley, 2008a), the number of cost pools and the number of cost drivers (Drury and Tayles, 2005; Brierley, 2007), or cost system functionality (Pizzini, 2006; Pavlatos and Paggios, 2009).

The results of the field study reported in chapter 7 point to the possibility that competition is not a sufficiently relevant factor for influencing cost system design. The qualitative findings, therefore, support the quantitative results. The field interview showed that some management accountants did not have access to competition information nor engaged in an assessment of the competition because such responsibilities were mainly controlled by the sales and marketing departments. Prior research also found that poor communication between the accounting and marketing functions as well as accountants' lack of marketing skills undermined the management accounting system and information (Nulty, 1992; Simon, 1992; Foster and Gupta, 1994; Pierce and O'Dea, 2003). For example, Foster and Gupta (1994) found a significant gap between the accounting and marketing functions regarding the required accounting information by the latter, and attributed this trend to the minimal interaction between the two functions. The perceived gap between accounting and sales and marketing departments may result in a minimal integration about competition information between the two departments.

Given the above explanations, it is possible that the competition-CSS association may be moderated by the extent to which management accountants engage in competitive assessment and maintain effective channels of communication with the sales and marketing managers. This is because accountants with a sufficient knowledge of competition, who engage in effective communication with marketing managers, can be knowledgeable about the possible changes required to make the cost system takes account of the competitive environment of their organisation.[44] Such knowledge should be reflected in the cost system to provide information that can support the marketing

[44] It should be noted that the role of management accountants, as examined quantitatively in the current study, does not cover the extent to which this group has sufficient knowledge of competition assessment, nor does it focus specifically on their relationship with the marketing managers.

function.

8.2.2 Business strategy and cost system sophistication

The empirical results reported by the current study do not support H2, which specifies that firms that follow a differentiation strategy are more likely to implement highly sophisticated cost systems than those pursuing a cost leadership strategy. The statistical results show that a cost leadership strategy was positively associated with CSS, as measured by the number of cost pools and the detailed cost system construct but not the number of cost drivers. By contrast, the differentiation strategy had a positive effect on the number of cost pools but was unrelated to either the number of cost drivers or the detailed cost system construct. Additionally, the standardised coefficient (β) was also used to compare which strategy has a larger effect on CSS, as measured by the number of cost pools (Hoyle, 1995; Linneman, 2011). Considering this, the current study found that the effect of cost leadership strategy on CSS was higher than the standardised coefficient of the differentiation strategy on CSS. This research, thus, rejected H2. Several studies could not find an association between the business strategy and ABC system (Frey and Gordon, 1999; Malmi, 1999; Bhimani et al., 2005; Elhamma and Zhang, 2013). In contrast, Gosselin (1997) reported that a prospector strategy (differentiator) was positively related to the adoption of an activity management (AM) approach which consists of three techniques: activity analysis (AA), activity cost analysis (ACA), and ABC.

While H2 was rejected, the findings of this study, to a limited extent, suggest that CSS can be significant for both strategies, since they positively influenced the dimension of CSS, namely the number of cost pools. This is consistent with Drury and Tayles (2005) and Al-Omiri and Drury (2007), who argue that sophisticated cost systems can be critical for cost leaders and differentiators. The field study revealed that the majority of the interviewees support the importance and relevance of CSS for both types of strategy. The interviewees emphasised that cost leaders face price pressure and seek cost reduction to improve production efficiency and effectiveness, which requires a sophisticated cost system in order to understand the processes of the activities and avoid over- or under-costing products. These explanations are consistent with the arguments found in previous research (Chenhall and Langfield-Smith, 1998; Malmi, 1999; Drury and Tayles, 2005).

By contrast, the interviewed companies pointed to the possibility that differentiators are most likely to exhibit greater product diversity and greater production complexity. It was also indicated, based on the field interviews, that such a linkage between differentiation and product diversity will entail the use of sophisticated cost systems in order to accurately measure the different resources that diverse products consume.

Given the field interview evidence and prior literature, it is argued that a cost leadership strategy can directly influence CSS while the differentiation-CSS association can be reflected as a mediation type of relationship rather than a direct association. More specifically, it is proposed that product diversity may mediate the differentiation-CSS association, where a differentiation strategy increases the level of product diversity which, in turn, necessitates the use of a sophisticated cost system.

8.2.3 The role of management accountants and cost system sophistication

Phase one of the explanatory sequential design strategy adopted by the current study provides some empirical evidence in support of H3. While the quantitative analysis found no effect of the role of management accountants on the number of cost drivers, a positive and significant relationship between management accountants and CSS, as represented by the number of cost pools and the detailed cost system, was evident. This suggests that management accountants may play an important role in the dimension of cost pools and also in the ability of the cost system to supply detailed cost information. This finding is in line with the theoretical argument that management accountants with more business engagement, as opposed to only an accounting orientation, are more likely to develop sophisticated cost systems. This is because developing a complex accounting system requires greater knowledge of the organisational activities and processes, especially the production activities from management accountants, in order to facilitate the implementation of such a complex system (Cooper et al., 1992b; Argyris and Kaplan, 1994; Johnston et al., 2002; Emsley, 2005; Cadez and Guilding, 2008).

The empirical results of this study also confirm to a certain extent the findings of prior case studies, which illustrated the relevance of the role of management accountants to the development of cost systems and different process change projects (Cooper and Turney, 1990; Friedman and Lyne, 1997; Chenhall and Langfield-Smith, 1999; Johnston et al., 2002). Similar conclusions have also been reported by survey studies regarding the relationship between the accountant role and different accounting techniques (Emsley, 2005; Cadez and Guilding, 2008).

Moreover, the qualitative findings emanating from the second phase of the explanatory sequential design lent considerable support to the results drawn from the quantitative analysis. Several explanations were provided by the interviewees, but most important was the knowledge and engagement of management accountants regarding the various organisational activities, particularly the manufacturing activities that can create a large percentage of the direct and indirect costs. These elements, as indicated by the interviewees, entail management accountants being in a position to develop a sophisticated cost system that can support the different organisational needs. Nevertheless, it was explained in section 8.2.1 above, based on the qualitative findings as well as prior research, that a gap exists between management accountants and the marketing personnel that may contribute to the former's poor knowledge of the competitive environment. This led to the assumption that the competition's effect on CSS depends on the degree to which management accountants interact with other functions and gain an understanding of the competition information. As a result of this, management accountants should expand their scope of activities to support not the only production requirements and needs, but also other functions' activities and needs. Such a positive interaction can be possibly reflected in the cost system design, to ensure that the cost system supplies relevant cost information to the different departments.

8.2.4 Size and cost system sophistication

It was anticipated in hypothesis H4 that the size of the organisation would be positively related to CSS. Although the size of the business unit, as measured by the number of employees, was found by the current study to have no relationship with either the number of cost drivers or the detailed cost system construct, its significant and positive effect on CSS, as represented by the number of cost pools, is evident. This finding is consistent with Brierley's (2007) study that empirically showed that the size of the organisation, as represented by either employee number or sales revenue, influenced the cost pools but not the cost drivers. Prior research also shows that cost system design, represented by CSS or ABC, is more likely to be adopted by larger firms than smaller ones (Lukka and Granlund, 1996; Krumwiede, 1998; Clarke et al., 1999; Groot, 1999; Malmi, 1999; Baird et al., 2004; Drury and Tayles, 2005; Al-Omiri and Drury, 2007).

The results of this study could indicate that larger organisations have larger financial and labour resources and higher knowledge that may facilitate the development of a sophisticated cost system, particularly the number of cost pools (Parker and Lettes, 1991; Nguyen and Brooks, 1997; Booth and Giacobbe, 1998; Krumwiede, 1998; Groot, 1999; Al-Omiri and Drury, 2007). It is also reasonable to expect larger organisations to exhibit greater complexity in terms of their manufacturing activities (Cadez and Guilding, 2008; King et al., 2010), which could imply that CSS, as represented by a large number of cost pools, is paramount in such organisations in order to homogenise the costs associated with each activity (Cooper and Kaplan, 1991a).

8.2.5 Cost structure and cost system sophistication

The quantitative results of this research reveal a positive and significant relationship between manufacturing overhead costs, as a percentage of the total costs, and the two dimensions of CSS, namely the number of cost pools and the number of cost drivers, but not the detailed cost system construct. The results point to the possibility that companies increase the sophistication level of their cost system in terms of cost pools and cost drivers because of a large percentage of manufacturing overheads. This is consistent with the argument that companies need a sophisticated cost system in order to track their consumption of different overhead costs by products, and so accurately capture the costs of products and avoid cross-subsidising between products, when these overhead costs represent a large proportion of the cost structure (Cooper and Kaplan, 1992; Kaplan and Cooper, 1998; Cagwin and Bouwman, 2002; Tsai and Lai, 2007; Al-Sayed and Dugdale, 2016).

The findings of this study, however, conflict with the previous CSS studies, which failed to detect a significant relationship between cost structure and CSS (Drury and Tayles, 2005; Al-Omiri and Drury, 2007). It is possible that previous CSS studies could not detect a relationship because their samples consisted of heterogeneous sectors, namely the manufacturing and service sectors, which may explain why these studies used indirect costs as a percentage of the total cost, rather than indirect manufacturing costs, a measure that may preclude the detection of such a relationship (Drury and Tayles, 2005; Al-Omiri and Drury, 2007). Brierley (2007) surveyed UK manufacturing companies and empirically found manufacturing overhead costs significantly and positively influenced the number of cost pools but not the number of cost drivers.

Moreover, the field study supplied different reasons that support the cost structure-CSS relationship. One important explanation is that companies can experience high manufacturing overhead costs due to the complexity of the production processes that need different support resources, thus leading these companies to use a high number of cost pools and cost drivers in order to accurately measure the costs of these resources and allocate them to products.

8.2.6 Product diversity and cost system sophistication

H6 hypothesised that product diversity will have a positive effect on CSS. The analysis of the structural model in chapter 6 shows that product diversity influenced neither the number of cost pools nor the number of cost drivers. The analysis, however, found that product diversity positively influenced the ability of cost systems to supply detailed cost information.

The results of this study do not differ from the majority of prior cost system research that also failed statistically to uncover a significant relationship between product diversity and cost system design (Bjørnenak, 1997; Nguyen and Brooks, 1997; Clarke et al., 1999; Baird et al., 2004; Brown et al., 2004; Al-Omiri and Drury, 2007; Brierley, 2007, 2008a; Charaf and Bescos, 2013). Nonetheless, the field interviews showed that many of the interviewees disagreed with the statistical results and furnished explanations referring to different aspects of product diversity, such as the physical size of the product, production complexity, and volume diversity that stimulate companies to use CSS in an environment with high product diversity. These explanations are in line with the literature's theoretical argument that links product diversity to CSS (Cooper, 1988a, 1988b, 1989a, 1989b; Kaplan and Cooper, 1998; Al-Omiri and Drury, 2007; Brierley, 2007).

Further, some scholars argue that the reason why prior research could not supply strong evidence about the product diversity-cost system association is because of the measurement of product diversity that may not capture the nature of product diversity (Nguyen and Brooks, 1997; Brown et al., 2004; Al-Omiri and Drury, 2007). Appendix 10 shows the different measurements of product diversity used by prior research. Among these, only four empirical studies reported a relationship between product diversity and cost system design, and each employed different measurement to define product diversity (Krumwiede, 1998; Malmi, 1999; Drury and Tayles, 2005; Schoute, 2011). In addition, Chenhall (2003, p. 130) criticises the field of MA because of the absence of developing robust measures for a construct with a highly ambiguous meaning. The results of the interviews reported in chapter 7 indicate that the non-significance of the product diversity-CSS relationship may be due to measurement scale used to measure product diversity. The findings of the field interviews suggest that the ordinal-scale measures of product diversity may be too narrow and contain ambiguity that may result in low variation between the product diversity construct and CSS. Instead of an ordinal scale, objective measures of four dimensions of product diversity were discussed and proposed for measuring product diversity, based on a comparison of these dimensions between the interviewed operating units. Future research may need to consider such a scale for measuring product diversity in order to verify its effect on cost system design.

8.2.7 Advanced manufacturing technologies and cost system sophistication

H7 and H8 state that advanced manufacturing technologies (AMTs) will moderate both the cost structure-CSS and product diversity-CSS associations. It is anticipated that, with low AMTs, cost structure and product diversity will positively and significantly lead to high CSS, compared to when AMTs are high. Unexpectedly, the moderation analysis fails to support the proposed relationships. These findings conflict with the argument that AMTs will diminish the role of CSS, especially for non-volume cost drivers. This argument is based on the assumption that AMTs can manage and reduce the organisational cost structure, especially the indirect labour costs, and shift the batch- and product-level costs caused by product diversity to facility-level costs (Abernethy et al., 2001; Schoute, 2011). Schoute (2011) reported that AMTs negatively moderated the relationship between product diversity and ABC use, but not ABC adoption.

A possible explanation for the non-significant effect reported by the current study is the low number of ABC systems within the final sample (5.5%). ABC systems were considered by prior CSS studies as representing the highest level of sophistication when designed to include many cost pools, and volume and non-volume cost drivers (Abernethy et al., 2001; Drury and Tayles, 2005; Al-Omiri and Drury, 2007; Schoute, 2011). Given the low number of ABC systems in the final sample, it could be argued that this study failed to detect such a relationship due to the low number of ABC systems that are considered more sophisticated than the direct and traditional absorption cost systems.

Another possible explanation is the heterogeneity of the manufacturing technologies. Different types of AMTs may have a different impact on the cost system. For example, Lee et al. (2006) and Abd (2016) indicated that flexible assembly systems require more different tasks than flexible machining systems, because the former engages in producing products that consist of different components that need to be joined simultaneously, whereas the latter includes the operation of one task at a time. Foster and Horngren (1988) undertook field interviews with 25 companies that had adopted AMTs in different countries to explore the effect of this on cost practices. The study reported that the companies that adopted flexible machining systems experienced no change in their cost practices except that the labour costs were reduced, and the labour hour methodology for assigning overhead costs to products was replaced by machine hours. Alternatively, the study found that the companies that implemented flexible assembly systems experienced different changes in their cost practices, most notably increases in different indirect cost categories and also in the number of cost drivers, including non-volume cost drivers, such as the number of inserts per board. Considering this, AMTs may have a moderating effect between the product diversity-CSS and cost structure-CSS associations under specific types of technologies (such as flexible assembly systems), and a direct effect under a different type of technology.

Finally, this research found that AMTs had a positive and direct effect on CSS, represented only by the number of cost pools and the detailed cost system construct. This result replicates the findings of prior research, which revealed empirical evidence of a direct relationship between AMTs and ABC systems (Hoque, 2000; Isa and Foong, 2005; Mat and Smith, 2014). The field study also points to a possible direct AMTs-CSS association because of the increased overhead costs due to the various extensive support activities associated with the use of AMTs, such as maintenance, supervision, workforce training, engineering, system development, and inspection tooling. This argument is also consistent with the reasoning provided by prior research that advocates the use of ABC systems to improve the managerial decisions regarding product costs and control of the overhead costs (Sriram, 1995; Koltai et al., 2000; Isa and Foong, 2005). Another possible explanation identified by the participants is the complexity of the production process, which is caused by the level of product diversity (see also Kotha and Swamidass, 2000). In such an environment, it would be far more difficult to control and accelerate the production process effectively and efficiently based on manual activities or conventional production equipment.

8.3 Consequences of cost system sophistication

This section will discuss both the quantitative and qualitative findings obtained from the first phase (survey questionnaire) and the second phase (field interviews) of the explanatory sequential design that focuses on the effect of CSS on product planning, cost management and so, ultimately, organisational performance. Hypotheses H9 to H12, presented in Table 8.1 above, will be the focus in this section.

8.3.1 Cost system sophistication, product planning and performance

H9 and H10 anticipated that CSS will be positively related to improved product planning decisions which will, in turn, mediate the effect of CSS on business unit performance, respectively. The statistical results of the questionnaire analysis showed that neither of these hypotheses were supported based on the dimensions of the number of cost pools and the number of cost drivers of CSS. Instead, the detailed cost system construct is the only measure that was found to be positively related to improved product planning, and that product planning indirectly mediated the relationship between the detailed cost system and business unit performance. This result provides very limited evidence of the importance of the cost system regarding product planning and so, ultimately, performance, since the effect of neither the cost pools nor the cost drivers was found to be significant.

These results conflict with the literature that supports the importance and relevance of using sophisticated cost systems to improve product planning decisions, which include new product design, product range, and output decisions, compared to the traditional, simple cost systems (Cooper and Kaplan, 1991a, 1991b; Turney, 1991; Innes et al., 1998; Kaplan and Cooper, 1998; Drury and Tayles, 2006).

A possible explanation for the insignificant effect of the cost pools and cost drivers on product planning, and, ultimately, organisational performance reported by the current study is that companies may find it difficult to design a cost system that can serve both purposes, namely product planning and cost management (Kaplan and Cooper, 1998; Cokins, 2001; Schoute, 2009). Cokins (2001) indicates that the level of timeliness, aggregation, and accuracy of cost information differs for these two purposes, as cost management requires more frequent reports and accurate information to identify opportunities for improvement and to monitor the efficiency of the processes. From this perspective, Schoute (2009) contends that the optimal level of cost system, based on the purpose for which it is used, can be compromised because of the different levels of complexity required for each purpose. Using moderation analysis, Schoute (2009) confirmed that a highly-complex cost system decreases a cost system's effectiveness in terms of satisfaction and intensity of use when it is used at a higher level of product planning's usage, but increases its effectiveness when it is used at a higher level of cost management's usage. Thus, it is possible that the surveyed companies in the current study have developed a sophisticated cost system to focus on cost management, such as cost reduction, performance measures, and process re-engineering, which consequently makes this cost system less effective with regard to product planning decisions.

A second possible reason for the non-significant result is that the companies may have been able to improve their product planning decisions during the early usage's stage after sophisticated cost system implementation, so it became difficult for them to realise more benefits from the cost system regarding product planning improvement. For example, some companies may find that some products are unprofitable and become a target for removal from the product range at an early stage of CSS usage. Nonetheless, constantly identifying and removing unprofitable products may not be a good strategy, as this can lead to a small product range. Alternatively, companies may turn to cost management applications, such as redesigning new processes, to keep continually shaving more costs and ultimately product costs. Such a strategy might help companies to keep their product price, design or output the same as their competitors in the market, but at the same time they can realise greater profitability due to the reduced product costs because of the continued improvement in cost management applications.

To support the above reason, Swenson (1995) revealed empirical evidence that some of the interviewed companies de-emphasised the use of ABC systems for product planning as their ABC systems progressed and evolved, and so these companies consequently shifted their focus to cost management applications. In addition, Innes and Mitchell (1995) indicated in their study that the ABC adopters had used ABC systems for an average of 3.5 years, while Chenhall (2004) reported that the ABC adopters had used them for an average of one year. While the former showed that cost management applications were more successful and popular than product planning, the latter found the opposite. This indicates that the surveyed companies in the current study may have already improved their product planning at an early stage of cost system use and then shifted their focus to cost management in order to continue constantly controlling and reducing their organisational costs.

The qualitative findings emanating from the field interviews provide some explanation of the non-significant effect of cost pools and cost drivers on product planning. The most frequently-mentioned explanation is that, while a number of participants recognise the importance of costs for product planning, they expressed the view that a cost system may not be the sole determinant for improving product planning decisions. They referred to various critical variables that may be more important in determining the product planning decisions than costs, such as the time to market, customers' taste and demand, competitors' actions, and technological advances. Drury and Tayles (2006) and Laitinen (2014) also expressed the view that other variables than costs can play a critical role in decision-making, especially pricing decisions, which makes the changes in these decisions too complex to be constantly effective. Examples of these variables include, but are not limited to, competitors' actions, market knowledge, the customers' power, and the involvement of multiple persons in the decision-making.

8.3.2 Cost system sophistication, cost management, and performance

This research hypothesised in H11 that CSS is positively related to improved cost management, and in H12 that cost management mediates the relationship between CSS and business unit performance. The results of the questionnaire analysis suggest that CSS has a significant positive effect, as represented by the number of cost pools, the number of cost drivers, and the detailed cost system, on improved cost management, and thus supports H11. Prior research also reported that the success, use, and purposes of ABC systems were found to be dominant among cost management applications compared to product planning (Innes and Mitchell, 1995; Swenson, 1995; Nguyen and Brooks, 1997; Groot, 1999; Innes et al., 2000; Cotton et al., 2003). The importance of improving cost management, especially performance measures, cost reduction, and budgeting decisions, generates a tendency to develop sophisticated cost systems in order to target and eliminate non-value-added activities, provide different cost drivers that can be used as performance measures to monitor the effectiveness and efficiency of activity performance, and improve resource capacity planning and the flexibility for setting a more dynamic budget (Turney, 1991; Shields, 1995; Kaplan and Cooper, 1998; Ittner, 1999; Ittner et al., 2002; Hansen et al., 2003; Stevens, 2004).

Additionally, H12 was supported, as the current research found a positive and significant indirect association between CSS and business unit performance through improvement in cost management. The statistical result also confirms that CSS alone did not have any significant direct effect on performance, which is in line with prior research that did not find any direct link between ABC and performance (Cagwin and Bouwman, 2002; Ittner et al., 2002; Maiga and Jacobs, 2003, 2008; Cagwin and Barker, 2006; Banker et al., 2008; Xiao et al., 2011; Pokorná, 2016).

The findings suggest that, by making a cost system more sophisticated, UK manufacturing companies will be more likely to benefit from and rely on such systems to improve different areas of cost management, namely budgeting, cost reduction and performance measures, and so ultimately and indirectly improve their organisational performance. Sophisticated cost systems can make a large portion of organisational costs more visible by identifying the different activities that consume the organisational resources and the drivers that reflect the demand for the cost objects required by the organisational activities (Turney, 1991; Kaplan and Cooper, 1998). Therefore, companies with such systems might be able to take actions to improve the organisational performance (Kaplan and Cooper, 1998; Hansen et al., 2003; Herath and Gupta, 2005; Cagwin and Barker, 2006; Maiga and Jacobs, 2008). The significant finding regarding the mediation role of cost management is also in line with Cooper and Kaplan's (1991b) theoretical argument that a cost system can increase and direct managerial knowledge towards better actions which, in turn, increases the profit for organisations.

In addition, the field interviews provide views that support the applicability of CSS for improving cost management applications. A group of interviewees indicated that such applicability stems from the capability of sophisticated cost systems to provide information that helps the management to control the resource spending and coordinate the organisational activities. Another group of interviewees provided different but complementary explanations, including that cost management applications are far easier to measure directly and control based on the information provided by the cost system compared to product planning decisions, which require not only cost information but also a knowledge of customer demand and power, the gaps in the market, and the competition.

8.4 Chapter summary

This chapter discussed the quantitative and qualitative results obtained from the survey questionnaire and field interview analysis, respectively. During the discussion of the current study's results, a comparison was made between the quantitative and qualitative findings with the relevant literature to highlight any differences and similarities between the two and to furnish possible explanations for these, especially for the non-significant effects that were observed in the quantitative analysis, before presenting the interviewees' views about such relationships.

The results of the antecedent factors for CSS were presented and discussed first. In this regard, it was stated during the discussion that the effect of the competitive environment on the CSS level may be influenced by the extent of management accountants' involvement in the assessment of competition and the establishment of communication channels between the accounting and marketing functions. In addition, the cost leadership and differentiation strategies were found to be relevant regarding the level of CSS. While cost leadership was presented in the discussion as having a direct relationship with CSS, it was proposed, based on the qualitative results, that a differentiation strategy may have an indirect effect on CSS through product diversity. Product diversity also represents an important factor of CSS but, quantitatively, this research was unable to provide empirical evidence of such a relationship. As discussed in this and the previous chapter, a possible reason for this unexpected finding is the ordinal-scale measurement used by the current study, as this research provides an alternative measurement based on absolute values. Our research findings also suggest that the organisational characteristics, in terms of the percentage of indirect costs, the role of management accountants, and organisational size, represent important factors that are relevant to the level of CSS. While this research could not find a significant moderating role for AMTs between the cost structure-CSS and product diversity-CSS associations, it reported a significant direct relationship between AMTs and CSS. Different explanations were discussed for these non-significant moderation findings, including the low number of ABC adopters in the current study's sample, and the heterogeneity of manufacturing technologies. Moreover, the results obtained from the quantitative and qualitative aspects regarding the importance of CSS to cost management, compared to product planning, found a direct and positive effect of CSS on cost management and an indirect relationship between CSS and performance through the role of cost management. Having discussed the quantitative and qualitative results, the next chapter will present the conclusion of this thesis.

Chapter 9: Conclusion

9.1 Introduction

The main topic of this thesis is the antecedents and consequences of cost system sophistication (CSS). The cost system has received great attention in the field of management accounting (MA) since the 1980s. Changes in the business environment during that period, such as automation and shorter product life, led to a high demand for an appropriate cost system to supply relevant cost information that would enable effective, fast decisions (Johnson and Kaplan, 1987; Kaplan and Cooper, 1998; Drury and Tayles, 2006; Krumwiede and Charles, 2014; Maiga et al., 2014; Drury, 2015). A review of the management and cost systems literature revealed a number of gaps regarding the concept of the cost system, the contingent factors of CSS, and the consequence of CSS. This thesis, thus, aims to provide some understanding of the practice of cost system design within UK manufacturing companies at different levels.

Firstly, the current research adopts the mediation approach of contingency theory to investigate both the antecedents and consequences of CSS as prior research offer an incomplete picture of the role of cost system by either using the selection approach or the moderation approach. In an attempt to explain the environmental and organisational contingent elements that lead to differences in CSS levels, seven contingency variables were deemed important and consequently required investigation in relation to cost system design. Different relationships were examined, including the direct effect of competition, business strategy, the role of management accountants, cost structure, product diversity, advanced manufacturing technologies (AMTs), and organisational size on CSS, as well as the moderation effect of AMTs on the cost structure-CSS association and product diversity-CSS association. Furthermore, the study expands the cost system-performance literature by investigating the potential mechanisms of CSS for influencing business unit performance through strategic and operational decisions. These decisions being respectively conceptualised as product planning and cost management, each of which was represented by a group of interrelated decisions. By segregating the purpose of cost systems into product planning and cost management, the current study was able to examine in greater depth the paths showing how CSS ultimately influences business unit performance.

To investigate the developed theoretical model, a positivist paradigm was adopted and a mixed methods design was operationalised to collect data from different sources. The mixed methods design is conducted in an explanatory mode (Brierley, 2014; Creswell, 2014). This includes a cross-sectional survey questionnaire that was first undertaken and analysed, followed by field interviews with professional accountants to furnish explanations about the results of the questionnaire analysis. The questionnaire was mailed to 1,957 UK manufacturing companies, resulting in the collection of 401 usable questionnaires (effective response rate = 20.5%). Moreover, structural equation modeling (SEM) was employed to test the formulated hypotheses while controlling for the measurement errors associated with the latent variable. The second stage of the mixed methods design sought the perceptions of cost system practitioners regarding the statistical results and also to refine the developed research model. Semi-structured interviews were conducted with 11 accountants from UK manufacturing companies and a matrix-style thematic analysis was employed to analyse the textual data (Braun and Clarke, 2006; King and Horrocks, 2010).

A summary of the key findings is presented in the next section. Sections 9.3 will outline the expected contributions of the present thesis. Next, the research limitations will be reported in section 9.4. The last section will provide directions for future research and potential modifications to the research model.

9.2 Summary of the research findings

The present study aimed to answer two questions that were formulated and presented in chapter 1. These two questions are:

1. Which contingent factors influence the sophistication level of a cost system?
2. Does CSS have an indirect impact on business unit performance through its role in product planning and cost management?

A summary of the research findings will be presented separately for each type of question in the following sub-sections.

9.2.1 The findings for the first research question

The first research question was constructed to identify the nature of the effect of seven contingency variables on CSS level. Eight hypotheses were developed and tested through the quantitative phase of the explanatory mixed methods design. The quantitative results suggested that the role of management accountants, the size of the organisation, and the cost structure affected different dimensions of CSS. In addition, the results suggested that business strategy (differentiation and cost leadership) could explain some dimensions of CSS, although cost leadership strategy was found to influence more aspects of the cost system than did the differentiation strategy.

The qualitative results also helped the current thesis to explain the nature of the relationships between the aforementioned factors and CSS. More specifically, the interviewees regarded the role of management accountants, cost structure, and cost leadership to be important factors that can directly influence the CSS level. On the other hand, the comments furnished by the interviewees reflect the possibility that the differentiation strategy can have a non-direct effect on the level of CSS through the role of product diversity in conveying the effect of the differentiation strategy to the cost system.

The survey results also indicate that neither competition nor product diversity influenced CSS, especially with regard to the number of cost pools and the number of cost drivers. While the non-significant competition-CSS relationship was unexpected, the follow-up interviews supplied different explanations for this. Above all, the idea that such a relationship may depend upon the extent of management accountants' involvement in competitive assessment and effective communication with the marketing department to moderate competition-CSS relationship (see chapter 8 section 8.2.1.). Furthermore, the practitioners of cost systems support the theoretical argument that product diversity has the most important influence on cost system design. The qualitative analyses, however, showed that the non-significant link between product diversity and CSS may be due to the measurement of product diversity, and consequently five objective measures for product diversity were developed based on the field interviews to capture variations in product diversity.

Finally, it was argued previously (see chapters 2 and 3) that different views exist regarding whether cost structure, product diversity, and AMTs have a direct or moderation effect on CSS. The statistical results failed to support the moderation effect of these variables, as AMTs were found to moderate neither the cost structure-CSS association nor the product diversity-CSS association. Instead, AMTs were found to increase the level of CSS. The qualitative results suggested that AMTs are more likely to be used in a highly-complex production environment, which can necessitate the use of a sophisticated cost system. Nonetheless, the heterogeneity of the types of manufacturing technologies and/or the low number of ABC users were proposed as possible reasons for the failure to detect a moderating role for AMTs.

9.2.2 The findings for the second research question

The second research question aims to expand the cost system-performance literature by investigating the linkage between cost system and business unit performance. To address this question, two purposes of cost systems, namely product planning and cost management, were hypothesised to be affected by the level of CSS and to mediate the CSS-performance association. Therefore, four hypotheses were formulated to answer the second research question.

The statistical result suggested a direct and positive effect of CSS on improved cost management but no significant linkage between CSS and improved product planning. In addition, the statistical results showed the mechanism whereby a sophisticated cost system would be financially beneficial for manufacturing companies. The survey analysis showed that cost management indeed significantly mediated the relationship between CSS and performance. Alternatively, the statistical analysis failed to find a significant association between CSS, measured by the number of cost pools and the number of cost drivers, and performance through product planning's mediation role.

Additionally, the qualitative analysis, based on the interviewees' comments, indicates that, even though a sophisticated cost system is important for product planning decisions, cost information is only one of many different inputs that can influence these decisions. The interviewees provided different reasons for this, including: (1) the crucial role of other factors, like customer power and market knowledge that can influence product planning and minimise the role of cost information; and (2) the qualitative nature of product planning, which requires non-monetary information, such as the size of, and the gap in the market, and the production capacity. On the other hand, the field study suggested that cost management was considered to be directly improved by a sophisticated cost system due to the need by the former for detailed cost information about the activities, processes, and operations that can be directly obtained through a sophisticated cost system.

In summary, the findings of the current research support the direct effect of CSS on cost management and the non-direct "mediation" effect of CSS on performance through cost management.

9.3 Research contribution

This thesis aims to add an incremental step to the academic literature on cost systems by understanding the practice of CSS among UK manufacturing companies and so increase our knowledge of the most important contextual elements that have led UK manufacturing companies to design a sophisticated cost system, and the expected benefits that can be realised from such a system. More specifically, the contribution of this thesis can be examined at the theoretical, methodological and practical levels.

9.3.1 Theoretical contribution

The current thesis presents a novel theoretical contribution with regard to the development of a holistic research model of the cost system that can capture its role within organisations as a causal chain of different relationships, as argued by different scholars (Kaplan and Cooper, 1998; Drury and Tayles, 2005; Pizzini, 2006). In this sense, it has been argued that environment and organisational factors will determine the design of a cost system, thus enabling management to make correct strategic and operational decisions, leading to improved economic performance. The current study adopts the mediation approach of contingency theory, which focuses on the direct and indirect relationships among different variables to investigate the causal chain of different relationships related to the design of the cost system. The mediation approach stands in contrast to earlier cost system models, which relied mainly on the selection approach of contingency theory. It enables academics to investigate complex aspects of the business environment related to the design of the cost system. More specifically, it allows for the examination of the effect of multiple contingency factors on the design of the cost systems. In addition, it enables researchers to investigate the outcomes of the cost system in terms of operational and strategic decisions and their effect on organisational performance, which cannot be captured by the selection approach.

The mediation approach used in this study has an important contribution to knowledge. The empirical results show that the mediation approach is superior in terms of its ability to furnish explanation about variation in the design of the cost system. This is because the mediation approach of contingency theory, coupled with the use of SEM analysis, can account for the commonality amongst the contingency factors and provide a broader understanding of the context within which the cost system operates, which can help researchers to find significant outcomes that may not be captured by selection or interaction approaches (Smith and Langfield-Smith, 2004). By using the mediation approach, this study is able to examine important contingent factors. It incorporates seven important contingency factors as exhibiting potential contingent relationships with CSS: competition, business strategy, the role of management accountants, product diversity, cost structure, AMTs, and size. It shows that size, the role of management accountants, business strategy, AMTs, and cost structure can lead to a variation in the design of CSS. Academic should now consider these factors based on the mediation approach when they attempt to investigate different cost system models.

In addition, the mediation approach provides a different conceptual lens with which to evaluate the relationships between the cost system and organisational performance, and suggests that a sophisticated cost system, by itself, does not improve organisational performance unless the cost information is utilised and used in different cost management applications, such as budgeting, performance measurement, and cost reduction. In the present study, the mediation approach uncovers a significant relationship between the cost system and organisational performance through the mediator role of cost management, which indicates that the findings of prior research are insufficient for examining the cost system and organisational performance. This is because prior research reported conflicting findings about the effect of cost systems on organisational performance based on the direct and interaction approaches and many studies did not find a positive relationship between the cost system and organisational performance (Gordon and Silvester, 1999; Cagwin and Bouwman, 2002; Ittner et al., 2002; Cagwin and Barker, 2006; Banker et al., 2008; Maiga and Jacobs, 2008; Xiao et al., 2011; Maiga et al., 2014; Pokorná, 2016).

Finally, this research shows that, theoretically, there are different possible paths that can connect the cost system to organisational performance, i.e. product planning and cost management, each of which is represented by a group of related decisions. Prior research either investigated each decision separately (Maiga and Jacobs, 2008; Laitinen, 2014) or combined the product planning and cost management decisions together under one variable (Shields, 1995; Swenson, 1995; Foster and Swenson, 1997; McGowan, 1998; Anderson and Young, 1999; Groot, 1999; Innes et al., 2000; Byrne et al., 2009; Pike et al., 2011; Abu-Mansor et al., 2012). Distinguishing between product planning and cost management, each of which is exhibited by a group of related decisions, is critical in order to scrutinise the extent to which a highly sophisticated cost system can improve product planning and/or cost management, since each requires different types of cost information.

Therefore, our results based on the mediation approach suggest that the conceptual models through which prior research has traditionally investigated the impact of cost systems need to be revisited and validated using the mediation approach in order to illustrate the different paths that connect the cost system to organisational performance.

9.3.2 Methodological contribution

The current thesis can be regarded as noteworthy in terms of the methodology used (see Cadez and Guilding, 2008). The study utilised two different methods of data collection, which have rarely been used in cost system studies: the acquisition of quantitative data by means of a survey questionnaire and the collection of qualitative data through the use of field interviews. Unlike prior research, the questionnaire was distributed to a large number (1,957) of UK manufacturing companies in an attempt to: (1) increase the statistical power in order to validate and test the research model precisely; and (2) improve confidence in the results obtained from the statistical analyses. This was also coupled with the use of a sophisticated analysis technique, namely SEM, which has not been used extensively in cost system studies, to examine a complex research model with different relationships (Anderson and Young, 1999; Cagwin and Bouwman, 2002; Maiga and Jacobs, 2008; Laitinen, 2014). Finally, this thesis is one of the few studies to develop a new measurement for product diversity, since it is considered as one of the key factors in influencing CSS, based on the qualitative data obtained from the field interviews. The use of the field interviews helped uncover some limitations in the ordinal scale of product diversity used by the current study. Thus, rather than an ordinal scale, which contains limited options, the thesis develops an objective scale to measure product diversity, which can measure the different dimensions of product diversity in absolute terms.

9.3.3 Practical contribution

Considering the perceived difficulties in implementing sophisticated cost systems, and the doubts about the financial benefits of sophisticated cost systems, the results of the current thesis offer a practical contribution for practitioners. The research model based on the mediation approach contributes to practice by showing (1) the degree of alignment between the contingency factors and CSS in order for sophisticated cost systems to provide relevant cost information that can suit their business environment; and (2) the degree of alignment between CSS and organisational performance through the indirect role of product planning and cost management, which help managers to highlight the conditions under which investing in a highly sophisticated cost system is most likely to pay off. More specifically, managers working in large manufacturing companies with either a cost leadership or differentiation strategy, high overhead costs, and AMTs should increase the number of cost pools to accurately homogenise and capture the costs of different activities and processes, and so make better decisions. Moreover, companies with high overhead costs should increase the number of cost drivers to accurately assign overhead costs to products, thus improving the accuracy of product costs and, consequently, competitive position by avoiding over- or under-costed products.

In addition, developing sophisticated cost systems is expensive and requires different resources to put into operation. Nonetheless, the results based on the mediation approach show that sophisticated cost systems can indirectly contribute to creating economic value for manufacturing companies through improving cost management applications. Manufacturing companies should pay special attention to cost management applications, which represent important areas for improvement, hinging on the use of a sophisticated cost system, by making many activities and operational costs visible and employing appropriate cost drivers, thereby enabling managers to control budget spending, improve the performance of activities, and reduce costs, consequently contributing to economic performance.

Finally, management accountants should also be aware of their important role in supporting sophisticated cost system development. Their time should not only be oriented towards functional accounting activities but should also be expanded to encompass a more business-oriented role by working closely with other departments and obtaining knowledge about different organisational activities. As a result of this wider role, they will be in a better position to accommodate non-accounting members' needs through developing a sophisticated cost system that also requires a detailed analysis of organisational activities, and the factors causing them, in order for such a system to supply important, accurate information that can help non-accounting managers make effective decisions.

9.4 Research limitations

Like any other research project, several limitations associated with the current thesis can be highlighted for future research to address. Firstly, no clear evidence of the causality between the variables can be supplied by cross-sectional survey data that are collected at one point in time, such as is the case in this research (Nicolaou, 2003; Van der Stede, 2014). Instead, cross-sectional research can only indicate association rather than causality. Therefore, recursive or reverse causality may exist among the variables (Chenhall, 2004). For example, past low performance may trigger companies to engage in developing sophisticated cost systems in order to supply accurate cost information for product planning and cost management. This would entail performance becoming an independent rather than a dependent variable (Otley, 2016). Nevertheless, the direction of the associations between the constructs reported by this study should be interpreted in light of the theory and literature that specify the direction of these relationships, as well as the field interviews that provided helpful suggestions regarding causality (Emsley, 2005; Ittner, 2014). To strengthen the claim of the causality for the associations between the contingency factors and CSS and between CSS and performance, future studies can use a longitudinal survey strategy to collect data at different time points using the same respondents to observe the sustainability of the influence of: (1) the contingency factors investigated by this study on CSS; and (2) CSS on product planning, cost management, and so, eventually, organisational performance.

Further, the developed model is considered to be complex because of the number of investigated constructs and different proposed hypotheses. Nevertheless, academic research projects are never comprehensive nor complete (Tillema, 2005; Hayes, 2013). The field interview data, as presented in chapter seven, identified several possible factors that were omitted from the research model that future research might investigate in relation to CSS level, including enterprise resource planning (ERP) systems and top management awareness of the importance of cost information.

Non-response bias was also detected between early and late responders regarding the percentage of manufacturing overhead costs and AMTs, which can be considered a limitation, even though all of the remaining non-response tests show satisfactory non-significant differences between early and late responders. In addition, competition, product diversity, and cost leadership strategy were found to have convergent validity below the 50% cut-off criterion. This represents another limitation of this study, whereby its empirical results in regard to these mentioned constructs need to be interpreted with caution, even though prior rigorous steps were taken by the current study including: (1) reviewing the most appropriate measurement scale used by prior research; (2) following closely the recommendations of Dillman et al. (2014) regarding an appropriate survey design; and (3) conducting a pilot test and interview prior to the distribution of the main survey. Unfortunately, it is uncommon in the cost system literature to apply rigorous analysis techniques, such as the confirmatory factor analysis (CFA) of SEM, to evaluate different aspects of the reliability and validity of the research constructs, which can help future research to select the most valid and reliable items (e.g. Krumwiede, 1998; Drury and Tayles, 2005; Al-Omiri and Drury, 2007; Brierley, 2007, 2008a).[45] Future work, thus, might consider the selection of a measurement scale for constructs that have been verified in terms of their validity and reliability using the CFA approach in prior research. This is because CFA was found to be a rigid statistical technique for assessing the entire validity of the constructs compared to other techniques (see Venkatraman and Ramanujam, 1987).

Finally, the research population investigated by the current study was restricted to medium- and large-size UK manufacturing companies. Although a large number of usable questionnaires were analysed (n = 401), it may be inapplicable to generalise the research findings to: (1) other contexts; and (2) small UK manufacturing companies. Replicating this study in different contexts and using small-size companies can extend the findings and offer what Otley (2001, p. 247) called "hard science" evidence regarding the boundaries of the research findings' applicability.

9.5 Further future work

The previous section discussed possible future opportunities based on the limitations associated with this study. Similarly, this section aims to offer possible avenues based on the results obtained from the field study to direct future work towards important areas that require further exploration. Figure 9.1 shows the tested research model coupled with

[45] It should be noted also that many studies that surveyed cost system design employed a low sample size that may prevent the use of covariance-based SEM, which is used in this study

several tentative propositions. The dotted lines in Figure 9.1 reflect these propositions and the solid lines indicate the confirmed hypotheses based on the quantitative and qualitative findings of this study. Exploratory case studies are more likely to be suitable for validating and confirming/refuting the applicability of these propositions. This is due to the fact that the field interviews were conducted under the explanatory mode, where the explanations of the significant and non-significant results were, to a large extent, the focus of this research rather than comparing and exploring, for example, the types and level of AMTs used by the 11 interviewed companies. Nevertheless, it was possible to provide some initial tentative propositions, where conducting exploratory case studies to observe the proposed patterns underpinning these propositions appears promising. Ryan et al. (2002, p.149) argue that exploratory case studies are specifically suitable for a research area that lacks a well-developed theory. The importance of conducting exploratory cases lies in their ability to uncover the reasons behind the use of particular accounting techniques and systems in order to generate hypotheses (Ryan et al., 2002). The following propositions are highlighted with regard to future projects:

1. It was discussed in section 8.2.1 that the degree to which management accountants maintain effective communication channels and have sufficient knowledge of the competitive assessment are possible reasons behind the non-significant effect of competition on CSS. Nevertheless, this proposed reason is tentative and requires further investigation to establish its applicability. Future research is encouraged to explore this by conducting exploratory case studies to validate whether the competition-CSS association is dependable on the existence of the role of management accountants, as depicted in proposition 1 (P1) in Figure 9.1.
2. The differentiation strategy was statistically found to be related to CSS, as reflected by the number of cost pools. The results of the field interviews showed

that the differentiation strategy-CSS association might be better reflected by a mediation relationship rather than a direct relationship. The qualitative findings indicated that product diversity may mediate the differentiation-CSS association. Future work can explore this area to compare the differentiation strategy's respective direct and indirect effect through product diversity on CSS, as shown in propositions P2 and P3 (Figure 9.1) to confirm whether the mechanism of product diversity mediates the differentiation strategy-CSS association. The measurement of product diversity based on objective scales, as discussed in section 7.3.5, should be borne in mind when investigating product diversity.

3. P4 in Figure 9.1 shows the modified relationship that was examined by the current research since the hypotheses that AMTs play a moderating role between the product diversity-CSS and cost structure-CSS relationships were statistically rejected. It was difficult to draw a conclusion due to the possibility that different competing reasons and different theoretical arguments underlie the AMTs-CSS relationship (see section 8.2.7). Exploratory case studies become valuable in providing insights about the degree to which AMTs can play a moderator role. Given the fact that this study surveyed a large number of UK manufacturing companies, the number of ABC users in the final sample was very low, which may preclude the detection of moderation, since it is argued that ABC is considered a highly sophisticated cost system (Abernethy et al., 2001; Drury and Tayles, 2005; Al-Omiri and Drury, 2007; Schoute, 2011). Future work may need to rely on third parties, such as ABC consulting firms or professional accounting companies, that have provided ABC services and consulting to manufacturing companies. Reliance on a third party has been successfully used in prior research to identify ABC users (see, for example, Chenhall, 2004). The reliance on such a

strategy may help future researchers to investigate whether a sophisticated ABC system is relevant to an AMTs' environment, by uncovering: (1) the degree to which these technologies are considered advanced and flexible; and (2) the type of manufacturing technologies used in these companies.

4. The field interviews revealed possible factors that had been omitted from the original research model. ERP systems (P5) and the awareness of the top management (TM) regarding the importance of cost information (P6) were recognised as important factors from a practical point of view in relation to CSS. Future research might investigate the degree to which these factors can influence CSS.
5. As a cost system with many cost pools and cost drivers is recognised as being more sophisticated and more detailed, it is argued that one of the benefits of such a system is related to improvements in various product planning decisions (Kaplan and Cooper, 1998; Brierley et al., 2006; Schoute, 2009). Because of the non-significant finding regarding the CSS-improved product planning association (P7 in Figure 9.1) reported by the current study, it becomes important that future work re-investigates this association by considering the reasons and conditions that are relevant to such a relationship (see section 8.3.1).

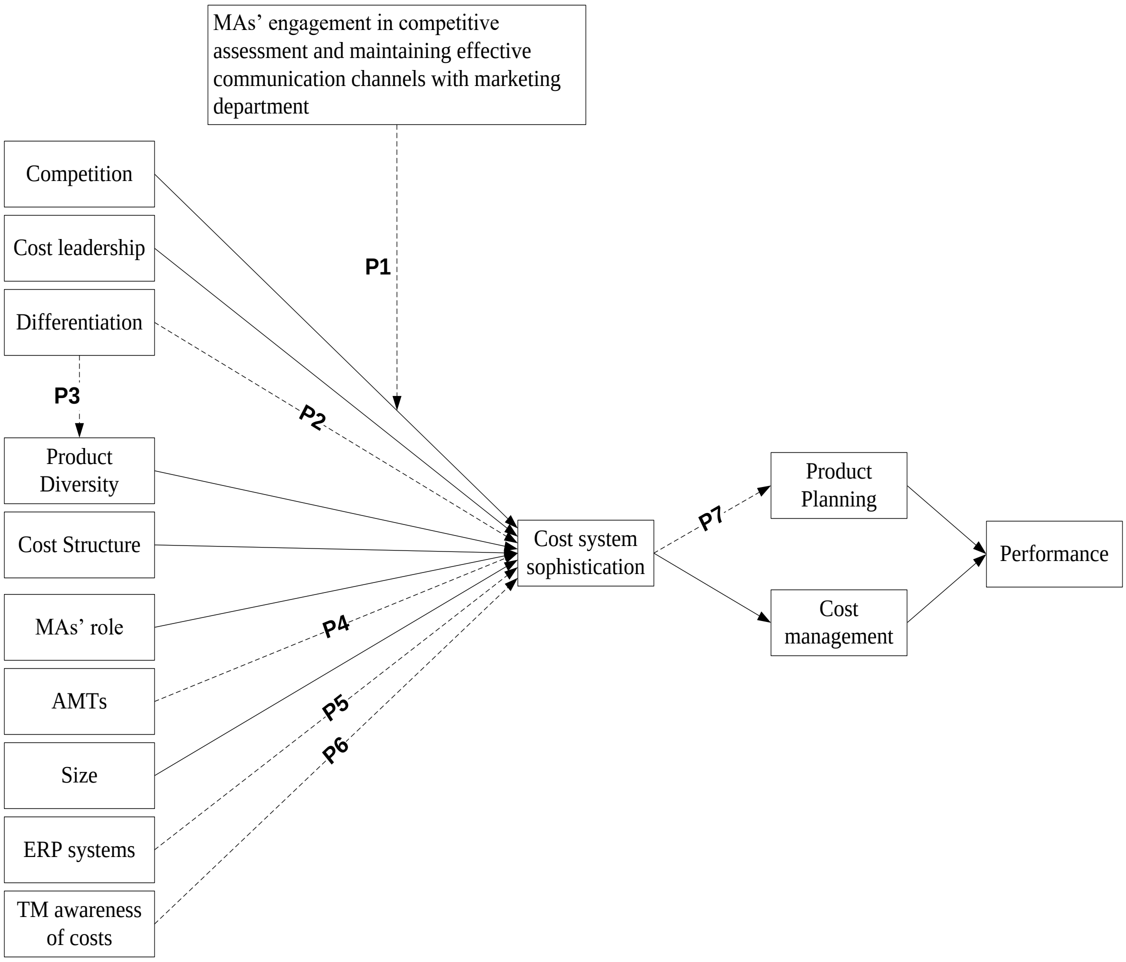

Figure 9.1: The modified research model.

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Appendix (1): Summary of ABC studies

Studies	Country	Research method	Contingent factors influenced ABC adoption	Factors not associated with ABC adoption	The definition of the cost system
Anderson (1995)	US	Longitudinal case study	**Individual factors:** Disposed to change, production process knowledge, role involvement, and informal support. **Organizational factors:** Centralization, functional specialization, internal communications and training. **Technological factors:** Complexity for users, compatibility with existing systems, relative improvements over the existing system (accuracy and timeliness) and relevance to managers' decisions and compatibility with firm strategy. **Task characteristics factors:** Uncertainty/lack of goal clarity, task variety, worker autonomy and worker responsibility/personal risk. **External environmental factors:** Heterogeneity of demands**,** competition, environmental uncertainty and external communications/role of external		ABC implementation stage: • Initiation; • Adoption; • Adaptation; • Acceptance.
Innes and Mitchell (1995)	UK	Questionnaire	Size.	Industry (manufacturing versus non-manufacturing companies).	• Currently using ABC; • Currently considering ABC adoption; • Reject ABC after assessment; • No consideration of ABC to date.
Shim (1996)	US	Questionnaire		Production automation is not associated with ABC adoption.	• ABC fully implemented; • ABC partially implemented; • Not implemented but plan to implement; • No plan to implement at all.
Bjørnenak (1997)	Norway	Questionnaire	Cost structure.	Product diversity, competition and size.	• Implemented ABC; • Currently implementing ABC; • Wanted to implement ABC.
Nguyen and Brooks (1997)	Australia	Questionnaire	Production complexity, size and competition.	Cost structure and product diversity.	• Currently using ABC; • Future planned to adopt ABC; • Adopted then rejected it but planned to adopt again in the future; • No plan to implement ABC.
Krumwiede (1998)	US	Questionnaire	Information technology, product diversity, continues manufacturing process (production type), size, decision usefulness of cost information, top management support, the number of years since ABC was adopted, the number of purposes identified for ABC, training and non-accounting ownership.	Implementation of total quality management, implementation of lean production system and clarity of ABC objectives.	• Approved for implementation; • Analysis; • Getting acceptance; • Implemented then abandoned; • Used somewhat;

					• Used extensively.
Gosselin (1997)	Canada	Questionnaire	Prospector strategy is associated with the adoption of all level of ABM (AA, ACA, and ABC). Vertical differentiation of organisational structure is associated with ABC adoption. Centralization and formalisation of organisational structure are associated with the implementation of ABC.	Size is not associated with ABM adoption and ABC adoption and implementation. Centralisation and formalisation are not associated with ABC adoption. Vertical differentiation is not associated with ABC adoption.	**Activity management (AM):** • Adoption of activity analysis (AA); • Adoption of activity cost analysis (ACA); • Adoption of ABC; • Implementation of ABC.
Malmi (1999)	Finland	Questionnaire	Competition, product diversity and size.	Business strategy (Differentiation vs. Cost leadership), production type and cost structure.	• Use of ABC; • Use of ABM; • Currently implementing ABC.
Clarke et al. (1999)	Ireland	Questionnaire	Multinational firms adopted ABC more than national firms and size.	Industry type, product diversity, and cost structure.	• Implemented ABC, • Assessing ABC, • Rejected ABC, • Not considered ABC.
Hoque (2000)	New Zealand	Questionnaire	Just-in-Time production is negatively associated ABC adoption. Production automation is associated with ABC adoption		• Use of ABC; • Use of volume traditional cost system.
Brown et al. (2004)	Australia	Questionnaire	Top management support, the support of an internal champion and organizational size.	Use of consultants, relative advantage, cost structure and product diversity	• Considering; • Considered then rejected; • Evaluated and approved for implementation; • Analysis; • Gaining acceptance; • Implemented then abandoned; • Restricted use; • Used somewhat; • Used extensively.
Baird et al. (2004)	Australia	Questionnaire	Decision usefulness of cost information, the cultural dimension of outcome orientation and the cultural dimension of tight versus loose control.	Business unit size and the cultural dimension of innovation.	**Activity-management (AM):** • Extent of use of activity analysis (AA); • Extent of use of activity cost analysis (ACA); • Extent of use of ABC.
Cohen et al. (2005)	Greece	Questionnaire		Overhead change during the last three years, Expected future overhead change, competition and firm size.	• Adopters (ABC users); • Supporters (considering ABC in the future); • Deniers (no consideration for ABC); • Unawares (no knowledge about ABC).
Askarany et al. (2007)	Australia	Questionnaire	Change in advanced manufacturing technology (AMT) is associated with ABC adoption		• Use of ABC; • Non-use of ABC.
Kallunki and Silvola (2008)	Finland	Questionnaire	Companies in mature and revival stages use ABC more than companies in the growth stage.		• Use of ABC; • Non-use of ABC.
Brierley	UK	Questionnaire	Business unit size.	competition, product customization	• Currently investigating ABC;

(2008a)				and cost structure.	• Intending to investigate using ABC; • Never considered ABC; • Currently using ABC; • Intending to use ABC; • Rejected ABC but established a system of activity analysis or cost driver analysis; • Implemented ABC and subsequently abandoned it; • Investigated using ABC and rejected it; • Rejected ABC, but never investigated its possible use.
Schoute (2011)	Neverland	Questionnaire	Advanced manufacturing technologies (AMTs) negatively moderate the relationship between product diversity and ABC use.	AMTs did not moderate the relationship between product diversity and ABC adoption.	• Currently considering ABC adoption; • No consideration of ABC to date; • Rejected ABC after assessment; • Currently using ABC; • Currently implementing ABC.
Askarany et al. (2012)	Australia, New Zealand, and UK	Questionnaire	Relative advantage, size and companies located in Australia have higher ABC adoption than those in UK.	The compatibility, ease of use and result demonstrability and trialability and type of industry (manufacturing versus non-manufacturing companies).	• Not considered ABC; • Considering ABC; • Rejected ABC; • Implemented ABC on a trial basis; • Implemented and accepted ABC.
Phan et al. (2014)	Australia	Questionnaire	Companies in maturity and revival stages use ABC more than those in the birth, growth and decline stages.	There is no difference between companies in birth, growth and decline stages in terms of ABC usage.	**Activity-based management (ABM):** • Extent of use of activity analysis (AA); • Extent of use of activity cost analysis (ACA); • Extent of use of ABC.
Pokorná (2015)	Czech Republic	Questionnaire	Business unit size, legal form of organisation (public companies have more ABC than limited-liability companies), companies with foreign owners have higher ABC adoption than local companies, cost structure negatively associated with ABC, ABC adoption is associated with balanced scorecard and business process reengineering and lean techniques	Type of industry.	• Using ABC; • Considering the implementation of ABC; • Abandoning ABC; • Did not consider ABC; • Refusing ABC.
Al-Sayed and Dugdale (2016)	UK	Questionnaire	**Factors associated with ABI initiation:** Perceived relative advantage, (-) perceived cost, level of overheads and top management support. **Factors associated with ABI adoption:** Level of overheads and top management support. **Factors associated with the extent of ABI use:** Top management support, champion support and size.	Compatibility, trialability, product complexity and diversity and perceived environmental uncertainty.	**ABI stages:** • No consideration; • Considered and rejects; • Initiation; • Adoption; • Ramp-up, routinisation and infusion **ABI use:** • The extent of ABI use.

Appendix (2): The pilot questionnaire

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Cost System Design:

Cost Systems in UK Manufacturing Companies

This survey seeks to understand cost systems in UK manufacturing companies by examining the content and type of the cost systems used, and the factors influencing and the consequences associated with the level of sophistication of cost systems. The answers you give are confidential. The number in the top right-hand corner is used to identify who has returned the questionnaire.

Please answer all of the questions. You may make any comments in the margins or on the back cover. You should answer the questionnaire from the perspective of the business unit that most clearly defines where you work (e.g. an autonomous company, a division of a divisionalised company, a manufacturing site within a division of a divisionalised company, etc.).

When you have completed the questionnaire please return it in the enclosed stamped addressed envelope.

Thank you for your help.

Management School
The University of Sheffield
Conduit Road
Sheffield
S10 1FL

Section A: The cost system and the role of the management accountant in your business unit

(A1) Of the following three types of costing methods, which costing method is used by your business unit for the purpose of the decision making and control? (Please circle the appropriate number.)

1. The direct costing method: Only direct costs are assigned to cost objects (such as products or product lines) and indirect costs are not assigned to cost objects. (If you choose this response, then please go to question A4).

2. The absorption costing method: Indirect costs are assigned to cost objects (such as products or product lines) using different overhead allocation rates by departments (or cost centres) or a single plant-wide overhead rate.

3. The activity based costing (ABC) method: Indirect costs are assigned to individual activity cost pools, rather than departments, and these costs are traced to cost objects (such as products or product lines) using cost drivers.

(A2) The typical procedure for assigning indirect costs to cost objects involves a 2-stage process. In the first stage, indirect costs are allocated to cost centres (or cost pools). In the second stage, overhead allocation rates (or cost driver rates) are established for each cost centre (or cost pool) to assign indirect costs to cost objects (such as products and product lines).
Please indicate below how many separate cost centres (or cost pools) are used to assign indirect costs to your chosen cost object. For example, if your organisation has five cost centres (or cost pools) all of which use a single allocation rate (such as direct labour hours), you should record a response of 5 in the space below.
(Insert Number Here:________________________.)

(A3) Please indicate below how many separate (and different) overhead allocation rates (or cost drivers) are used in the second stage of the two-stage process described in Question A2. For example, if your organisation has five cost centres (or cost pools) and uses two different overhead allocation rates (or cost drivers) (such as direct labour hours and machine hours) you should record a response of 2 in the space below.
(Insert Number Here:________________________.)

(A4) To what extent does the cost accounting system provide data that allows you to analyse costs at the following levels? (Please circle the appropriate number.)

	Do not do this	Poor	Adequate	Good	Excellent
a. Product level	1	2	3	4	5
b. Batch level	1	2	3	4	5
c. Product line level	1	2	3	4	5
d. Department level	1	2	3	4	5
e. Customer level	1	2	3	4	5
f. Supplier level	1	2	3	4	5
g. Brand level	1	2	3	4	5
h. Distribution channel level	1	2	3	4	5

(A5) Many management accountants have dual responsibilities for both the accounting function (department) as well as the business unit. For example, a management accountant may be responsible to the accounting function for the integrity of journal entries and to managers in the wider business unit to provide them with costing information for decision making purposes. With these dual responsibilities in mind, please answer the following questions.

a. To what extent is your work determined by the needs of the accounting function and managers of the business unit? (Please circle the appropriate number.)

1. Almost all of my work is determined by the accounting function.
2. A lot of my work is determined by the accounting function.
3. My work is determined equally by the accounting function and by the business unit.
4. A lot of my work is determined by the business unit.
5. Almost all of my work is determined by the business unit.

b. What amount of your working day is spent with staff from the accounting function and the business unit? (Please circle the appropriate number.)

1. I spend almost all of my time with staff in the accounting function.
2. I spend a lot of my time with staff in the accounting function.
3. I spend an equal amount of time with staff in the accounting function and the business unit.
4. I spend a lot of my time with staff in the business unit.
5. I spend almost all of my time with staff in the business unit.

(Question A5 continued)

c. With dual responsibilities, management accountants are often accountable to superiors in both the accounting function and the business unit. Which of the following most reflects your situation? (Please circle the appropriate number.)

1. I report directly to superiors in the accounting function only.
2. I report directly to superiors in the accounting function and indirectly to superiors in the business unit.
3. I report equally to superiors in both the accounting function and the business unit.
4. I report directly to superiors in the business unit and indirectly to superiors in the accounting function.
5. I report directly to superiors in the business unit only

d. To what extent do you see your role to be part of the accounting function or the business unit? (Please circle the appropriate number.)

1. I see myself almost entirely as part of the accounting function.
2. I see myself mainly as part of the accounting function.
3. I see myself equally as part of both the accounting function and the business unit.
4. I see myself mainly as part of the business unit.
5. I see myself almost entirely as part of the business unit.

e. In determining your performance, to what extent is it based on your work for the accounting function and/or work for the business unit? (Please circle the appropriate number.)

1. My performance is based totally on my work for the accounting function.
2. A lot of my performance is based on my work for the accounting function.
3. My performance is based equally on my work for the accounting function and business unit.
4. A lot of my performance is based on my work for the business unit.
5. My performance is based totally on my work for the business unit.

f. If you received requests simultaneously from both the accounting function and the business unit and both claimed they were important, which one would you be most likely to deal with first? (Please circle the appropriate number.)

1. I would almost certainly deal with the accounting request first.
2. I would probably deal with the accounting request first.
3. I would be equally likely to deal with either request first.
4. I would probably deal with the business unit request first.
5. I would almost certainly deal with the business unit request first.

Section B: Your business unit and the environment in which your business unit operates

(B1) What is the level of the intensity of your business unit's market competition for each of the following areas? (Please circle the appropriate number.)

	Not at all	To a little extent	To some extent	To a considerable extent	To a great extent
a. Competition for raw materials, parts and equipment.	1	2	3	4	5
b. Competition for new product development.	1	2	3	4	5
c. Competition in promotion, advertising, and selling and distribution in your main line of business.	1	2	3	4	5
d. Competition in the quality and variety of products.	1	2	3	4	5
e. Price competition in your main line of business.	1	2	3	4	5
f. Competition from major competitors.	1	2	3	4	5

(B2) What is the level of the diversity of products produced by your business unit? (Please circle the appropriate number.)

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
a. Product lines are quite diverse.	1	2	3	4	5
b. The products within each product line are quite diverse.	1	2	3	4	5
c. Most products require the same processes to design, manufacture and distribute.	1	2	3	4	5
d. There are major differences in the volumes (lot sizes) of products.	1	2	3	4	5
e. The costs of support departments (e.g. engineering, purchasing and marketing) are about the same for each product line.	1	2	3	4	5
f. Products are produced in different sizes.	1	2	3	4	5
g. Products are produced in different batch sizes.	1	2	3	4	5

(B3) To what extent has your business unit experienced an improvement for each of the following decision and control areas over the last three years? (Please circle the appropriate number.)

	Do not make this decision	No Improvement	Low improvement	Average improvement	High improvement	Very high improvement
a. Product pricing decisions.	0	1	2	3	4	5
b. Customer profitability analysis.	0	1	2	3	4	5
c. New product design decisions.	0	1	2	3	4	5
d. Product range decisions.	0	1	2	3	4	5
e. Outsourcing decisions.	0	1	2	3	4	5
f. Product output decisions.	0	1	2	3	4	5
g. Cost reduction decisions.	0	1	2	3	4	5
h. Budgeting.	0	1	2	3	4	5
i. Performance measurement	0	1	2	3	4	5
j. Stock valuation.	0	1	2	3	4	5
k. Process reengineering and improvement.	0	1	2	3	4	5

(B4) To what extent have the following indirect costs increased over the last five years? (Please circle the appropriate number.)

		Not at all	To a little extent	To some extent	To a considerable extent	To a great extent
a.	Indirect labour costs associated with material handling, maintenance, quality control and inspection.	1	2	3	4	5
b.	General and administrative costs associated with personnel administration, accounting, securities and management salaries.	1	2	3	4	5
c.	Facilities and equipment costs associated with insurance, depreciation of plant and equipment, tooling, rent, energy and utility costs.	1	2	3	4	5
d.	Engineering costs associated with the salaries of manufacturing engineers and industrial engineers and other engineering costs associated with the design of products.	1	2	3	4	5
e.	Material overhead costs associated with the procurement and movement of materials.	1	2	3	4	5
f.	Material overhead costs associated with coordination of raw material, component, assemblies and finished products.	1	2	3	4	5

(B5) What is the approximate percentage cost structure (e.g. direct material, direct labour costs etc.) of your business unit? (Please insert the approximate percentages.)

	%
a. Direct materials costs.	
b. Direct labour costs.	
c. Manufacturing overhead costs.	
d. Non-manufacturing overhead costs.	
Total percentage	100%

(B6) What are your beliefs about your business unit's competitive strategy? **(**Please circle the appropriate number.)

		Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
a.	One of our objectives is to be the lowest cost producer in our industry.	1	2	3	4	5
b.	We place considerable emphasis on reaping cost advantages from all sources.	1	2	3	4	5
c.	We seek to maintain brand identification, rather than compete mainly on price.	1	2	3	4	5
d.	We seek to be unique in our industry and find that buyers are willing to pay a premium price for that uniqueness.	1	2	3	4	5
e.	We invest in technology to develop low-cost product designs.	1	2	3	4	5
f.	We invest in technology to develop unique product designs.	1	2	3	4	5

(B7) To what extent has your business unit experienced an improvement in performance over the last three years? (Please circle the appropriate number.)

		No improvement	Low improvement	Average improvement	High improvement	Very high improvement
a.	Market share (of products produced at your plant).	1	2	3	4	5
b.	Return on sales (profit before corporate expenses divided by sales).	1	2	3	4	5
c.	Sales on assets (sales divided by total assets).	1	2	3	4	5
d.	Return on net assets (net profit before tax divided by net assets).	1	2	3	4	5

(B8) Many companies have undertaken major investments in Advanced Manufacturing Technologies (AMTs), particularly in computer-assisted manufacturing processes, such as computer-aided design (CAD), computer-integrated systems (CIS) and computer-aided manufacturing (CAM). These offer improved quality and reliability for production processes, and permit much greater manufacturing flexibility and automation.

To what extent are Advanced Manufacturing Technologies (AMTs) used in your business unit? (Please circle the appropriate number.)

1. Not at all.
2. To a little extent.
3. To some extent.
4. To a considerable extent.
5. To a very great extent.

(B9) To what extent has your business unit used the following Advanced Manufacturing Technologies (AMTs). (Please circle the appropriate number.)

	Not at all	To a little extent	To some extent	To considerable extent	To a great extent
a. Computer-aided design (CAD).	1	2	3	4	5
b. Computer-aided manufacturing (CAM).	1	2	3	4	5
c. Robotics.	1	2	3	4	5
d. Flexible manufacturing systems (FMS).	1	2	3	4	5
e. Computer integrated systems (CIS).	1	2	3	4	5
f. Automated material handling systems.	1	2	3	4	5

(B10) What is the approximate number of employees in your business unit?
(Insert number here:________________________)

(B11) What was the approximate annual sales revenue of your business unit in the recently produced/published financial statements?
(Record approximate amount here :**£**_______________)

(B12) Please provide the following information about yourself?
Job Title: ______________________________________
Number of years in this position ____________________

Is there anything else you would like to say about the design of the questionnaire and the factors that affect the level of sophistication and the consequences of the cost system? If so, please use the space below.

As part of this research would you be willing to answer questions about the design of questionnaire in a face-to-face interview? ☐ Yes ☐ No

If Yes, please provide a name, and a contact telephone number or email address:

Name: ____

Telephone Number: ____

Email: ____

Your contribution to this effort is greatly appreciated

Appendix (3): Letter accompanying the pilot questionnaire

Advance letter

Potential respondent's address

19th January 2015

Dear Sir/Madam

You have been selected to take part in the pilot test of a questionnaire about the role of cost systems in UK manufacturing companies. This research will be useful in indicating the content and type of cost systems and the factors and consequences associated with the design of cost systems. The pilot testing of the questionnaire is part of my PhD research at the University of Sheffield.

Your company has been identified by using the Financial Analysis Made Easy (FAME) database which contains information about UK companies, such as the type of industry and addresses of companies.

Your participation in the pilot testing of the questionnaire is very valuable. I would be grateful if you would be kind enough to participate in this research project. You will receive the pilot questionnaire in the post in two weeks time. I would be grateful if you would please complete it and returned it as soon as possible.

If you have any questions or concerns about the pilot questionnaire please feel free to contact me.

Thanking you in anticipation.

Yours faithfully,

Badr Banhmeid
PhD student
Management School
University of Sheffield
E-mail: bbbanhmeid1@sheffield.ac.uk

Cover letter

Potential respondent's address

2nd February 2015

Dear Sir/Madam

As promised in my letter of 19/01/2015, I enclose a copy of the pilot questionnaire about the role of cost system in UK manufacturing companies. The pilot questionnaire includes questions about:

- The factors that cause changes in the level of cost system design.
- The effects of different levels of cost system design on business units' decision making and performance.

Your help is needed. I would be grateful if you could please complete the questionnaire and provide suggestions about the relevance and wordings of the questions included in the questionnaire. The answers you give are confidential.

If you have more than one manufacturing business unit please forward the questionnaire to any one of them. The business unit's management accountant should complete this questionnaire. It would be helpful if you could please return the questionnaire to me as soon as possible in the enclosed stamped-addressed envelope.

Yours faithfully,

Badr Banhmeid
PhD student
Management School
University of Sheffield
E-mail: bbbanhmeid1@sheffield.ac.uk

First follow-up letter

Potential respondent's address

16th February 2015

Dear Sir/Madam,

About two weeks ago I sent you a pilot questionnaire about the role of the cost system in UK manufacturing companies. The pilot questionnaire includes questions about:

- The factors that cause changes in the level of cost system design.
- The effects of different levels of cost system design on business units' decision making and performance.

If you have already returned the pilot questionnaire, then please accept my sincere thanks. If not, I would be grateful if you would please complete the questionnaire and return the questionnaire in the enclosed stamped-addressed envelope, please. The answers you give are confidential. Your help is needed.

Yours faithfully,

Badr Banhmeid
PhD student
Management School
University of Sheffield
E-mail: bbbanhmeid1@sheffield.ac.uk

Second follow-up letter

Potential respondent's address

2nd March 2015

Dear Sir/Madam,

About four weeks ago I sent you a pilot questionnaire about the role of the cost system in UK manufacturing companies. The pilot questionnaire includes questions about:

- The factors that cause changes in the level of cost system design.
- The effects of different levels of cost system design on business units' decision making and performance.

I recognise how busy you must be and greatly appreciate you taking a few minutes of your time to complete this questionnaire. If by chance you did not receive the pilot questionnaire, or it got misplaced, I have enclosed a replacement. It would be very helpful if you could please return your completed questionnaire as soon as possible. I undertake to ensure the confidentiality of all information received.

Yours faithfully,

Badr Banhmeid
PhD student
Management School
University of Sheffield
Mobile No: 07552336156
E-mail: bbbanhmeid1@sheffield.ac.uk

Appendix (4): The final questionnaire

£

Cost System Design:

Cost Systems in UK Manufacturing Companies

This survey seeks to understand cost systems in UK manufacturing companies by examining the content and type of the cost systems used, and the factors influencing and the consequences associated with the level of sophistication of cost systems. The answers you give are confidential. The number in the top right-hand corner is used to identify who has returned the questionnaire.

Please answer all of the questions. You may make any comments in the margins or on the back cover. You should answer the questionnaire from the perspective of the business unit that most clearly defines where you work (e.g. an autonomous company, a division of a divisionalised company, a manufacturing site within a division of a divisionalised company, etc.).

When you have completed the questionnaire please return it in the enclosed stamped addressed envelope.

Thank you for your help.

Management School
The University of Sheffield
Conduit Road
Sheffield
S10 1FL

Section A: The cost system in your business unit

(A1) Which of the following three types of costing methods is used by your business unit for the purposes of the decision making and control? (Please circle the appropriate number.)

1. The direct costing method: Only direct costs are assigned to cost objects (such as products or product lines) and indirect costs are not assigned to cost objects. (If you choose this response, then please go to question A4).
2. The absorption costing method: Indirect costs are assigned to cost objects (such as products or product lines) using different overhead allocation rates by departments (or cost centres) or a single plant-wide overhead rate.
3. The activity based costing (ABC) method: Indirect costs are assigned to individual activity cost pools, rather than departments, and these costs are traced to cost objects (such as products or product lines) using cost drivers.

(A2) The typical procedure for assigning indirect costs to cost objects involves a 2-stage process. In the first stage, indirect costs are allocated to cost centres (or cost pools). In the second stage, overhead allocation rates (or cost driver rates) are established for each cost centre (or cost pool) to assign indirect costs to cost objects (such as products and/or product lines).

Please indicate below how many separate cost centres (or cost pools) are used to assign indirect costs to your chosen cost object. For example, if your organisation has five cost centres (or cost pools) all of which use a single allocation rate (such as direct labour hours), you should record a response of 5 in the space below.
(Insert Number Here:________________________.)

(A3) Please indicate below how many separate (and different) overhead allocation rates (or cost drivers) are used in the second stage of the two-stage process described in Question A2. For example, if your organisation has five cost centres (or cost pools) and uses two different overhead allocation rates (or cost drivers) (such as direct labour hours and machine hours) you should record a response of 2 in the space below.
(Insert Number Here:________________________.)

(A4) How well does the cost accounting system provide data that allows you to analyse costs at the following levels? (Please circle the appropriate number.)

		Not at all	Poor	Adequate	Good	Excellent
a.	Product level	1	2	3	4	5
b.	Batch level	1	2	3	4	5
c.	Product line level	1	2	3	4	5
d.	Department level	1	2	3	4	5
e.	Customer level	1	2	3	4	5
f.	Supplier level	1	2	3	4	5
g.	Brand level	1	2	3	4	5
h.	Distribution channel level	1	2	3	4	5

Section B: The role of the management accountant in your business unit

(B1) Management accountants may have dual responsibilities for both the accounting function (or department) as well as the business unit. For example, a management accountant may be responsible to the accounting function for the integrity of journal entries and to managers in the wider business unit to provide them with costing information for decision making purposes.

Below are pairs of statements about the role of the management accountant. Please circle one number for each pair of statements in each row. For example, if the statement on the far-left hand side applies then circle 1; or if the statement on the far-right hand side applies then circle 5; or if the other options in between apply then circle 2, 3 or 4.

Almost all of my work is determined by the accounting function.	1	2	3	4	5	Almost all of my work is determined by the business unit.
I spend almost all of my time with staff in the accounting function.	1	2	3	4	5	I spend almost all of my time with staff in the business unit.
I report directly to superiors in the accounting function only.	1	2	3	4	5	I report directly to superiors in the business unit only.
I see myself almost entirely as part of the accounting function.	1	2	3	4	5	I see myself almost entirely as part of the business unit.
My performance is based totally on my work for the accounting function.	1	2	3	4	5	My performance is based totally on my work for the business unit.
When I receive requests simultaneously from both the accounting function and business unit, I will almost certainly deal with the accounting function request first.	1	2	3	4	5	When I receive requests simultaneously from the accounting function and business unit, I will almost certainly deal with the business unit request first.

Section C: Your business unit and its environment

(C1) Please indicate the level of competition that your business unit faces for each of the following areas over the last three years? (Please circle the appropriate number.)

	Not at all	To a little extent	To some extent	To a considerable extent	To a great extent
a. Competition for raw materials, parts and equipment.	1	2	3	4	5
b. Competition for new product development.	1	2	3	4	5
c. Competition for promotion, advertising, and selling and distribution in your main line of business.	1	2	3	4	5
d. Competition for the variety of products.	1	2	3	4	5
e. Competition for the quality of products.	1	2	3	4	5
f. Price competition in your main line of business.	1	2	3	4	5

(C2) Please indicate your level of agreement about the diversity of products produced by your business unit over the last three years? (Please circle the appropriate number.)

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
a. Product lines are quite diverse.	1	2	3	4	5
b. The products within each product line are quite diverse.	1	2	3	4	5
c. Most products require different processes to design, manufacture and distribute.	1	2	3	4	5
d. There are major differences in the volumes (lot sizes) of products.	1	2	3	4	5
e. The costs of support departments (e.g. engineering, purchasing and marketing) are different for each product line.	1	2	3	4	5
f. Products are produced in different physical sizes.	1	2	3	4	5

(C3) What are your beliefs about your business unit's competitive strategy? **(**Please circle the appropriate number.)

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
a. One of our objectives is to be the lowest cost producer in our industry.	1	2	3	4	5
b. We place considerable emphasis on reaping cost advantages from all sources.	1	2	3	4	5
c. We seek to maintain brand identification, rather than compete mainly on price.	1	2	3	4	5
d. We seek to be unique in our industry and find that buyers are willing to pay a premium price for that uniqueness.	1	2	3	4	5
e. We invest in technology to develop low-cost product designs.	1	2	3	4	5
f. We invest in technology to develop unique product designs.	1	2	3	4	5

(C4) To what extent have the following indirect costs increased over the last three years? (Please circle the appropriate number.)

	Not at all	To a little extent	To some extent	To a considerable extent	To a great extent
a. Indirect labour costs associated with material handling, maintenance, quality control and inspection.	1	2	3	4	5
b. General and administrative costs associated with personnel, administration, accounting and management salaries.	1	2	3	4	5
c. Facilities and equipment costs associated with insurance, depreciation of plant and equipment, tooling, rent, energy and utility costs.	1	2	3	4	5
d. Engineering costs associated with the salaries of engineers and other engineering costs associated with the design of products.	1	2	3	4	5
e. Material overhead costs associated with the procurement and movement of materials.	1	2	3	4	5
f. Material overhead costs associated with coordination of raw material, component, assemblies and finished products.	1	2	3	4	5

(C5) To what extent has your business unit experienced an improvement for each of the following decision and control areas over the last three years? (Please circle the appropriate number.)

	Do not make this decision	No Improvement	Low improvement	Average improvement	High improvement	Very high improvement
a. Product pricing decisions.	0	1	2	3	4	5
b. New product design decisions.	0	1	2	3	4	5
c. Product range decisions.	0	1	2	3	4	5
d. Outsourcing decisions.	0	1	2	3	4	5
e. Product output decisions.	0	1	2	3	4	5
f. Cost reduction decisions.	0	1	2	3	4	5
g. Budgeting.	0	1	2	3	4	5
h. Customer profitability analysis.	0	1	2	3	4	5
i. Performance measurement	0	1	2	3	4	5
j. Stock valuation.	0	1	2	3	4	5
k. Process reengineering and improvement.	0	1	2	3	4	5

(C6) To what extent has your business unit experienced an improvement in performance over the last three years? (Please circle the appropriate number.)

	No improvement	Low improvement	Average improvement	High improvement	Very high improvement
a. Market share (of products produced at your plant).	1	2	3	4	5
b. Return on sales (profit before corporate expenses divided by sales).	1	2	3	4	5
c. Sales on assets (sales divided by total assets).	1	2	3	4	5
d. Return on net assets (net profit before tax divided by net assets).	1	2	3	4	5

(C7) Advanced Manufacturing Technologies (AMT) consists of hardware and software that computerise and automate the design and production of products.

To what extent do the following statements about your use of manufacturing technologies apply in your business unit? (Please circle the appropriate number.)

	Not at all	To a little extent	To some extent	To a considerable extent	To a great extent
a. We apply computer-enhanced technology to improve the flexibility of manufacturing.	1	2	3	4	5
b. We utilize production technology that is among the most flexible in our industry.	1	2	3	4	5
c. We have incorporated real-time process control into our production systems.	1	2	3	4	5
d. We reorganize our facilities as necessary to increase our manufacturing flexibility	1	2	3	4	5
e. We use Advanced Manufacturing Technologies (AMT) in our production process.	1	2	3	4	5

(C8) What is the approximate percentage cost structure (e.g. direct material, direct labour costs etc.) of your business unit? (Please insert the approximate percentages.)

	%
a. Direct materials costs.	
b. Direct labour costs.	
c. Manufacturing overhead costs.	
d. Non-manufacturing overhead costs.	
Total percentage	100%

(C9) What is the approximate number of employees in your business unit?

(Insert number here :_________________________)

(C10) What was the approximate annual sales revenue of your business unit in the last year?

(Record approximate amount here :**£**________________)

(C11) Please provide the following information about yourself?
Job Title: ____

Number of years in this position _____________________

Is there anything else you would like to say about the factors that affect the level of sophistication and the consequences of the cost system? If so, please use the space below.

Would you like to receive a summary of the survey results? ☐ Yes ☐ No

If Yes, please provide your name and email address below.

As part of this research would you be willing to answer further questions about your costing system in a face-to-face interview? ☐ Yes ☐ No

If Yes, please provide a name, and a contact telephone number or email address below.

Name: ____

Telephone Number: ____

Email: ____

Your contribution to this effort is greatly appreciated.

Appendix (5): Letters accompanying the final questionnaire

Cover letter

For the attention of Management Accountant

11th May 2015

Dear Sir/Madam,

You have been selected to take part in a PhD research project that I am conducting at the University of Sheffield. Your company have been identified from the online-Financial Analysis Made Easy (FAME) database. The PhD project is concerned with cost system design and its antecedents and consequences in UK manufacturing companies. This will be useful for academics and practitioners by revealing the similarities and variations in the content and variety of cost systems, and the factors influencing and the consequences associated with the design of cost systems. The PhD project is supervised by Dr. John Brierley and Dr. Wael Hadid at the University of Sheffield.

This research is conducted by a questionnaire. I would be grateful if you would please complete the enclosed questionnaire and return it to me in the enclosed stamped-addressed envelope. The number in the top right-hand corner was used to match this letter with the number on the top right corner in the questionnaire.

If you prefer to complete an online version of this questionnaire instead of the paper version, please email me at bbbanhmeid1@sheffield.ac.uk and I will send you the link to the online version.

The conduct of this research has been approved by the Ethics Committee of Sheffield University Management School. The responses you provide to the questionnaire are confidential. The names of individual respondents and their firms will not be released. Please do not hesitate to contact me if you have any queries regarding the research project at bbbanhmeid1@sheffield.ac.uk.

Yours faithfully,

Badr Banhmeid
PhD student
Sheffield University Management School

First follow-up letter

For the attention of Management Accountant

1st June 2015

Dear Sir/Madam,

About three weeks ago I sent you a questionnaire concerning the PhD research project that I am conducting at the University of Sheffield. Your company has been identified from the online-Financial Analysis Made Easy (FAME) database. The PhD project is concerned with cost system design, and its antecedents and consequences in UK manufacturing companies. I recognise how busy you must be and greatly appreciate you taking a few minutes of your time to complete the enclosed questionnaire.

This PhD research project will be useful for academics and practitioners by revealing the similarities and variations in the content and variety of cost systems, and the factors influencing and the consequences associated with the design of cost systems.

Please complete and return the questionnaire to me in the enclosed stamped-addressed envelope. If you prefer to complete an online version of this questionnaire instead of the paper version, please email me at bbbanhmeid1@sheffield.ac.uk and I will send you the link to the online version. The number in the top right-hand corner was used to match this letter with the number on the top right corner in the questionnaire.

The conduct of this research has been approved by the Ethics Committee of Sheffield University Management School. The responses you provide to the questionnaire are confidential. The names of individual respondents and their firms will not be released. Please do not hesitate to contact me if you have any queries regarding the research project at bbbanhmeid1@sheffield.ac.uk.

Yours faithfully,

Badr Banhmeid
PhD student
Sheffield University Management School

Second follow-up letter

For the attention of Management Accountant

22nd June 2015

Dear Sir/Madam,

I have recently sent you a couple questionnaires related to my PhD project. Unfortunately, as of today, I have not received your completed questionnaire. Your company has been identified from the online-Financial Analysis Made Easy (FAME) database.

My PhD project is concerned with cost system design, and its antecedents and consequences in UK manufacturing companies. This PhD research project will be useful for academics and practitioners by revealing the similarities and variations in the content and variety of cost systems, and the factors influencing and the consequences associated with the design of cost systems.

Please complete and return the questionnaire to me in the enclosed stamped-addressed envelope. If you prefer to complete an online version of this questionnaire instead of the paper version, please email me at bbbanhmeid1@sheffield.ac.uk and I will send you the link to the online version. The number in the top right-hand corner was used to match this letter with the number on the top right corner in the questionnaire.

The conduct of this research has been approved by the Ethics Committee of Sheffield University Management School. The responses you provide to the questionnaire are confidential. The names of individual respondents and their firms will not be released. Please do not hesitate to contact me if you have any queries regarding the research project at bbbanhmeid1@sheffield.ac.uk.

Yours faithfully,

Badr Banhmeid
PhD student
Sheffield University Management School

Appendix (6): The manufacturing industries covered in the survey

SIC UK code	Industry type
10	Manufacture of food products
11	Manufacture of beverages
12	Manufacture of tobacco products
13	Manufacture of textiles
14	Manufacture of wearing apparel
15	Manufacture of leather and related products
16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
17	Manufacture of paper and paper products
19	Manufacture of coke and refined petroleum products
20	Manufacture of chemicals and chemical products
21	Manufacture of basic pharmaceutical products and pharmaceutical preparations
22	Manufacture of rubber and plastic products
23	Manufacture of other non-metallic mineral products
24	Manufacture of basic metals
25	Manufacture of fabricated metal products, except machinery and equipment
26	Manufacture of computer, electronic and optical products
27	Manufacture of electrical equipment
28	Manufacture of machinery and equipment
29	Manufacture of motor vehicles, trailers and semi-trailers
30	Manufacture of other transport equipment
31	Manufacture of furniture
32	Other manufacturing

Appendix (7): Non-response bias tests

Chi-Square Tests for Industries

	Value	*df*	Asymptotic Significance (2-sided)
Pearson Chi-Square	7.081[a]	10	0.718
Likelihood Ratio	7.13	10	0.713
Linear-by-Linear Association	0.239	1	0.625
N of Valid Cases	266		

[a] 0 cells (.0%) have expected count less than 5. The minimum expected count is 6.30.

Chi-Square Tests for the types of cost system

	Value	*df*	Asymptotic Significance (2-sided)
Pearson Chi-Square	0.784[a]	2	0.676
Likelihood Ratio	0.784	2	0.676
Linear-by-Linear Association	0.610	1	0.435
N of Valid Cases	266		

[a] 0 cells (0.0%) have expected count less than 5. The minimum expected count is 8.24.
[b] Cost system consisted of three types; direct cost, traditional absorption and ABC systems

Independent samples test of the variables of interests

	Levene's Test		t-test for Equality of Means		
	F	Sig.	t	df	Sig. (2-tailed)
Number of cost pools	0.210	0.647	–0.135	264	0.892
			–0.135	262	0.893
Number of cost drivers	0.000	0.996	–0.388	264	0.698
			–0.388	263	0.698
Detailed cost system	1.407	0.237	0.244	264	0.807
			0.244	258	0.808
Accountant	0.081	0.776	0.338	264	0.735
			0.338	262	0.736
Competition	0.325	0.569	–0.058	264	0.954
			–0.058	262	0.954
Product diversity	1.977	0.161	–0.236	264	0.813
			–0.235	255	0.814
Cost leadership	2.561	0.111	1.055	264	0.292
			1.052	259	0.294
Differentiation	8.048	0.005	0.800	264	0.424
			0.796	249	0.427
Product planning	0.450	0.503	–0.448	264	0.655
			–0.447	260	0.655
Cost management	0.107	0.743	–0.002	264	0.998
			–0.002	264	0.998
Performance	0.034	0.853	0.772	264	0.441
			0.772	263	0.441
Advanced manufacturing technologies	0.079	0.778	1.984	264	**0.048***
			1.982	261	0.049
Manufacturing overhead costs	2.187	0.140	–2.542	264	**0.012***
			–2.553	262	0.011
Number of employees	1.294	0.256	–1.016	264	0.310
			–1.020	262	0.308

* Significant at the 0.05 level

Appendix (8): The interview guide

Introduction:

1. Introduce myself.
2. Information about my research and the interview:
   - 2.1 This study focuses on the factors that impact cost system sophistication. More specifically, this research measures the sophistication by the number of cost pools and cost drivers.
   - 2.2 All the information that you will provide is confidential. No data will be associated with any individual or organisation.
   - 2.3 Can I record the interview, please? This will help me to review the interview and to remember your comments.

Section 1: Research finding questions

Figures 1 below shows the results of my research model when cost system sophistication is measured by cost pools. Cost structure, AMTs, the accountant's role, cost-leadership and differentiation strategies and size influence cost system sophistication when measured by cost pools. Cost system sophistication measured by cost pools also influence cost management decisions, which in turn influence performance.

On the other hand, when cost system sophistication is measured by cost drivers, none of these factors, except overhead costs, influence sophistication. However, cost system sophistication measured by cost drivers influence cost management decisions, which in turn influence performance.

<u>**Competition**</u>

1. Could you explain why you think there is no effect for competition on cost system sophistication?

   Probing: IF the interviewee fails to provide an answer to question 1, then the following question will be asked:

2. Can you explain whether competition influences cost system sophistication or not? (If

yes, How, if No Why)

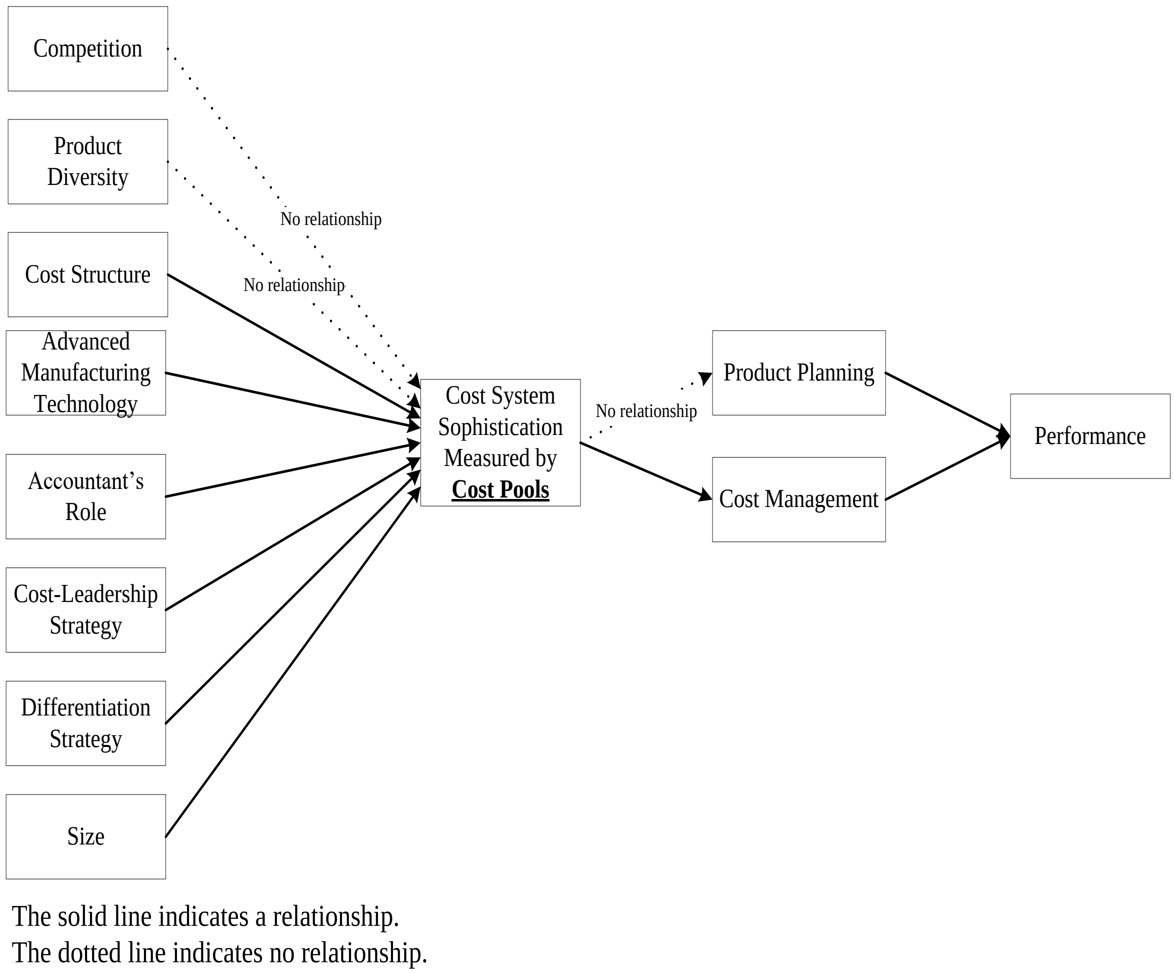


Figure 1: The results of the quantitative analysis

Product diversity

1. Could you explain why you think there is no effect for product diversity on cost system sophistication?

Probing: IF the interviewee fails to provide an answer to question 1, then the following question will be asked:

2. Can you explain whether product diversity influences cost system sophistication or not? (If yes, How, if No Why).

Cost structure

1. Could you explain why you think there is a positive effect for overhead costs on cost system sophistication?

Probing: IF the interviewee fails to provide an answer to question 1, then the following question will be asked:

2. Can you explain whether overhead costs influences cost system sophistication or not? (If yes, How, if No Why).

Advanced Manufacturing Technologies (AMTs)

1. Could you explain why you think there is a positive effect for AMTs on cost system sophistication? (Note: Effect for Pools. No Effect for Drivers).

Probing: IF the interviewee fails to provide an answer to question 1, then the following question will be asked:

2. Can you explain whether AMTs influence cost system sophistication or not? (If yes, How, if No Why).

3. Do you think there is a relationship between AMTs, product diversity and cost system sophistication? (If yes, How, if No Why).

4. Do you think there is a relationship between AMTs, overhead costs and cost system sophistication? (If yes, How, if No Why).

Accountant's Role

1. Could you explain why you think there is a positive effect for accountant's role on cost system sophistication? (Note: Effect for Pools. No Effect for Drivers).

Probing: IF the interviewee fails to provide an answer to question 1, then the following question will be asked:

2. Can you explain whether accountant's role influences cost system sophistication or not? (If yes, How, if No Why).

Differentiation Strategy

1. Could you explain why you think there is a positive effect for differentiation strategy on cost system sophistication? (Note: Effect for Pools. No Effect for Drivers)

Probing: IF the interviewee fails to provide an answer to question 1, then the following question will be asked:

2. Can you explain whether differentiation strategy influences cost system sophistication or not? (If yes, How, if No Why).

Cost Leadership Strategy

1. Could you explain why you think there is a positive effect for cost leadership strategy on cost system sophistication? (Note: Effect for Pools. No Effect for Drivers)

Probing: IF the interviewee fails to provide an answer to question 1, then the following question will be asked:

2. Can you explain whether cost leadership strategy influences cost system sophistication or not? (If yes, How, if No Why).

Product Planning Decision

1. Could you explain why you think there is no effect for cost system sophistication on product planning decisions? (product planning decisions include new product design decision, product range decisions, product outputs decisions, pricing)

Probing: IF the interviewee fails to provide an answer to question 1, then the following question will be asked:

2. Can you explain whether cost system sophistication influences product planning decisions or not? (If yes, How, if No Why).

Cost Management Decisions

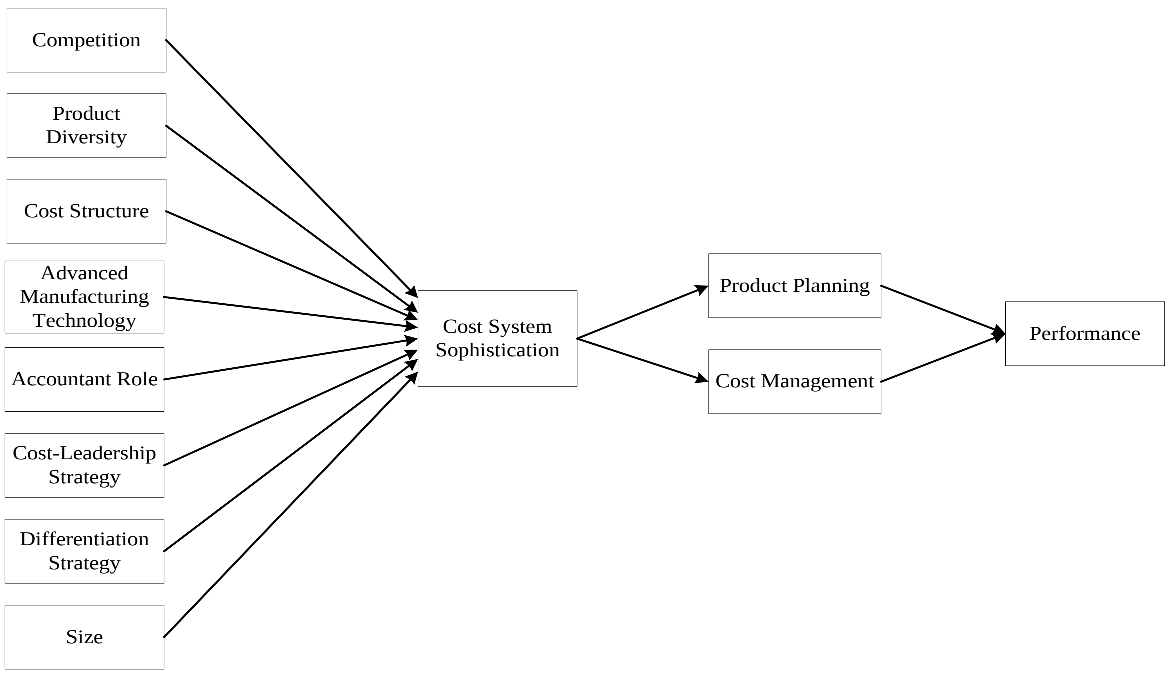
1. Could you explain why you think there is a positive effect for cost system sophistication on cost management decisions? (cost management includes budgeting, cost reduction, performance measures).

Probing: IF the interviewee fails to provide an answer to question 1, then the following question will be asked:

2. Can you explain whether cost system sophistication influences cost management decisions? (If yes, How, if No Why).

Sections 2: other factors and definition of CSS

The following figure shows the factors that were considered to influence cost system sophistication, such as product diversity and cost structure.



<u>New possible factors of CSS</u>

1. What other factors do you think determine cost system sophistication?

    a. Why?

    b. Can you define this factor?

    c. How is it related to cost system sophistication?

    d. Do you think this factor should have a direct relationship with cost system sophistication?

    • IF No, Why? Is there an indirect relationship?

    • IF Yes, How?

<u>Definition of cost system sophistication</u>

1. Is the number of cost pools appropriate measure to measure the level of the sophistication of cost system?

a. IF No, Why? What other measures do you think can reflect the sophistication of cost system?

b. If Yes, Why

2. Is the number of cost drivers appropriate measure to measure the level of the sophistication of cost system?

a. IF No, Why?

b. If Yes, Why?

Sustainability

I would like to ask you about environmental strategy or sustainability

1. Does your company have a formal strategy to address environmental issues that arise from production, distribution or consumption of products and services? (e.g. (1) Developing products that cause less damage to the environment, (2) Use of cheaper recycled raw materials, (3) Pollution prevention control systems which limit the costs of compliance with environmental regulations, (4) Waste disposal is undertaken in a manner which minimises its impact on the environment, (5) Air pollution control plant.)

a. If No, why?

b. If Yes**,** can you provide some examples of actions taken by your company that include environmental concerns?

Probes:

1. Does your company consider environmental issues in the strategic planning process? Examples if Yes: (e.g. (1) New product development, (2) Location of new manufacturing plants, (3) R&D investments and (4) Technology development such as pollution prevention and waste management.)

2. Do you develop products and processes that minimize environmental impacts? What about new products? Examples if Yes.

3. Do environmental concerns influence the investment decisions in production technologies? Examples if Yes.

4. Do you have environmental standards as performance measurements for all products? Examples if Yes.

5. Is there a clear instruction for managers to implement the company environmental goals?

Examples if Yes.

If the interviewee indicates that there is an environmental strategy, I will ask the following questions.

1. Are there any cost accounting procedures that have been used by your company to trace environmental costs such as waste, recycling, energy, pollution to cost object? If Yes, can you explain these procedures?

2. Does your cost system allocate the environmental costs to the activities that cause the costs and to the respective cost centres? If Yes, can you explain these activities and the cost centres in more detail?

3. What about overhead cost allocation rates (cost drivers)? Do you use a specific cost driver for the assignment of the environmental cost? If Yes, explain, If No, why?

4. Does the costing of environmental costs influence cost system sophistication when measured by the number of cost pools and the number of cost drivers?

5. Please describe what motivated your company to collect environmental costs? (e.g. (1) Requirement/regulation, (2) Board initiated and (3) Corporate social responsibility initiative).

Appendix (9): Proposed questions for measuring product diversity

It was discussed in chapter 7 section 7.3.5 that the ordinal scales used by the current study to measure product diversity are too narrow and are a crude measure to approximate the different aspect of product diversity. As a result, five objective measures were proposed to capture the number of product line and the product number, production complexity, volume diversity and product physical size. The objective scale of product diversity has 5 items, as shown below:

<u>The diversity of product lines and the number of product:</u>

1. What is the approximate number of product lines did your plant produce in the last year? ______
2. What are the approximate number products codes used to represent the products? ______

<u>Production complexity:</u>

3. Please indicate the approximate number of processes and operations that products go through from the stage of preparing the material for production to the stage of finalising the product and prepared it for shipment. (If the product goes through three different production departments, such as cutting, assembly and painting, and each department consists of four different processes and operations, you should state 12 as an answer). ______

<u>Volume diversity:</u>

4. Please indicate the approximate number of volume lines devoted for products in your plant. ______

<u>Product physical size:</u>

5. Please indicate the approximate number of different product's physical sizes produced by your plants (If your plant produces 100 products in 3 different physical size, the answer then should be 3). ______

Appendix (10): Measurement of product diversity

Study	Dependent variable	Measurement of product diversity	Results of the association between product diversity and cost system
Krumwiede (1998)	Implementation stages of ABC adoption.	1. Product lines are quite diverse. 2. Most products require different processes to design, manufacture and distribute. 3. There are major differences in the volumes (lot sizes) of products. 4. The costs of support departments (e.g. engineering, purchasing and marketing) are different for each product line.	Significant
Malmi (1999)	ABC adoption vs. non-adoption.	1. Number of product variants (Log_{10} of the number of products)	Significant
Drury and Tayles (2005)	Cost system sophistication	1. Variation in consumption of support overhead cost	Significant
Schoute (2011)	ABC adoption vs. non-adoption	1. Number of products (Log_2 of the number of product) 2. Product physical size 3. Product complexity 4. Product batch size	Significant
Nguyen and Brooks (1997)	ABC adoption vs. non-adoption.	1. Facility flexibility 2. Change in products and designs 3. Product-volume variation 4. Product-complexity variation	Not significant
Bjørnenak (1997)	ABC adoption vs. non-adoption.	1. Number of product variants (Log_{10} of the number of products) 2. The degree of customized production	1. Not significant for the number of product variants. 2. Significant but inconsistent with the hypothesis developed for the degree of customization.
Groot (1999)	ABC adoption vs. non-adoption	1. Number of product lines 2. Number of packaging lines	1. Significant for the number of product lines. 2. Non-significant for the number of packaging lines.
Brown et al.	ABC adoption vs. non-	1. Product lines are quite diverse.	Not significant

(2004)	adoption.	2. Most products require different processes to design, manufacture and distribute. 3. There are major differences in the volumes (lot sizes) of products. 4. The costs of support departments (e.g. engineering, purchasing and marketing) are different for each product line.	
Brierley (2007)	Cost system sophistication	1. Product customisation. 2. Uniqueness/standardisation of the product	Not significant
Al-Omiri and Drury (2007)	Cost system sophistication	1. Product lines are quite diverse. 2. Most products require different processes to design, manufacture and distribute. 3. There are major differences in the volumes (lot sizes) of products. 4. The costs of support departments (e.g. engineering, purchasing and marketing) are different for each product line.	Not significant
Charaf and Bescos (2013)	ABC adoption vs. non-adoption.	1. Product lines are quite diverse. 2. Most products require different processes to design, manufacture and distribute. 3. There are major differences in the volumes (lot sizes) of products. 4. The costs of support departments (e.g. engineering, purchasing and marketing) are different for each product line.	Not significant
Al-Sayed and Dugdale (2016)	Activity Based Innovations (ABI)	1. Product lines are quite diverse. 2. Most products require different processes to design, manufacture and distribute. 3. There are major differences in the volumes (lot sizes) of products. 4. The costs of support departments (e.g. engineering, purchasing and marketing) are different for each product line.	Not significant