

Towards an Understanding of the Sophistication of the Product Costing System

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Abstract: There has been an increasing amount of research that has considered the sophistication of the product costing system. This research has assumed that sophistication relates to the assignment of overheads to product costs and has identified various constructs that influence that sophistication. The research has not considered the possibility of alternative definitions of sophistication and, hence, the possibility of different constructs influencing these different definitions of sophistication. This paper uses a cross-sectional field study based on 55 interviews with management accountants in Great Britain to identify 16 different definitions of sophistication. Of these, the three most popular relate to the assignment of overheads to product costs (as identified in prior research), the inclusion of all costs in product costs and the understandability of the product costing system. For each of these three definitions different constructs are found to influence that sophistication.

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INTRODUCTION

Changes in the business environment in the last 20 years, such as deregulation, global competition, the decline in information costs, greater product ranges and the development of enterprise-wide information systems have prompted many companies to increase the sophistication of their product costing systems (Abernethy et al. 2001; Drury and Tayles 2005).¹ In the context of manufacturing industry, Drury and Tayles (2005) suggest that a more sophisticated product costing system will be expected to be able to identify the different resources which are consumed by the products produced.²

Much of the prior research on sophistication has been concerned with comparing companies that use activity-based costing (ABC) (or sophisticated systems) with users of other types of product costing system (or unsophisticated systems) (Bjørnenak 1997; Gosselin 1997; Booth and Giacobbe 1998; Joshi 1998; Krumwiede 1998; Clarke et al. 1999; Groot 1999; Malmi 1999; Hoque 2000; Schoute 2004). However, researchers have identified difficulties in trying to distinguish between ABC and other types of product costing system (Dugdale and Jones 1997; Drury and Tayles 2005), and, as a consequence, research has moved away from classifying product costing systems in this way. To the author's knowledge, three pieces of research have considered the sophistication of a range of different types of product costing system, namely Drury and Tayles (2000, 2005) and Abernethy et al. (2001). All of these have

defined sophistication in terms of the assignment of indirect overhead costs to product costs.³ In addition, Abernethy et al. (2001) and Drury and Tayles (2005) have derived models of the influence of constructs on this pre-specified definition of sophistication. Abernethy et al. (2001) used an inductive, multiple case study approach to highlight the influence of product diversity on sophistication when sophistication was defined in terms of the assignment of manufacturing overheads in cost systems. In contrast, Drury and Tayles (2005) used a deductive approach to test, using multiple regression analysis, the influence of a number of constructs on sophistication when defined as the assignment of all types of overheads to cost objects.

Prior research has imposed a definition of sophistication in terms of overhead assignment, but research has not examined the possibility of alternative definitions of sophistication which can improve its specification and measurement (for a discussion of this in the context of management accounting constructs, see Chapman 1997; Ittner and Larcker 2001). By not considering alternative definitions of sophistication and the possibility of different constructs influencing different definitions of sophistication researchers run the risk of “theoretical sterility and tunnel vision in their research methods” (Parker and Roffey 1997, 226; see also Arrington and Francis 1989). Prior research has not given the opportunity for management accountants that use product costing systems to exhibit their views on what is meant by sophistication and the influences on that sophistication. If management accountants regard sophistication as being something other than the method of overhead assignment and/or identify different influences from those shown in prior research of sophistication, then this may mean that prior research is incomplete. If this view is correct, then one must question the results of prior research.

This is not meant to imply that the results of prior research are worthless, but that there is a need to take a step back and reconsider how research has defined sophistication and identified its influences. In relation to identifying the influences on sophistication, Abernethy et al. (2001) and Drury and Tayles (2005) point out that there have been inconsistent findings in the ABC contingency theory literature which led to the need for further empirical research into the factors influencing cost system design. Rather than conducting another quantitative research study to achieve this objective, this paper applies the call of Merchant and Van der Stede (2006) for more accounting researchers to conduct field studies and, more specifically, the call of Lillis and Mundy (2005) to use cross-sectional field studies to examine knowledge gaps in management accounting. This is necessary in this research area because Drury and Tayles (2005) refer to the problem of measuring sophistication and the constructs that influence it. As a consequence, Drury and Tayles (2005) suggest the need to carry out descriptive case studies to identify the meaning of sophistication and its influences. By doing this with an inductive-based cross-sectional field study it may be possible to identify alternative definitions of sophistication and influences on sophistication which have not been identified by prior theory and prior quantitative research. As a consequence, the results of field study research can influence theory development (Ferreira and Merchant 1992; Keating 1995). Furthermore, a cross-sectional field study will assist in building a dialogue between cross-sectional field study and quantitative research methods, because the results of the field study can be tested subsequently using larger samples and quantitative methods (Chapman 1997; Lillis and Mundy 2005). The use of a cross-sectional field study also has the advantage over a single site case study of offering the opportunity to compare results over a variety of subjects and settings. Thus, the approach is able to utilize the characteristics of the

breadth of surveys and the depth of case studies, while each of these methods possesses only one of these characteristics (Lillis and Mundy 2005).

Given these issues the following three research questions were addressed in a cross-section field study involving interviews with 55 management accountants working in manufacturing operating units in Great Britain. The first question was:

(1) What is meant by the sophistication of the product costing system?

In order to gain an understanding of the perceived level of sophistication of product costing systems, the management accountants were asked about the level of sophistication of their product costing systems. Thus, the second research question was:

(2) How sophisticated are operating units' product costing systems?

Finally, the third question concerned the influences on the sophistication of the product costing system and was:

(3) What are the main influences on the sophistication of operating units' product costing systems?

Like Abernethy et al. (2001), but unlike Drury and Tayles (2005),⁴ this research is confined to manufacturing firms because they are assumed to be a relatively homogeneous group, distinct from firms in the non-manufacturing sector. The non-manufacturing sector is a much more heterogeneous group; for example, hospitals are different from banks, which are different from schools. When comparing manufacturing and non-manufacturing firms, Rotch (1990) has emphasized their different characteristics. In particular, non-manufacturing firms' output is often more difficult to define. Activity following a service request is less predictable, and joint capacity costs make up a higher proportion of total costs and are difficult to assign to output. Related to Rotch's (1990) final point, Clarke et al. (1999) argued that the cost

structure of manufacturing firms is different from non-manufacturing firms. Specifically, there are no or few direct material costs and possibly no direct labour costs in non-manufacturing firms. This means that indirect overhead costs generally make up a larger proportion of total costs for non-manufacturing firms, whereas direct material costs are usually the largest cost incurred by manufacturing firms (Brierley et al. 2001). This distinction could explain why non-manufacturing firms have been found to be more likely than manufacturing firms to adopt ABC (Kaplan and Cooper 1998; Drury and Tayles 2000). These differences provide a justification for studying sophistication in the manufacturing and non-manufacturing sector separately and, except for the discussion of the results of Drury and Tayles (2005), the literature review is confined to reviewing research conducted in manufacturing industry.

Unlike prior research, which has defined sophistication in terms of overhead assignment, the results of this cross-sectional field study revealed that the management accountants offered 16 different definitions of the sophistication of the product costing system. The three main definitions were expressed in terms of overhead assignment (as in prior research), the inclusion of all costs in product costs and the understandability of the product costing system. In relation to the second research question, none of the interviewees considered they had sophisticated product costing systems, and they identified them as being unsophisticated or neither sophisticated nor unsophisticated. For the third research question there were different influences on sophistication when sophistication was defined in terms of overhead assignment, the inclusion of all costs and understandability.

The remainder of the paper is organized into four further sections. Section two provides a review of the literature into sophistication, and is divided into a discussion of how prior research has defined sophistication and identified the influences on that

sophistication. Section three discusses the research method in terms of a cross-sectional field study based on interviews with 55 management accountants working in British manufacturing industry. Section four presents and discusses the results relating to the three research questions. Section five offers some conclusions, identifies some of the limitations of the research and suggests opportunities for future research.

LITERATURE REVIEW

Definitions of Sophistication

In the context of product costing, Drury and Tayles (2005) defined low levels of sophistication as those having a single plant-wide first-stage cost pool and a single volume-based second-stage cost driver. As the number of first-stage cost pools and second-stage cost drivers increases,⁵ then sophistication increases. An increase in the number of cost pools increases the ability of the costing system to capture the different resources used to produce a firm's different products. Although Drury and Tayles (2005) did not discuss the make-up of these cost pools in any detail, they are presumably the equivalent of responsibility cost centers in a traditional costing system, which assigns overheads to products using volume-based cost drivers and activity cost pools in an ABC system. Increases in the number of cost centers in a traditional volume-based cost driver costing system will reduce the diversity of the production process within each cost center and will lead to more accurate product costs (Drury et al. 1993). Similarly increases in the number of activity cost pools in an ABC system will increase the accuracy of product costs by also identifying a variety of different second-stage cost drivers that influence those cost pools. An increase in the number of

cost drivers is expected to increase sophistication because a higher number of cost drivers are likely to represent a better measure of the quantities of resources consumed by products through identifying the cost driver that is the cause of each cost pool. Although Drury and Tayles (2000) defined sophistication in a similar manner to Drury and Tayles (2005), they referred to direct costing as being an unsophisticated system because it excludes indirect overhead costs from product costs. The Drury and Tayles (2005) definition of sophistication, referred to above, ignores this situation and is only concerned with the assignment of indirect overhead costs to product costs.

Drury and Tayles (2005) also argued that sophistication will be affected by the extent to which transaction, duration or intensity cost drivers are used. The sophistication of these cost drivers increases with the difficulty in measuring them and the extent to which they capture the resources consumed by the product during production. Drury and Tayles (2005) stated that transaction drivers are the least sophisticated type of cost driver because they represent the number of times an activity is performed. Duration drivers represent a higher level of sophistication because they represent the amount of time taken to perform an activity. Intensity drivers represent the highest level of sophistication because these are based on directly charging for the resources used when an activity is performed.⁶

At high levels of sophistication there will be many cost pools, many cost drivers (consisting of both volume and non-volume-based cost drivers), and duration and intensity cost drivers. When using this type of cost system, Drury and Tayles (2005) pointed out that overheads should be allocated to cost pools either by direct charging or by assigning overheads using the cause-and-effect cost driver of each cost pool. Thus, a highly sophisticated system would be a complicated ABC system.⁷ Based upon their definition of sophistication, Drury and Tayles (2005) subsequently

measured sophistication using a combination of the number of cost pools and cost drivers used to allocate and assign overheads to product costs to produce a 15-point sophistication scale from a least sophisticated system score of 2 to a most sophisticated system score of 16. The allocation of overheads to cost pools and the extent to which transaction, duration and intensity drivers are used in cost assignment were excluded from the measure because of measurement difficulties. From their 15-point scale, the 170 respondents to their survey had a median level of sophistication of 7.⁸

Drury and Tayles (2000) measured sophistication by three categories, namely, unsophisticated, low sophistication and sophisticated respectively. Unsophisticated systems were described as those having four or fewer cost pools and two or fewer cost drivers, or six to ten cost pools and one cost driver. Sophisticated systems were those with eleven or more cost pools and five or more cost drivers. Any other combination of cost pools and cost drivers was defined as a low sophistication system. Of the organizations included in Drury and Tayles (2000) sample of 169 respondents, 21 percent has unsophisticated systems, 58 percent had low sophistication and 21 percent has sophisticated systems.

Abernethy et al. (2001) defined sophistication in a similar way to Drury and Tayles (2005), except that they made a distinction between the type and nature of cost pools. Abernethy et al. (2001) distinguished between responsibility-based cost pools, which are the same as cost centers used in a traditional costing system, and activity cost pools which are used in an ABC system. Although Drury and Tayles (2005) referred only to cost pools, it is considered that this is a cosmetic difference relating to the use of terminology. Based on the work of Cooper (1990), Abernethy et al. (2001) also referred to the use hierarchical cost pools (and its associated hierarchical cost drivers) in the product costing system. In contrast, Drury and Tayles (2005) did not mention

this, but referred instead to the influence of the use of transaction, duration and intensity drivers on sophistication (see above), which would form part of the hierarchical cost drivers.

Like Drury and Tayles (2005), Abernethy's et al. (2001) regarded a system with low sophistication as having one cost pool and a volume-based cost driver and a sophisticated cost system as having a number of cost pools, including hierarchical cost pools, and a number of hierarchical cost drivers. Thus, as in Drury and Tayles (2005) the most sophisticated systems would take the form of an ABC system. Abernethy et al's (2001) measure of sophistication was cruder, however, than Drury and Tayles' (2000, 2005) because they defined product costing systems as having either a low level or high level of sophistication, with the level of sophistication being determined by the authors. Low levels of sophistication were identified in four of the units they visited and consisted of between one and three cost pools and one cost driver. The fifth unit was identified as having a high level of sophistication because it had a large number of cost pools and used two volume-based cost drivers. Despite not having hierarchical cost pools and hence using only volume-based cost drivers, the management at this unit considered they were using ABC. Although Abernethy et al. (2001, 269) correctly state that this system "is clearly not a fully fledged ABC system", it does raise the issue of differences in interpreting the nature of product costing systems. This occurs also in Abernethy et al's (2001) interpretation of the fifth unit's cost system as having a high level of sophistication, because others may interpret it as having a relatively low level of sophistication as it includes only two cost drivers and does not include hierarchical cost pools or hierarchical cost drivers. This leads to the question of how management accountants interpret the sophistication

of their product costing systems, which is addressed in the second research question in this paper.

Influences on Sophistication

Based upon their definition of sophistication described above, Abernethy et al. examined the influence of product diversity on sophistication, and Drury and Tayles (2005) developed and tested a model of the influence of cost structure, intensity of competition, product diversity, degree of customization of products, organization size, importance of cost information in decision making and the corporate sector within which an organization operates on sophistication. A brief discussion of the influence of these constructs, except for the corporate sector, is provided below and for more information the reader is referred to Drury and Tayles (2005). The corporate sector is irrelevant in this study because it is concerned with only the manufacturing sector.

When higher levels of indirect overheads are incurred to produce products it is argued that there is a greater need to use a sophisticated cost system to assign these costs to products. If not, it is possible that an unsophisticated system will lead to significant distortions in product costs. In cases when overheads (excluding facility-level costs) make up a high proportion of total product costs, some consider that ABC should be used (Kaplan and Cooper 1998). In contrast, if the level of overheads is relatively low, then a relatively unsophisticated system may be adequate (Drury and Tayles 2005). Drury and Tayles (2005), however, did not find a significant effect for indirect costs as a percentage of total costs on sophistication.

Prior research has identified a relationship between the intensity of competition in the marketplace and the use of the management accounting system (Khandwalla 1972; Mia and Clarke 1999). In relation to product costing, it has been suggested that when

competition is very intense then firms should implement ABC (Cooper 1988a; Kaplan and Cooper 1998). Even if a firm does not implement ABC, it has been argued that firms have a greater need in a competitive environment for a sophisticated costing system that assigns overheads to products more accurately than a less sophisticated system (Drury and Tayles 2005). If a more sophisticated system is not implemented then a competitor or competitors may take advantage of errors arising from inaccurate product costs (Cooper 1988a). Despite these arguments, Drury and Tayles (2005) did not find a significant influence for the intensity of competition on sophistication.

When more diverse products are produced then more resources and activities will be required to produce them. As a consequence, overheads will increase and it is likely that a more sophisticated system will be required to capture these resources and activities in product costs (Cooper 1988b; Drury and Tayles 2005). When an organization produces a diverse range of products then an ABC system may be required (Cooper 1988a; Kaplan and Cooper 1998). The minimum number of cost drivers required will depend on the complexity of the product mix and the required level of product cost accuracy (Cooper 1988b). Abernethy et al. (2001) and Drury and Tayles (2005) found a positive relationship between product diversity and sophistication. However, this result needs to take account of the following two issues. Abernethy et al (2001) found that the decision to invest in advanced manufacturing technology (AMT) had the effect of reducing overheads which meant there was less need for a sophisticated product costing system. Also, Drury and Tayles (2005) did not measure product diversity in terms of the variety of products produced, but in terms of the consumption of support department overheads by an organization's different products and services. Given that it is possible for an organization to produce a relatively narrow range of products which consume a high quantity of overheads, one

has to question whether the measure of product diversity, actually measures product diversity.

Customized products are produced, in general, by non-repetitive manufacturing methods for which it is not possible to set standard costs (Drury and Tayles 2005). To increase the accuracy of customized product costs a more sophisticated product costing system would be required, and, in this situation, Kaplan and Cooper (1998) suggested that an ABC system should be used. They recommended that overheads should be charged directly to products using intensity cost drivers. Drury and Tayles (2005) pointed out that the cost of operating a sophisticated costing system is likely to be related positively to higher levels of customized production. Companies that produce a high level of customized products may have to undertake a cost-benefit analysis to see if they are able to invest in a sophisticated costing system. If they do not pass this cost-benefit analysis then they will not invest in a sophisticated cost system. The cost of operating a sophisticated costing system is expected to be lower when standardized products are produced. As a consequence of undertaking cost-benefit analyses, Drury and Tayles (2005) anticipated that less sophisticated systems will be used in operating units producing customized products, while more sophisticated systems will be used by operating units producing a wider range of standardized products. This result was confirmed by them finding a negative relationship between the level of customization and sophistication.

Drury and Tayles (2005) found that organizational size, measured by annual sales revenue, was positively related to sophistication. Krumwiede (1998) pointed out that the reasons for the size impact are unclear. It may be that as larger organizations tend to have access to relatively larger resources, they are able to invest in more sophisticated product costing systems. Furthermore, Drury and Tayles (2005) pointed

out that larger firms are likely to have a greater range of products, services and customers which creates the need for a more sophisticated costing system; whereas smaller firms are likely to have a smaller range of products, services and customers and have less need for a sophisticated system. In this case, however, size can only act as a proxy for firms having the resources to invest in sophisticated systems, and having a wide range of products, services and customers that necessitate a sophisticated system. Large firms do not invest in sophisticated systems because they are large. If they did, this does not explain, for example, why all large firms do not have ABC systems. As a consequence, firms are likely to invest in costing systems because of factors which have already been mentioned like the level of competition, product diversity, degree of product customization etc., subject to having the funds, personnel and time etc., to make the investment.

Product costs are used in the calculation of product profits and are likely to have a role in product-related decisions. If a company uses an unsophisticated system that produces inaccurate product costs in product related decisions it is possible that incorrect decisions may be made, such as ceasing the production of profitable products and continuing the production of unprofitable products (Kaplan 1988; Drury et al. 1993; Drury and Tayles 1994, 1995, 2000; Kaplan and Cooper 1998). Drury and Tayles (2005) point out that the need to produce accurate product costs is likely to vary with the profit margins of the firm. When product profit margins are high for all products then it is sufficient to have less accurate product costs, because product profits are likely to be high regardless of the accuracy of product costs. In this situation product profitability analysis is likely to be less important than when product profit margins are low. In this case more accurate product costs may be required for product profitability analysis which can be applied in product mix decisions. However,

Drury and Tayles (2005) did not find a significant effect for the importance of cost information in decision making (when measured by the importance of periodic profitability analysis in decision making) on sophistication.

Drury and Tayles (2005) identified seven papers which have studied sophistication by comparing the characteristics of operating units with ABC systems with those that did not use ABC.⁹ From this research and further papers by Joshi (1998), Groot (1999) and Schoute (2004), significant effects ($p < 0.05$) on ABC adoption have been found for the:¹⁰

- Cost structure when defined as the percentage of overhead costs to total value added costs (Bjørnenak 1997). Although the effect was in the opposite direction for Clarke et al. (1999),¹¹ and non-significant effects were reported when cost structure was defined in a variety of ways (Booth and Giacobbe 1998; Joshi 1998; Groot 1999; Malmi 1999; Schoute 2004).
- Level of competition when defined as (1) the percentage of sales exported (Bjørnenak 1997; Malmi 1999) and (2) the perceived change in competition (Malmi 1999). Also, non-significant effects were reported for the intensity of competition (Schoute 2004), number of competitors (Bjørnenak 1997) and price makers compared with price takers (Booth and Giacobbe 1998).
- Product diversity when defined as (1) the number of products/product lines/product variants (Clarke et al. 1999; Malmi 1999; Schoute 2004) (with non-significant effects reported by Bjørnenak (1997), Booth and Giacobbe (1998) and Groot (1999)), and (2) a composite score derived from a variety of measures (Krumwiede 1998). Although, non-significant effects were reported for the number of product lines introduced (Booth and Giacobbe 1998).

- Degree of customization (Bjørnenak 1997) and Bjørnenak (1997) found a similar result to Drury and Tayles (2005), whereby firms with customized production were less likely to have adopted ABC. Although non-significant effects were reported for make mainly customized product or standard products, and make-to-order and make-to-stock (Malmi 1999), and also for non-job shop compared to job shop production (Krumwiede 1998).
- Size when defined as annual sales revenue (Joshi 1998; Krumwiede 1998; Clarke et al. 1999) and number of employees (Groot 1999; Malmi 1999; Hoque 2000). Also, non-significant effects were reported when size was measured by the number of employees (Bjørnenak 1997; Schoute 2004), and both annual sales revenue and number of employees (Booth and Giacobbe 1998).
- Number of production lines (Groot 1999). Although a non-significant effect was reported by Schoute (2004).
- Degree of automation in the factory (Hoque 2000).
- Extent to which just-in-time (JIT) is used (being related negatively to ABC usage) (Hoque 2000).
- Use of a serial unit production process (Schoute 2004).
- Organizational structure, when defined as mechanistic verses non-mechanistic structure (Gosselin 1997; Schoute 2004).

Also, non-significant effects were reported for the type of production process (Malmi 1999), lean production techniques (Krumwiede 1998), the interaction between JIT production and automation (Hoque 2000), the use of AMT (Schoute 2004), number of packing lines (Groot 1999), total quality management (Krumwiede 1998), the quality of information technology (Krumwiede 1998), the decision usefulness of cost information (Krumwiede 1998), competitive strategy (Schoute 2004), cost leadership

verses product differentiation strategy (Malmi 1999) and perceived environmental uncertainty (Schoute 2004).

The review of prior research shows that researchers have imposed a definition of the sophistication of the product costing system in their research as a method used to assign overheads to product costs (Drury and Tayles 2000, 2005; Abernethy et al. 2001) or the comparison between ABC systems and non-ABC systems (Bjørnenak 1997; Gosselin 1997; Booth and Giacobbe 1998; Joshi 1998; Krumwiede 1998; Clarke et al. 1999; Groot 1999; Malmi 1999; Hoque 2000; Schoute 2004). Research has not considered the possibility of alternative definitions of sophistication. If alternative definitions exist then this means that prior research has adopted a narrow view of sophistication. This, in turn, means that it is possible for there to be different influences on sophistication when sophistication is defined in different ways. The next section describes the research methods which were employed to get access to management accountants in Great Britain in order to investigate how they defined sophistication and identified its influences.

RESEARCH METHOD

Questionnaire and Interview Subjects and Design

Potential questionnaire subjects were obtained from a list of 854 members of the Chartered Institute of Management Accountants (CIMA) in Great Britain with job titles of cost, management or manufacturing accountant, and employed in British manufacturing industry. An introductory letter was posted to all potential subjects detailing the research objectives and informing them that they would receive a

questionnaire in two weeks time. Each questionnaire was accompanied by a covering letter, which assured subjects of the confidentiality of responses, and a stamped-addressed envelope. Any non-respondents to the initial mailing of the questionnaire were posted a follow-up letter two weeks later, and a further follow-up letter, questionnaire and stamped-addressed envelope were posted to non-respondents two weeks after that. After identifying potential subjects who worked in the same operating unit, operating units which had closed down, potential subjects who had left their operating unit and subjects who were not involved in manufacturing or product costing, the total potential subjects working in independent operating units declined to 673. A total of 280 usable responses were received (effective response rate = 41.6 percent) and, of these, 274 respondents indicated they used product costs in decision making (which was defined as pricing, make-or-buy, cost reduction, product mix, output level, product design, evaluating new production process and product discontinuation decisions). The questionnaire covered all aspects of product costing and was divided into five sections covering the product costing system, overhead rates, activity-based costing, product costs and decision making, and background information about the operating unit.¹²

Of the 274 questionnaire respondents using product costs in decision-making, 55 ticked a box on the back cover of the questionnaire to indicate they were willing to make themselves available for a face-to-face interview to discuss their questionnaire responses in more detail. The interviews were conducted at the interviewee's place of work, were semi-structured, tape recorded, and lasted for an average of 1 hour 26 minutes. The interviews covered all aspects of product costing, part of which concerned the issue of the sophistication of the product costing system. In relation to sophistication, the interviewees were asked initially:

(1) How would you define the term the sophistication of a product costing system?

Given the definition of sophistication provided by the management accountants, they were then asked:

(2) How sophisticated is your operating unit's product costing system?

(3) What are the main influences on the sophistication of your operating unit's product costing system?¹³

Data Analysis

The interviews were analysed using qualitative research methods (Lincoln and Guba 1985; Miles and Huberman 1994; Strauss and Corbin 1998). The portion of the interviews relating to sophistication was transcribed and analysed using open, axial and selective coding techniques (Strauss and Corbin 1998). Open coding involved a line-by-line analysis of the transcribed interviews to identify key words and phrases. Axial coding followed from this, and involved the clustering of codes to identify core categories in the data and, where necessary, relationships between core categories. Selective coding involved the identification of a central category or categories that answered the research question. To assist in the axial and selective coding written memos were used to provide meaning to the interviews and to outline ideas. The results of this coding are described in the results and discussion section below.

RESULTS AND DISCUSSION

Definitions of the Sophistication of the Product Costing System

The majority of interviewees defined the sophistication of the product costing system in one of three ways: (i) the assignment of overheads in product costs (n = 12), (ii) the inclusion of all costs in product costs (n = 11) or (iii) the degree to which product cost information is understandable (n = 4). The definition of sophistication as the assignment of overheads was consistent with prior research. Here the degree of sophistication varied from a direct costing system, when indirect costs are not included in product costs, to an ABC system which identifies overheads in different cost pools and assign them to products using a number of different cost drivers using volume and batch-based cost drivers as defined in Cooper's (1990) hierarchy of activities. In between these two extremes of sophistication were product costing systems that assign overheads to products costs by allocating overheads to cost centers and assigning them to product costs using volume-based cost drivers. Hence, in between extremes of direct costing and ABC, sophistication can vary from a single cost center and a single cost driver, to a large number of cost centers and a few volume-based cost drivers.

This definition of sophistication is that the same as that of Drury and Tayles (2000) and is similar to that of Drury and Tayles (2005) and Abernethy et al. (2001), except that Abernethy et al. (2001) and Drury and Tayles (2005) only considered sophistication in the situation when indirect overheads are included in product costs. In addition, in terms of terminology, interviewees in this research referred to costs being allocated to cost centers which is analogous to the cost pools referred to by Drury and Tayles (2005) and responsibility-based cost pools referred to

by Abernethy et al. (2001). It is also noteworthy that, unlike Drury and Tayles (2005), none of the interviewees distinguished between transaction, duration and intensity cost drivers when defining sophistication. They referred only to the inclusion of a volume and batch-based cost drivers and did not refer to product-sustaining cost drivers (Cooper, 1990). This may be because they did not consider how the measurement of the cost driver affected sophistication, or it could be because of ignorance of these types of cost driver. Whichever it is needs to be investigated in subsequent research.

Sophistication was also defined in terms of the inclusion of all costs in product costs. This definition of sophistication is different from that found in the product costing literature because of the emphasis on the calculation of material and labour costs, as well as overhead costs. The issue of the inclusion of material and labour costs in product costs in manufacturing industry has been ignored because of the relative ease with which these costs can be included in product costs (Innes and Mitchell 1990; Drury and Tayles 2005). When sophistication is defined in this way, a sophisticated product costing system should reflect the production process by including materials, labour and overheads in product costs. The bill of materials should be complete. The recording of the labour costs will vary with the extent to which the product costing system records the times worked to produce the product for each different route a product takes through the factory and for each different grade of labour which works on the product. Overheads should be assigned to product costs using an adequate number of cost centers and cost drivers.

In the third definition of sophistication, the sophistication of the product costing system was not defined in terms of the actual calculation of product costs, but in terms of its perceived understandability by non-accounting staff. In other words, a system

that management accountants would expect non-accounting staff to find difficult to understand is a sophisticated system, while a system which management accountants regard as being capable of being understood by non-accounting staff is an unsophisticated system. One of the consequences of having a sophisticated system is the fear that it will not be used by non-accounting staff in decision making. Thus, the emphasis is on having a simple system because it will be understood and used by non-accountants. In this case the sophistication is based on the effect of product cost information, rather than its calculation.¹⁴

Eighteen interviewees gave 13 other definitions of sophistication and these are summarized in Table 1. For some of these responses sophistication was defined in terms of the actual calculation of product costs such as the direct charging of overheads to products and the recording of a detailed bill of materials. Some definitions did not relate to the actual calculation of product costs, such as the frequency with which product costs are updated and tracking costs through the production process. While other definitions concerned the application of product costs, such as meeting a business need and the time it takes to respond to a query.

Insert Table 1 here

Of the remaining ten interviews, nine did not answer the question about what is meant by sophistication and for one interviewee the quality of his English was too poor to interpret. The remaining two research questions examine the interviewees' perception of the sophistication of their operating unit's product costing system, rather than a general system, and the influences on that system. These two questions are addressed based on the responses of the 27 interviewees for which there is a

consensus amongst them that the sophistication of the product costing system can be defined in terms of either overhead assignment, the inclusion of all costs or its understandability.

The Level of Sophistication of the Product Costing Systems

The 27 interviewees were asked to specify the level of sophistication of the product costing system at their operating unit. Their responses were coded as to whether they regarded the system as sophisticated, neither sophisticated nor unsophisticated (or neutral), or unsophisticated.¹⁵ Table 2 shows a summary of how interviewees perceived the degree of sophistication of their product costing systems based on their definition of sophistication. None of the interviewees regarded their product costing systems as sophisticated, which is hardly surprising because none of them used intensity cost drivers, or made extensive use of hierarchical cost pools and hierarchical cost drivers. The majority of interviewees that defined sophistication as the inclusion of all costs and just under half of those that defined sophistication as overhead assignment regarded their systems as having neutral sophistication. All of the interviewees that defined sophistication in terms of the understandability of the product costing system had unsophisticated systems. There now follows a discussion of why the interviewees, for each type of sophistication, regarded their product costing systems to be either neutral sophistication or unsophisticated.

Insert Table 2 here

Overhead Assignment Sophistication

Using Drury and Tayles' (2005) 15-point overhead assignment sophistication measure, the 11 interviewees that included overheads in product costs had a median sophistication of 6 which is slightly lower than the 7 of Drury and Tayles (2005).¹⁶ When applying Drury and Tayles' (2000) three sophistication categories to the same 11 interviewees, five had unsophisticated systems and six had low sophistication systems. These classifications were similar to the unsophisticated and neutral sophistication levels provided by the interviewees except for two interviewees that defined their systems as unsophisticated and were in low sophistication category of Drury and Tayles (2000), and one interviewee defined their system as neutral when it was unsophisticated according to the Drury and Tayles' (2000) categorization.

The interviewees that defined sophistication as being neutral expressed some concern over the adequacy of the method of overhead assignment, and, as a consequence, this may result in the reporting of inaccurate product costs. Given this problem, interviewees were uncertain whether a sophisticated system was worthwhile because a lot of time would be required to update and revise the product costing system, and it may not be practicable to maintain an ABC system when there was no guarantee that it would lead to better decision making. Thus, although operating units identified problems with assigning overheads to product costs using systems which they defined as having a neutral level of sophistication, they were prepared to accept these problems rather than having a more sophisticated system because the cost of these systems may exceed the benefits. Product costing systems were regarded as being unsophisticated when the product costing system was a direct costing system, or because of the inadequacy of the method of assigning overheads to products. This

arose when either too few cost drivers were used to assign overheads or when an inappropriate cost driver rate(s) was(were) used.

Table 3 provides a comparison between the degree of sophistication in operating units that defined sophistication as overhead assignment, and sophistication measured in terms of the number of cost drivers and the number of cost centers used in the calculation of product costs. The number of cost drivers used in overhead assignment varied from zero (in direct costing systems) to three. In general, the interviewees that defined their sophistication as neutral used two or three cost drivers, whereas interviewees that defined their systems as being unsophisticated used zero or one cost driver. The number of cost centers used in overhead assignment varied from 0 to 60. Operating units defined as having neutral sophistication used 6 to 60 cost centers in overhead assignment, while the majority of operating units that defined their systems as unsophisticated had four or fewer cost centers. Hence, the number of cost drivers and the number of cost centers used in the product costing system provided some indication of overhead assignment sophistication. The more cost drivers/cost centers an operating unit used the more sophisticated was the product costing system.

Insert Table 3 here

Only one of the original 55 interviewees referred to sophistication in terms of the need to include non-manufacturing overheads in product costs and only one of the 12 interviewees that defined sophistication in terms of overhead assignment referred to this issue in discussions about sophistication. A total of five of the 11 interviewees that included overheads in product costs included non-manufacturing overheads in those costs, and assigned them to product costs using volume-based cost drivers. It is

unlikely that this will produce accurate product costs because non-manufacturing overheads are unlikely to be related to volume-based cost drivers.

Inclusion of All Costs Sophistication

Interviewees that defined sophistication as the inclusion of all costs felt that their product costing systems recorded material and labour costs adequately, but, like those defining sophistication in terms of overhead assignment, did not record overheads adequately. This was because operating units did not use enough cost drivers to assign overheads to products. Thus, although these interviewees defined sophistication differently to those that regard it solely as overhead assignment, both of these two sets of interviewees considered that the sophistication of their product costing systems was compromised by the treatment of overheads. Although no measure of the adequacy of the inclusion of all costs was included in the questionnaire, the fact that sophistication was compromised by the treatment of overheads means that it is possible to make a comparison between how operating units defined their degree of sophistication, and sophistication measured in terms the number of cost drivers and the number of cost centers used in the calculation of product costs. This comparison is illustrated in Table 4 which shows that the seven operating units using product costing systems with neutral sophistication used one, two or three cost drivers to assign overheads to products. In contrast, unsophisticated systems consisted of either zero or one cost driver and hence contained fewer cost drivers than systems with neutral sophistication. The distinction between neutral and unsophisticated systems was not as obvious when sophistication was measured in terms of the number of cost centers. For neutral levels of sophistication the number of cost centers varied from 1 to 22+, whereas for unsophisticated systems they varied from 0 to 20.

Insert Table 4 here

Understandability Sophistication

As all the interviewees that defined sophistication in terms of its understandability by non-accounting staff regarded their product costing systems as being unsophisticated, it was not possible to compare these systems with neutral or sophisticated systems. In all cases the interviewees emphasized the simplicity of their system, which is similar to a case examined by Scapens et al. (1996) where accounting information was kept as simple as possible to ensure that it could be used throughout the company. It was not possible to compare these unsophisticated systems to some measure of understandability because no such measure was included in the questionnaire. However, it is possible to use the number of cost drivers and number of cost centers as a proxy for understandability. In other words, the higher the number of cost drivers and cost centers, the less understandable the product costing system. The four systems had one or two cost drivers and 10, 17, 35 and 100 cost centers, and were as sophisticated or more sophisticated than the unsophisticated systems identified by operating units defining sophistication in terms of overhead assignment and the inclusion of all costs. Thus, although these systems may be regarded as relatively simple, they could have been simpler and, hence, easier to understand. There may be trade off between having a very simple system that does not include overheads in product costs, and a slightly more sophisticated system that does assign overheads to product costs, and can still be understood by non-accounting staff. Also, unlike the results of some prior research studies (Innes and Mitchell 1990, 1991; Gietzmann 1991; Bhimani and Pigott 1992; Norris 1994; Friedman and Lyne 1995; Greeson and Kocakulah 1997; Gunasekaran and Saradi 1998), none of the

interviewees were of the opinion that an ABC system would enhance understandability.

Influences on the Sophistication of the Product Costing System

The influences on the sophistication of the product costing system are identified separately when sophistication is defined in terms of overhead assignment, the inclusion of all costs and understandability.

Overhead Assignment Sophistication

When sophistication was defined as overhead assignment and operating units had a parent company and the parent specified the design of the product costing system, then the parent determined its sophistication. In this case the product costing system was a standard system across all subsidiaries in the group, and its degree of sophistication was determined by the parent.

Other operating units were able to design their own product costing system and there were a number of influences on sophistication. The importance of product cost information in decision making influenced managements' demand for that information and, hence, the sophistication of the product costing system. Thus, the more information management demands the more sophisticated the system will need to be to meet that demand. In one operating unit, if management wanted information that was not available from the current system they had to authorize the supply of funds to invest in systems to supply that information. This demand for information led to this operating unit developing an in-house ABC system, which involved the company identifying, in addition to two volume-based cost drivers, separate batch-based activity cost pools and their associated batch-based cost drivers. The first phase

of this development involved identifying production order costs and calculating a cost driver rate per production order. The interviewee said the next step was to increase sophistication by identifying other suitable cost pools and cost drivers from the current product costing system.

The importance of product information in decision making was, in turn, influenced by the profit of the operating unit. If profit was very high then there was less need for a sophisticated system. In one operating unit, which did not have a parent company and used a direct costing system, the interviewee said:

I think it's worth saying at this point that [*name of company*] has had some excellent growth over the years and has been, and still is, a profitable business and it seems to be the case that because the profitability is there, the need to really understand and screw down every nut and bolt element of cost has not really been there. The business is profitable and generates profit. So whether or not we generate 60 percent or 62 percent [*profit margin*] isn't really the issue.

It was of no consequence that the direct costing system used by the company was the least sophisticated cost system for overhead assignment. As the company continued to make high profits the direct costing system was adequate for product costing and calculating product profits, and negated the need for a more sophisticated system. The company would only need to consider having a more sophisticated system if profits declined. Then it would become important to distinguish between the profits of individual products after assigning overheads to products. This arose in another operating unit when the company assigned overheads to products in the 1980s using a single plant-wide cost driver when the operating unit was making high profits. Given these high profits, individual product costs were not important in decision making. When operating unit profits declined in the 1990s, management became more concerned with individual product profits and the importance of product costs in decision making increased. As a consequence, the method of allocating and assigning

overheads to product costs was refined by allocating overheads to one of eight different cost centers and assigning overheads to product costs by calculating a cost driver rate for each cost center using a single cost driver. These product costs were then applied by the company in decisions like product introduction and product discontinuation decisions. In both the cases described above, the importance of product costs in decision making was influenced by the overall profits of the companies concerned, and not individual product profits as suggested by Drury and Tayles (2005). When overall profits were high the companies did not review individual product profits. It was only when overall profits declined that individual product profits became important and, as a consequence, management demanded this information.

The level of manufacturing technology affected sophistication. The higher the level of manufacturing technology, the more overhead was incurred and the higher the level of sophistication needed to assign overheads to products. In one operating unit the technology was simple and produced a simple product. As manufacturing overheads represented 22 percent of the manufacturing product cost there was little need to use a large number of different cost drivers to assign manufacturing overheads to product costs and hence the system was relatively simple and assigned overheads to products using two cost drivers.

A major factor limiting the extent to which operating units can assign overheads to products in a more precise manner was the limit on the funds available to invest in new software, or new hardware and software. The implication of this was that companies were forced to use relatively unsophisticated product costing systems, even though they would like to invest in more sophisticated systems. For example, in one operating unit, which did not have a parent company, the interviewee explained that

because of software limitations only a direct labour hour rate could be used to assign overheads to products. He said:

Certainly there are parts of the process where we want to use machine rates. You have stages where you load products into a machine and you take it out three days later ... and you record a couple of minutes [*of*] labour, when you should be looking at the machine time.

The implication of this software deficiency was the existence of a wide gap between the information available and information needed. For example, the company could not account adequately for customized sales. Thus, although the inability to record customized sales meant there was a need to improve the method of assigning overheads to products this did not directly influence the sophistication of the product costing system because sophistication was determined (or restricted) by the lack of funds available for investment in new software. If funds had been available then the need to record the cost of customized products would have a direct influence on sophistication and the company would invest in a product costing system that could record the cost of customized products. This is different from the argument of Drury and Tayles (2005) whereby there is a negative relationship between the degree of customization and sophistication. In this case, the lack of funds which were available to invest in a sophisticated (or more sophisticated) system prevented the investment in such a system, and moderated the relationship between the level of customization and sophistication. If the funds had been available to make the investment then the cost of operating the system would not have been prohibitive and there would be a positive relationship between the degree of customization and sophistication.

In another case a company wanted to invest in a new product costing system because the intense competition in the marketplace meant it was important to record accurate product profits to compete effectively. Again, this factor did not determine the sophistication of the product costing system, because the prohibitive cost of new

hardware that was necessary to run the new software moderated the impact of competition on sophistication. In this case competition would only influence sophistication of the product costing system directly if the company had the funds to invest in the required hardware and software. This finding is not new and surveys of have found the high cost was an important factor limiting the extent to which companies can implement complex management accounting systems (Cobb et al. 1992; Groot 1999).

From the above analysis, Figure 1 provides a model of the influence on sophistication when the parent company determines the design of the product costing system and sophistication is measured in terms of overhead assignment. In this case, this is the sole influence on sophistication and is dependent on factors peculiar to the parent which could either lead to increases or decreases in the level of sophistication. Figure 2 shows a model of overhead assignment sophistication when the parent company does not determine the design of the product costing system or the operating unit does not have a parent. This model can be refined and tested using qualitative or quantitative research methods.

Insert Figure 1 and Figure 2 here

Overall operating unit profitability is expected to influence sophistication via its influence on the importance of product costs in decision making and managements' demand for product cost information. Specifically, operating unit profitability is expected to have a negative impact on the importance of product costs in decision making, which is expected to have a positive impact on managements' demand for product cost information and this is expected to have a positive impact on

sophistication. Even if operating unit profitability does not have an effect on sophistication, the importance of product cost information in decision making is expected to have a positive and indirect influence on sophistication via managements' demand for product cost information. The level of manufacturing technology is expected to have an indirect and positive effect on sophistication via the level of overheads, and not having the funds to invest in a product costing system is expected to have a direct and positive effect on sophistication. The level of customized sales and the level of competition are expected to have positive effects on sophistication, but these are both moderated by the lack of funds available to invest in systems to produce the required level of sophistication.

Inclusion of All Costs Sophistication

As in the case of operating units that define sophistication in terms of overhead assignment, operating units that have a parent company that specifies the design of the product costing system, then the parent determines its sophistication. Instead of designing the product costing system, the parent may decide to standardize the software that is used across the group and hence determine the software that its subsidiary uses. The subsidiary is then able to design the cost system subject to using the specified software. In the case of one operating unit the interviewee said:

That's everything isn't it? We operate our costing system around what we've got, so it's one hundred percent.

In this case, if an operating unit wants to include a large number of different costs in its product cost then sophistication may be limited by the ability of the software to cope with this volume of costs. When the parent does not determine the software used, this will be determined by the operating unit and this choice can, in turn, determine sophistication.

Although the parent may not influence the design of the system or specify the software that is used, it may influence sophistication by specifying the importance of product costs in decision making. In one case the interviewee said:

We find in this company accounting has changed its role completely. We've become an American company in the last three or four years. The awareness the managers have today of that information and the requirements they require for information today is totally different to what it was. So management is the key if they want something. If they don't want something, it won't happen and that's number one.

As a consequence of this change in ownership, the importance of product cost information increased, the demand for product cost information increased and this had knock on effects for the sophistication of the product costing system. If management wanted information that was not currently supplied by the product costing system, then, if practicable, changes were made to the system to obtain that information.

Operating units which were not influenced by their parent company in the design of or the software used in their product costing system, or did not have a parent were able to design their own system. For operating units that made only customized sales, the level of manufacturing technology influenced sophistication. For example, higher levels of manufacturing technology were able to record the amount of time a machine spent in the production process and the units produced by that machine. For lower levels of technology this information had to be recorded manually. In the case of a bespoke box manufacturer the interviewee said:

Our five main machines have computers attached to them that count the number of boxes on, and start and stop and all the rest of it and record the information automatically. That's five machines, the other 14 or 15 out there a guy stands out there and pushes a box through one-by-one, and we're relying on him writing on a piece of paper when he started, when he stopped and how many he did. If he gets that wrong, which can happen more often than not then obviously your costing system then goes a bit wrong. You're then comparing bad information with your estimate. You may well decide you're not

making any money on this, when actually the guy forgot that he had an hour for break.

Thus, if information was not recorded accurately by shop floor labour then this compromises the ability of the product costing system to record labour and overhead costs in the product cost. This type of error could be avoided by using a higher level of technology, but the extent to which this investment can be made is dependent on having the funds available to make the investment. If funds are not available this may limit the ability of the costing system to provide accurate information.

As sophistication is defined in terms of the inclusion of all costs, it is necessary to ensure that materials and labour are complete. When the operating unit produces only customized products, the emphasis was not the percentage of materials and labour in the product costs, but the quantity of different materials and labour used to produce the product. Thus, a company which recorded 100 components in a product cost making up 50 percent of the product cost would need a more sophisticated system, than a company which recorded one component making up 75 percent of the product cost. The same argument applies to the recording of labour costs. It is the quantity of different types of and the rates per hour worked of labour, rather than the total cost of labour that requires a more sophisticated system. In a manufacturer of bespoke metal sheets, one of the key problems in product costing was recording the times worked and rate per hour of the different types of labour that worked on the variety of different labour routings through the factory. In the situation when an operating unit produced a combination of standardized and customized products, then this did not have any effect on sophistication. Sophistication is affected only when the operating unit produces solely customized products.

For those operating units that did not make solely customized sales, sophistication was limited by the cost of the product costing systems, and the time available for and

the cost of collecting data and operating the system. The latter result is surprising because it has been claimed that data collection and operating costs are not a barrier against increasing cost system sophistication beyond a single volume-based cost driver rate (Drury et al. 1993; Drury 2004) and for implementing ABC (Cooper 1988a).

As in the case of identifying the influences on overhead assignment sophistication, when the parent company determines the design of the product costing system then that determines the inclusion of all costs sophistication. Hence Figure 1 also applies to inclusion of all costs sophistication. Figure 3 shows a model of inclusion of all costs sophistication when the parent company does not determine the design of the product costing system or the operating unit does not have a parent. This model can be used to test and refine, using qualitative or quantitative research methods, the influence of six independent constructs on sophistication. The parent may influence the design of the system by specifying the software that is used and/or the importance of product cost information in the operating unit. In this case more powerful software and/or a higher level of importance for product cost information are/is expected to increase sophistication. In the same way, the software used by an operating unit that has the freedom to determine which software to use could influence sophistication by providing a limit on the design of the product costing system.

The production and sale of solely customized products is expected to have an indirect and positive effect on sophistication via the level of manufacturing technology, and the quantity of different materials and labour included in the product. The software used by the operating unit when it chooses its own software is expected to have a direct effect on sophistication. Also, a lack of funds to invest in a product costing system is expected to have a direct and negative effect on sophistication, and

the lack of time available for and cost of data collection are expected to have a direct and negative effect. If the models shown in Figures 1, 2 and 3 were tested using quantitative multiple regression techniques the model's constructs could be obtained via a questionnaire, and Table 5 provides details of how these constructs could be measured.

Insert Figure 3 here

Insert Table 5 here

Understandability sophistication

Each of the four operating units that defined sophistication in terms of understandability had a parent and for two of them the parent specified the design of the product costing system. Hence, the factors determining sophistication are the same as those shown in Figure 1. In both cases the costing system was simple and hence understandable by non-accounting staff. Of the other two operating units, in one, the production process was labour intensive and costing was kept as simple as possible so that the labour on the factory floor understood why they were booking the materials used and their time worked to individual products produced. This helped to ensure the accuracy of material, labour and overhead costs in product costs. The other operating unit had invested in new software to include more overheads in the product cost, but one effect of this was that the system had become less understandable by non-accounting staff. As a result the company had to perform a balancing act between having more product costs that included more overheads and a less understandable product costing system. Overall, the main determinant of understandability

sophistication was the need to design and operate a product costing system that was understandable to both the suppliers and users of this information.

CONCLUSION

Prior research into the sophistication of the product costing system has assumed that sophistication relates to the assignment of overheads to products. The results of this cross-sectional field study show that this is a narrow view of sophistication. Although 16 different definitions of sophistication were provided by the interviewees, two were found to predominate, namely overhead assignment and the inclusion of all costs. This shows the advantage of carrying out cross-sectional field study research to obtain the views of practitioners in the field about a research topic. In this case, this led to the development of not only different definitions of sophistication, but different models of the influences on different definitions of sophistication. This can allow the research in this area to progress in different directions by developing, testing and refining different models of sophistication using both qualitative and quantitative research methods. These different research methods should be seen as complementing each other in developing knowledge (Goulding 2002; Lillis and Mundy 2005).

An alternative perspective is that the assignment of overheads to product costs is the key issue in product costing. This is illustrated by this issue taking up a large proportion of leading cost/management accounting textbooks (e.g. Kaplan and Atkinson 1998; Atkinson et al. 2004; Drury 2004; Horngren et al. 2006), and articles in both practitioner magazines and academic journals. As a consequence, research such as this paper could be regarded as a waste of time. However, it is not the

privilege of academics to determine what is meant by a management accounting concept. This is the preserve of the management accountants themselves, who are working in management accounting. Their voice should and deserves to be heard, and this has been attempted in this paper and has resulted to in the development of the topic.

It is important to note that some of the constructs which have been included in prior research into both overhead assignment sophistication and ABC adoption are not included in the models of overhead assignment and inclusion of all costs sophistication. In relation to these models these include JIT production, number of production lines, organizational size, organizational structure and product diversity. Given the small samples used to develop the models it is important that future research does not totally discard these constructs, and does consider whether they should be included in refinements of the model.

Although the coding techniques used to analyse the interviews are used in grounded theory (Strauss and Corbin 1998), this research does not actually apply pure grounded theory (Lillis 1999) because of the structured method of data collection and because it does not use theoretical sampling.¹⁷ Theoretical sampling was not used because the sample of interviewees was effectively a convenience sample based upon questionnaire respondents who agreed to be interviewed. This may mean that the results are incomplete and could limit the influence of the findings on theory development (Ferreira and Merchant 1992; Keating 1995; Lillis and Mundy 2005). As a consequence, the models developed in this research cannot be described as high level theories (Llewelyn 2003). They are low level theories, and are what Llewelyn (2003) describes as level two: differentiation theories. This means that these findings should not only be tested using quantitative research methods, but also replicated and

confirmed or refined by other field studies. This would either give credence to the results of this research or the refinement of the results which could range from minor modifications to major changes.

As stated earlier, Abernethy et al (2001) pointed out that the decision to invest in AMT has the effect of reducing overheads which means that when a diverse range of products is produced there is less need for a sophisticated product costing system. Although the management accountants were asked which type of technology their operating units used in production (including AMT), many of them did not know the difference between different types of manufacturing technology, like numerical control machines, computer-aided manufacturing, flexible manufacturing systems and AMT, or, if they did, they did not know if these types of technology were used in the factory. As a consequence, this data was too unreliable to be analysed. Future research needs to replicate the work of Abernethy et al. (2001) to confirm whether investment in AMT results in a decline in overheads and an investment in a relatively unsophisticated product costing system.

Further research needs to replicate the results of this research, not only in the UK, but in other countries in order to refine the models and to compare them between different countries. Unlike this research, which developed the models across a variety of manufacturing industries, there is a need to develop models in different manufacturing industries to confirm if there are differences between industries. This could assist in understanding if one definition of sophistication is more appropriate in one industry than another. As well as developing and refining models there is a need to test them using quantitative research methods and quantitative researchers should not be hesitant to embrace the results of qualitative research into their models (Chapman 1997).

Given the issues identified above these results are still significant because they provide an alternative approach to the study of the sophistication of the product costing system which has yielded different results from prior research. These are the identification of a variety of definitions of the sophistication of the product costing system and that for the two main ones, overhead assignment and the inclusion of all costs, there are differences in the influences upon these two types of sophistication. As a consequence, the results of this research illustrate the opportunity for cross-sectional field study research to enhance our understanding of a research area and model development.

TABLE 1
Other Definitions of Sophistication

	<u>N</u>
The ability of directly charge overheads to products	2
How frequently product costs are updated	2
Tracking costs through the production process to supply costs at each production stage	2
Product costing systems that meet the business need	2
Product costing systems that can be used in decision making	2
Inclusion of all costs in product costs and the speed with which information is provided to users	1
Whether and how non-manufacturing overheads are assigned to product costs	1
Recording a detailed bill of materials	1
The production of accurate product costs	1
The production of accurate actual product costs	1
The ability to provide information about product profitability and customer profitability, and for being used for financial accounting purposes and commercial decisions	1
The quality of information it supplies to management, the speed at which it supplies information to management and its ability to change for a different set of circumstances	1
How quickly information can be obtained from the product costing system to respond to a query	<u>1</u>
	<u>18</u>

Table 2
The Sophistication of the Interviewees' Product Costing Systems
for each Type of Sophistication

	<u>Unsophisticated</u>	<u>Neutral</u>	<u>Sophisticated</u>	<u>Total</u>
Overhead assignment	7	5	–	12
Inclusion of all costs	4	7	–	11
Understandability	<u>4</u>	<u>–</u>	<u>–</u>	<u>4</u>
	<u>15</u>	<u>12</u>	<u>–</u>	<u>27</u>

Table 3
A Comparison of Interviewees' Perception of Overhead Assignment Sophistication and the Number of Cost Drivers and Number of Cost Centers Included in the Product Costing System

	<u>Unsophisticated</u>	<u>Neutral</u>	<u>Total</u>
Panel A: Overhead Assignment Sophistication and the Number of Cost Drivers			
3 cost drivers	1	1	2
2 cost drivers	1	3	4
1 cost driver	4	1	5
0 cost drivers	<u>1</u>	<u>—</u>	<u>1</u>
	<u>7</u>	<u>5</u>	<u>12</u>
Panel B: Overhead Assignment Sophistication and the Number of Cost Centers			
60 cost centers	—	1	1
21 cost centers	1	—	1
12 cost centers	1	1	2
8 cost centers	—	1	1
7 cost centers	1	1	2
6 cost centers	—	1	1
4 cost centers	1	—	1
1 cost center	2	—	2
0 cost centers	<u>1</u>	<u>—</u>	<u>1</u>
	<u>7</u>	<u>5</u>	<u>12</u>

Table 4
A Comparison of Interviewees' Perception of Inclusion of All Costs
Sophistication and the Number of Cost Drivers and
Number of Cost Centers Included in the Product Costing System

	<u>Unsophisticated</u>	<u>Neutral</u>	<u>Total</u>
Panel A: Overhead Assignment Sophistication and the Number of Cost Drivers			
3 cost drivers	–	2	2
2 cost drivers	–	2	2
1 cost driver	3	3	6
0 cost drivers	<u>1</u>	–	<u>1</u>
	<u>4</u>	<u>7</u>	<u>11</u>
Panel B: Overhead Assignment Sophistication and the Number of Cost Centers			
22+ cost centers	–	1	1
20 cost centers	1	1	2
11 cost centers	1	1	2
7 cost centers	–	1	1
4 cost centers	–	1	1
1 cost center	1	2	3
0 cost centers	<u>1</u>	–	<u>1</u>
	<u>4</u>	<u>7</u>	<u>11</u>

TABLE 5
Measurement of the Constructs in the Models
of Overhead Assignment and Inclusion of All Costs Sophistication

<u>Construct</u>	<u>Possible Methods of Measuring Constructs</u>
Dependent construct: Sophistication When defined as:	
Overhead assignment	Number of second-stage cost drivers, number of first-stage cost pools, psychometric construct assessing the sophistication of the system at including the different types of overhead in the product cost
Inclusion of all costs	Psychometric construct assessing the sophistication of the system at including all the different types of materials, labour and overhead in the product cost
Other constructs	
Parent company specifies the design of the product costing system	Coded yes = 1 and no = 0
Parent company specifies the software to be used	Coded yes = 1 and no = 0
Parent company specifies the importance of product cost information in decision making	Coded yes = 1 and no = 0
Power of software used by the operating unit when it chooses its own software	Psychometric construct
Operating unit profit	E.g. Average gross profit margin, net profit margin over a number of prior years
Importance of product costs in decision making	Psychometric construct
Management's demand for product cost information	Psychometric construct
Level of manufacturing technology	Psychometric construct
Level of overheads	E.g. Proportion of non-facility level manufacturing overheads to total manufacturing costs, non-facility level overheads to total costs
Level of customized sales	Psychometric construct
Solely customized sales	Coded all customized = 1, not all customized = 0
Level of competition	Psychometric construct
Quantity of different materials and labour included in product	Psychometric construct
Lack of funds available to invest in the product costing system	Psychometric construct
Lack of time available for and the cost of data collection and operation	Psychometric construct

FIGURE 1
Model of Overhead Assignment Sophistication when the Parent Company
Determines the Design of the Product Costing System



FIGURE 2
Model of Overhead Assignment Sophistication when the Parent Company Does Not Determine the Design of the Product Costing System or the Operating Unit Does Not Have a Parent

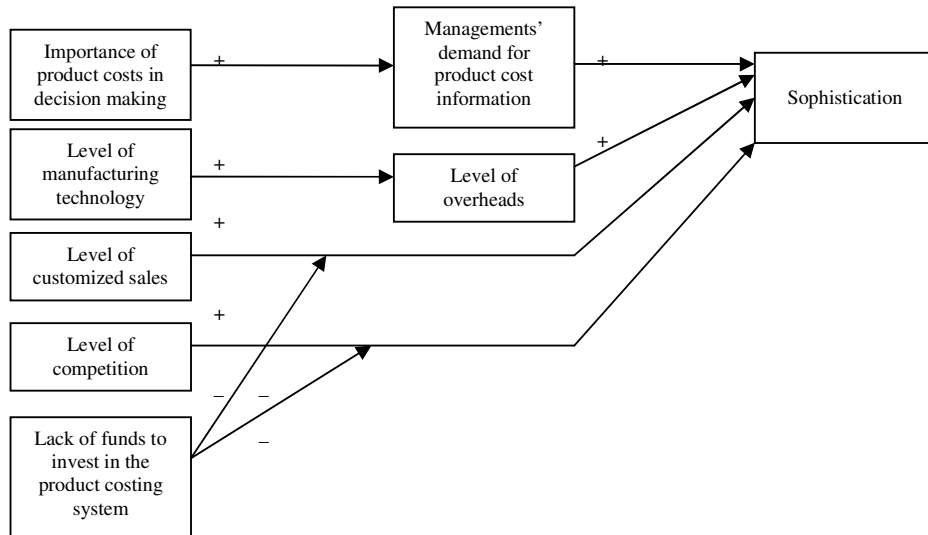
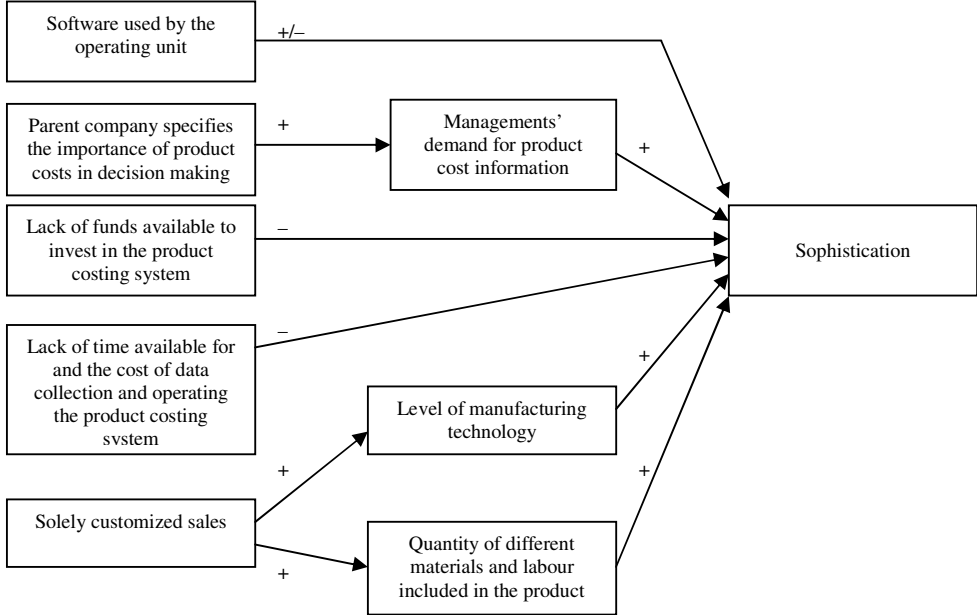


FIGURE 3
Model of Inclusion of All Costs Sophistication when the Parent Company Does Not Determine the Design of the Product Costing System or the Operating Unit Does Not Have a Parent



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NOTES

¹ The terms product costing system, costing system, cost system and system are used interchangeably throughout the paper.

² The term sophistication is not a standard term in the product costing literature. Drury and Tayles (2005) used the terms sophistication and complexity interchangeably, although they tended to use the term complexity more often. This is because one of the reviewers to Drury and Tayles (2005) preferred the term complexity to sophistication (Private communication with Colin Drury).

³ The terms indirect overhead costs, indirect overheads, indirect costs, overhead costs and overheads are used interchangeably throughout the paper.

⁴ The Drury and Tayles (2005) include firms from both manufacturing and non-manufacturing industry.

⁵ The terms first-stage cost pools and cost pools, and the terms second-stage cost drivers and cost drivers which form part of the two-stage overhead allocation and assignment process are used interchangeably throughout the paper.

⁶ For a discussion of each of these types of driver, see Kaplan and Cooper (1998).

⁷ In general, highly sophisticated product cost systems are expected to produce accurate product costs, but it is possible that a less sophisticated system will produce accurate product costs when overheads represent a small proportion of total costs and the products produced consume the costs of different activities in similar proportions (Drury and Tayles 2005). In this case a direct costing system may be appropriate (Cooper and Kaplan 1987; Cooper 1997). If the costs of increasing sophistication are less than the benefits of increasing that sophistication, then a more sophisticated system should be implemented and used (Cooper 1988a). In some cases, however, companies may deliberately produce inaccurate costs to induce desired behavioral responses (Merchant and Shields 1993). When implementing ABC, there is a trade-off between the accuracy of the product costing system and its sophistication (Homburg 2001). Namely, a high number of cost drivers are likely to lead to more accurate costs, whereas although a smaller number of cost drivers are likely to lead to less accurate costs, they are likely to lead to lower system running costs and will be easier for management to understand (Cooper 1990; Homburg 2001; and for an example illustrating this, see Innes and Mitchell 1989). In contrast, some researchers have found that the introduction of ABC had increased non-accountants understanding of cost information (Innes and Mitchell 1990, 1991; Gietzmann 1991; Bhimani and Pigott 1992; Norris 1994; Friedman and Lyne 1995; Greeson and Kocakulah 1997; Gunasekaran and Saradi 1998).

⁸ This statistic was not reported by Drury and Tayles (2005), and is calculated from data reported in their paper.

⁹ Drury and Tayles (2005) identify an eighth paper as Hoque and James (2000) (which they incorrectly refer to as Hoque (2000b)), but this paper is not concerned with ABC.

¹⁰ It is difficult to compare the results of these studies because they define ABC adoption in different ways. These include units that have defined ABC in terms of: using (or adopted or implemented) verses not using (or not adopted or not implemented) (Gosselin 1997; Joshi 1998; Clarke et al. 1999; Groot 1999), using verses rejected (Booth and Giacobbe 1998), using activity based cost allocation verses using volume-based cost allocations (Hoque 2000), using or implementing verses not using or not implementing, and using verses not using (Malmi 1999; Schoute 2004), implemented, currently implementing or wanted to implement it verses did not want to adopt or have not decided (Bjørnenak 1997) and using, implementing, approved for implementing, or implemented and abandoned verses considered then rejected, considering or not considered (Krumwiede 1998).

¹¹ This is based on a Mann-Whitney U statistic calculated by the author using the data provided by Clarke et al. (1999) comparing respondents using and not using ABC. The same statistic was applied for the results of the Clarke et al. (1999) study for the influence of product diversity and size on ABC use.

¹² A copy of the questionnaire is available upon request.

¹³ Thus, the results of this research were based on the responses of the interviewees. The questionnaire was used to gain access to the interviewees and provided information about product costing at the interviewee's operating unit prior to the interview. Management accounting research which has gained access to interviewees in this way includes: O'Dea and Clarke (1994), Scapens et al. (1996), Pierce and O'Dea (2003) and Vedd and Kouhy (2005). In addition, the questionnaire provided data that was used in analysing the results about the number of cost drivers and the number of cost centers used in product costing at each operating unit, and the annual sales turnover and number of employees in each operating unit.

¹⁴ The interviewees were not asked to clarify their answers in terms of the calculation of product costs in order not to influence their answer to this and subsequent questions about the level of sophistication of their product costing systems and the influences on this sophistication.

¹⁵ Drury and Tayles (2005) regard the term sophistication as being controversial because it could be construed that a sophisticated system is a desirable system for all companies. They point out that simplistic systems may be viewed as being sophisticated by small companies, whereas large companies would regard them as being simplistic. A review of the operating unit sizes by annual sales turnover and number of employees did not reveal any patterns across the three different types of sophistication because the operating units were of a similar size. Of the 27 operating units, only three operating units had a turnover in excess of £100m and only one had in excess of 1,000 employees.

¹⁶ One of the operating units that defined sophistication as overhead assignment sophistication used direct costing.

¹⁷ When using theoretical sampling the sample evolves during the research and is not predetermined at the start of the research. Each case sampled using theoretical sampling builds upon and adds to data already collected and analysed, and contributes to building theory. As the analysis progresses the sampling becomes more specific because the researcher is interested in sampling only those cases that contribute to building theory.