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An examination of the factors influencing the inclusion of non-manufacturing overhead costs in product costs

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Abstract: Research has not examined the factors influencing the inclusion of non-manufacturing overhead costs in product costs. This paper addresses this deficiency by using the results of questionnaires completed by British management accountants in manufacturing industry to test a logistic regression model of the factors influencing whether or not non-manufacturing overhead costs are included in product costs that are used in decision making. The only significant effect in the logistic regression analysis was for the percentage of non-manufacturing overhead costs to either total costs or total overhead costs, but the result was not in the direction expected. Specifically the smaller the non-manufacturing overhead percentage the more likely were operating units to include non-manufacturing overhead costs in product costs. In addition, there were non-significant effects for the level of competition, product customisation, the influence of financial reporting requirements over product costing and operating unit size, when measured by annual sales revenue or number of employees.

Keywords: non-manufacturing overhead costs, manufacturing overhead costs, questionnaire survey, logistic regression analysis

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1 Introduction

The 1980s and 1990s saw a lot of criticism of the allocation and assignment of so-called fixed overhead costs to manufactured product costs, (e.g. Kaplan, 1984, 1985, 1988; Cooper and Kaplan, 1987, 1988, 1991; Johnson and Kaplan, 1987; Kaplan and Cooper, 1998). It was argued that the inappropriate allocation and assignment of overhead costs resulted in the calculation of inaccurate products costs. This led to the possibility of incorrect decisions being made through, for example, ceasing the production of profitable products and continuing the production of unprofitable products (e.g. Kaplan, 1988; Drury et al., 1993; Drury and Tayles, 1994, 1995, 2000; Kaplan and Cooper, 1998). Prior research has examined the validity of these criticisms by identifying the methods used to allocate and assign total overhead costs or manufacturing overhead costs to product costs in manufacturing industry (e.g. Cohen and Paquette, 1991; Shields et al., 1991; Ask and Ax, 1992; Clarke, 1992; Green and Amenkhienan, 1992), rather than non-manufacturing overhead costs. In addition, other research has been concerned with this issue through examining the application of activity-based costing and the extent to which it can overcome the criticisms referred to above (e.g. Innes and Mitchell, 1995; Groot, 1999; Innes et al., 2000; Cotton et al., 2003).

Drury and Tayles (1994) note that management accounting research has virtually ignored the treatment of non-manufacturing overhead costs in product costs. This

exclusion from prior research is surprising given that non-manufacturing overhead costs make up a substantial average percentage of total organisational costs, of slightly less than 20 percent (Drury et al. 1993; Lukka and Granlund, 1996; Clarke, 1997).[1] Given the above, the objective of this paper is to fill a gap in the costing literature by examining the factors that influence the inclusion/exclusion of non-manufacturing overhead costs from product costs that are used in decision making (when defined as selling price, make-or-buy, product mix, output level, cost reduction and product design decisions).[2] This is done by using the results of a questionnaire survey of management accountants in British manufacturing industry to test a logistic regression model of the influence of the level of competition, product customisation, size of the non-manufacturing overhead costs, extent to which financial accounting influences product costing and operating unit size on the inclusion/exclusion of non-manufacturing overhead costs from product costs used in decision-making. The remainder of the paper is organised in the following way. Section two presents a literature review of the limited research that has been undertaken into the treatment of non-manufacturing overhead costs in product costs, and the development of the research propositions and the logistic regression model. Section three details the research method. Section four reports the results and section five discusses the results and offers some conclusions.

2 Literature Review, Research Propositions and Model Development

2.1 Literature Review

For organisations that assign overhead costs to product costs, Johnson and Kaplan (1987), Kaplan (1988) and Kaplan and Cooper (1998) note that many of them assign only manufacturing overhead costs to product costs, and non-manufacturing overhead costs such as administration, corporate, distribution, marketing and selling costs are charged as a period cost to the profit and loss account in the year they are incurred. Only a limited number of somewhat dated surveys have examined the percentage of organisations that include non-manufacturing overhead costs in product costs used in decision making and these surveys show that the percentage varies considerably, ranging from 40 percent (Emore and Ness, 1991), 53 percent (Haldma and Lääts, 2002), 55 percent (Haldma et al., 1998), 61 percent (Lamminmaki and Drury, 2001), 78 percent (Drury et al., 1993) and 84 percent (Fremgen and Liao, 1981).

Kaplan and Cooper (1998) consider that excluding non-manufacturing overhead costs from product costs leads to the production of poor quality decision making information because of evidence that the inclusion of these costs in product costs can influence the relevance of product costs used in decision making (e.g. Johnson and Kaplan, 1987; Johnson and Loewe, 1987; Cooper and Kaplan, 1988; Kaplan, 1988; Menzano, 1991). Another reason for their inclusion arises from pricing research, which has found that total product costs, that is after the inclusion of non-manufacturing overhead costs are used in pricing decisions (Fremgen and Liao, 1981; Govindaragan and Anthony, 1983; Joye and Blayney, 1990; Dean et al., 1991; Drury et al., 1993; Haldma et al., 1998; Lamminmaki and Drury, 2001).

As well as the research described above, prior research into overhead costs has considered the factors that influence the number of overhead cost pools and cost drivers that are used to assign overhead costs to product costs (Abernethy et al., 2001; Drury and Tayles, 2005; Al-Omiri and Drury, 2007), and the factors influencing ABC usage relative to its non-usage (e.g. Bjørnenak, 1997; Gosselin, 1997; Krumwiede, 1998; Clarke et al., 1999; Groot, 1999; Malmi, 1999; Hoque, 2000; Baird et al., 2004; Brown et al., 2004; Al-Omiri and Drury, 2007; Baird, 2007). This paper extends this research to consider the factors that influence the inclusion of non-manufacturing overhead costs in product costs used in decision-making.

2.2 Proposition Development

Five constructs are examined as possible factors that could explain whether operating units, that include overhead costs in product costs used in decision-making, include non-manufacturing overhead costs in those costs. As prior research has not considered the issue of the factors influencing the inclusion of non-manufacturing overhead costs in product costs, propositions, rather than hypotheses, for the constructs are discussed below and from these the research model is derived.

2.3 Competition

Prior research has identified a positive relationship between the level of competition in the marketplace and the use of management accounting systems (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, 1988; Kaplan and Cooper, 1998). Even if firms do not implement ABC, it has been argued that in a competitive environment they need more detailed overhead allocation and assignment procedures to produce accurate product costs (Drury and Tayles, 2005). If more detailed overhead procedures are not used, as indicated, for example, by the exclusion of non-manufacturing overhead costs from product costs, then a competitor or competitors may take advantage of errors arising from their omission from product costs. Hence:

> *P1*: The level of competition is related positively to whether non-manufacturing overhead costs are included in product costs used in decision-making.

2.4 Product Customisation

Customised products are produced usually by non-repetitive manufacturing methods for which it is not possible to set standard costs (Drury and Tayles, 2005).[3] To increase the accuracy of customised product costs, more complicated overhead procedures may be required. An increase in the level of customised products would be expected to lead to increases in the cost of support services, such as selling and marketing, and raising invoices. In order to ensure that these costs are accounted for in decision-making, they should be included in product costs used in decision-making. Hence:

> *P2*: The level of product customisation is related positively to the inclusion of non-manufacturing overhead costs in product costs used in decision-making.

2.5 Non-manufacturing Overhead Costs

Given that overhead costs can be broadly classified between manufacturing and non-manufacturing overhead costs, it is proposed that operating units are more likely to include non-manufacturing overhead costs in their product costs, the higher the percentage share of these costs. Thus, if non-manufacturing overhead costs make up a relatively large percentage of operating unit costs then operating units may be more likely to include these costs in their product costs. Similarly, given that operating units which include overhead costs in product costs are likely to include manufacturing overhead costs in their product costs, they may be more likely to include non-manufacturing overhead costs in their product costs as well if they make up a relatively large percentage of their total overhead costs. Hence:

> *P3*: The percentage share of non-manufacturing overhead costs is related positively to the inclusion of non-manufacturing overhead costs in product costs used in decision-making.

2.6 Financial Accounting Influence

Kaplan and Cooper (1998) and Lamminmaki and Drury (2001) speculate that their non-inclusion is because financial accounting standards prohibit the assignment of these non-manufacturing overhead costs to product costs, but this has not been tested in prior research. Consequently, if financial accounting standards exhibit such an

influence over product costing practice, then non-manufacturing overhead costs will not be included in product costs. Hence:

> *P4*: The level of influence of financial accounting requirements over product costing is related negatively to the inclusion of non-manufacturing overhead costs in product costs used in decision-making.

2.7 Operating Unit Size

In prior research relating to overhead cost pools and costs drivers, Drury and Tayles (2005) and Al-Omiri and Drury (2007) found that operating unit size, when measured by annual sales revenue, was related positively to the number of cost pools and cost drivers included in the costing system. Krumwiede (1998) points out that the reasons for this size effect are unclear. It may be that larger operating units have access to relatively larger resources, and are therefore able to invest in product costing systems that use more cost pools and more cost drivers. Furthermore, Drury and Tayles (2005) point out that larger organisations are likely to have a greater range of products, services and customers, which creates the need for more cost pools and cost drivers. A similar argument can be applied to the issue of non-manufacturing overhead costs. Larger organisations may have the resources necessary to invest in product costing systems that include non-manufacturing overhead costs, as well as manufacturing overhead costs, in product costs. Hence:

> *P5*: Operating unit size is related positively to whether non-manufacturing overhead costs are included in product costs used in decision-making.

2.8 The Research Model

The four propositions described above can be summarised in the following quantitative research model, which can be used to test the influence of the four constructs on the inclusion of non-manufacturing overhead costs in product costs used in decision-making. For those manufacturing firms that include overhead costs in their product costs, the dependent construct is whether or not non-manufacturing overhead costs are included in product costs used in decision-making. Given that this is a binary coded construct, the research model is in the form of a binary logistic regression (hereafter logistic regression) model. The model can be written in the form of the log of the odds of non-manufacturing overhead costs being included in product costs, that is:

$$\log\left(\frac{p(\text{NMOD INCLUDED})}{p(\text{NMOD NOT INCLUDED})}\right)$$

$$= B_0 + B_1(\text{COMP}) + B_2(\text{CUST}) + B_3(\text{NMODPER}) + B_4(\text{FINACC}) + B_5(\text{SIZE}) \quad (1)$$

or as the odds of non-manufacturing overhead costs being included, that is:

$$\frac{p(\text{NMOD INCLUDED})}{p(\text{NMOD NOT INCLUDED})}$$

$$= e^{B0 + B1(\text{COMP}) + B2(\text{CUST}) + B3(\text{NMODPER}) + B4(\text{FINACC}) + B5(\text{SIZE})} \quad (2)$$

$$= e^{B0}\, e^{B1(\text{COMP})} e^{B2(\text{CUST})} e^{B3(\text{NMODPER})} e^{B4(\text{FINACC})} e^{B5(\text{SIZE})} \quad (3)$$

Where:

NMOD INCLUDED = Non-manufacturing overhead costs are included in product costs used in decision-making.

NMOD NOT INCLUDED	=	Non-manufacturing overhead costs are not included in product costs used in decision-making.
COMP	=	The level of competition in the market.
CUST	=	The level of product customisation.
NMODPER	=	The percentage of non-manufacturing overhead costs measured by either the percentage of non-manufacturing overhead costs to total costs (total operating unit costs) (NMOD/TC) or the percentage of non-manufacturing overhead costs to the total overhead costs (manufacturing and non-manufacturing overhead costs) (NMOD/TODC).
FINACC	=	The extent to which financial accounting requirements influence product costing requirements.
SIZE	=	The size of an organisation measured by either the annual sales revenue (SALES) or the number of employees (EES).
$B_{0 \ldots 5}$	=	Unstandardised regression coefficient.

From the above, there are four versions of the model, depending on whether NMODPER is measured by NMOD/TC or NMOD/TODC and whether SIZE is measured by SALES or EES. Version 1 includes NMOD/TC and SALES, version 2 includes NMOD/TC and EES, version 3 includes NMOD/TODC and SALES, and version 4 includes NMOD/TODC and EES. The four versions of the model are shown in the Appendix.

3 Research method

Questionnaire subjects were obtained from a list of 854 members of the Chartered Institute of Management Accountants in Great Britain with job titles of cost, management or manufacturing accountant, and working in British manufacturing industry. An introductory letter was posted to all potential subjects outlining the research objectives and informing them that they would receive a questionnaire in two weeks time. Each questionnaire included a covering letter, which assured subjects of the confidentiality of their responses, and a stamped-addressed envelope. Non-respondents to the initial mailing of the questionnaire were posted a follow-up letter two weeks later, and another follow-up letter, questionnaire and stamped-addressed envelope were posted to non-respondents two weeks after that. After identifying potential subjects who had worked in the same operating unit, potential subjects who had left their operating unit, operating units that had closed down, and subjects who did not work in manufacturing or product costing, the total potential subjects employed in independent operating units decreased to 673. A total of 280 usable responses were received (effective response rate = 41.6 percent) and, of these, 274 respondents indicated that they used product costs in decision-making.[4]

The questionnaire covered a number of product costing issues and respondents were asked to answer the questionnaire from the perspective of the operating unit in which they worked. Information about whether or not non-manufacturing overhead costs are included in product costs used in decision-making was obtained from a question that asked how non-manufacturing costs are treated in product costs. This had responses of, they are not included in product costs (coded 0), or they are allocated to products on the basis of the manufacturing costs of each product, selling

price of each product, the cause (cost driver) of each type of non-manufacturing overhead cost or other (all coded 1). Given that in some cases, operating units will not consider including non-manufacturing overhead costs in their product costs because they use direct costing, it was necessary to exclude these operating units from the sample. They were identified by responses to another question that asked how operating units calculated overhead rates and contained a response relating to the use of direct costing.[5] This means that the sample tested in the research model included at least manufacturing overhead costs in product costs.[6]

The level of competition was measured by responses to two questions developed by the researcher. The first question covered the current general level of competition for the major products produced by the operating unit with responses on a five-point Likert scale ranging from 1 = Very intense to 5 = Very slack. The second question requested information about the expected level of competition over the next two years for the major products produced by the operating unit, with responses ranging from 1 = Very high to 5 = Very low. For the purpose of data analysis, the scores on these two questions were reverse scored and summed and divided by 2 to provide a measure of the general level of competition from a high score of 5 to a low score of 1.

Product customisation was also measured by two questions developed by the researcher. For both questions, respondents were required to identify the range of products produced on a five-point Likert type scale. For the first question responses ranged from 1 = Virtually all customised products to 5 = Virtually all standardised products and for the second question responses ranged from 1 = At least 95% of products produced are unique and produced to satisfy individual customer's orders to 5 = At least 95% of products are identical products produced in large quantities. For

data analysis, the responses to both questions were reverse scored and summed and divided by 2 to give a high score of 5 to a low score of 1.

The two measures of the percentage share of the non-manufacturing overhead costs were obtained from responses to a question that requested information about the cost structure of the operating unit. Respondents were requested to provide the percentages of direct material costs, direct labour costs, manufacturing overhead costs and non-manufacturing overhead costs to total operating unit costs. The percentage of non-manufacturing overhead costs to total operating unit costs (NMOD/TC) was obtained directly from questionnaire responses. The percentage of non-manufacturing overhead costs to total overhead costs (NMOD/TODC) was calculated as the percentage of non-manufacturing overhead cost percentage to the total overhead cost percentage (manufacturing overhead cost and non-manufacturing overhead cost percentages).

Financial accounting influence was measured by responses to two questions developed by the researcher. Both questions asked about the extent to which the need to meet financial accounting requirements influences the need to produce product cost information for decision making. The responses to both questions were coded on a five-point Likert scale ranging from 1 = strongly agree to 5 = strongly disagree. For the purpose of data analysis, the scores on these two questions were reverse scored and summed and divided by 2 to provide a measure of financial reporting influence from a high score of 5 to a low score of 1.

Operating unit size was measured in two different ways. Respondents were asked to indicate the approximate annual sales revenue of their operating unit in the last financial year and the approximate number of employees in their operating unit. As the distribution of both size measures was skewed positively and to reduce the

number of outliers in the logistic regression analysis, a $\log_n$ transformation was applied to these constructs in the subsequent logistic regression analysis.

4 Results and Discussion

Using listwise deletion, there were 169 useable respondents included in the logistic regression analysis. The discriminant validity of the three psychometric measures of competition, product customisation and financial accounting influence was confirmed by an exploratory factor analysis using a principal components analysis with a varimax rotation. This reveals that the three measures of each construct loaded on to three separate factors, with eigenvalues exceeding one.[7] In addition, the discriminant validity of these three factors was confirmed by the non-significant ($p > 0.05$) Spearman rank correlation coefficients between them. The reliabilities of these constructs were confirmed by Cronbach's alpha for the competition, product customisation and financial accounting influence constructs of 0.932, 0.800 and 0.601 respectively. Two of these are at least equal to the recommended level of 0.80 (Carmines and Zeller, 1979), and the reliability of the financial accounting influence measure is slightly higher than the minimum acceptable level of 0.60 (Price and Mueller, 1986).

In addition, the construct validity of all of the constructs was assessed by calculating Cramér's Coefficient C for the dependent construct in the research model with the independent constructs.[8] These correlations are shown in Table 1, and reveal that the only significant correlation is with product customisation. The discriminant validity of the independent constructs in the model is confirmed in Table 1 by the low Spearman rank correlation coefficients between them. Only one of the correlations is

significant, between NMOD/TC and annual sales revenue (r = –0.288), which indicates that the independent constructs are measuring different constructs. In addition, this indicates that multicollinearity is unlikely to be a problem in the logistic regression analysis. The correlations between each of the two measures of non-manufacturing overhead cost percentage and operating unit size are 0.745 and 0.812 respectively. This indicates that, as expected, each of these two items are each measuring similar constructs, and justifies excluding them from the same version of the model.

Insert Table 1 about here

Descriptive statistics for each of the constructs included in the research model are shown in Table 2. The descriptive statistics show that the majority (61.5 percent) of operating units include non-manufacturing overhead costs in product costs used in decision-making. This provides up-to-date information about the level of inclusion and the result is between the extremes found in prior research. In addition, operating units face a high level of competition; produce a mixture of customised and standardised products; on average, non-manufacturing overhead costs make up a low absolute percentage of total operating unit costs, which is similar to prior empirical research, and about half of all overhead costs; and financial accounting requirements do not tend to influence product costing. Although there are some large operating units included in the sample, many of them are not very large. This is illustrated by the upper quartiles for annual sales revenue and number of employees being £80m and 765 employees respectively.

Insert Table 2 about here

Table 3 shows the results of the logistic regression analysis for the four versions of the research model. In all versions of the model, the Homer and Lemeshow goodness-of-fit statistic is not significant, which indicates a good fit. For each version, the only significant effect is for the non-manufacturing overhead costs percentage using either of the measurement methods. However, the sign of the regression coefficient is not in the direction expected. This shows that the lower the percentage of non-manufacturing overhead costs to total operating unit costs or to total overhead costs, the higher is the likelihood of operating units including non-manufacturing overhead costs in their product costs. Hence, none of the five propositions involving the effect of competition, product customisation, non-manufacturing overhead percentage, financial accounting influence and size are accepted.

In versions 1 and 2 of the model, the non-manufacturing overhead cost percentage is measured by the percentage of non-manufacturing overhead costs to total operating unit costs. In version 1, size is measured by the annual sales revenue and this model predicts 86.5 percent of those including non-manufacturing overhead costs in product costs correctly and 29.2 percent of those not including non-manufacturing overhead costs are predicted correctly. This results in 64.5 percent of the total 'includers' and 'non-includers' being predicted correctly, which is higher than the 50 percent indicated by the naïve model. In version 2, size is measured by the number of employees and this model predicts 86.5 percent of those including non-manufacturing overhead costs in product costs correctly and 27.7 percent of those not including non-manufacturing overhead costs are predicted correctly. This results in 63.9 percent of the total 'includers' and 'non-includers' being predicted correctly. In

versions 3 and 4 of the model, the non-manufacturing overhead cost percentage is measured by the percentage of non-manufacturing overhead costs to total overhead costs. In version 3, size is measured by the annual sales revenue and this model predicts 86.5 percent of those including non-manufacturing overhead costs in product costs correctly and 24.6 percent of those not including non-manufacturing overhead costs are predicted correctly. This results in 62.7 percent of the total 'includers' and 'non-includers' being predicted correctly. Finally, in version 4, size is measured by the number of employees and in this model, 85.6 percent of those including and 23.1 percent of those not including non-manufacturing overhead costs are predicted correctly. This again results in 61.5 percent of the total 'includers' and 'non-includers' being predicted correctly.

The implication of the results in Table 3 is that when there is an absolute one percent increase in the non-manufacturing overhead cost percentage and the values of the other independent constructs remain unchanged, the log odds of non-manufacturing overhead costs being included in product costs used in decision making decreases by 0.042, 0.044, 1.936 and 1.959 (the value of the regression coefficient or B_3 in the model) in versions 1, 2, 3 and 4 respectively. Similarly, the odds of non-manufacturing overhead costs being included in product costs decreases by 0.958, 0.957, 0.144 and 0.141 (which is shown in the Exp(B) column in Table 3) in versions 1, 2, 3 and 4 respectively.

Insert Table 3 about here

5 Conclusion

This paper has used logistic regression analysis to assess the impact of the factors that influence the inclusion of non-manufacturing overhead costs in product costs used in decision-making in operating units in British manufacturing industry. The results of the research indicated that just over half of the operating units included non-manufacturing overhead costs in product costs, which is between the extremes found in prior research. The only significant effect in the logistic regression analysis was for the percentage of non-manufacturing overhead costs when measured relative to either total operating unit costs or total overhead costs. However, the sign of the effect was not in the direction expected. The lower the non-manufacturing overhead cost percentage the more likely were operating units to include non-manufacturing overhead costs in product costs used in decision-making.

The results indicate that the level of competition, product customisation, financial accounting influence and operating unit size do not have a significant effect on the inclusion decision. The non-significant effect for competition may indicate that, contrary to Cooper (1988), Kaplan and Cooper (1998) and Drury and Tayles (2005), the marketplace does not have any affect on the design of the product costing system. Hence, it is not anticipated that the results would change if there were a sudden increase in the level of competition. The lack of an effect for the level of product customisation on the inclusion decision may be because any changes in the level of product customisation are more likely to have an impact on manufacturing overhead costs, rather than non-manufacturing overhead costs and consequently they may be more likely to affect whether manufacturing overhead costs are assigned to product costs. The relatively moderate level of the influence of financial accounting

requirements over product costing may explain its non-significance. In other words, as operating units' product costing methods are not influenced heavily by financial accounting requirements, operating units prepare their product costs to satisfy their own internal reporting requirements. The lack of an effect relating to operating unit size indicates that operating units that did not include non-manufacturing overhead costs may have the resources in their product costing systems to include these costs in their product costs but choose not do this for cost-benefit reasons.

The limitations of the research includes problems with possible non-response bias to the questionnaire, possible response bias to the questions in the questionnaire and possible model misspecification that may be a consequence of variables being omitted from the model. The latter problem may exist in this research given that the Cox & Snell R^2 and Nagelkerke R^2, shown in Table 3, are all small.[9] This may indicate that the significant effect for non-manufacturing overhead costs is a spurious result and that there are other factors that need to be taken into consideration. Thus further research could consider including the extent to which non-manufacturing costs are relevant costs for decision making, the level of importance given to producing relevant product costing information for decision making, whether all or only some non-manufacturing overhead costs are included in product costs, the extent to which individual non-manufacturing costs can be identified because some may be joint costs that are not separately identifiable and the extent to which it is possible to assign non-manufacturing costs to product costs using non-volume-based cost drivers.

Appendix: The Four Versions of the Research Model

Version 1:

$$\log\left(\frac{p(\text{NMOD INCLUDED})}{p(\text{NMOD NOT INCLUDED})}\right)$$

$$= B_0 + B_1(\text{COMP}) + B_2(\text{CUST}) + B_3(\text{NMOD/TC}) + B_4(\text{FINACC}) + B_5(\text{SALES})$$

or as the odds of non-manufacturing overhead costs being included, that is:

$$\frac{p(\text{NMOD INCLUDED})}{p(\text{NMOD NOT INCLUDED})}$$

$$= e^{B0 + B1(\text{COMP}) + B2(\text{CUST}) + B3(\text{NMOD/TC}) + B4(\text{FINACC}) + B5(\text{SALES})}$$

$$= e^{B0}\, e^{B1(\text{COMP})} e^{B2(\text{CUST})} e^{B3(\text{NMOD/TC})} e^{B4(\text{FINACC})} e^{B5(\text{SALES})}$$

Version 2:

$$\log\left(\frac{p(\text{NMOD INCLUDED})}{p(\text{NMOD NOT INCLUDED})}\right)$$

$$= B_0 + B_1(\text{COMP}) + B_2(\text{CUST}) + B_3(\text{NMOD/TC}) + B_4(\text{FINACC}) + B_5(\text{EES})$$

or as the odds of non-manufacturing overhead costs being included, that is:

$$\frac{p(\text{NMOD INCLUDED})}{p(\text{NMOD NOT INCLUDED})}$$

$$= e^{B0 + B1(\text{COMP}) + B2(\text{CUST}) + B3(\text{NMOD/TC}) + B4(\text{FINACC}) + B5(\text{EES})}$$

$$= e^{B0}\, e^{B1(\text{COMP})} e^{B2(\text{CUST})} e^{B3(\text{NMOD/TC})} e^{B4(\text{FINACC})} e^{B5(\text{EES})}$$

Version 3:

$$\log\left(\frac{p(\text{NMOD INCLUDED})}{p(\text{NMOD NOT INCLUDED})}\right)$$

$$= B_0 + B_1(\text{COMP}) + B_2(\text{CUST}) + B_3(\text{NMOD/TODC}) + B_4(\text{FINACC}) + B_5(\text{SALES})$$

or as the odds of non-manufacturing overhead costs being included, that is:

$$\frac{p(\text{NMOD INCLUDED})}{p(\text{NMOD NOT INCLUDED})}$$

$$= e^{B0 + B1(\text{COMP}) + B2(\text{CUST}) + B3(\text{NMOD/TODC}) + B4(\text{FINACC}) + B5(\text{SALES})}$$

$= e^{B0}\, e^{B1(COMP)} e^{B2(CUST)} e^{B3(NMOD/TODC)}\, e^{B4(FINACC)} e^{B5(SALES)}$

Version 4:

$\log\left(^{p(\text{NMOD INCLUDED})}/_{p(\text{NMOD NOT INCLUDED})}\right)$

$= B_0 + B_1(COMP) + B_2(CUST) + B_3(NMOD/TODC) + B_4(FINACC) + B_5(EES)$

or as the odds of non-manufacturing overhead costs being included, that is:

$^{p(\text{NMOD INCLUDED})}/_{p(\text{NMOD NOT INCLUDED})}$

$= e^{B0 + B1(COMP) + B2(CUST) + B3(NMOD/TODC) + B4(FINACC) + B5(EES)}$

$= e^{B0}\, e^{B1(COMP)} e^{B2(CUST)} e^{B3(NMOD/TODC)} e^{B4(FINACC)} e^{B5(EES)}$

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Table 1 Cramér's coefficient C and Spearman rank correlation coefficients[a]

	1.	2.	3.	4a.	4b.	5	6a.	6b.
1. NMOD INCLUDED[b]	1.000							
2. COMP	0.210	1.000						
3. CUST	0.303*	0.016	1.000					
4a. NMOD/TC	0.598[c]	−0.120	−0.067	1.000				
4b. NMOD/TODC	0.799[c]	–0.069	–0.048	0.745**	1.000			
5. FINACC	0.133	−0.010	−0.014	0.074	0.089	1.000		
6a. SALES	0.742[c]	0.104	0.001	−0.288**	–0.089	0.097	1.000	
6b. EES	0.755[c]	0.053	0.006	−0.107	–0.106	0.112	0.812**	1.000

Note: [a] * $p < 0.05$, ** $p < 0.001$.

[b] As this construct is coded on a nominal scale (non-manufacturing overhead costs included or not included), all of the correlation coefficients involving this construct are calculated using Cramér's coefficient C. All of the correlation coefficients between the independent constructs in the research model are Spearman rank correlation coefficients.

[c] Although these values of Cramér's coefficient C are higher than the significant value of 0.303 with product customisation, the coefficients are not significant because the significance is given by a chi-square statistic with $df = (r - 1)(k - 1)$, where k is the number of points on the scale measuring the dependent construct ($k = 2$) and r is the number of points on the scale measuring the independent construct. For the competition and product customisation construct, $r = 5$. However, the non-manufacturing overhead percentage and size constructs are measured on a ratio scale and r is much higher. This means that the df is high and the chi-square statistic is not high enough for these values of Cramér's coefficient C to be significant.

Table 2. Descriptive Statistics

Constructs	Median	Mean	Standard Deviation	Minimum	Maximum
Competition[a]	4.500	4.340	0.616	2.000	5.000
Product differentiation[a]	3.000	3.142	1.322	1.000	5.000
NMOD/TC	15.000%	16.927%	10.240	1.000%	51.000%
NMOD/TODC	50.000%	47.770%	19.362	6.000%	95.000%
FINACC[a]	3.000	2.899	0.922	1.000	5.000
Size: Annual sales revenue[b]	£40.000m	£42.317m	2.468	£1.600m	£4386.000
Size: Number of employees[b]	380.000	403.187	1.763	20.000	12000.000

	N	*(%)*
Include non-manufacturing overhead costs in product costs	104	(61.5)
Do not include non-manufacturing overhead costs in product costs	65	(38.5)
	169	(100.0)

Note: [a] Scored from lowest possible score = 1 to highest possible score = 5.
[b] The values for the median and mean are the antilog of the $\log_n$(SALES) and $\log_n$(EES) median values, and the standard deviation is the square root of the antilog of the variance of the $\log_n$(SALES) and $\log_n$(EES) values.

Table 3. Logistic regression analyses

	Regression coefficient	Standard error	Wald statistic	p	Exp(B)
Version 1: Including the percentage of non-manufacturing overhead costs to total operating unit costs (NMOD/TC) and operating unit size measured by annual sales revenue.					
Constant	–0.418	1.428	0.086	0.770	0.659
Competition	0.204	0.267	0.584	0.445	1.226
Product differentiation	0.190	0.126	2.289	0.130	1.210
NMOD/TC	–0.042	0.017	6.530	0.011*	0.958
Financial accounting influence	−0.040	0.182	0.047	0.828	0.961
Size: Annual sales revenue	0.072	0.130	0.309	0.578	1.075

Note: * $p < 0.05$.
[a]Hosmer and Lemeshow Test: $X^2 = 3.776$, df = 8, $p = 0.877$.
–2 Log Likelihood = 213.420.
Cox & Snell $R^2 = 0.067$.
Nagelkerke $R^2 = 0.091$.

Version 2: Including the percentage of non-manufacturing overhead costs to total operating unit costs (NMOD/TC) and operating unit size measured by the number of employees.					
Constant	–0.449	1.592	0.080	0.778	0.638
Competition	0.208	0.266	0.612	0.434	1.231
Product differentiation	0.188	0.126	2.238	0.135	1.207
NMOD/TC	–0.044	0.016	7.273	0.007**	0.957
Financial accounting influence	−0.031	0.182	0.028	0.866	0.970
Size: Number of employees	0.048	0.158	0.093	0.761	1.049

Note: ** $p < 0.01$.
[a]Hosmer and Lemeshow Test: $X^2 = 3.687$, df = 8, $p = 0.884$
–2 Log Likelihood = 213.639
Cox & Snell $R^2 = 0.066$
Nagelkerke $R^2 = 0.090$

Table 3 (continued) Logistic regression analyses[a]

	Regression coefficient	Standard error	Wald statistic	p	Exp(B)
Version 3: Including the percentage of non-manufacturing overhead costs to total overhead costs (NMOD/TODC) and operating unit size measured by annual sales revenue					
Constant	–0.318	1.447	0.048	0.826	0.728
Competition	0.183	0.264	0.482	0.488	1.201
Product differentiation	0.198	0.125	2.508	0.113	1.219
NMOD/TODC	–1.936	0.870	4.955	0.026*	0.144
Financial accounting influence	−0.047	0.181	0.069	0.793	0.954
Size: Annual sales revenue	0.124	0.126	0.969	0.325	1.132

Note: * $p < 0.05$.
[a]Hosmer and Lemeshow Test: $X^2 = 5.205$, df = 8, $p = 0.735$.
–2 Log Likelihood = 215.088.
Cox & Snell $R^2 = 0.058$.
Nagelkerke $R^2 = 0.079$.

Version 4: Including non-manufacturing overhead costs to total overhead costs (NMOD/TODC) and operating unit size measured by the number of employees.					
Constant	–0.231	1.616	0.020	0.886	0.794
Competition	0.193	0.263	0.541	0.462	1.213
Product differentiation	0.195	0.125	2.441	0.118	1.215
NMOD/TODC	–1.959	0.868	5.093	0.024*	0.141
Financial accounting influence	−0.028	0.181	0.025	0.875	0.972
Size: Number of employees	0.049	0.156	0.100	0.752	1.050

Note: * $p < 0.05$
[a]Hosmer and Lemeshow Test: $X^2 = 4.190$, df = 8, $p = 0.840$
–2 Log Likelihood = 215.976
Cox & Snell $R^2 = 0.053$
Nagelkerke $R^2 = 0.072$

Notes

[1] In the latter paper, Lukka and Granlund (1996) refer to fixed manufacturing costs and other fixed costs. The latter are assumed to be the same as non-manufacturing overhead costs.

[2] In addition to decision making, other roles of product cost information that are not covered in this research include: (1) the allocation of costs between cost of goods sold and inventory for the purpose of inventory valuation and profit measurement and (2) planning, control and performance measurement (Johnson and Kaplan, 1987; Kaplan and Cooper, 1998).

[3] The product customisation construct is not the same as product diversity, which has been used in the models of overhead assignment procedures developed by Drury and Tayles (2005) and Al-Omiri and Drury (2007). Specifically, product diversity can be divided between volume diversity and support diversity. The former is analogous to product customisation and the latter arises from products consuming resources in different proportions. As the level of support diversity increases, then the complexity of the production process can increase. By having support diversity, a company is able to produce customised products.

[4] A copy of the questionnaire is available upon request.

[5] This response was "Overhead rates are not calculated. Direct costs are directly identified with products and overhead costs are charged as a period cost to the profit and loss account. Of the other five possible responses available, three related to various forms of absorption costing, one related to ABC and the fifth requested a description of other methods.

[6] The possibility of non-response bias was tested by a Chi-square test for the dependent construct and Mann-Whitney tests for the independent constructs to compare respondents who had returned the questionnaire prior to the first reminder being sent out ($n = 101$) and those who returned the questionnaire after the second reminder had been sent out ($n = 30$). This did not reveal any significant differences between these two groups and, hence, non-response bias may not be a problem. This and all subsequent statistical tests are two-tailed tests, and the default level of significance is $p = 0.05$.

[7] The factor loadings were 0.927 and 0.926 for each of the two items measuring competition, 0.914 for both the two items measuring product customisation, and 0.846 and 0.845 for each of the two items measuring financial accounting influence. The appropriateness of the factor analysis was confirmed by the Kaiser-Meyer Olkin measure of sampling adequacy (Kaiser, 1974), Bartlett's Test of Specificity (Bartlett, 1950, 1951) and reviewing the off-diagonal elements of the anti image covariance matrix (Kaiser, 1963; Dziuban and Shirkey, 1974).

[8] Cramér's Coefficient C measures the degree of association when one or more of the constructs is measured on a nominal scale (see Siegel and Castellan, 1988).

[9] These are logistic regression analysis' equivalent of the adjusted R^2 in linear regression analysis.