

# The Determinants of Overhead Assignment Sophistication in Product Costing Systems

John A. Brierley

The assignment of overhead costs to product costs has been identified as one of the key issues in ensuring that accurate product costs are calculated and used in decision making.<sup>1</sup> Inaccurate product costs may lead to incorrect decisions, such as producing unprofitable products and not producing profitable products.<sup>2</sup>

Recent research has identified overhead assignment sophistication as the most commonly defined form of product cost-system sophistication.<sup>3</sup> This type of sophistication relates to how the product costing system is designed to assign overhead costs to product costs. The research found that overhead assignment sophistication varies from a direct costing system (when indirect costs are excluded from product costs) to an activity-based costing (ABC) system,

*What factors influence the sophistication of a company's product costing system? Maybe not surprisingly, the answer seems to be "parent companies," when they exist. Otherwise, the degree of importance of product cost information in decision making at the company plays a big role, as this article explains.*

© 2010 Wiley Periodicals, Inc.

which identifies overhead costs in different cost pools and assigns them to products using a variety of cost drivers consisting of volume- and batch-level cost drivers.

In between these two extremes, overhead assignment sophistication can vary from a product costing system with a single cost center and a single cost driver, to a large number of cost centers and a few volume-level cost drivers. At least three research articles have developed and tested models of the influences on the overhead assignment sophistication of product costing systems. Drury and Tayles<sup>4</sup> and Al-Omiri and Drury<sup>5</sup>

adopted a deductive research approach by developing and testing models, using multiple regression analysis, of the factors influencing overhead assignment sophistication when measured by the number of cost pools and the number of cost

drivers used to assign overhead costs to product costs. In contrast, Abernethy et al.<sup>6</sup> adopted an inductive research approach to develop a model of the impact of product customization (or, as they called it, *product diversity*) on the number of cost pools and cost drivers.

Given the relatively little research that has been conducted in this area, it is perhaps a little presumptuous to adopt a deductive research approach. It is preferable in the early stage of research in this area to adopt an inductive research approach by developing a model of the influences on overhead assignment

sophistication. This builds on the research of Abernethy et al. but extends it by identifying all the main factors influencing overhead assignment sophistication, rather than just examining the influence of product customization. This model can then be tested using a deductive research approach.

This article relies on interviews with management accountants in the manufacturing industry in Great Britain to develop a model of the factors influencing overhead assignment sophistication. The results show that when an operating unit has a parent company, the parent determines the design of the product costing system; this is the sole determinant of overhead assignment sophistication.

By contrast, when an operating unit does not have a parent company or the parent does not influence the design of the product costing system, overhead assignment sophistication is influenced by:

- the impact of the importance of product costs in decision making on management's demand for product cost information;
- the influence of the level of manufacturing technology on the level of overhead costs; and
- the moderating effect of the lack of funds to invest in the product costing system on the influence of the level of customized sales and the level of competition on overhead assignment sophistication.

### **FACTORS INFLUENCING OVERHEAD ASSIGNMENT SOPHISTICATION**

The three articles described earlier examined the influence of

a number of factors on overhead assignment sophistication. In these articles, overhead assignment sophistication has been defined in terms of the number of cost pools, the number of cost drivers, or a combination of both of these, and the results of this research are described in the paragraphs that follow.

When higher levels of indirect overhead costs are incurred to produce products, there is likely to be a need for greater overhead assignment sophistication to assign these costs to products. If not, significant distortions may occur in product costs. In cases when overhead costs

*The results show that when an operating unit has a parent company, the parent determines the design of the product costing system; this is the sole determinant of overhead assignment sophistication.*

(excluding facility-level costs) make up a large proportion of total product costs, some have suggested that ABC should be used.<sup>7</sup> Drury and Tayles and Al-Omiri and Drury, however, did not find a significant influence for indirect costs as a percentage of total costs on overhead assignment sophistication.

In relation to product costing, it has been suggested that when competition is intense, firms should implement ABC.<sup>8</sup> Even if a firm does not implement ABC, it has been argued that firms have a greater need in a competitive environment for a higher level of overhead assignment sophistication.<sup>9</sup> If this level of overhead assignment sophistication is not implemented, then

a competitor or competitors may take advantage of errors from inaccurate product costs. Accordingly, Al-Omiri and Drury found a significant influence for the intensity of competition on overhead assignment sophistication, although Drury and Tayles did not find a significant effect.

When more customized products are produced, it is likely that more activities and overhead costs will be required to produce them. Consequently, overhead costs will increase, and it is likely that a higher level of overhead assignment sophistication will be required to capture these activities in product costs.<sup>10</sup>

Ultimately, an ABC system may be required.<sup>11</sup> From this, as product customization increases, overhead assignment sophistication would have to increase to capture this customization. Al-Omiri and Drury did not find a significant relationship between them. However, this result should be interpreted with care, because Abernethy et al.

found that the relationship was moderated by whether or not operating units used advanced manufacturing technology (AMT) in their production process. This was because AMT reduced overhead costs, and consequently only a low level of overhead assignment sophistication was required to assign overhead costs to products.

Drury and Tayles pointed out that the cost of operating a product costing system with high levels of overhead assignment sophistication is likely to be related positively to the level of customized production.<sup>12</sup> Companies that produce a high level of customized products may need to undertake a cost-benefit analysis to see if they are able to

invest in a high level of overhead assignment sophistication. If they do not pass this cost-benefit analysis, they will not invest in a higher level of overhead assignment sophistication. As a consequence of undertaking cost-benefit analyses, Drury and Tayles anticipated that lower levels of overhead assignment sophistication will be used in operating units producing customized products, while higher levels will be used by operating units producing a higher level of standardized products. Finding a negative relationship between product customization and overhead assignment sophistication confirmed this result.

Drury and Tayles and Al-Omiri and Drury observed that organizational size, when measured by annual sales revenue, was related positively to overhead assignment sophistication. This may be because larger organizations tend to have access to relatively larger resources and are able to invest in higher levels of overhead assignment sophistication.

If product costs are important in decision making, more accurate product costs will be needed to make those decisions. Consequently, as the importance of product costs increases, then higher overhead assignment sophistication will be required to calculate more accurate product costs. Al-Omiri and Drury found a positive relationship between the importance of product costs in decision making and overhead assignment sophistication. In contrast, Drury and Tayles did not find a significant relationship, but this may be because they measured importance by the importance of periodic profitability analysis in decision making, which may not be the most appropriate measure.

In addition, Al-Omiri and Drury found that the quality of information technology used by organizations and the extent to which organizations adopted other accounting innovations did not have a significant influence on overhead assignment sophistication. Having reviewed the results of prior research, the article continues by describing the research methods used to derive the research model of the determinants of overhead assignment sophistication.

## RESEARCH METHOD

The interviewees for this research were obtained from answers to a questionnaire concerned with product costing in manufacturing industry.<sup>13</sup> The questionnaires were sent to a list of management accountants supplied by the Chartered Institute of Management Accountants in Great Britain with job titles of cost, management, or manufacturing accountant, and employed in the British manufacturing industry. A total of 280 usable questionnaires were received (the effective response rate was 41.6 percent). Of these, 274 respondents indicated that they

used product costs in decision-making, and 55 ticked a box on the back cover of the questionnaire to indicate their willingness to make themselves available for a face-to-face interview to discuss their questionnaire responses in more detail. The interviews were conducted at the interviewees' workplaces; they were semi-structured, tape-recorded, and lasted for an average of 96 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 how they defined sophistication. Twelve interviewees defined it in terms of overhead assignment sophistication. They were then asked which factors influenced this sophistication. Descriptive statistics relating to the size of these operating units are shown in Exhibit 1.

## RESULTS AND DISCUSSION

In operating units that had a parent company and whose parent specified the design of the product costing system, the parent determined the level of overhead

**Exhibit 1**

### Descriptive Statistics Relating to Size of the Operating Units (*n* = 12)

	<i>Annual Sales Revenue</i>	<i>Number of Employees</i>
Mean	£65.6m	502.6
Standard Deviation	£87.4m	541.4
Median	£31.5m	250.0
Minimum	£10.0m	140.0
Maximum	£305.0m	2,000.0

assignment sophistication. In this case, the product costing system was a standardized system across all subsidiaries in the group.

In other cases, operating units were able to design their own product costing system, and there were a number of influences on overhead assignment sophistication. The importance of product cost information in decision making influenced management's demand for that information and, hence, the overhead assignment sophistication. Thus, the more information management demands, the more sophisticated the system needs 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 the operating unit developing an in-house ABC system, which involved the company identifying, along with two volume-level cost drivers, separate batch-level cost pools and their associated batch-level 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 overhead assignment sophistication by identifying other suitable cost pools and cost drivers from the product costing system.

The higher the level of manufacturing technology, the more overhead costs were incurred and the higher the level of overhead assignment sophistication needed to assign overhead costs to products. In one operating unit, the technology was simple and produced a simple product.

As manufacturing overhead costs represented 22 percent of manufacturing costs, there was little need to use a large number of different cost drivers to assign manufacturing overhead costs to product costs and, hence, the product costing system was relatively simple and assigned overhead costs to product costs using two cost drivers. This result is contrary to Drury and Tayles and Al-Omiri and Drury who did not find a significant relationship between the level of indirect costs to total costs and overhead assignment sophistication.

A major factor limiting the extent to which operating units can assign overhead costs to products in a more precise man-

*The higher the level of manufacturing technology, the more overhead costs were incurred and the higher the level of overhead assignment sophistication needed to assign overhead costs to products.*

ner 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 low levels of overhead assignment sophistication, even though they would like to invest in higher levels of sophistication. For example, in one operating unit, the interviewee explained that because of software limitations only a direct labor hour rate could be used to assign overhead costs 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] labor, 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 overhead costs to products, this did not directly influence overhead assignment sophistication because it was 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 overhead assignment sophistication, and the company would invest

in a product costing system that could record the cost of customized products. This is different from Drury and Tayles' argument, whereby there is a negative relationship between product customization and sophistication. In this research, the lack of funds that 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 product customization and overhead assignment 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 product customization and overhead assignment 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 overhead assignment sophistication directly, if the company had the funds to

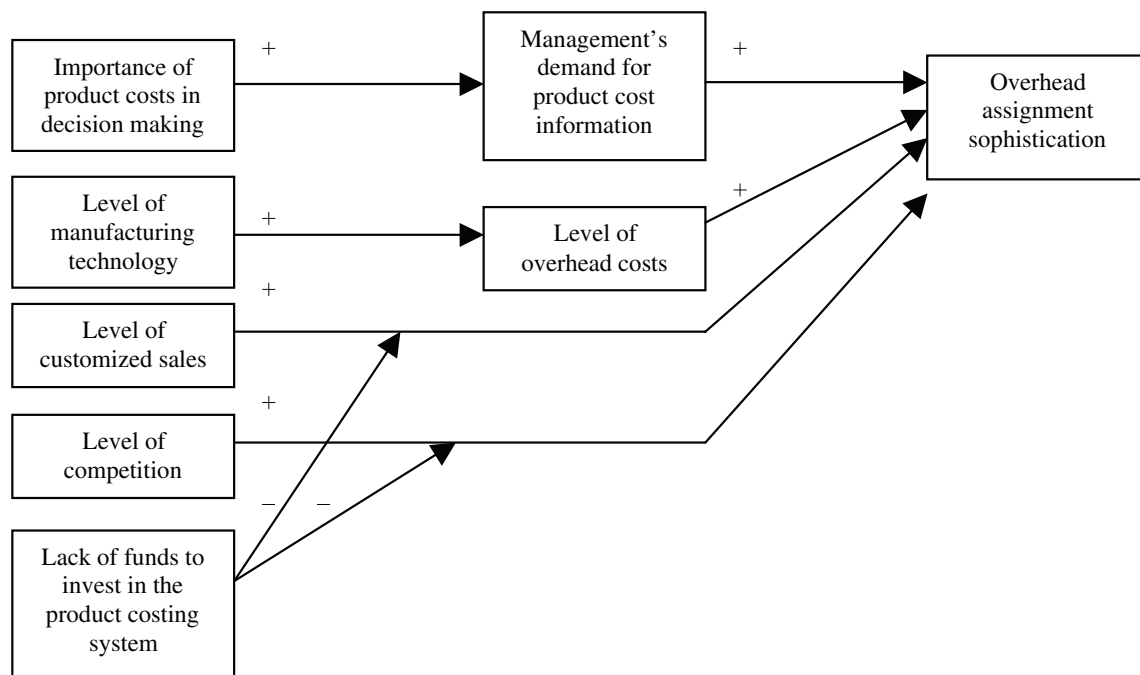
invest in the required hardware and software. This finding shows that prior researchers need to consider refining their models of the influence of the level of competition by not assuming that competition influences overhead assignment sophistication directly. The finding in this research is not new, and surveys have found that a high cost was an important factor limiting the extent to which companies can implement complex management accounting systems.<sup>14</sup>

In prior deductive research, operating unit size has been hypothesized and found to have a direct influence on overhead assignment sophistication.<sup>15</sup> In this research, no such effect was observed. The results of this

research show that, rather than including operating unit size as a factor in models of the factors influencing overhead assignment sophistication, it is more appropriate to include the more refined factor of the funds available for investment in the product costing system. In addition, prior research has hypothesized that operating unit size has a direct and positive effect on overhead assignment procedures. The results of this research reveal that size, in the context of having the funds to invest in a product costing system, has a moderating effect on the influence of the level of customized sales and the level of competition on overhead assignment sophistication. In future research,

**Exhibit 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**



researchers will need to test for the existence of this moderating effect.

From the above analysis, when the parent company determines the design of the product costing system, this is the sole influence on overhead assignment sophistication and is dependent on factors peculiar to the parent, which could either lead to increases or decreases in overhead assignment sophistication. Exhibit 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.

In the model, the importance of product cost information in decision making is expected to have a positive and indirect influence on overhead assignment sophistication via management's demand for product cost information. The level of manufacturing technology is expected to have a positive and indirect effect on overhead assignment sophistication via the level of overhead costs. The level of customized sales and the level of competition are expected to have positive effects on overhead assignment sophistication, but each of these effects are moderated by not having the funds available to invest in product costing systems.

## CONCLUSION

This article has used the results of interviews with qualified management accountants in the British manufacturing industry to develop a model of the determinants of the overhead assignment sophistication of product costing systems. The resulting model is summarized in Exhibit 2.

It is important to note that some of the factors that have been included in prior research into overhead assignment sophistication were not included in the model of overhead assignment sophistication. These include organizational size, the quality of information technology, and the extent to which the organization has adopted other accounting innovations. Given the small sample used to develop the model, it is important that future research does not totally discard these factors and considers whether they should be included in refinements of the model.

As stated earlier, Abernethy et al. pointed out that the decision to invest in AMT has the effect of reducing overhead costs, 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 they were used in their operating unit. Consequently, this data was too unreliable for analysis. Future research needs to replicate the work of Abernethy et al. to confirm whether investment in AMT results in a decline in overhead costs and a need to invest in a relatively unsophisticated product costing system.

Given the issues identified above, these results are still significant because they provide an inductive-based approach for the development of a model of the influences on overhead assign-

ment sophistication. In order to progress research in this area, this article takes a step back from prior research models, which have imposed a model for testing, by developing a model for testing. It is now the job of researchers to test this model using empirical data.

## NOTES

1. Kaplan, R. S., & Cooper, R. (1998). *Cost and effect: Using integrated systems to drive profitability and performance*. Boston, MA: Harvard Business School Press.
2. Ibid.
3. Brierley, J. A. (2008). Toward an understanding of the sophistication of product costing systems. *Journal of Management Accounting Research*, 20(Special Issue), 61–78.
4. Drury, C., & Tayles, M. (2005). Exploring the design of overhead absorption procedures in UK organizations. *British Accounting Review*, 37, 47–84.
5. Al-Omiri, M., & Drury, C. (2007). A survey of factors influencing the choice of product costing systems in UK organizations. *Management Accounting Research*, 18, 399–424.
6. Abernethy, M. A., Lillis, A. M., Brownell, P., & Carter, P. (2001). Product diversity and costing design: Field study evidence. *Management Accounting Research*, 12, 261–280.
7. See note 1.
8. See note 1. Cooper, R. (1988). The rise of activity-based costing—Part two: When do I need an activity-based cost system? *Journal of Cost Management for the Manufacturing Industry*, 2(3), 41–48.
9. Cooper, R. (1988). The rise of activity-based costing—Part two: When do I need an activity-based cost system? *Journal of Cost Management for the Manufacturing Industry*, 2(3), 41–48.
10. See note 4.
11. See note 8.
12. See note 4.
13. See note 3.
14. Cobb, I., Innes, J., & Mitchell, F. (1992). *Activity based costing—Problems in practice*. London: Chartered Institute of Management Accountants. Groot, T. L. C. M. (1999). Activity-based costing in U.S. and Dutch food companies. *Advances in Management Accounting*, 7, 47–63.
15. See notes 4 and 5.

**John A. Brierley** is a senior lecturer in accounting and finance at the University of Sheffield in the United Kingdom. A qualified chartered accountant, his teaching interests are in financial and management accounting, and his research interests are in product costing.