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Reasons for Adopting Different Capacity Levels in the Denominator of Overhead Rates: A Research Note

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Abstract

There has been criticism of the use of budgeted capacity as the denominator of overhead rates. Prior questionnaire-based research has analysed which type of capacity is used in the denominator of overhead rates, but it has not assessed why these capacity levels are used. This paper uses grounded theory techniques to analyse 50 interviews with British management accountants about why a particular capacity level is used to determine the denominator of overhead rates. The results reveal that budgeted capacity is used because the calculation of the denominator is regarded as part of the budgeting process. Practical capacity and normal capacity are used to ensure that products are not under or overcosted.

Keywords

Product Cost
Overhead Rate
Denominator Capacity
Budgeted Capacity
Practical Capacity
Normal Capacity.

Introduction

In general, the management accounting literature offers four methods for calculating the denominator capacity level of overhead rates. These are theoretical maximum capacity,¹ practical capacity, normal capacity and this year's budgeted capacity (e.g. DeBruine and Sopariwala, 1994; Dilton-Hill and Glad, 1994; McNair, 1994; Maguire and Heath, 1997; Drury, 2004). The theoretical maximum capacity is the maximum output a factory can produce over a period (normally one-year). The practical capacity is the theoretical maximum capacity less normal waste and idle time. The normal capacity is the average long-run factory output, which is the output a factory usually produces in a year. This year's budgeted capacity is determined as part of a company's planning process (McNair, 1994).

The annual budgeted capacity is an attractive method for calculating the denominator capacity because it is relatively easy to obtain an annual forecast of activity (Drury, 2004). Using this method each year's overheads are charged to the products produced in that year. Cooper and Kaplan (1991) reject the use of this year's budgeted capacity as the denominator because it is a short-term denominator capacity level that may distort product costs and may lead to incorrect product-related decisions.

When budgeted capacity varies from period to period to a different extent than variations in the budgeted overhead in the numerator of the overhead rate, they argue that budgeted capacity will lead to fluctuating overhead rates, which will not represent long-run cost driver rates. In periods of declining capacity the use of budgeted capacity in the denominator may lead to the *death spiral*, as increases in

¹ The US management accounting literature tends to refer to theoretical capacity rather than theoretical maximum capacity (e.g. DeBruine and Sopariwala, 1994; Dilton-Hill and Glad, 1994; Maguire and Heath, 1997; McNair, 1994). As this research is conducted in Great Britain, the British term theoretical maximum capacity is used instead (see Drury, 2004).

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overhead rates of products using this capacity leads to increases in product costs which in turn leads to increases in selling prices.

This is followed by reductions in demand and further reductions in capacity leading to further increases in overhead rates, product costs and selling prices (Cooper and Kaplan, 1991).

In the context of activity-based costing (ABC), Cooper and Kaplan (1992) argue that ABC systems are resource consumption models that are dependent on the use of practical capacity as the denominator of cost driver rates. By using practical capacity it is possible to distinguish between the cost of resources *available* for manufacturing, the cost of resources *used* in manufacturing and the cost of *unused* resources (Cooper and Kaplan, 1992).²

When using practical capacity the cost of not achieving this capacity is charged as a period cost to the income statement and is not charged to the product(s). Having product costs based on practical capacity levels that remain constant from period to period means that the variations in budgeted capacity, referred to above, do not influence product costs. Maguire and Heath (1997) point out that there are two problems with using practical capacity.

First, when determining the practical capacity, managers may allow for matters that are within their control and understate practical capacity, and overstate the overhead rate and product cost. Second, management may ignore the flexibility requirements that are needed when deciding the capacity level to provide a quality service.

Drury et al. (1993) point out that the advantage of normal capacity is that it provides an estimate of the long-run average capacity, because seasonal and cyclical fluctuations are averaged out. The

problem with this method, however, is the difficulty of estimating normal capacity. McNair (1994) considers the appropriate capacity is theoretical maximum capacity, because capacity should be regarded as the ability of a company to create value for its customers and resources that do not add value are waste. By minimising waste a company can maximise its capacity and establish a target to aim for, which helps to identify opportunities for improvement and waste management. Drury (2004) rejects the use of theoretical maximum capacity because it is unlikely to be achieved, and Maguire and Heath (1997) reject it because the achievement of theoretical maximum capacity may not be sustainable over the long-term and may lead to a decline in customer service.

Drury (2004) points out that practical capacity is more appropriate for human resources where the supply of resources can be adjusted to match demand, but its use is questionable for physical resources because their supply cannot be adjusted easily by discrete amounts. As a consequence, Drury (2004) argues that normal capacity should be used as a measure of physical resources, although the distinction between practical and normal capacity is only important when normal capacity is significantly less than practical capacity.

Although prior research has given an indication of *which* capacity levels are used in the denominator of overhead rates, Brierley et al. (2001), Drury and Tayles (1994, 1995) and Lamminmaki and Drury (2001) point out that research has not considered *why* certain capacity levels are used. As a consequence, the objective of this research is to extend prior research by adopting an interpretive approach using grounded theory techniques to develop an understanding about why certain capacity levels are used.

This is achieved by analysing the results of questionnaires sent to, and interviews with, management accountants working in British manufacturing industry. The results of this research will be useful to both academics and practitioners by giving an insight into why different capacity levels are used.

² The calculation of the practical capacity is beyond the scope of this paper, but is discussed in Sopariwala (1998, 1999).

The remainder of the paper is organised in the following way. The second section outlines prior research into the various methods used to calculate the capacity level in the denominator of overhead rates. The third section provides some information about the grounded theory technique. The fourth section details the research methods, the questionnaires, interviews, and the respondents of the survey. The fifth section reports and discusses the results of the survey. The sixth section concludes the research.

Prior Research

In the UK, Drury et al. (1993) found the majority of companies (66%) used this year's budgeted capacity as the denominator of overhead rates; whereas only 6% used practical capacity, 11% used normal capacity, 14% used actual capacity and 3% used other methods.

Similar results were reported in Ireland (Clarke, 1992). In New Zealand, Lamminmaki and Drury (2001) found that 60% used budgeted capacity, 2% used practical capacity, 13% used normal capacity and 25% used actual capacity, while in the USA, Chiu and Lee (1980) (reported in Sopariwala, 1998) found that 58% and 21.1% of survey respondents used budgeted and practical capacity respectively. Finally, of ten Swedish companies studied, eight used budgeted capacity and two used normal capacity (Alnestig and Segerstedt, 1996).

Although there has been a little research into the measurement of the denominator capacity level of overhead rates, from the evidence available, the majority of firms used budgeted capacity, which could lead to fluctuations in product costs from period to period and may adversely affect product-related decisions. Drury et al. (1993) suggest that the popularity of budgeted capacity arises from the desire to assign all overheads incurred to products rather than writing off any overheads arising from excess capacity as a period cost to the income statement. Furthermore, Drury and Tayles (1994) suggest that budgeted capacity is used because more realistic

forecasts can be made in a single year using this method than with other methods.

In addition, Drury and Tayles (1994) and Lamminmaki and Drury (2001) suggest that the popularity of budgeted capacity arises from the lack of coverage of this issue in cost/management accounting textbooks, and hence a lack of knowledge of alternatives. Thus, in addition to understanding its application in practice, there is a need to describe this issue in textbooks, although it is beginning to appear in leading textbooks (e.g. Drury, 2004; Horngren et al., 2002). Although the researchers listed above have speculated about why budgeted capacity is used in practice, to the authors' knowledge, no-one has investigated why budgeted capacity and other capacity levels are used in practice.

The Grounded Theory Technique

Grounded theory is a qualitative research method whereby theory is developed from data gathered and analysed as part of the process of building theory (Strauss and Corbin, 1998). The researcher builds theory by allowing theory to emerge from the data. Theory evolves during the research and is developed from the continual collection and analysis of data (Strauss and Corbin, 1998). Strauss and Corbin's (1998) approach to grounded theory is used in this research because the phenomena studied is specified in the questionnaire and forms the basis for understanding why different capacity levels are used in the denominator of overhead rates.

It is incorrect to say that the approach to grounded theory adopted in this research mirrors that of Strauss and Corbin (1998) because it does not use theoretical sampling. When using theoretical sampling, the sample evolves during the research and is not predetermined at the start of the research. Theoretical sampling is based on concepts that have emerged from the data analysis that seem to be relevant for building theory. As a result each case sampled 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. Theoretical sampling was not used in this research because the sample of interviewees was effectively a convenience sample based on the questionnaire respondents who agreed to be interviewed, which may mean that it may not be possible to develop theory fully.

Research Methods

Questionnaire Subjects and Questionnaire 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 respondents detailing the research objectives and informing them that they would receive a questionnaire two weeks later.

The questionnaires were 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. A further follow-up letter, questionnaire and stamped-addressed envelope were posted to non-respondents four weeks after the initial questionnaire had been sent out. 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).

Of these, 274 respondents indicated that they used product costs in decision making, of which 219 incorporated overheads into product costs and provided details of the

type of capacity level used in the calculation of overhead rates.³

Information about the calculation of the denominator in overhead rates was obtained from a single question on the questionnaire. Specifically, the question asked for information about *which* type of denominator was used in the calculation of overhead rates with possible responses of theoretical maximum capacity, practical capacity, normal capacity, this year's budgeted capacity, this year's actual capacity, last year's actual capacity and other.⁴

Interview Subjects and Interview Design

Of the 219 questionnaire respondents that assigned overheads in product costs, 50 indicated, by ticking a box on the back-cover of the questionnaire, that they were willing to make themselves available for an interview to discuss their questionnaire responses in more detail. Thus, the questionnaire provided a means of gaining access to the interviewees. The interviews were wide ranging and covered all aspects of product costing. They were conducted at the interviewee's place of work, were semi-structured, tape recorded, and lasted for an average of 1 hour 26 minutes. In relation to this research, the interviewees were asked *why* they used a particular capacity measure as the denominator of overhead rates.

Results

The Questionnaire Results

Table One shows, as in prior research, that the majority of questionnaire respondents calculated the denominator capacity level of overhead rates based on this year's

³ A copy of the questionnaire is available upon request from the first author.

⁴ The possibility of non-response bias could not be tested because it was not possible to perform a chi-square test to compare responses to the question about the denominator level in overhead rates from respondents who returned the questionnaire within two weeks of the initial questionnaire being sent out and respondents who returned the questionnaire after receiving the second follow-up letter four weeks after the initial questionnaire had been posted.

budgeted capacity (n = 118, 53.9%). Unlike prior research, however, a not insignificant proportion of respondents used practical capacity (n = 37, 16.9%) and normal capacity (n = 35, 16.0%). Relatively few respondents used theoretical maximum capacity, this year's actual capacity, last

year's actual capacity and other methods. The remainder of this section analyses why the interviewees shown in Table One used each method (except for theoretical maximum capacity for which there were no interviewees) to calculate the denominator capacity.

Table One: Denominator Capacity Levels Used to Calculate Overhead Rates

	Questionnaire respondents		Interviewees	
	N ^a	(%)	N	(%)
Theoretical maximum capacity	4	(1.8)	–	(–)
Practical capacity	37	(16.9)	9	(18.0)
Normal capacity	35	(16.0)	6	(12.0)
This year's budgeted capacity	118	(53.9)	27	(54.0)
This year's actual capacity	9	(4.1)	2	(4.0)
Last year's actual capacity	12	(5.5)	4	(8.0)
Other	4 ^b	(1.8)	2 ^c	(4.0)
	<u>219</u>	<u>(100.0)</u>	<u>50</u>	<u>(100.0)</u>

Notes: a. One-sample $X^2 = 317.187$, $df = 6$, $p = 0.000$.

b. The other questionnaire respondents are made up of (a) 70% of theoretical maximum capacity, (b) actual hours worked over the last three months, (c) this year's budgeted capacity updated at the half-year and (d) this year's budgeted capacity and this year's actual capacity.

c. Items (a) and (b) in note 2 above.

(Questionnaire respondents: useable N = 219, interviewees: useable N = 50)

Budgeted Capacity

Four of the 27 interviewees using budgeted capacity as the denominator of their overhead rates did not know why they used this type of capacity. Of the remaining 23 interviewees, 15 said they used budgeted capacity because this was part of the budgeting process. Of these 15 operating units, 12 gave this as the only reason for using budgeted capacity and three others gave this and one other reason, including that the budgeted capacity was near to practical capacity, near to normal capacity and the need to recover overheads from products produced.

Of the remaining eight operating units, three said the decision to use budgeted capacity was imposed by the parent

company, two used it as a method to recover overheads from products produced, two considered the information was readily available and one considered that budgeted capacity was similar to normal capacity. Most of the explanations provided were brief and offered little detail as to why operating units used budgeted capacity. The following is a more reasoned justification about why budgeted capacity was used as the overhead rate, based on the budget providing a target to be achieved and the need to recover overheads. The interviewee said:

We set a budgeted plan and then obviously we have a number of targeted hours that we would have. The objective of manufacturing was to

recover its material, labour and overhead costs within those production hours. So the obvious target for them was the rate per hour that was [based] on the budget.

Most interviewees in operating units using budgeted capacity could either not offer any reasons about why they did not use other methods to measure capacity, or were unaware of or incorrectly interpreted the implications of using these methods. For example, two interviewees said they did not use theoretical maximum, practical or normal capacity because the factory was not operating close to these capacity levels.

This view ignored the fact that any unused capacity calculated using these rates is not included in product costs, but is charged directly to the income statement. Another interviewee said his operating unit did not have the complexity in their production process to justify the use of other types of denominator, but it is uncertain how the complexity of the production process is related to the type of denominator used.

One interviewee claimed that practical capacity was inappropriate, because it would lead to prices being set at too low a level. This could be overcome, however, by charging a higher mark-up on product costs. Only one interviewee was aware of the possible implications of annual variations in the budgeted capacity. In order to try to smooth out variations in overhead rates arising from a sudden decrease in the budgeted capacity, the denominator capacity in this operating unit was reduced, but not to the budgeted level.

Eight interviewees were able to provide details of changes in budgeted capacity over time and the implications of this for product costs. Two said that capacity remained the same over time and hence product costs were not unaffected by capacity changes, three said that although capacity changed over time product costs did not change because total overheads changed in line with capacity, and a further three said changes in capacity led to changes in product costs. In the latter case, two interviewees said the increase in product

costs had affected decision-making. In one case the interviewee said it had become accepted that capacity reductions led to increases in overhead rates and increases in product costs.⁵

Practical Capacity

Five of the nine interviewees used practical capacity because the operating unit operated at this level of activity, so there was no unused capacity in these operating units. The interviewee from the only operating unit using activity-based costing was the only one to refer to using practical capacity as a method of capacity management and avoiding the *death spiral*.

He said:

We used to have a plant to convert seed to oil. ... We determined what was a desirable level of output for that plant, although they weren't making it, and we billed our costs up at what was a desired level rather than lose business by being over-priced. But what you then say is this is all the number of days we're doing. The slack is a management problem. You don't keep bumping up your recovery rate by reducing your denominator. What you say is what the denominator should be in that type of equipment and anything that falls short is a management problem and it's up to management to find out how they're going to fill that.

By using a practical capacity that was higher than both budgeted and actual capacity, the company was able to lower its costs in products using this capacity and thus keep its prices down.⁶ Similarly, another interviewee used practical capacity to avoid the *death spiral* because using a lower capacity would increase costs

⁵ In this case the interviewee said his operating unit had not given any consideration to using other measures of capacity, but he was interested in the subject and asked the interviewer to forward articles on capacity measurement.

⁶ The indication here is that companies were using a 'cost-plus' approach to pricing.

unrealistically in products using such capacities.

An interviewee, from a chemical company, said they used practical capacity because other methods of capacity were inappropriate. Specifically, he said that theoretical maximum capacity could not be sustained because vats would overflow leading to production problems. It was difficult to determine normal capacity because of seasonal fluctuations in demand and budgeted capacity was not used because of inaccuracies in the budget. Finally, one interviewee did not know why his operating unit used practical capacity.

Normal Capacity

Of the six interviewees using normal capacity, three said that normal capacity was approximately equal to the expected capacity of the factory. Of the other three interviewees, one said they used it because as prices were based on costs, using a capacity level “less than that we would be pricing ourselves out of the market”. From the opposite perspective, one interviewee said they did not use theoretical maximum capacity or practical capacity because this would lead to product costs being underestimated. In addition, this interviewee said normal capacity was used instead of budgeted capacity because of errors in the budget.

He said:

Budgeted capacity may be a target capacity, it may be pushed up a little bit for the budgeting exercise ... I use normal capacity for the rates rather than a budgeted capacity which had been enhanced to get the budget approved.

Another interviewee said normal capacity was used because it avoided the problems of using either budgeted or actual capacity.

He said:

It has been traditional in this company to use a constant approach and that

approach is felt to be best based on normal capacity. We do get peaks and troughs in capacity from year to year but it would be very difficult for us to try to set cost rates that took into account some years when business is running at a higher level than other years. So we tend to average the capacity out and work on what we would think of as a normal capacity. ... We wouldn't change that basis unless there was some change in the way the business was operating. Unless we know there was a new product that was going to give us extra demand and that we were going to create the manufacturing capacity to make that product.

This Year's Actual Capacity

Two operating units used this year's actual capacity to calculate actual product costs. One said they used the actual capacity for the previous 12 months (which was updated every month), and that budgeted capacity was not used because it was unlikely to be a fair reflection of actual capacity. The other said that at the start of the financial year the budgeted capacity was used as the denominator but this was revised each month based upon the year-to-date actual capacity level.

Last Year's Actual Capacity

Four interviewees used last year's actual capacity because the information was easy to use and readily available. One said slight adjustments were made to the capacity for inefficiencies in the previous year and following a comparison with the current year's budget. All of the interviewees said that overhead rates did not fluctuate dramatically from year to year, and hence avoided the potential problem of fluctuations in product costs. In addition, they added that this measure of capacity was preferable to either theoretical maximum, practical or normal capacity because of the problem of defining these capacity levels.

Other Methods

There were two interviewees using other methods to calculate the denominator. One

operating unit calculated capacity as 70% of the theoretical maximum capacity. The interviewee said this percentage could be higher or lower than practical capacity, but that overhead rates remained constant from year to year and would only decrease following cost reductions. The other operating unit measured capacity as the actual hours worked over the last three months because this was the method specified by the US parent company, but the interviewee believed the method was superior to budgeted capacity because of the unreliability of the budget.

Conclusion

This paper has applied grounded theory techniques to develop an understanding about the reasons for using different capacity levels in the denominator of overhead rates in manufacturing industry. The insights obtained are that operating units use budgeted capacity as the denominator of their overhead rates because this is deemed to be part of the budgeting process. In other words, budgetary information that has been prepared for planning and control purposes is being applied in product costing and decision making.

This method of calculating overhead rates is deeply embedded in operating units that use it (Burns et al., 2003; Burns and Scapens, 2000), so much so that they are unaware of the possibility of product costs including the cost of unused capacity in product costs and, as a consequence, adversely affecting product related decisions.

In addition, they are unaware of the implications of using practical or normal capacity level, which would exclude the cost of unused capacity from product costs. In some cases, the use of budgeted capacity did not have an effect on decision making either because the capacity or the overhead rate remained constant over time. In other cases, the overhead rate increased because of reductions in capacity, which had increased product costs of the products using such capacities, and this in turn affected decision-making. In this case, the danger is that operating units will descend

into the death spiral because increases in product costs may lead to increases in selling prices followed by a decline in demand leading to further falls in capacity and an increase in overhead rates, product costs and prices. There is a need for the management accountants to be educated, possibly through continuing practice development, about the alternative ways of calculating the denominator of overhead rates and the implications of doing this for product costs and decision-making.

Practical capacity and normal capacity are used to ensure that products are not under or overcosted, which, in the latter case, could lead to them being overpriced. Those using practical or normal capacity were trying to calculate overhead rates, which remained relatively constant over time and hence avoided fluctuations in product costs and the possibility of changes in prices and the death spiral.

In addition, many of the interviewees using practical or normal capacity were aware of why they were not using budgeted capacity. In comparison to prior research, a higher percentage of the questionnaire respondents used practical or normal capacity, which may be an indication that the increasing coverage of this subject in cost/management accounting textbooks is beginning to have an influence on practice. As stated earlier, however, there is a need to continue to increase the education of management accountants about this issue.

Interviewees using this year's actual capacity were trying to calculate the actual cost, rather than the standard cost, of the product. Those using last year's actual capacity used it because the information was readily available and this avoids the problem of calculating the denominator using the actual capacity for the period, which is unlikely to be readily available.

Furthermore, the denominator used did not vary with the turnover, number of employees, the type of production process, manufacturing overhead percentage, non-manufacturing overhead percentage, whether profitability analysis is used in decision-making and the importance of

product costs in various types of decisions in operating units.

Given that the theory building in the research has been based on convenience sampling, rather than theoretical sampling, the understandings developed in this paper should be regarded as tentative and incomplete. As a consequence, the results of the research have enhanced our understanding of the calculation of the denominator of overhead rates, rather than led to the development of a fully fledged theory. There is a need to replicate this research to confirm, refine and amend theory. Preferably, this needs to be conducted using theoretical sampling, but it would be difficult to gain access to practitioners using this method of sampling. It may be more practicable to attempt theory development by undertaking longitudinal research into product costing practice to identify how practice changes over time (see Burns and Scapens, 2000).

In addition, it is necessary to undertake case study research to examine product costing practice in a single operating unit to obtain an in-depth analysis of product costing practice, in general, and the calculation of the denominator of overhead rates, in particular. In addition, the case study research would involve examining those contextual, organisational and cultural factors that are likely to influence and shape observed practice (Hopwood, 1983). This would overcome one of the limitations with this paper where technical practice is at the foreground of the analysis and organisational aspects are left in the background.

This paper has provided an initial insight into why manufacturing units calculate the denominator of overhead rates in a particular way. This is useful because it gives an indication of how to calculate denominators and the reasons for calculating those denominators. It is particularly useful at indicating to practitioners who are using budgeted capacity as the denominator, why they may want to reconsider the method used to calculate the denominator. We hope that

other researchers will be interested to pursue this issue in future research.

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