Capacity Costs—A Perspective

Dileep Dhavale

EXECUTIVE SUMMARY

- Capacity costs have risen much faster than other manufacturing or services costs in recent years and, thus, have caught the attention of managers.
- This article, the second in a series of two, explains different methods for analyzing capacity costs. The first article described resources—those with a defined capacity and those with undefined capacity—and capacity costs.
- Most resources used in both the manufacturing and service sectors are defined-capacity resources. These resources have installed capacities.
- To obtain additional capacity from defined-capacity resources usually requires substantial effort, a relatively large investment, and also a long lead time.

The first article in this series categorized resources as either defined-capacity resources or undefined-capacity resources. This distinction is useful in understanding capacity costs. Manufacturing and service resources that have undefined capacities have no capacity costs, but the capacity costs of resources that have defined capacities must be managed for optimal results.

Because some defined-capacity resources vary according to the unit level, batch level, or product level, their consumption (whether in manufacturing or service industries) can be explained by *cost drivers.* The consumption of some other defined-capacity resources does not depend on the level of manufacturing or service activity.

COST OF IDLE CAPACITY

This article describes a method to provide managers information about the cost of idle capacity for each resource used in manufacturing or in providing services. The first step in this analysis is to identify the resources.

Some resources are obvious—such as direct materials and direct labor—while others may be much harder to identify and define. For

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example, what degree of detail is necessary to analyze the capacity cost of a manufacturing engineering department? Does this resource need to be separated by the department's various functions (such as process planning, tooling, and engineering)? Or, alternatively, should the engineering department's resources be segregated by product lines such that there are not one but several separate "departments" within the department?

Answers to questions such as these help managers decide whether there should be one resource called "manufacturing engineering" or whether the department should be considered as several smaller resources, each with its own capacity and cost.

KEEPING DETAIL MANAGEABLE

Although detailed cost information gives managers a clearer picture, from a practical perspective, the number of resources analyzed must be kept at a manageable level simply because of the cost of collecting and maintaining data. Unnecessarily detailed information may prove to be a distraction. Therefore, it may be worthwhile to divide resources having large costs into subcategories while bundling some small-cost resources into one category. The best persons to make such a determination are those who will be using capacity cost information.

Because cost drivers must be used to analyze costs, resources must be defined such that they are mutually exclusive and contain costs that vary predominantly with respect to only one kind of cost driver (i.e., unit-level, batch-level, or product-level cost drivers).

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Consider, for example, the setup resource. If all setups on all machines are approximately similar in terms of time needed and other miscellaneous demands, then a unit-level cost driver such as number of setups would be appropriate. But if some numerically controlled machines have setup needs that differ significantly from those of the other machines, then "number of setups" would not be a good cost driver.

To obtain capacity costs, managers have to analyze general ledger accounts and budgets. For example, to determine salaries of employees in the setup department and their fringe benefits, payroll accounts have to be disaggregated. To determine occupancy cost of the department, perhaps a formula based on square footage can be used after depreciation expense of the building is determined from appropriate accounts.

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Sometimes hard data are unavailable, so estimates have to be made to allocate general ledger accounts to different resources. But after an initial analysis disaggregates accounts into resources, the same relationships may be used in later years unless changes (e.g., in technology or processing) make a new disaggregation needed. Note that disaggregation of general ledger accounts to obtain cost pools for resources is the first step in activity-based costing (ABC). If a company already uses ABC, this step may be unnecessary.

Exhibit 1. Capacity Cost Analysis

Resources	Type	Variability Level	Practical Capacity	Actual Cost of Capacity	Cost of Capacity per Unit	Actual Usage of Capacity	Actual Cost of Usage or Consumption	Cost of Idle Capacity
Electricity	UD	U	N/A	N/A	$.08/K Whr.*	N/A	$80,000	$0
Materials	UD	U	N/A	N/A	$5/lb*	N/A	350,000	0
Temp. workers	UD	U	N/A	N/A	$25/hr.*	N/A	30,000	0
Setups	D	U	2,000 setups	$250,000	$125/setup	1,700 setups	212,500	37,500
Direct labor	D	U	20,000 hours	300,000	$15/hr.	19,000 hours	285,000	15,000
Material handling	D	B	2,000 moves	100,000	$50/move	2,100 moves	105,000	(5,000)
Order & receiving	D	B	2,500 orders	200,000	$80/order	2,525 orders	202,000	(2,000)
Manufacturing engineering	D	P	400 ECNs	300,000	$750/ECN	385 ECNs	288,750	11,250
Plant administration	D	F	N/A**	N/A	N/A	N/A	120,000	N/A
Property tax	D	F	N/A**	N/A	N/A	N/A	20,000	N/A

Types: D = defined; UD = undefined
Levels: U = unit; B = batch; P = product; F = facility
N/A = Not applicable
*These are cost of purchasing a unit, since they don't have capacities.
**For these facility-level resources, practical capacities cannot be measured in manufacturing-related variables.

ANALYZING CAPACITY COSTS

Exhibit 1 describes the analysis of capacity costs that would be performed at the end of a year. Assume that column 1 shows resources used in a small manufacturing firm. Based on the discussion in the first article in this series, these resources are categorized as either defined-capacity (D) or undefined-capacity (UD) resources in the second column.

The predominant variability of the resources is described in the third column, which helps to determine appropriate cost drivers for these resources (except for the last two). Determination of a cost driver is a significant step because practical capacity of a resource is measured in terms of its cost driver, which is used in analysis of capacity costs.

The next column shows cost of capacity, which is defined as the recurring costs of maintaining capacity plus any depreciation (or allocation) of capital-layout costs. The last two resources do not have a cost driver because they are not influenced by manufacturing variables. (In the language of ABC, they are *facility-level* resources.)

Cost of unit capacity in the next column is based on the practical capacity of the resources. The two facility-level resources have no practical capacity, so they have no unit capacity costs. Because the first three resources have no installed capacity, they do not have costs of capacity. These undefined-capacity resources are available as needed; the cost of purchasing a unit is listed in this column.

The "usage of capacity" column indicates amounts of the resources used in manufacturing. Based on this usage and unit-capacity cost in the previous column, cost of usage is computed.

The last column (the cost of idle capacity) is the difference between the cost of capacity and the cost of usage. A positive value indicates idle capacity, whereas a negative value indicates that the resource was used beyond its capacity. This is possible for certain type of resources. Material handling, for example, can work extra hours—that is, beyond the employees' practical capacity.

Analysis of Idle Capacity Costs

In Exhibit 1, the undefined-capacity resources have zero cost of idle capacity. This is due to the fact that these resources have no installed capacity and whatever amounts of the resources are purchased are also used up in operations (or in case of materials, unused amounts are inventoried).

With defined-capacity resources the manager should decide what to do with the idle cost of such resources. The choices are:

- Decrease the capacity of a resource, thus decreasing or eliminating cost of idle capacity.
- Do nothing; treat it as cost of doing business.

It may not always be possible to eliminate the cost of idle capacities. In fact, after careful analysis a manager may opt for retaining idle capacities to maintain operational flexibility.

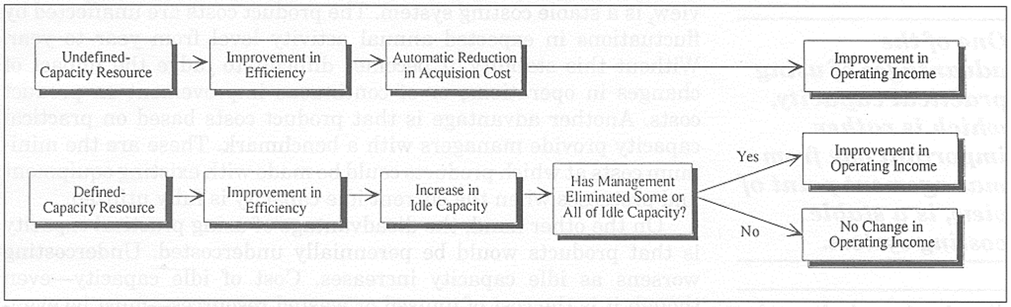
The first choice, of course, is the obvious one. If the setup shop has the practical capacity for 2,000 setups and is currently doing 1,700 setups, a 15 percent reduction would eliminate any idle capacity. Even though the reduction necessary to achieve a full utilization is obvious, its implementation requires a thorough analysis of the demand for the resource and its current capacity. Some of those considerations as they relate to the setup resource are as follows:

- An exact 15 percent reduction may not be possible. If one person of five is laid off, capacity may drop by 20 percent. This is true of most resources whose capacities can be increased or reduced only in discrete chunks.
- If the five people specialize in different types of setups, it may not be possible to lay off even one person.
- Quick setups are basic to flexible manufacturing and small batches can be manufactured only if setups can be made quickly and as soon as they are required.
- Setup workers are highly skilled and trained and in great demand; a layoff would result in a permanent loss of the employee. If the company expects growth in future business the layoff would be ill advised.

Not all idle capacity costs are inappropriate and candidates for reduction. Some idle capacities may be unavoidable; others may be needed to maintain flexibility. Only a careful review of idle capacities in light of other variables can tell a manager what the right course of action is.

Any one of these considerations may influence the manager to retain all five setup operators and write off the cost of idle capacity as a necessary cost of business. This scenario points out the fact that it may not always be possible to eliminate the cost of idle capacities. In fact, after careful analysis a manager may opt for retaining idle capacities to maintain operational flexibility. Indeed, in some instances it might be the lower-cost choice in the long run. The moral is that not all idle capacity costs are inappropriate and candidates for reduction. Some idle capacities may be unavoidable; others may

Exhibit 2. Impact of Efficiency Improvements on the Bottom Line



be needed to maintain flexibility. Only a careful review of idle capacities in light of other variables can tell a manager what the right course of action is.

Impact of Efficiency Improvement on Capacity Costs

The most fruitful avenue available for managers to reduce the capacity costs is to improve the efficiency of use of resources.

The most fruitful avenue available for managers to reduce the capacity costs is to improve the efficiency of use of resources. Continuous improvement philosophy has helped to achieve significant efficiency improvement for those companies that have adopted it. Efficiency gains under this program are incremental, whereas introduction of a new technology or a new process provides a one-time jump in efficiency. Efficiency improvements have a different impact on undefined-capacity and defined-capacity resources. Understanding this difference helps managers take appropriate further action.

When efficiency of use of undefined-capacity resources is improved, less of them are needed and the cost of acquiring them decreases immediately. A manager need take no further action. Not so with defined capacity resources. Improving efficiency increases idle capacity and its cost. Unless management takes action to slash idle capacity, there will be no savings from improved efficiency. In many practical cases, this additional step required to reduce the idle capacity is not carried out, arguably for very good reasons. In such instances, the improved efficiency has no impact on the bottom line of that company. Exhibit 2 summarizes this concept.

PRODUCT COSTING AND CAPACITY COSTS

Most manufacturing firms in the United States use predetermined overhead rates (under either conventional or ABC methods) that include idle capacity costs. When idle capacity costs are inadvertently hidden in this manner, it may provide misleading information to managers.

The solution to this problem is to compute predetermined overhead rates based on practical capacity level instead of expected annual activity level. One of the advantages of using practical capacity, which is rather important one from management point of view, is a stable costing system. The product costs are unaffected by fluctuations in expected annual activity level from year to year. Without this stability, it becomes difficult to judge the impact of changes in operations, or of continuous improvement on product costs. Another advantage is that product costs based on practical capacity provide managers with a benchmark. These are the minimum costs at which products could be made with existing equipment and processes when the current idle capacity is fully utilized.

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On the other hand, the disadvantage of using practical capacity is that products would be perennially undercosted. Undercosting worsens as idle capacity increases. Cost of idle capacity—even though it is the cost of unused or wasted resources—must be eventually recovered from regular orders. Another obstacle in incorporating practical capacity in cost accounting is income tax regulations. The Tax Reform Act of 1986 adopted uniform capitalization rules for purposes of costing inventories. One of those rules prohibits use of practical capacity in allocation of indirect manufacturing costs (Treas. Reg. §1.263A-2(a)(4)). Of course, the rules do not prohibit use of practical capacity for accounting purposes, but adjustment to cost of goods sold and inventory would be required.

Ortho-McNeil Pharmaceutical

Ortho-McNeil Pharmaceutical was concerned that the financial performance reports provided to managers using conventional annual activity level did not highlight cost of idle capacity. Pharmaceutical companies operate in an extremely dynamic environment, where new drugs are being introduced continually and demand for many high-volume, popular drugs may be seasonal and hence volatile. Production changes are frequent and demand must be met quickly. Under such operating conditions, management of production capacity becomes crucial in overall control of costs. The financial reports that referred to capacity costs as fixed costs gave an apparent impression that nothing can be done about them.

Costing of drugs (done through standard costing) included cost of idle capacity. Pricing of drugs and bidding for additional business was based on these costs. Unfortunately, these costs were affected substantially by expected activity level for any given year. Less expected activity meant higher idle capacity costs, which then were allocated to products, making them more expensive. On the other hand, higher activity levels meant lower manufacturing costs for products.

This created an interesting dilemma when preparing bids for new business. If the company had a high level of activity in a given year, its bids for new business were lower. Conversely, if the company had lower activity level, it had higher standard costs. Hence, its bids for new business were higher. Precisely when the company needed new business it could not compete because the costing system came up with higher bids.

To avoid sending managers the wrong signals and to encourage them to manage capacities actively, Ortho-McNeil Pharmaceutical now uses practical capacity in performance reports and product costing. When the burden of idle capacity cost is shown separately and products are costed without including this burden, it provides some clear-cut choices for managers. To reduce the idle burden cost, the company could bring in more outside business, increase sales of company products, consolidate, and/or cut some capacities. What managers previously termed "fixed cost" and ignored because they thought nothing could be done about it suddenly drew their attention. The stable standard costs under practical capacity provide a better framework for performance measurement, pricing of the products, and, specifically, preparation of bids for new business. Most important, there is now an accountability for the management of the fixed costs, the vice president of operations.

Managers found the information so useful in managing idle manufacturing capacity that the company tried the concept of cost of idle capacity in nonmanufacturing situations. Ortho-McNeil has a large sales force that visits health care providers to acquaint them with newer as well as established drugs marketed by the company. Initial presentations of new drugs take longer as a great deal of information is exchanged with the providers. As a new drug becomes accepted or well-known, the length of contact is reduced. Ortho-McNeil needed to know the practical capacity of its sales force. Was there any idle capacity? If so, what should be done about it?

Based on different types of presentations for drugs in different groups and number of health care providers visited, the company was able to compute the idle capacity of the sales force. With this information, management was able to restructure the operations of their sales force and take on additional work of marketing drugs for other companies. Because it is expensive and time-consuming to train a medical sales representative, sales representatives were let go only as a last resort. (For more information about Ortho-McNeil's experience with practical capacity, contact Robert E. Campbell, Franchise Controller, Pharmaceuticals Worldwide.)

Babcox & Wilcox

Babcox & Wilcox is a world-renowned manufacturer (established in 1867) of steam generation equipment and industrial boilers. From the 1970s to about the early 1980s, this heavy manufacturer worked at capacity, fulfilling heavy defense needs and supplying utilities that were trying to meet increased demand for electricity. As defense spending slowed and the utilities started to encourage conservation instead of building new power plants, the company suddenly found itself with increasing idle capacity.

In its heyday, the company was using a three-year moving average of forecasted costs and activity levels (measured in direct labor hours) to compute overhead rates. The company had very high fixed costs because the equipment it makes requires huge work areas (called *bays*, which are larger than 100,000 sq. feet), heavy machinery, and cranes. As activity levels dropped and idle capacity increased, overhead rates increased enormously. Just as the volume of business was dropping, the higher overhead rates made it difficult to prepare competitive bids for new business.

In this new business environment, Babcox & Wilcox decided that it had to actively manage the capacity and its fixed cost. It did away with the three-year-moving average of activity levels and replaced it with practical capacity. The overhead rate no longer fluctuated based on expected operating levels. Stable overhead rates made it possible to offer competitive bids and attract new business. In a financial report to managers, the idle capacity cost was highlighted so managers could clearly see its impact on manufacturing costs and the bottom line. Attention of the managers now focused on ways to eliminate the idle cost. To decrease idle capacity and to downsize it whenever possible, they took several actions to attract new business. They cultivated replacement-part business. The company offered upgrades of existing power generation equipment. These upgrades generated more power with less pollution and with greater efficiency. The company undertook a complete restructuring of manufacturing operations to increase efficiency and eliminate duplication. This restructuring resulted in closure of some plants. Some bays were mothballed so that they were available when additional demand required more capacity. A system was put in place where managers would continually review idle capacity and related cost to determine whether further actions are needed. (For more information about Babcock & Wilcox's use of idle Capacity costs, contact John D. Vujevich, Controller of the Energy Services Division.)

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Both Ortho-McNeil and Babcox & Wilcox indicate they have benefited from using practical capacity to isolate the cost of idle capacity. Their experience has not indicated any problems arising from its use on a company-wide basis. It is interesting to note that this simple yet potent concept has yet to receive widespread acceptance.

Special Orders and Bids

Exhibit 1 provides valuable information for special orders that are not part of ongoing business. These orders are accepted generally on a one-time-only basis and are expected to cover only "variable costs" and provide some profit. Without Exhibit 1 information, a manager preparing a bid will include direct labor and materials and variable overhead as the "variable costs."

However, Exhibit 1 indicates that direct labor currently has idle capacity and, hence, no additional cost would be incurred if the order were to be accepted. A manager, in this manner, would be able to estimate accurately the true cost of the order by examining resources used by the order and whether or not they have idle capacity. The actual cost of the order to the company would be only for use of defined-capacity resources that are not idle and all undefined-capacity resources.

Exhibit 3. Cost Burden of Idle Capacity

Resources	Budgeted Cost of Capacity	Practical Capacity	Expected Activity During the year	Idle Capacity in Percent	Expected Cost Burden of Idle Capacity
Electricity	$85,000	N/A	N/A	0%	$0
Materials	360,000	N/A	N/A	0	0
Temp. workers	20,000	N/A	N/A	0	0
Setups	245,000	2,000 setups	1,760 setups	12	30,000
Direct labor	280,000	20,000 hours	19,000 hours	5	15,000
Materials handling	120,000	2,000 moves	2,000 moves	0	0
Ordering and receiving	220,000	2,500 orders	2,400 orders	4	8,000
Manufacturing engineering	275,000	400 ECNs	300 ECNs	25	75,000
Plant administration	140,000	N/A	N/A	0	0
Property tax	20,000	N/A	N/A	0	0

COST BURDEN OF IDLE CAPACITY

It is possible to provide an estimate of cost of idle capacity even when expected activity levels (instead of practical capacities) are used for predetermined overhead rates. Exhibit 3 computes this estimate of additional manufacturing cost due to idle capacity, called *cost burden of idle capacity*. The first column shows budgeted amounts for the resources (data are for the same company described in Exhibit 1). The second column shows practical capacity; the third shows expected activity levels. These levels are used in determining the predetermined overhead rates (not shown here). The fourth column expresses idle capacity as a percent of practical capacity. Based on these percent values and budgeted cost for resources, the last column calculates the expected cost burden of idle capacity.

The sum of the last column shows that $128,000 worth of resources are expected to remain idle during the year. In full absorption costing with annual activity level, the cost burden of idle resources is charged to production. Information in Exhibit 3 shows that overall idle capacity cost burden for products is $128,000/ $1,765,000 = 7.25 percent. This means that 7.25 percent of the manufacturing cost of a product is due to idle capacity. Had the practical capacity been used to compute the overhead rates (instead of expected annual activity), the cost burden of idle capacity would not have been charged to the products.

In an ABC setting, it would be possible to obtain an estimate of cost burden of idle capacity separately for each product. Because the products use different resources, products using resources with more idle capacity will have a higher percentage of the cost burden. For an illustration, assume that the total manufacturing cost of a product is $3,120.40. The product was charged the following amounts for use of four resources that have idle capacities: setup, $139.20; direct labor, \$44.21; ordering and receiving, \$275; and manufacturing engineering, \$916.67. The cost burden of idle capacity for this product is obtained by multiplying percentage idle capacities from Exhibit 3 and respective usage costs as given above. The cost burden turned out to be \$258.08 and percentage amount, \$258.08/\$3,120.40 = 8.3 percent. This product carries a higher burden of idle capacity cost than an average product.

CONCLUSION

Management of idle capacity is an important aspect of cost containment. Providing segregated cost of idle capacity based on unused practical capacity highlights the problem areas and prompts management response. Product costs based on practical capacity provide a benchmark and focus management attention on either paring idle capacity or using it up by bringing in new business.