Capacity Costs—A Perspective

Dileep Dhavale

EXECUTIVE SUMMARY

- *Capacity* costs have risen much faster than other manufacturing or services costs in recent years. As a result, they have caught the attention of many managers.
- This article, the first in a series of two, describes the relationship of resources to capacity costs. The second article explains different methods of analyzing capacity costs.
- Resources may be categorized into two types—those with a *defined capacity* and those with *undefined capacity*, depending on whether or not their capacities can be measured.
- Most resources used in both the manufacturing and service sectors are defined-capacity resources. These resources have *installed capacities*.
- To obtain additional capacity for defined-capacity resources usually requires substantial effort, a relatively large investment, and also a long lead time.

As a preliminary step toward tackling capacity and its cost, this article first discusses *resources*, which can be defined as anything an organization needs to produce goods or to provide services. Thus, a plant building, supervisors, and foremen can all be considered resources. Other manufacturing resources include jigs, tools, dies, and the raw materials on which they are used. In a service setting such as hospitals, doctors and nurses are resources, and so are the operating rooms and cafeterias.

Resources can be defined in two ways–those having a defined capacity and those having undefined capacity. They are categorized depending on whether or not their capacities can be measured. This distinction is important, because to control the costs of an undefined-capacity resource, only consumption must be controlled. For a defined-capacity resource, by contrast, *consumption* and *acquisition* of the resource must both be controlled. Both types of capacity are discussed in the following sections.

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DEFINED-CAPACITY RESOURCES

Most resources used in the manufacturing and service sectors are defined-capacity resources. These resources have *installed capacities*. To obtain additional capacity requires substantial effort, a relatively large investment, and a long lead time. Furthermore, the cost of usage or consumption is generally less than the acquisition cost, because resource capacity is not fully utilized. Some examples of defined-capacity resources are machinery, equipment, direct labor, and manufacturing engineering departments.

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A machine has the capacity to produce a certain number of parts *whether or not the capacity is used.* To increase capacity, however, the company must buy another machine. But buying another machine requires substantial lead time if the machine must be manufactured to order; it requires much less lead time if the machine can be purchased from a dealer's inventory.

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Workforces

Workforces are generally—although not necessarily—considered defined-capacity resources. Most companies in the United States like to maintain stable workforces for as long as possible. Only rarely do companies hire and fire permanent employees (as opposed to temporary employees) at will, because doing so incurs substantial costs, to say nothing of public relations problems and problems with employee morale.

Usually companies lay off or hire permanent workers based on a long-run expectation that the employees will be needed. Therefore, permanent labor may be considered a defined-capacity resource. Certainly, exceptions to this generalization exist in industries that require low-skill labor (for example, in fast-food companies) or in industries that experience quick changes in demand (the automobile industry, for example).

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Support Departments

A support department such as manufacturing engineering provides a good example of a defined-capacity resource. The number of engineers hired in the department is based on expected long-term demand for their services. Since it is expensive to hire and train highly skilled employees, they are normally unaffected by short-term fluctuations in production levels.

The defined-capacity nature of labor forces in an industrial setting can be well illustrated by the job losses that occur when a company *downsizes* or engages in *business reengineering*. Because of changes in the economy, available technologies, or a company's business strategy, the company's long-term expected level of employment may fall, which will normally cause the company to decrease the capacity of its workforce. A reduction in the number of permanent

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UNDEFINED-CAPACITY RESOURCES

Utility costs such as electricity and natural gas provide good examples of resources with undefined capacities. Undefined-capacity resources have no installed capacity; a company can obtain them as needed without incurring any additional ordering cost. (One might argue that the capacity of the cables or pipes that provide electricity or gas is a limiting factor, and hence that these resources also have defined capacity rather than undefined capacity. Ordinarily, however, the capacity of pipes or cables is large enough to pose no constraint.) Because a company pays only for the gas or electricity it actually uses, its consumption costs for these resources equal its acquisition costs for them—that is, the purchase price plus some minor incidental costs.

Materials are another example of a resource that has undefined capacity, because materials have no installed capacity. Instead, a company orders materials as they are needed. (It may be argued that warehouse capacity is a limiting factor. In practice, however, warehouse capacity is not a constraint for purchased materials. The prevalence of just-in-time systems has also freed up additional warehouse space.)

Unused materials are ordinarily inventoried and not charged to production, so the usage cost equals the acquisition cost. Temporary employees and outside contractors also fall in this category; they are hired and let go as needed.

PRACTICAL CAPACITY

Management accounting textbooks define *theoretical*, *ideal*, and *practical* capacities for manufacturing or service systems:

- *Theoretical capacity* exists when all operating constraints are ignored.
- *Ideal capacity* is generally defined as capacity assuming *optimal* operating conditions.
- *Practical capacity* takes into account unexpected events (such as breakdowns) and also suboptimal operating conditions (such as occasional shortages of parts or defective output).

This article uses practical capacity as the relevant measure and defines it as *the maximum output of a production or service system under normal operating conditions.*

Changes in Practical Capacity

Practical capacity should not be considered a fixed number. Management must make *deliberate* changes in practical capacities to control costs.

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But, aside from an overt management action to increase or decrease capacity—for example, by adding a new shift or an assembly line, selling off a plant, or shortening the workday—there are many *indirect* ways to affect capacity, including the following:

- Reducing setup times.
- Implementing continuous improvement.
- Improving quality.
- Improving worker training and skills.
- Taking advantage of the learning-curve effect.
- Increasing automation.
- Eliminating non-value-added activities.

Unequal Capacities

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For example, the idle capacity of machines may not be fully used because of insufficient capacity in manufacturing engineering, which cannot process any new engineering change orders without hiring additional employees. Similarly, a hospital's empty beds may go unused because of a shortage of nurses.

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Primary Versus Secondary Resources

In manufacturing, practical capacity generally refers to the capacity of machines or of direct labor; in hospitals it refers to patient beds. In analyses of capacity costs, however, it is important to consider the capacities of all the resources. To use the idle capacity of the main resource, significant investments may be necessary to install additional capacities in one or more secondary resources.

Manufacturing or service variables can explain consumption of many defined-capacity resources. For example, more direct labor capacity will be used if more labor hours are worked; more setup capacity will be used if more setups are performed. Using the vocabulary of *activity-based costing* (ABC), a *cost driver* can be identified as a resource (direct labor and setups can both be considered as cost drivers).

For some defined-capacity resources, no cost drivers (or *causal relationship*) can be found between the resources and any manufacturing or service variable. For such resources, the capacities cannot be expressed in terms of a manufacturing or service variable; their usage does not depend on the level of any manufacturing or service activity (for example, many occupancy costs and administrative costs).

Exhibit 1. Capacity Cost of Setup Department

Wages and benefits	$180,000
Tools, occupancy, supplies, and the like	70,000
	$250,000

COST OF CAPACITY

The cost of capacity is defined as the cost of establishing and maintaining a given capacity for a certain period. It includes all recurring costs incurred in maintaining an installed capacity plus allocations (*depreciation*) of capital costs related to that capacity. For example, the capacity cost of the machines in a department includes the costs of maintenance and repairs plus depreciation expense.

Cost of capacity changes when the capacity of a resource is changed. Usually the cost of capacity will increase or decrease along with increases or decreases in capacity, although the relationship is not always linear. Often the capacity of a resource can be increased only in discrete steps; a continuous, smooth mathematical relationship is impossible. (Examples include hiring a new engineer for the manufacturing department or buying a new piece of equipment. Capacity on these instances will go up by discrete amounts. Acquisition of capacity in lesser amounts is generally not feasible.)

EXAMPLE OF THE COST OF CAPACITY

Assume that a small manufacturer uses a team of five employees to set up machines in a job shop. These five employees are highly skilled, and they specialize in different types of machines found in the shop. For the sake of simplicity, assume that different setups take about the same time and consume approximately the same level of setup resources.

The annual budget of the setup department is shown in Exhibit 1. Assume the following about the setup department:

- The setup department expects to perform 1,800 setups during the current year.
- The practical capacity of the department is 2,000 setups.
- The cost of one setup based on practical capacity is $125 ($250,000/2,000 = $125).

Given these facts about the setup department, questions such as the following can be raised:

- Is the resource fully utilized?
- What should the company do with the unused resource?
- Should the company reduce the capacity of the resource?
- How should the company charge products for use of the resource?

- Should the charge be based on expected annual activity (1,800 setups) or the practical capacity (2,000 setups)?
- What are the advantages of using one activity level over the other?

The answers to these questions form the framework for analyzing capacity costs, which is the subject of the second article in this series.

COST OF USAGE OR CONSUMPTION

When resources are consumed in manufacturing a product or providing a service, the cost of resources consumed is allocated to the product or service. Many organizations use relatively sophisticated methods such as activity-based costing to fairly allocate the cost of using resources.

Cost of *usage* (or *consumption*) is the cost that entities are charged for using a resource. The entity charged may be a cost object such as a production batch or another department in the same company. The consumption or usage cost is computed based on predetermined overhead rates for resources. For resources that are not included in overhead, rates similar to the overhead rates (such as hourly rate for labor) are used in determining the cost of usage or consumption.

Cost of Acquiring Resources

Note that the cost of *acquiring* resources (the cost of capacity) differs from, and is independent of, the cost of *using* resources (the usage cost). Unfortunately, many textbooks, cost studies, and reports fail to distinguish between the cost of acquiring capacity and the cost of using it. Implicitly, they assume that the usage cost (as determined by product costing or flexible budgeting) exactly equals the cost of capacity.

However, the usage cost and the cost of capacity actually equal each other only for undefined-capacity resources. For most resources (that is, defined-capacity resources), the real cost of interest is the cost of capacity, not the cost of usage. After all, the cost of capacity is the cost that appears on income statements and affects the bottom line. By contrast, usage costs are merely an accounting technique for *allocating* capacity costs to users. Exhibit 2 summarizes the differences between the two types of resources.

CONTROL OF CAPACITY COSTS

A common fallacy observed in discussions about budgets and costs (and in textbooks as well) has to do with the notion that controlling cost drivers can control costs. Using the example given previously, if the number of setups were reduced from 1,800 to 1,600 by an intensive reengineering of the process, would the setup cost decrease simply because the cost driver activity was decreased? What are the savings?

Too often, the "savings" are computed as 200 setups $\times$ \$125 = \$25,000. Organizations that rely heavily on flexible budgeting often

Exhibit 2. Comparison of Defined-Capacity and Undefined-Capacity Resources

	Defined-Capacity Resources	Undefined-Capacity Resources
Resource capacity	Resource has installed capacity	Resource does not have installed capacity
Ease of acquisition	Additional capacity is costly and has longer lead time	Available as needed
Costs	Cost of maintaining capacity and cost of its use are not equal	Cost of acquisition equals usage cost
Examples of resources	Equipment, plant building, support departments, labor	Electrical power, natural gas, materials, temporary help

make calculations such as this. But the answer (as discussed in the second article in this series) is that there are *no savings*. To achieve the savings, something else has to be done.

CONCLUSION

Resources can be defined as anything needed to manufacture goods or provide services. Resources can be categorized into two types to make analyzing capacity costs easier.

Undefined-capacity resources do not need or have installed capacity. Defined-capacity resources, on the other hand, have measurable capacities and it is usually time-consuming and expensive to alter the capacities.

Most resources used in both manufacturing and service industries are defined-capacity resources. To control the costs of defined-capacity resources, their consumption and their acquisition must both be decreased. With undefined-capacity resources, reduction of consumption alone decreases costs. ♦