



# Back to the future with Gantt

By Larry R. White

*Effective capacity measurement and costing should take cues from a legendary engineer*

Using an organization's resource capacity efficiently and effectively is a logical and obvious component of cost and, consequently, profitability management. While managing capacity and cost doesn't grow a business like sales revenue, management can exercise much greater control over resource capacity and cost. And when sales do expand, a 2,000-year-old proverb of the Romans applies: "There is no gain so certain as that which proceeds from the economical use of what you already have."

H.L. Gantt, the prominent engineer best known for creating the Gantt chart for work planning and scheduling in the early 1900s, had many insights into capacity measurement, management and costing that can provide a strong foundation for examining these issues today.

## Root causes

The dynamics of measuring and costing capacity can get complex, but managers should keep in mind one simple idea. It is the job of every manager and employee to create excess and idle capacity by accomplishing the task more efficiently and effectively than in the past. When this occurs, the accomplishment of that manager or employee should be commended.

Stop and ask: How often does this happen? Or is it the case that efficiency gains are more often hidden by managers and employees? The most common answers to questions like these are not the positive answers that lead toward optimization. One has to wonder why.

A primary reason is because incentive systems and budgeting processes focus on financial metrics for discrete organizational elements and relatively short periods of time. They don't take a cross-organizational, longer-term view of creating value. If a plant makes process improvements resulting in excess capacity, the plant manager will be pressured to turn that excess capac-

ity into cash savings. This stresses the very employees who successfully became more efficient. Instead, that pressure should be on sales and marketing to create more demand or research and development to identify a new product that can be produced with the newly available capacity.

Another common scenario occurs when a work group becomes more efficient and reports its success. The group gets commended, maybe even receiving a small reward, followed by a budget cut. Later, when the group seeks funding for a new investment to improve productivity even more, the process is painful – so painful that the group's management decides to keep future improvements quiet until they have enough flexibility to report some savings without disclosing so much that the leaders have to face the new investment process again.

A large part of the problem is the way business is measured. Business performance measurement is driven by the financial reporting model and generally accepted accounting principles (GAAP) created by accounting standard setting bodies such as the Financial Accounting Standards Board in the United States or the International Accounting Standards Board in Europe.

These standards and underlying principles work well when, as intended, they inform investors and creditors in the capital markets. However, the conceptual frameworks that form their foundation clearly show that these financial reporting standards were not intended to be used as a primary source of information for making internal operation and production decisions.

Traditional cost and management accounting education seeks to link GAAP to management information, but it doesn't work because the dominant principle for modeling information for internal decision-making is causality (cause and effect). GAAP places many principles and rules ahead of representing cause-and-effect relationships.

## A historical perspective

Fortunately, managerial costing is a relatively young discipline, and it is possible to look back to a time before financial accounting and reporting were so dominant. Between 1915 and 1920, Gantt and A.W. Church, an accountant, engaged in a lively and well-documented debate about how capacity should be measured and reported on financial statements.

Gantt's position was that excess/idle capacity should be identified and reported separately, since it was a critical indicator for a business. Church was an advocate of full costing for financial reporting, which rolled all the costs of production into product cost, though he did develop some methodologies for internally identifying excess/idle capacity. At the end of this debate, Gantt's position won and was accepted by the accounting profession of the day. However, various situations during the Great Depression and World War II caused Church's position to become the foundation for today's GAAP and financial reporting.

Gantt's observations remain insightful today. Let's look at a few of his insights, as recorded by Thomas Klammer in *Capacity Measurement & Improvement*.

On including the full cost of capacity in product cost versus identifying the cost of idle capacity, Gantt identified the two leading theories about accounting for product cost. The first theory holds that an article's cost should include all expenses used to produce it, even if an associated expense didn't contribute to the desired end of producing products. Under the second theory, an article's cost only includes expenses needed for its production. Any other expenses must be charged to some other account.

The first theory adds the expense of maintaining an idle part of the plant to a product produced in a separate part of the plant, while the second theory would deduct such expenses from profits. When plants operated at full capacity, both theories give the same

cost per unit. But when plants operate at less than full capacity, the first theory increases the cost of the product. The second theory places the expense of idle machinery in a separate account, leaving the cost of the product constant.

“It is most interesting to note that when costs are figured on the second basis, great activity immediately ensues to determine why machinery is idle, and to see what can be done to put it in operations,” Gantt emphasized. “It is realized at once that this machinery had better be operated, even if no profits are obtained from its operation and only the expense, or even part of the expense, of maintaining that machinery is earned.”

On the usefulness of accounting information to internal management, Gantt maintained that most cost systems, and the theories they are based on, were devised by accountants to benefit financiers who used the metrics to criticize the factory, making it responsible for all of a business’ shortcomings. In this they have succeeded, largely because these methods do not allow plant superintendents to present their side of the case.

On the other hand, Gantt’s theory of tracking costs holds that its prime function should let superintendents know whether they are doing their work as economically as possible, a function ignored in most of the cost systems in use. Accountants who attempt to show those numbers take so long to get their figures that the results are worthless because it is too late to use them for their intended purpose.

On accounting’s product cost information and idle capacity, Gantt observed that during flush times when business was plentiful, overhead was allocated across high production levels. This showed that costs per product are low and indicates that prices could be reduced. But when the economy dips and business declines, overhead costs (including the expenses of idle capacity) are allocated across lower produc-

tion levels. This shows higher product cost, indicating that prices needed to be increased.

“In other words, our present systems of cost accounting go to pieces when they are most needed,” according to Gantt.

It is surprising and somewhat discouraging how relevant Gantt’s comments are to us today. While knowledge of capacity management and costing has advanced to some extent, Gantt’s core theory and some of his techniques remain highly applicable to improving capacity measurement and costing inside your organization.

### Improving capacity measurement and costing

The first issue that needs to be addressed is what measure of capacity will be used for your resources. There are five common definitions:

- 1. Theoretical capacity:** The full amount of time a resource is available. For owned resources, this is 24 hours each day multiplied by 365 days each year. For employees and contracted or leased resources, capacity is the amount of time per the contract.
- 2. Practical capacity:** The amount of productive time generally attainable by a resource. This measure for owned equipment subtracts unavoidable downtime for planned maintenance, setups, sometimes historical levels of breakdowns and planned idle time. For employees, it subtracts planned absences and training time.
- 3. Normal capacity:** The planned amount of productive time. It often is based on historical data or averages.
- 4. Budgeted capacity:** The capacity required based on the current period budget
- 5. Actual capacity:** The capacity achieved for a time period

Theoretical capacity is the only measure that makes all capacity clearly visible for evaluation and examination by

management. And as Gantt observed in the first quote, visibility ensured that “great activity” ensued to determine why machines or any particular resources were idle.

Historically, the theoretical measure has been a tough sell. Gantt used practical capacity. But in today’s highly competitive and rapidly changing business environment, every minute of capacity should be examined continuously for its potential to create greater value. Clearly time for setups, routine maintenance and breakdown have been the subject of lean initiatives for decades. Even the view of traditional office building capacity is changing as consultants, field representatives and salesmen – no matter how senior – often are shifted from standing office space to hoteling arrangements if they frequently are out of the office.

The second aspect concerns capacity deployment or use. While capacity usage insights would vary among the five capacity measurement definitions, theoretical capacity offers the most comprehensive set of use definitions. Below are the three basic categories of capacity usage for theoretical capacity.

- 1. Productive capacity use:** The resource capacity is used for the purpose for which it was employed or acquired. Capacity usage provides direct value to the management objectives of the company. It also may represent the use of capacity for process or product development, which provides future value.
- 2. Nonproductive capacity use:** Capacity not in a productive state or not in one of the defined idle states. Nonproductive capacity includes setups, maintenance, standby, scheduled downtime, unscheduled downtime, rework and scrap.
- 3. Idle/excess capacity use:** Capacity not currently scheduled for use. The Consortium for Advanced Management-International (CAM-I) capacity model breaks idle capacity into

**FIGURE 1**

## Subdivided capacity

The Consortium for Advanced Management-International provides examples that fall into the three types of capacity usage for theoretical capacity. Source: *Capacity Measurement and Improvement*, CAM-I, 1996

<b>Idle</b>	<b>Not marketable</b>	<b>Excess – not usable</b>
	<b>Off-limits</b>	<b>Management policy</b>
		<b>Contractual</b>
		<b>Legal</b>
	<b>Marketable</b>	<b>Idle but usable</b>
<b>Nonproductive</b>	<b>Standby</b>	<b>Process balance</b>
		<b>Variability</b>
	<b>Waste</b>	<b>Scrap</b>
		<b>Rework</b>
		<b>Yield loss</b>
	<b>Maintenance</b>	<b>Scheduled</b>
<b>Unscheduled</b>		
<b>Setups</b>	<b>Volume</b>	
	<b>Changeover</b>	
<b>Productive</b>	<b>Process development</b>	
	<b>Product development</b>	
	<b>Good product</b>	

three specific classes: not marketable (no market exists, or management made a strategic decision to exit the market), off-limits (capacity unavailable for use) and marketable (a market exists but capacity is idle).

Figure 1, developed by CAM-I, provides examples of each type of capacity use. In today’s business environment, it seems likely that Gantt would have supported a measurement focus on theoretical capacity. In his speeches and writings, he referred to the interest cost, depreciation cost and cost of providing space for resources as important costs of idle capacity. These are most relevant to theoretical capacity.

The two main issues capacity measurement should seek to address are how to optimize nonproductive time given a business’ strategy and objectives and identifying idle time for use in pursuing new opportunities or cost reduction.

Gantt developed a tool for investigating, measuring and costing “idleness,” which for him included portions of idle time and nonproductive time as defined in this article.

### Cause and effect should guide cost assignment

The issue that Gantt often wrestled with was where to assign or allocate the costs of nonproductive and idle capacity, and that issue remains relevant today. When the intention is to generate information that internal management uses to make decisions about production, operations, etc., the guiding principle for cost assignment must be cause and effect.

If a strong, clear and traceable causal relationship exists between the input resources and a management objective or output you are costing, e.g., a product, internal project or intermediate output or component, there is no complexity beyond ensuring any idle capacity is identified in the input resources.

However, if establishing a relation-

ship between an input resource and an output requires a stretch in cause-and-effect logic, you are dealing with a weaker causal relationship. The best approach is to stop because you will be creating data that distort decision-making information. Assigning noncausal or weak causal costs means that output will have a cost that will not react logically to changes in its level of output or changes in its production process.

The best approach is to examine what the input resource responds to. Is there another process you should model? Is the resource supporting a product group or family directly, and is it a stretch in logic to assign it to a particular product? For example, take a machine that produces two products, A and B. Lack of demand has resulted in excess capacity. How should the cost be divided: quantity, cost, sales revenue, machine time? A better answer would be assigning the cost to the part of the organization that is responsible for cre-

ating demand. After all, the excess capacity is available to produce product A, B or an entirely new product. The problem is lack of demand, not the inefficiency of the production process.

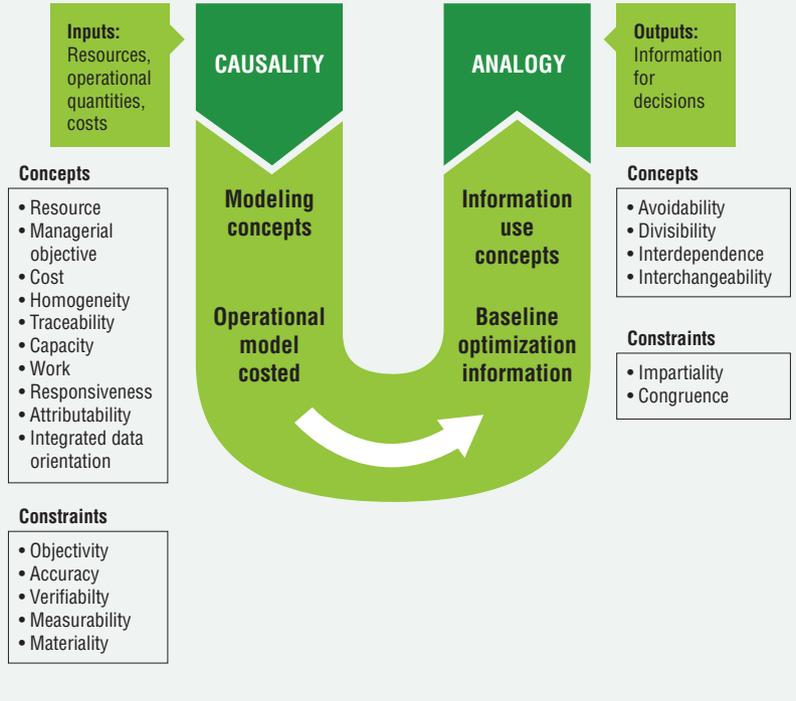
A cause-and-effect-based approach to costing enables better decisions, particularly at the operating level, because costs reflect actual resources used. The many small improvements and changes that need to be made each day can be evaluated quickly on a financial basis because marginal and incremental costs are accurate and clear. And convoluted overhead allocations made with weak or arbitrary drivers don’t need to be researched, explained and eventually eliminated as irrelevant.

Until 2013 and the publication of the Institute of Management Accountant’s “Conceptual Framework for Managerial Costing,” virtually nothing had been published to identify the different principles and concepts associated with creating cost information that helps

FIGURE 2

## Deriving the right data

This framework shows that organizations must start with an operational model of their resources to create cost information that can be useful for internal managers. Source: “Conceptual Framework for Managerial Costing,” Institute of Management Accountants (IMA), 2013



managers of your enterprise make decisions. Nearly everything about costing in organizations was derived from the generally accepted accounting principles designed for external financial reporting, which are not suitable for managerial costing.

Figure 2 shows how the managerial costing conceptual framework links resources, operations and money for making internal decisions. The diagram makes it clear that the key to creating effective cost information for internal decisions is to begin with an operational model of the organization’s resources. The objective is to show how processes consume (or, in the case of excess capacity, don’t consume) those resources to produce other resources, activities, intermediate outputs/objectives and final outputs and objectives.

An operational model of resource quantities will include resource capacities. Such a model serves as the foun-

ation and establishes the requirements for creating cost information. This requirement is quite different from the goal of financial reporting. Cost information must reflect resources, their use or nonuse and their relationships. Most financially oriented models focus their costing efforts on products; they generalize resource cost information into dollars – lacking capacity measures – and create an approximation that meets financial reporting requirements, not the requirements of process managers and employees.

In July 2009, the International Federation of Accountants published the “International Good Practice Guide: Improving and Evaluating Costing in Organizations,” one of the first major documents that identified how cost accounting for financial reporting often was insufficient at guiding internal decisions. The federation concurrently published an information paper, “A

## On the Web

A more extensive discussion of the principles required for costing internal management decisions can be found in the Institute of Management Accountant’s task force report, “The Conceptual Framework for Managerial Costing.” It is available at <http://bit.ly/1EXfzH>.

Costing Levels Continuum Maturity Framework,” that evaluated costing methods for capacity measurement and costing capability (see Figure 3).

Resource consumption accounting (RCA) was originally designed in a work group of CAM-I to reflect operations and resource capacity and overcome the information deficiencies of traditional costing and activity-based costing. RCA begins with an operational model of resources, then it models fixed and proportional quantity relationships through processes, and lastly it applies money to the model to cost identified managerial objectives. RCA provides marginal and fixed costs at all levels of objectives and resources, clearly identifies excess capacity and logically applies weak and noncausal costs to appropriate levels of the organization based on control and responsibility.

## Implementing a solution

While the knowledge to measure and cost capacity exists, it is not widely known or taught. It took Gantt five years to change the thinking of the accounting profession in his time. Today the financial reporting model is far more imbedded in accounting education, law and regulation, and the accounting profession.

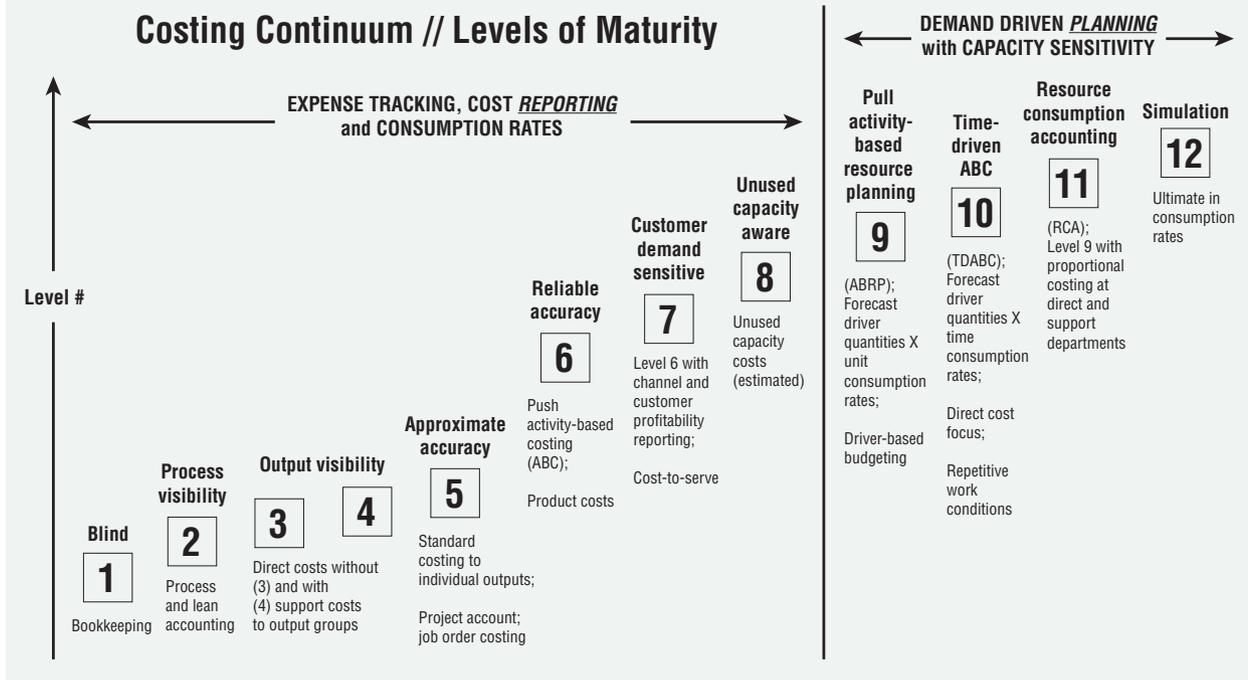
Therefore, you may face a five-year battle inside your organization to create a capacity and cost measurement system designed explicitly to help your managers make decisions for the betterment

FIGURE 3

## Framing costs

This costing levels continuum framework evaluates costing methods for capacity measurement and costing capability.

Source: International Federation of Accountants



of your enterprise, one that is free from the influence of financial reporting standards. The accounting profession is so focused on the external financial reporting model in its education that the individual professional has almost no perception that it is not the single, ultimate and infallible financial model of business.

Today's manufacturing and operational enterprise solutions collect enormous amounts of data, and that data provides most of the information necessary to model and measure resource capacity, the intermediate and final outputs, and management objectives. Current best-of-breed systems can, in a cost-effective fashion, plug the costing hole in the information that helps manufacturing managers make decisions. Some ERP systems also have that capability, but the configuration changes, and their ripple effects that will be required are almost never embraced by the finance organization.

Generating the necessary financial information on resource costs is

the final step, and fortunately, access to information is becoming easier. So the question will be when and how to engage the finance department. Of course, that will depend on individuals and organizational culture. Whenever that engagement occurs, maintain a solid list of financial information deficiencies that are making decisions difficult for operating managers – distorted costs, cost to resource mismatches, areas of information opacity, noncausal depreciation schedules and other gaps.

A frequent response from accounting will be that you don't need a new costing approach; you only need to look at the "relevant costs" or the "true costs" of the resources, processes or outputs. This must mean that the financial statement costs they so diligently calculate in the financial accounting system are "irrelevant" and "not true." In any case, you should point out that such "relevant cost" can only be had from costs compiled strictly based on cause and effect. The logical failures Gantt pointed out a century ago remain valid

today, and as he successfully argued, there is a better way. Let's rediscover and promote it again today. ❖

*Larry R. White is the executive director of the Resource Consumption Accounting Institute. He retired from the U.S. Coast Guard after 28 years and has a bachelor's degree from the U.S. Coast Guard Academy and an MBA from Columbia University. White co-authored the Statement of Management Accounting: Conceptual Framework for Managerial Costing, writes the Finance View column for AutomationWorld magazine and has contributed to numerous publications for the Manufacturing Enterprise Solutions Association Metrics Committee. He was global chairman of the board for the Institute of Management Accountants, a member of the International Public Sector Accounting Standards Board and a member of the professional certification board of the Association of Government Accountants.*