

A Guide to Integrating Revenue Management and Capacity Analysis

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COMPANIES OF ALL SIZES ARE LIMITED BY ANY NUMBER OF CONSTRAINTS: CAPACITY OF THEIR PLANTS AND OTHER PHYSICAL STRUCTURES, DISTRIBUTION CHANNELS, RULES AND REGULATIONS, SIZE AND EDUCATION OF THE WORKFORCE, AND ACCESS TO RAW MATERIALS, TO NAME A FEW. YET IT IS OFTEN NOT THE RESOURCES YOU HAVE—BUT WHAT YOUR ORGANIZATION DOES WITH THEM—THAT CAN MAKE THE DIFFERENCE BETWEEN BARELY PROFITABLE AND BOOMING. HERE IS HOW TO MAKE THE MOST OF YOUR OPPORTUNITIES.

Call it the neglected topic. While revenue management has been popular in several industries since the mid-1980s, you really have to search to find any mention of it in the accounting and finance literature. That is a bit odd considering that revenue management utilizes differential pricing and other techniques to influence customer demand for an organization's products and services. Over time, both the techniques employed and the range of industries have expanded to the point where revenue management is now applied in a wide variety of organizations.

American Airlines is credited with introducing the practice of revenue management—then known as yield

management—in 1985.¹ The first low-fare airlines, most notably People Express, had appeared on the scene, posing a major threat to the established carriers. American did not consider matching the low fares across the board to be an option, as the revenue loss would be too great. Instead, it sought ways to target fare reductions to customers, times, and flights in a way that would most impact its new competitors while maintaining its normal price structure in other circumstances. Thus, American's targeted price reductions tended to keep customers flying American. The strategy proved successful, and People Express and other new low-fare airlines did not survive for long.

Even after the competitive threat disappeared, however, yield management survived as a technique because it was seen as a way to maximize revenues and fill what would otherwise be empty seats by offering targeted price reductions. The technique spread to other airlines as well as other industries with economic characteristics similar to that of airlines, such as hotels, restaurants, and golf courses. Over time, the term *yield management* changed to *revenue management*.

Because revenue management is ultimately about generating additional revenue by selling unused capacity profitably, one of the important considerations in revenue management is an understanding and analysis of capacity. Specifically, this article addresses how the Computer-Aided Manufacturing—International (CAM-I) capacity model applies to revenue management.²

TRADITIONAL CHARACTERISTICS OF REVENUE MANAGEMENT

Organizations that have adopted revenue management techniques tend to share certain characteristics.³ They include:

- ◆ **Capacity is fixed.** The company cannot readily change either its total capacity or its response to changes in demand. An airline has a certain number of aircraft, each with a given seating capacity, deployed among various routes. Hotels have fixed numbers and types of rooms. Golf courses can accommodate only so many players each day. Capacity changes require some time and are usually costly. Of course, fixed capacity by itself is not unusual; virtually all organizations have a more or less fixed capacity.
- ◆ **Service capacity is perishable.** Unsold seats on a flight, vacant hotel rooms, empty tables at a restaurant, and rental cars remaining on the lot all represent permanently lost revenue opportunities. This characteristic is most common for service industries; product-based industries can usually inventory unsold goods for future sale, although some items, such as groceries and other perishables, are also short-lived.
- ◆ **The cost structure includes high fixed costs and low variable costs.** While this cost structure is not inherently necessary for revenue management, it was common among early users. If few costs varied with

sales, most of the revenue gained from applying differential pricing fell to the bottom line, and the increase in profits was about the same as the increase in revenues. Assuming a high-fixed, low-variable cost structure was more a convenience than a necessity. Because incremental costs were minimal, revenue decisions could be made without concern for the cost side. For an airline, the flight crew, ground support, and aircraft operating costs will be largely unaffected by adding another passenger. Fuel costs will increase slightly, along with the cost of additional on-board refreshments, but little else will change. Taking on a few more passengers at reduced prices will generally contribute to profits—at least in the short term. Revenue management techniques can still be used where this cost structure does not apply, but greater attention must be paid to the profit margin on the increased revenues.

- ◆ **Demand patterns are uncertain or time-variable.**

Demand often varies according to time and the whims of the consumer. An airline may fill its early-morning and evening flights with business travelers on same-day trips, but its midday and weekend flights may be underutilized. A resort hotel may be full on weekends but have lots of empty rooms during the week. A restaurant may have empty tables before 6 p.m. These situations are opportunities to attract customers to slower times by offering discounts or other incentives. Revenue management assumes that some customers are price conscious and can be induced to shift their business to the underutilized times if the price or incentive is attractive.

- ◆ **The company is able to forecast its demand.** Attracting additional customers to underutilized service times requires the ability to forecast demand by identifying when excess service capacity is likely to exist. Then the company must decide which customers should receive lower-priced offers. The goal is to attract potentially new customers, not convert existing customers who pay full price.

Although these five conditions were common among early users of revenue management, they are not required for revenue management techniques to be applied. Three of these conditions are fairly common to

all businesses: fixed capacity, uncertain or varying demand, and the ability to forecast demand. The other two—a cost structure heavily weighted to fixed costs and perishable “inventory”—are more restrictive. These conditions are not inherently necessary, but they do make the application of revenue management easier. Added revenue approximates added profit if variable costs are minimal, and perishable capacity eliminates the consideration of inventory policy. As revenue management has grown in its applicability, companies lacking one or more of the above conditions have found ways of using these techniques.

DIMENSIONS OF CAPACITY MANAGEMENT

Concern with the analysis, costing, and management of capacity has been a long-standing issue in management accounting. One common issue is what to do with the cost of capacity that is not currently used. Should it be identified separately from product costs, or should it be incorporated into product costs even though the excess capacity is not needed for current production? Another common theme involves the efficient use of capacity. Over the past 30 years, several capacity-related management techniques have been developed, including material requirements planning (MRP), Just-in-Time (JIT) production, and the Theory of Constraints (TOC).

Throughout the capacity literature, two themes have dominated: how to account for the cost of unutilized capacity and how to use existing capacity in the most efficient way. Neither theme has a connection to revenue generation. There is, however, one technique that does relate to revenue management. The CAM-I model analyzes how capacity is used, including the question of how much of it is currently generating revenues. Developed by a group of large corporate and nonprofit entities, major CPA firms, and others, the CAM-I model is a useful tool for considering how additional revenues might be generated by changing strategies or policies relating to capacity utilization.⁴

CAPACITY ANALYSIS AND THE CAM-I MODEL

As mentioned earlier, revenue management is about generating additional revenue by selling unused capacity profitably. Thus it is essential to know what one's

capacity is and how it is currently deployed.

Capacity was easy to measure in the early applications of revenue management: the number of seats on a flight, the number of rooms in a hotel, the dining capacity of a restaurant, and so forth. When revenue management is applied to more complex organizations, however, a better model of capacity is needed. The CAM-I model analyzes the current use of capacity, with emphasis on physical capacity. But an organization's capacity entails more than its physical assets. The “Four Ps” of capacity include physical, personnel, processes, and purchases:

- ◆ **Physical capacity** consists of buildings, equipment, vehicles, technology, and the like. Physical capacity is potentially available for use at any time.
- ◆ **Personnel capacity** is the people power needed to operate the organization. It is present only as management decides to provide it.
- ◆ **Process capacity** refers to the way business is conducted, and it plays a role in terms of how much business an organization can handle.
- ◆ **Purchase, or supply, capacity** is the organization's ability to acquire all the goods and services needed to operate—in the right quantities, locations, and time periods.

The CAM-I capacity model focuses primarily on physical capacity, although it can be used for the personnel dimension as well. Capacity measurement begins with a notion of *rated capacity*, which is usually a 24/7/365 availability of physical resources. Time is the basis of measurement. The rated capacity is then classified into three segments: idle, nonproductive, or productive.⁵

Idle Capacity

There are various reasons why physical capacity may be idle. It may be said to be *off-limits*, meaning that some factor prevents its use. Laws or regulations may specify times when the business cannot operate; for example, bars may have opening and closing times set by law. Contractual provisions may allow a store in a shopping mall to operate only during hours when the mall is open. Physical limitations, too, may prevent use; a golf course cannot function at night or during snowy, north-

Table 1: Sara's Table, Analysis of Physical Capacity

Productive time (24 open hours x 70% utilization)	16.8 hours
Nonproductive time, stand-by capacity – restaurant is open and staffed but has unfilled space (24 hours x 30%)	7.2 hours
Nonproductive time, preparation and cleanup – restaurant is staffed but is not serving customers (3 hours/day x 6 days)	18 hours
Idle time , restaurant is not in use	<u>126 hours</u>
Total time	168 hours

ern winters. Sometimes, idle capacity is determined by management, which sets business hours. Thus, some off-limits idle capacity is mandatory while others are discretionary.

Capacity may be idle because it is considered non-marketable, meaning there is insufficient demand to justify its use. For example, a grocery store may have too little demand during overnight hours to justify being open 24 hours a day.

Capacity also may be idle even when it is potentially marketable but management does not exploit the opportunity: a dinner-only restaurant that could be open for breakfast and lunch, for example. *Marketable idle capacity* suggests that unexploited—though not necessarily profitable—revenue opportunities exist.

Nonproductive Capacity

Capacity is nonproductive when the physical facilities are in use but are not producing salable goods and services, such as when a manufacturing operation is down for repair/maintenance or setup work. Producing defective goods or waste is also using capacity in a nonproductive way. A major nonproductive use of capacity occurs when the business is open and staffed—the physical capacity is in use—but it is not generating as much revenue as it could because customers are in short supply. This is called *stand-by capacity*. The physical facilities were designed to handle a given number of customers, but at times there are not enough customers.

Nonproductive time does not imply that the use of capacity is unnecessary; it simply means that the capacity is not generating revenues. An airline requires time for maintenance, loading and unloading passengers, waiting for a connecting flight to arrive, and waiting for

planes to take off, but these activities do not generate revenue. The more time spent in these nonproductive activities, the less time is spent transporting passengers. While nonproductive time often can be managed, it usually cannot be eliminated.

Productive Capacity

Capacity is productive when it generates revenue by producing salable goods and services. Although this is certainly desirable, it is insufficient by itself. For instance, producing excess goods for inventory may not necessarily be a profitable use of capacity. The goal of revenue management is to increase capacity utilization *and* be profitable.

Here is an example of applying the CAM-I capacity model to a business: Sara's Table restaurant is open for dinner only, six days a week. Service hours are from 5 p.m. to 9 p.m., but the restaurant is staffed from 4 p.m. to 11 p.m. to allow for setup, food preparation, dining service, and cleanup. The physical capacity of the restaurant is available 168 hours per week (24 hours times seven days). At most, productive use of the physical capacity is 24 hours per week (four hours times six days), depending on how full the restaurant is. Nonproductive time is at least 18 hours per week (the three hours daily of preparation and cleanup) plus any time that customers are not present during open hours. The restaurant is idle 126 hours per week.

Suppose that Sara's Table could serve 150 dinners each evening during its regular dining times. In a typical week, however, an average of 105 dinners are served daily, or 70% of the maximum. The weekly capacity analysis is shown in Table 1.

Each week, the physical facilities are productive 10%

Table 2: Sara's Table, Analysis of Personnel Capacity

Productive time (4 open hours x 20 people x 70% utilization)	56 hours
Nonproductive time, stand-by capacity – restaurant is open and staffed but has unfilled space (4 hours x 20 x 30%)	24 hours
Nonproductive time, preparation and cleanup – restaurant is staffed but is not serving customers (3 hours x 20)	60 hours 84 hours
Idle time , restaurant is not in use and is not staffed	<u>0 hours</u>
Total time	140 hours per day

of the available time, nonproductive 15% of the time, and idle 75% of the time.

USING THE CAPACITY MODEL TO ENHANCE REVENUES

By analyzing physical capacity, we focus attention on how the physical resources are used. As pointed out, the goal is not just increased utilization but *profitable* utilization. Knowing how much of a business's physical capacity is idle or nonproductive—and why—can point to opportunities for revenue growth.

What can Sara's Table do to grow its revenue? On an average night, it is only 70% full. Pricing promotions, such as coupons or early-bird specials, could increase the number of customers, converting the nonproductive stand-by capacity into productive capacity. Management might also consider whether longer dinner hours or being open for lunch or breakfast would add enough revenue to increase profits. If Sara's food-preparation (kitchen) capacity exceeds its food-service (dining) capacity, it could offer take-out or catering services. Physical capacity is expensive to acquire and maintain, yet Sara's is using only 10% of its capacity productively.

Sara's Table is similar to plenty of other businesses. Hotels, golf courses, theaters, rental car companies, and freight companies have fairly well-defined measures of their service capacity and can track how much of it is being utilized (or *not* being utilized). Manufacturing companies probably have some knowledge of their maximum output capability, given their machines and process times, although variations in product mix may complicate the measurement. Professional service firms, such as accountants and lawyers, may focus more on the service capacity of their personnel (discussed next),

rather than their physical resources. For some business types, however, the analysis of physical capacity is more challenging, such as measuring how much of a retail store is being used effectively.

The CAM-I capacity model focuses on physical capacity; this is what the term "capacity" means to most people. Physical capacity is typically a major investment that represents a large fixed cost to most businesses, and it is not modified easily or quickly. But considering how a company would increase the utilization of physical capacity for greater revenue and profit also requires that we consider other dimensions of capacity as well. To make physical capacity operational typically requires personnel, processes, and purchases. Here is a look at each of these in more detail.

Personnel

Personnel are required to convert physical capacity into revenue. Aircraft cannot generate revenues by themselves; they require pilots, flight attendants, and ground crew, among others. Unlike physical assets, personnel staffing is discretionary and generally can be adjusted up or down easily. There is usually little if any idle personnel capacity because a business is not staffed if it is not open. Nonproductive personnel capacity may certainly exist, especially stand-by capacity—the business is open and staffed to serve customers, for instance, but the planned number of customers may not come.

We can use the CAM-I framework to analyze productive and nonproductive personnel capacity. Returning to Sara's Table, assume there are 20 employees—a manager, cooks, other kitchen workers, servers, and dishwashers—all working from 4 p.m. to 11 p.m. Table 2 shows how the total personnel capacity of 140 hours

per day is distributed.

There is no idle capacity for personnel because the restaurant is not staffed at times other than 4 p.m. to 11 p.m. on the six open days.

For some businesses, revenue generation may depend more on managing personnel capacity than managing physical capacity. Professional service firms, for example, earn revenues by selling the time of their professional staff rather than by using their physical resources.

Purchases

In addition to physical facilities and personnel, businesses require materials, supplies, and external services to be able to generate revenue. Thus, a dependable supply of such items—in the locations, quantities, and times needed—is another important dimension of capacity. Of course, some companies have extensive internal supply and distribution networks, and others depend on external suppliers.

Processes

Revenue generation depends on having sufficient processes in place to make the other elements—physical capacity, personnel, and purchases—operational. Adequate information systems are one of the important processes for many businesses. For example, airlines and hotels depend on sophisticated reservation systems to operate.

Revenue-generating processes also impact capacity. The physical capacity of Sara's Table is determined by the size of its kitchen and dining area. Its personnel capacity is determined by the number and capabilities of its food preparation and service workers. The restaurant's purchases dimension is a steady and reliable source of food and service products. But we cannot measure the revenue generation capacity of Sara's Table without knowing something about its processes: Is it a fast-food outlet, a buffet operation, casual dining, or fine dining? A fast-food restaurant, with its shorter preparation, service, and seating times, would have a greater customer capacity than a fine-dining restaurant, but that does not necessarily mean that it would generate greater revenue or higher profits.

CAPACITY: A MULTIDIMENSIONAL CONCEPT

The illustration of Sara's Table demonstrates that capacity is multidimensional. Physical capacity is the most constraining, as it is not easily changed in the short term. Understanding how physical capacity is used—how much of it is idle or nonproductive—is central to revenue management. A profitable way to enhance revenues without additional capital investment involves finding ways to convert some idle or nonproductive time or space to productive use.

Processes are probably the next most constraining feature of capacity; like physical capacity, they are not changed easily. Businesses establish—and customers come to expect—a certain pattern and style of operations.

Personnel and purchases are usually the most flexible dimensions of capacity, yet they also have considerable impact on revenue generation and profitability. Inadequate staffing or an insufficient supply of materials, for example, may turn customers away as they become dissatisfied with the quantity or quality of the goods or services provided. A few years ago, Circuit City, a large chain of consumer electronics stores, laid off all of its highest-paid sales personnel in a misguided attempt to reduce costs and increase profitability. The results were disastrous. The remaining salespeople were young and inexperienced and were unable to offer the technical information and advice customers needed. Customers were dissatisfied and took their business elsewhere. The chain soon filed for bankruptcy.

SOME KEY TAKEAWAYS

In "Making Money from Available Capacity: A Proposed Model for Fostering Innovation," James T. Low, Savya Rafai, and Audrey Taylor stated that "the danger is that current available capacity is viewed as an anchor rather than an opportunity."⁶

Capacity analysis can help create those opportunities and is central to revenue management. By applying the CAM-I model to physical capacity, we determine how much of the time our capacity is idle or nonproductive and, from there, whether some of it can be converted to productive and profitable revenue-generating use.

As a management accountant or financial professional, consider how your company's business model—its

processes for delivering goods and services—impacts capacity. Personnel and supply should be reasonably aligned with capacity utilization: not too much, not too little. It stands to reason that if some idle or nonproductive capacity can be made productive, adequate personnel and supplies must be available as well.

In many business environments, capacity considerations can be very complex. Still, you cannot manage revenues effectively without a good understanding of how much capacity your organization has and how it is currently being used. ■

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ENDNOTES

- 1 Robert G. Cross, *Revenue Management: Hard-core Tactics for Market Domination*, Broadway Books, New York, N.Y., 1997; Barry C. Smith, John M. Leimkuhler, and Ross M. Darrow, "Yield Management at American Airlines," *Interfaces*, January/February 1992, pp. 8-31.
- 2 Ronald J. Huefner, *Revenue Management: A Path to Increased Profits*, Business Expert Press, New York, N.Y., 2011.
- 3 Sheryl E. Kimes, "A Strategic Approach to Yield Management," in Anthony Ingold, Una McMahon-Beattie, and Ian Yeoman, eds., *Yield Management: Strategies for the Service Industries*, second edition, International Thomson Business Press, London, England, 2001.
- 4 The CAM-I Capacity Interest Group, Thomas Klammer, ed., *Capacity Measurement & Improvement: A Manager's Guide to Evaluating and Optimizing Capacity Productivity*, Irwin Professional Publishing, Chicago, Ill., 1996.
- 5 *Ibid.*, p. 15.
- 6 James T. Low, Savya Rafai, and Audrey Taylor, "Making Money from Available Capacity: A Proposed Model for Fostering Innovation," *Management Accounting Quarterly*, Summer 2010, pp. 10-28.

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