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Zen Accounting: How Japanese Management Accounting Practice Supports Lean Management

By Robert Hutchinson, Ph.D., and Kun Liao, Ph.D., CQE

The historical roots of capacity accounting and lean management are examined in an effort to better understand how they evolved and in what competitive environment they would make sense. We then examine the nuances of capacity management and quantitatively demonstrate how capacity accounting undermines the very essence of lean management. Next we discuss Japanese cost accounting practice as it relates to lean management and finally draw conclusions with implications for management accounting practice within lean organizations in the United States.

Despite a plethora of literature on the subject, a great deal of confusion continues to surround the concept of lean accounting. One possible source of confusion is that it is really measured along two different dimensions. The first refers to what extent a management accounting system supports lean management principles in the long run, and the second refers to the efficiency of the accounting system itself in delivering needed information to management in a timely and cost-effective manner.

Many managers have become increasingly aware of the inherent problems with their legacy cost accounting systems, particularly along the first dimension. Traditional costing systems often create perverse incentives for managers that undermine the principles of lean management. Practitioners have looked to management accounting researchers and consultants to offer alternatives that would be lean along both dimensions. Given the attention activity-based costing (ABC) and resource consumption accounting (RCA) have received in the management accounting literature, it appears that a

chasm between operations management and management accounting theory has grown wider.

Lawrence Grasso illustrates this point in his article, "Are ABC and RCA Accounting Systems Compatible with Lean Management?" in the Fall 2005 *Management Accounting Quarterly*.[1] While Grasso's conclusions are correct in suggesting the incongruence of these two costing systems with lean management, particularly along the second dimension, he misses a key nuance of capacity management theory that puts capacity accounting methods such as RCA directly at odds with lean management, particularly along the first dimension.

According to Grasso, "The cost of developing and maintaining an RCA system far exceeds the benefits for lean businesses. It would be hard to imagine a lean-oriented company adopting RCA. From an accounting perspective, it would also be hard to characterize a company using an RCA system as lean."[2] While this statement is certainly true, it focuses more on the cumbersome nature of RCA and misses a far more important fact: Any derivation of capacity accounting is fundamentally incompatible with lean management. Grasso's statement—"Excess resources (i.e., unused capacity) are a waste"—while generally true and widely accepted as common sense, clearly overlooks a subtle nuance of capacity management in the context of a lean organization.[3] In fact, studies have proven that some excess capacity is optimal in a stochastic environment.[4]

Capacity Accounting's German Origins

Resource consumption accounting and other forms of capacity accounting have received a great deal of attention recently in management accounting literature. In essence, capacity accounting uses the total amount of the allocation base at capacity to calculate overhead rates and assign cost to cost objects.[5] The idea of using the theoretical capacity as a basis for allocating manufacturing overheads is not a new one; rather, it is derived from German cost accounting practices, which have long focused on capacity utilization. The use of such capacity accounting methods finds its genesis in the early industrialization of Germany.

In the early days of industrialization, Germany was at a major disadvantage compared to the other European powers because it did not have colonies in South America, Asia, and Africa and the ready access they provided to the raw materials demanded by industrialization. In order to compete with the burgeoning textile industry in England, Germany was forced to create its own dyes synthetically. Hence, the country became an early leader in the chemicals sector, where it continues to dominate with such global heavyweights as BASF, Bayer, Hoechst, Sigma-Aldrich, and others.

Even early on, chemical production required relatively higher investments in fixed capital and lower levels of variable manufacturing costs than the textile industry it served. With such a high degree of operating leverage, it is no wonder that industry executives continue to say, "Capacity utilization is king!" Given this historical background, it makes sense that cost accounting systems that emphasize identifying and quantifying underutilized production capacity would have German origins while Anglo-American cost accounting systems tended to place emphasis on controlling direct labor.

Today's proponents of capacity accounting say that it addresses two main concerns of traditional costing systems that derive their predetermined overhead rates based on estimated or budgeted activity in the coming period. First, because the predetermined overhead rate is based on "actual" capacity, it will not fluctuate from period to period with budgeted activity. Second, products are only charged for the portion of the resources they actually use; therefore, they are not unduly burdened in the marketplace.

Any sort of capacity-based cost accounting system virtually ensures that there will be underapplied overhead at the end of any accounting period.[6] This amount of unallocated overhead can be treated in two ways: either allocated between cost of goods sold and finished goods inventories or treated as a period expense. Proponents argue that in order for capacity accounting to have a real impact, however, underapplied overhead should not be buried in inventory accounts. They suggest that underapplied overhead really represents the "Cost of Unused Capacity," which should show up on the income statement as a period expense.

To illustrate this point, assume the production data in

Table 1: Hypothetical Production Data

Actual volume	40,000 units
Selling price	$40.00 per unit
Variable production cost	$24.00 per unit
Fixed MOH	$100,000 per year
Capacity	50,000 units
Fixed SG&A	$500,000 per year

Table 1. Under the traditional approach to overhead allocation, the predetermined overhead allocation rate would be $2.50 per unit ($100,000/40,000 units budgeted volume). Under the capacity accounting method, the allocation rate would be $2 per unit ($100,000/50,000 units at capacity). The differences can be seen in the income statements in Table 2.

Given the old adage, "You get what you measure," there is no doubt that factory managers will then find ways to ensure that this period expense is minimized. Understanding the inverse relationship between capacity utilization and the cost of idle capacity, the managerial incentives created come into direct conflict with the principles of lean management.

Lean Management's Japanese Origins

The concept of lean management has very different origins from capacity accounting. The practices that we call lean management today were originally laid out in Taiichi Ohno's seminal work, *Toyota Production System*.[8] Ohno had worked his way up through the ranks of Toyota, starting out in the Toyoda family's loom business and, prior to World War II, moving into the start-up Toyota Motor Company.[8] The Toyota Production System (TPS) was born out of necessity, as post-war Japanese economic growth demanded a greater variety of goods than could be economically produced using mass production because of the significantly diminished domestic market and devastated infrastructure.

Since lean management was introduced in the United States in the early 1980s, a plethora of literature has been written on the subject. Unfortunately, the popularity of the subject itself may add to some of the confusion among management accountants searching for a lean accounting system. Referring to Ohno's original work may clear up a lot of misconceptions, particularly when it comes to the issue of capacity utilization management.

Capacity Utilization in the Toyota Production System

At its essence, TPS seeks to eliminate waste in all its forms from the production process. This brings us immediately to a key source of confusion vis-à-vis capacity management. To bring this into better focus, it is necessary to first stipulate that *kaizen* (Japanese for continuous improvement) is a *journey* and not a *destination*. Ohno understood that waste would never be totally eliminated in any production process; therefore, it is necessary to categorize and prioritize the types of waste that are the greatest impediment to efficient production.

Inventory is by far one of the most nefarious of all forms of waste because it not only ties up working

Table 2: Hypothetical Income Statements

Traditional Method		*Capacity Method*	
Revenue	$1,600,000	Revenue	$1,600,000
Cost of Goods Sold	$1,060,000	Cost of Goods Sold	$1,040,000
Gross Margin	$540,000	Gross Margin	$560,000
SG&A Expense	$500,000	**Cost of Idle Capacity**	$20,000
Net Operating Income	$40,000	SG&A Expense	$500,000
		Net Operating Income	$40,000

capital—it actually hides production inefficiencies and defects. One of the primary tenants of TPS is the concept of Just-in-Time (JIT) production, where production is pulled by actual customer demand, and inventory levels are minimized. Despite our understanding of the wastefulness of maintaining inventory, the building of inventory seems to be culturally engrained. According to Ohno, "To prepare for future natural disasters, people are accustomed to stockpiling goods, for example the Japanese farming tribes. Although not necessarily a bad social custom, I deny its value in industry. I am talking about the way today's managers store raw materials and finished products to meet unexpected demands….[Accepted wisdom tells us] if a new machine is purchased, keep it operating full-time….As long as it is running smoothly, let the machine produce to capacity….In case of future trouble with the machine, let it produce while it can. This way of thinking is still deeply rooted among manufacturing people."[9]

With volatility in customer demand, simply eliminating inventory can cause serious problems with service level. This is where excess production capacity becomes a necessary aspect of TPS. Put quite simply, TPS trades inventory buffers for capacity buffers and actually advocates maintaining excess productive capacity whenever possible. In Ohno's words: "Let's consider Toyota's thinking about what is economically advantageous from the standpoint of production capacity. Opinions differ on the economic advantages of maintaining extra production capacity. In brief, excess capacity utilizes workers and machines that are otherwise idle, incurring no new expense. In other words, they cost nothing."[10]

The principle of maintaining capacity buffers simplifies managerial decision making under several different scenarios. In each case, knowing that excess productive capacity exists virtually ensures that managers will make the correct decisions for long-term competitive advantage under the following scenarios:

- Make or buy decisions become a marginal (variable) analysis where only the additional cost of materials and labor are relevant.
- Preventive maintenance and line work does not require any cost consideration; there is no marginal cost.
- Reducing lot sizes carries no marginal cost; reducing setup times, therefore, becomes a separate issue not immediately affecting production.

From Ohno's perspective, capacity buffers make detailed cost analyses irrelevant to operational decision making: "When there is excess capacity, loss or gain is evident without requiring cost studies. The most important thing to know is the extent of excess capacity at all times….At Toyota, we go one step further and try to extract improvements from excess capacity. This is because, with greater productive capacity, we don't need to fear new cost."[11]

Ohno makes a key distinction between the operating (rated capacity) vs. operable rate (scheduled capacity) of a machine process, placing a greater emphasis on the latter. Rated capacity, sometimes called engineering capacity, is the maximum theoretical speed at which a machine can operate assuming no breakdowns, failures, or shutdowns. Even if achievable, it can only be sustained for brief periods. Scheduled capacity is the expected standard rate or speed. Actual capacity includes downtime for breakdowns, stoppages, and regular maintenance as well as allowances for yield problems. What is most important for TPS is that production capacity is always available when it is needed, which is what Ohno refers to as 100% of operable rate: "The operating rate is the current production level in relation to the full operating capacity of the machine for a specified length of time. If sales go down, the operating rate naturally drops. On the other hand, if orders increase, the operating rate can reach 120% or more through shift work and overtime. Whether an operating rate is good or bad is determined by the way equipment is used relative to the quantity of products needed. The operable rate at Toyota means a machine's availability and operable condition when the operation is desired. The ideal 100% depends on good equipment maintenance and rapid changeovers."[12]

The amount of capacity in excess of expected demand is the operation's capacity cushion. The common view of capacity cushion associates it with resources such as floor space, equipment, and people. This kind of capacity cannot provide the same speed of

response as can inventories, but it is inherently more flexible in that the specific mix and volumes of products demanded by customers can be produced within the company's normal lead time.[13]

Capacity Management in a Lean Environment

Let's look at a brief quantitative example to demonstrate the impact of increased capacity utilization on manufacturing system performance and the levels of work-in-process (WIP) inventory in particular. Assume that we are talking about a lean manufacturing system with JIT production, so production only takes place in the presence of actual customer demand. Now suppose a workstation has an engineering (operating) capacity of 20 pieces per hour and a work order arrival rate of (a).

Suppose that both the interarrival time (1/a) of work orders and the time it takes to process the orders (p) are governed by exponential probability distributions. In other words, the probability of a customer order arriving does not depend on the time of day, is independent of previous customer orders, and is independent of the number of customer orders currently in queue. Analogously, this implies that the probability of the workstation completing any job in the given small amount of time remains the same no matter how many jobs are waiting in queue or how much time an order has already spent in process.

If customer orders arrive at an average rate of 12 per hour, the probability that one will arrive during any given second during that hour is 1/300, or 0.00333 [(12/60)/60]. In general, if the probability of a customer order during a short period of time Δt is equal to $(a \times \Delta t)$, then the average time between arrivals is 1/a; therefore, the interarrival rate will be 1/12 of an hour, or 5 minutes (60/12).

Given the assumption of an exponential arrival and processing rates, it can be shown that if the arrival rate is (a), then the probability of no customer orders arriving during a long period of time from (T) is equal to e^{-aT}. Similarly, the processing rate (p) would have an average processing time of 1/p; therefore, the percentage of time the workstation is idle during any time period is equal to 1-(a/p). If orders arrive at a rate of 12 per hour and the machine can process them at a rate of 20 per hour, that means the machine will be idle approximately 40% of the time.

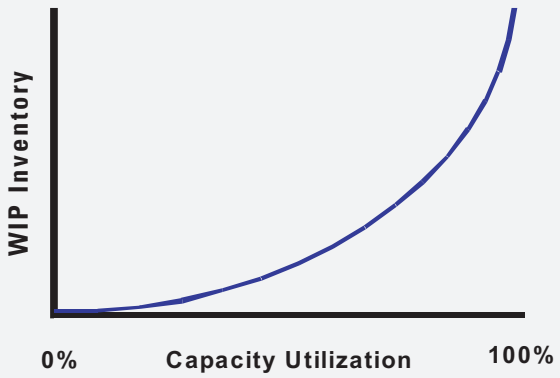
Now comes the important point: Even though the machine process has 40% excess capacity, we still might expect to see work-in-process inventory because some of this capacity is lost to enforced idle time from the market. In this case, the average number of orders either being processed or in queue N can be calculated as N = a/(p-a), or 1.5. So even with 40% excess capacity, we would expect to see an average of 0.5 orders in queue waiting to be processed.

In the case of exponential interarrival and service times, the average time an order spends in a stable system is from the time it arrives until it is completed, equal to T = 1/(p-a). This is because the average number of orders in a line is equal to the average rate at which they arrive multiplied by the average amount of time each order spends in queue, or $N = a \times T$. This implies that T = N/a, or $a/(p\text{-}a) \times 1/a$, or 1/(p-a). This is based on the famous "Little's Law," named for the man who first proved that critical WIP is equal to throughput time cycle time ($WIP = TH \times CT$). To calculate the total average cycle-time per order, we simply multiply the number of orders in process or in queue (N) by the average interarrival time (1/a) to get 0.125 hours, or 7.5 minutes.

What is most important from this example is the impact on WIP inventory as capacity utilization increases. For example, suppose that the order arrival rate increases by 50% to 18 per hour, which is still well within the rated capacity of our workstation. In this situation, the WIP inventory (N) would increase 600% from 1.5 to nine, and the average cycle time would have a corresponding increase from 7.5 minutes to 30 minutes. What lean manufacturers understand is that in the face of demand uncertainty, as capacity utilization approaches its maximum, overall manufacturing system performance deteriorates rapidly. The general relationship between capacity utilization and WIP inventory is shown in Figure 1. The mathematical proof of this relationship has been reconfirmed in computer simulations as well; with increased utilization, inventory increases while throughput and contribution decrease.[14]

One other nuance of capacity management important to note is the difference between making improve-

Figure 1: The Relationship between Capacity Utilization and Inventory



ments to existing machine processes versus adding new machines as a strategy for creating capacity buffers. Returning to our previous example, the two decision sets from which management must choose in the face of the increasing demand are to either add another machine or make improvements to the existing machine in order to increase its processing rate.

Looking at the first option, suppose that an additional workstation is added. In this case, the arrival rate for each individual machine station would be cut in half to nine orders per hour. We therefore would expect that the number of orders in each queue would fall to 0.82, or 9/(20–9), so that the number of orders in both lines would be 1.64, and the average time an order would wait in the system would be 5 minutes 28 seconds ($0.82 \times 1/9 \times 60$ minutes).

Now suppose that an improvement could be made to the existing machine that would cut its processing time in half so that it could produce 40 units per hour. According to the equation, the number of customers would fall to 0.82, or 18/(40-18), but the average waiting time for an order would be only 2 minutes 44 seconds ($0.82 \times 1/18 \times 60$ minutes)—half the time compared to the first option of adding another machine. In other words, doubling the capacity rate of an existing slower process is more effective at lowering inventory than doubling the number of slower processes. This fact has major implications for management accounting practice.

Implications for Management Accounting Practice

Much like their operations management colleagues, management accounting researchers and practitioners have looked to Japan for examples of how lean accounting systems should be developed. After all, Japan is the birthplace of lean management, and many Japanese industries have adopted it to their competitive advantage. Many accounting researchers are greatly surprised to find that Japanese management accounting practices appear rather simplistic and in many cases simply wrong.

One of the first surprises may be that traditional absorption costing remains the dominant form of accounting in Japan. This may seem counterintuitive, as many management accountants in the United States have advocated throughput accounting or other variable costing methods, particularly with the popularity of Theory of Constraints manufacturing. Japanese management accounting has rejected variable costing almost universally. According to Michiharu Sakurai and Phillip Y. Huang, "In addition to the declining direct labor cost, the main labor cost in a flexible manufacturing company consists of paying those who work in maintenance, monitoring, R&D and software development. These labor costs are basically indirect or fixed costs. Consequently, the variable portion of the direct costing tends to decrease, and material costs have become the only variable cost in direct costing….For companies using flexible manufacturing system, absorption costing becomes the only meaningful costing approach."[15]

Probably the single most popular alternative to traditional costing systems in the United States has been activity-based costing. ABC was first proposed in the early 1980s by management accounting researchers as a way to drive more accurate product costs in the context of ever-rising levels of manufacturing overhead. For all the hype created around this costing system, the truth is that most of those companies that have experimented with ABC have abandoned it, and lean organizations

have rejected it altogether.[16] This is not a surprise as Japanese management accountants have also rejected ABC.

In Japan, cost accountants have vigorously sought more reasonable allocation bases, especially since the installation of flexible manufacturing systems began. Quite a few Japanese companies have selected the product line instead of the product as the cost object. This led to the development of a system that is often referred to as direct charge of overhead to product line system (DCOPLS).[17] It results in cost accounting systems with few allocations, which are useful for cost reduction but not accurate for product costing.[18]

Japanese firms have a strong tendency toward cost management. They often use techniques that they know to be less-precise measures of product cost, e.g., DCOPLS, in order to direct the behavior of employees to certain goals. Thus, the cost accounting system binds itself more tightly to the strategic mission and less tightly to the concerns about precision in measurement than in the United States.[19] Companies do not want to fund individual production lines for each product, and thus they have shared production processes. In Japan, production decisions are certainly not designed to facilitate accounting. According to Takeo Yosikawa, "Management accounting is the servant of production, not its master."[20]

Capacity accounting, much like ABC, fails to add value vis-à-vis Japanese management techniques. While ABC is certainly a failure along the first dimension of a lean accounting system, i.e., it is not a lean process, capacity accounting is also difficult to classify as a lean process. Simply trying to calculate productive capacity is nearly impossible in most flexible manufacturing environments. Even for a single facility, there usually is considerable uncertainty as to how its capacity ought to be measured for planning purposes. For example, an operation's rated capacity is different from both its scheduled capacity and actual capacity.[21]

Moreover, capacity accounting actually undermines the core principles of lean management in that it creates perverse incentives for managers to overproduce and postpone preventive maintenance in an effort to increase capacity utilization of key equipment. In an effort to improve machine and equipment efficiency, many Japanese companies emphasize preventive and corrective maintenance over breakdown maintenance. These companies regularly measure rates of unexpected equipment failures, ratios of preventive to corrective maintenance to total maintenance, and other variables that track machine performance.[22]

While maintaining capacity buffers is not completely cost free, Japanese lean management does not consider it the same category of waste as an inventory buffer. All things being equal in terms of the amount of working capital associated with buffers, maintaining a capacity buffer is by far the preferred mode because it is inherently more flexible than maintaining inventory buffers. Capacity buffers need not be discounted or written down for spoilage, obsolescence, or shrinkage, and, as discussed earlier, capacity buffers ensure a firm can meet any additional customer demands in a timely manner.

The In-Yo of Japanese Management Accounting Practice

Japanese management accounting practice tends to be relatively traditional, conventional, and not dissimilar to Western practice.[23] What is evidently different is the acceptance of both the good and the bad, or *In-Yo*, of management accounting systems. Unlike their Western counterparts, Japanese management accountants have long since abandoned the quest for true cost, largely rejecting ABC, and have learned to accept the inaccuracies of their accounting systems so long as they support operational strategy.

According to Grasso, "Because the lean management process exposes problems, you do not need to wait for an accounting cost report to discover you have a problem."[24] In other words, costing is important for decision making but not for control purposes. Although it may be unwise to assume that Japanese management accounting can be treated as a homogeneous and distinctive whole, the research tends to confirm that costing and cost management systems in small and medium-sized Japanese firms resemble those of larger successful Japanese companies. Costing systems and cost management practices, though not uniform, emphasize simple routine accounting.

Accounting in Japan is not professionalized, and

management structures tend to be less specialized than in Western companies. Differences in the division of managerial labor, professional orientation, and nomenclatures for positions and departments between Japanese and Western companies make it difficult to dichotomize whether responsibilities for maintaining cost recording systems in the Japanese companies reside in accounting or nonaccounting departments. Sometimes these would be designed as cost-engineering sections staffed not by specialist-trained accountants but rather by design or production engineers pursing career paths within general management and production.[25] One universal feature of Japanese management accounting is its integration with other facets of management, especially quality control, JIT, value engineering, and target costing.[26]

American executives argue that a logical causal relationship should exist between the overhead burden and the assignment of costs to individual products. They believe that an allocation system should capture the reality of shop floor costs as precisely as possible. Japanese companies are certainly aware of this perspective, but many of the companies examined do not seem to share it. They argue that it is more important to have an overhead allocation system that motivates employees to work in harmony with the company's long-term goals than it is to pinpoint production costs.

Japanese managers want their accounting systems to help create a competitive future, not quantify the performance of their organizations at this moment.[27] Japanese companies seem to use accounting systems more to motivate employees to act in accordance with long-term manufacturing strategies than to provide senior management with precise data on costs, variances, and profits. Accounting plays more of an "influencing" role than an "informing" role. For example, high-level Japanese managers seem to worry less about whether an overhead allocation system reflects the precise demands each product makes on corporate resources than about how the system affects the cost-reduction priorities of middle managers and shop floor workers. As a result, they sometimes use allocation techniques that U.S. executives might dismiss as simplistic or even misguided.[28] One central principle that seems to guide management accounting in Japan is that accounting policies should be subservient to corporate strategy, not independent of it.[29]

From the Japanese manufacturing management perspective, *kaizen* is a journey and not a destination. So, too, Japanese management accountants have taken a Zen-like approach to developing cost accounting systems. While the perfect cost accounting system may not exist, the pursuit of this system may be where management accountants add value. As one manager interviewed in a survey of Japanese management accounting practices put it, "Thinking about cost systems is more important than costing itself." Along the same lines, another manager stated, "Costs are certainly important…but more important are people researching their actions."[30] ■

Robert Hutchinson, Ph.D., is an assistant professor in the department of accounting at the University of Detroit Mercy. Robert is a member of IMA's Detroit Chapter. You can reach him at (313) 993-1161 or hutchirl@udmercy.edu.

Kun Liao, Ph.D., CQE, is an assistant professor in the department of finance and operations & supply chain at Central Washington University. Kun is a Certified Quality Engineer (CQE). You can reach him at (509) 963-1174 or liaok@cwu.edu.

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