What's Wrong with Supply Chain Metrics?

Unless they change, they will remain a roadblock to operational success.

PART 1 OF 3

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A "Deep Truth" lies at the heart of how we perceive reality and how we behave in light of that perception. It is simply what we know. Yet challenging a Deep Truth is extremely difficult. Nobel Prize-winning physicist Niels Bohr once said the evidence to replace a Deep Truth must be so compelling, so obvious, that people must let go of their attachment to the status quo. In other words, once you see a deeper truth, you simply can't go back.

Today in industry we have a Deep Truth that permeates all of our operational decision making and behavior. It's the assumption that return on investment (ROI) is maximized through and directly corresponds to the minimization of unit cost. Challenging this deep truth can be career limiting. After all, who would stand in front of the CEO and the board of directors and say, "We absolutely should not direct our people to minimize unit cost"?

Everything from curricula approved by academia to the approaches and solutions offered by consulting firms to the major enterprise resource planning (ERP) software providers is a part of this Deep Truth. Indeed, entire corporate careers have been built around it and devoted to promulgating it. Exposing today's Deep Truth would be threatening to many who are invested heavily in the old ways, and they will act accordingly.

What if Today's Deep Truth Is Totally, Completely, Unequivocally False?

This series of articles adapted from our upcoming book, *Demand Driven Performance—Using Smart Metrics*, will show that today's Deep Truth is false and will demonstrate how corrosive it can be to organizational effectiveness and ROI. Our argument is based on the following points:

1. The whole idea that least unit product cost is an effective measure is an inappropriate use of an equation that both economics and physics reject.

2. In 1934, legislation created a reporting requirement that has become the focus of accounting information and that replaced, almost by accident, the real definition and rules for relevant information for decision making and product costing.

3. All of our information systems are hardcoded and/or configured to compile cost reporting and resource area measures from the wrong or misapplied rules and assumptions about how costs and revenue behave.

4. Unit cost has become such a Deep Truth that it has eclipsed the entire discipline of relevant cost information derived according to management accounting principles.

5. Even those who know what relevant costs are and how to calculate them operate inside a system that isn't capable of providing relevant information in an appropriate time frame in which to act.

6. People no longer even question taking actions they know will lead to predictable and dire negative consequences that they must deal with later.

Bad Math

Unit cost equations aren't in and of themselves bad. They are simply linear, additive equations. The belief that unit cost calculations are actually meaningful for internal decision making is simply wrong. The current rules that generate the cost and reporting information industry uses to judge performance and make strategic and tactical decisions simply don't reconcile well with what's required to drive ROI in today's environment. One fundamental assumption underlies these rules: that ROI is maximized through and directly corresponds to the minimization of unit cost. This assumption is false. To grasp why this assumption is false requires an understanding of two key principles.

Principle 1: Flow Comes First

The recognition of manufacturing and supply chain as a process and system is essential to understanding how it should work. Understanding how it should work gives everyone the capability to define what the rules should be. Which rules need to stay? Which need to go? Which need to change? Which need to be added?

The essence of manufacturing (and supply chains in general) is simply the flow of materials from suppliers, through plants, through distribution channels to customers, as well as the flow of information to all parties about what is planned and required, what is happening, what has happened, and what should happen next. An appreciation of this brings us to what is known as:

The first law of manufacturing—"All benefits will be directly related to the speed of flow of information and materials." (See George Plossl, *Orlicky's Material Requirements Planning*, 2nd edition, McGraw-Hill, New York, N.Y., 1994, p. 4.)

A caveat here is that all information and materials must be relevant to the market expectation. We frequently observe organizations drowning in oceans of data with little relevant information and large stocks of irrelevant materials (i.e., too much of the wrong stuff).

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"All benefits" will encompass:

1. Service. A system that flows well produces consistent and reliable results. This has implications for meeting customer expectations not only on delivery performance but also on quality. This is especially true for industries that have shelf-life issues. Do you want to dine at the restaurant that has poor flow or great flow?

2. Revenue. When service is consistently high, market share grows or, at a minimum, doesn't erode.

3. Inventories. Raw and pack, work-in-process, and finished goods inventories will be minimized and directly proportional to the amount of time it takes to flow between stages and through the total system. The less time it takes products to flow through the system, the less the total inventory investment (Little's Law will help you understand this point).

4. Expenses. When flow is poor, additional activities and expenses are incurred to close the gaps in flow. Examples would be expedited freight, overtime, rework, cross-shipping, and unplanned partial ships. Most of these activities directly cause cash to leave the organization and are indicative of an inefficient overall system. In many companies, these expedite-related expenses are underappreciated and undermeasured.

5. Cash. When flow is maximized, material that a company paid for is converted to cash at a relatively quick and consistent rate. This makes cash flow much easier to manage and predict. Additionally, the expedite-related expenses previously mentioned are minimized.

When revenue is maximized and protected, inventory is minimized, and additional and/or unnecessary ancillary expenses are eliminated, return on investment is favorable. Every for-profit company has a universal primary goal: maximize some form of return on shareholder equity. The best sustainable way to achieve that goal is to *promote and protect flow*. This is the very definition of an efficient manufacturing and distribution *system*. Conversely, one of the fastest ways to compromise ROI and system efficiency is to make decisions and reinforce behaviors that impede or block flow. We have to acknowledge that unit cost equations have nothing to do with measuring and/or predicting system flow.

Once everyone realizes the importance of flow, a few key principles emerge:

1. Time is the ultimate constraint. It's also the most precious resource employed in the manufacturing process. Because of the continual shrinkage of customer tolerance times, this principle is truer today than ever before. The important time is the time that it takes to move through the system. Without this in the front of our mind, we can misuse and distort behavior around time (particularly at the resource level).

2. The system must be well-defined and understood. Clear definitions about how materials and information should move will determine whether the existing system is even capable of maximizing flow.

3. Linkages or connections between points in the system must be smooth. Relevant materials and information need to pass smoothly from one point to the other. The greater the friction at these points, the more flow is impeded, the longer the system cycle time, and the greater the working capital investment.

Putting these principles together illuminates an important point. *A company's ability to better manage time and flow from a systemic perspective will determine its success in relation to ROI.* Companies that understand these three

key principles adopt a strategy of flow-centric efficiency to maximize system flow to market pull.

Today, however, most companies operate as if the first law of manufacturing connects all benefits directly to the minimization of unit cost (push and promote), not better flow performance. This drives all reporting, measures, tactical planning, and execution actions to the following objectives:

- ◆ Minimize total product unit cost;
- ◆ Maximize resource utilization;
- ◆ Strive for positive overhead, labor, and volume variances; and
- ◆ Initiate cost-reduction efforts with emphasis on machine, labor, and inventory reductions that quantify the expected savings on fully absorbed standard costs.

Obviously there can't be two first laws of manufacturing, especially since their policies, rules, measures, and tactics create actions and priorities that are in direct conflict with each other. Unit cost measures and the actions they drive actually impede system efficiency and flow and are one of the major sources of variation and a significant source of the bullwhip effect discussed later.

Principle 2: Linear vs. Nonlinear Complex Systems

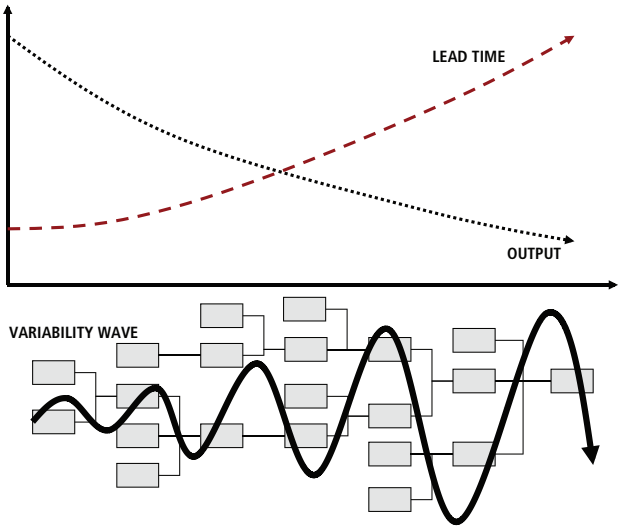
Understanding the need for flow isn't enough to understand the total implications for cost behavior. The supply chain systems of today are clearly nonlinear, dependent-event, complex systems. This simply means that today's supply chains don't look like chains anymore—they look and act like complex webs composed of a significant number of nodes of manufacturers, transportation companies, and distributors. Flow of information and materials loop and iterate in a nonlinear way through these larger numbers of nodes and connections.

It's crucial to understand how the increased complexity makes today's supply chains much more susceptible to variability as opposed to supply chains and manufacturers in the 1950s and 1960s. Managing and limiting this variation is a huge challenge to flow and productivity.

The law of variability states, "The more that variability exists in a process, the less productive that process will be." (See *APICS Dictionary*, 11th edition, APICS The Association for Operations Management, 2004, p. 71.)

Our concern about this definition is that it doesn't adequately highlight the impact of variability at the system level. The impact of variability must be understood and then managed at the system level rather than the discrete process level. The war on variability that has been waged

Figure 1: Illustrating the Law of System Variability



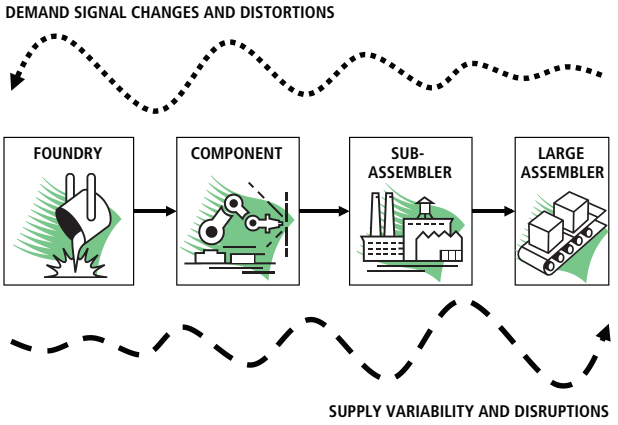
for decades has been focused most often on a discrete process level with little focus on impact on the total system. Variability at a local level in and of itself doesn't kill system flow. What kills system flow is the accumulation and amplification of variability. Accumulation and amplification happen because of the nature of the system complexity—the manner in which the discrete areas interact (or fail to interact) with each other. Thus we propose a new law:

The law of system variability—the more that variability is passed between discrete areas, steps, or processes in a system, the less productive that system will be. The more areas, steps, or processes and connections in the system, the more erosive the effect to system productivity will be.

Figure 1 illustrates the law of system variability. The lower half of the graphic depicts a network of connections. It could represent a project network, a bill of material, or even a routing. The point is it depicts a set of relationships between discrete events, areas, or entities that culminates in some form of completed product, project, or end state. The large, squiggly line represents a variability wave that accumulates and amplifies through the system. Delays frequently accumulate, whereas gains rarely accumulate. The graph above the network section shows the impact of the variability wave on system lead time and output. In short, lead time expands while output decreases.

Problems associated with variability being passed between discrete areas, steps, or processes are nothing new to the manufacturing and supply chain world. In

Figure 2: The Bullwhip Effect



supply chain, there's the *bullwhip effect*, a rather infamous effect in industries with large, extended supply chains dominated by major assemblers. Examples would include aerospace, automotive, and consumer electronics. Figure 2 illustrates the bullwhip effect. Distortions and changes in demand signals move from right to left (customer to supplier), and delays and shortages are passed from left to right (supplier to customer).

In addition to the increased variability of complex nonlinear systems, the rules of how costs behave and how flow should be protected are different than in linear systems; many are the opposite. Most business leaders and operational personnel don't understand these differences. Conventional costing and reporting information is based on a linear system rule set and mathematics. The underlying assumption that it can or should be applied to today's complex manufacturing and supply chains is invalid.

The Rise of GAAP

As all accountants know, generally accepted accounting principles (GAAP) is the basis for standard reporting. A requirement for the fair presentation of financial statements to external users, GAAP is also a forensic snapshot of past performance. This means it is accurate for past cost information, but it won't be accurate for predicting how costs will behave today and in the future. In the current volatile and complex environment, it's a mistake to assume that the specific circumstances that produced a certain unit cost in the past will be encountered in the exact same way now and in the future. Thus, if companies use GAAP cost information to make planning, execution, and investment decisions today, they are *guaranteed* to use wrong or irrelevant information. Outcomes simply won't match expectations. These misalignments in expectations are reflected in the financial statement variances to plan and the failure of most improvement projects to deliver their promised savings to the bottom line.

Combined with the use of GAAP, the failure to recognize supply chains as nonlinear, complex systems creates and reinforces an assumption about the relationship between cost performance and ROI. Companies are led to believe that cost improvements everywhere fall to the bottom line. This belief and the pervasive behavior it drives have been hardcoded into all of our information reporting and performance measures. We simply can't see another way. Yet financial accounting and management accounting have very different purposes, reporting tools sets, and history.

Today, industry reports on the efficiency of each resource, assuming that local resource efficiency translates to and drives total system efficiency. A tenth of an hour saved here saves a tenth of an hour for the whole system. That savings is quantified as a total cost savings defined by the sum of the unit-cost savings. The assumption is that the sum of the cost savings will fall to the bottom line. This Deep Truth is embedded in the product cost roll-up structure of every supply chain. In fact, manufacturing information systems with time standards and material requirements intended to plan, schedule, and execute have been transformed into product cost-centric systems to satisfy GAAP financial statement presentation for external reporting. Companies have lost their connection to management accounting and cash generation over time and replaced it with a mathematically inappropriate equation of fully absorbed unit cost over time.

The systematized drive to minimize costs leads to the opposite of its intention: lower service levels, depletion of cash, inflation of inventory, and the squandering of resource capacity and materials. Plant controllers and managers know this; they see it every day. They are constantly placed in conflict between meeting cost performance measures and protecting the other key performance indicators (KPIs). They know that if they do nothing but minimize and optimize cost performance, it directly jeopardizes the ROI of the whole system. Ask them what something costs, and, before answering, they will ask you why you want to know and what you're going to do with it. In other words, they're trying to determine whether they need to tell the whole story rather than simply give an answer that could lead to trouble. This is one of the biggest indicators that our cost-driven systems and the real world don't reconcile.

While GAAP is an imposed requirement to report to

external users, a company doesn't have to impose it on its internal users. GAAP wasn't built or intended to drive decisions in manufacturing and supply chain assets—that's the job of *management accountants*.

MRP II and the Decline of Relevant Information

As early as 1962, material requirements planning (MRP) systems revolutionized the way companies calculated what to make, what to buy, and when to make and buy it. As the use of MRP spread and the power of computers increased, more and more functionality was added. In 1972, closed-loop MRP integrated capacity scheduling and reconciliation into MRP. In 1980, financials were integrated into MRP, transforming it into manufacturing resources planning (MRP II).

MRP II is a method for effectively planning the use of all resources of a manufacturing company. Ideally, it addresses operational planning in units and financial planning in dollars, and it has a simulation capability to answer what-if questions. It's made up of a variety of processes, each linked together: business planning, production planning (sales and operations planning), master production scheduling, material requirements planning, capacity requirements planning, and the execution support systems for capacity and material. Output from these systems is integrated with financial reports such as the business plan, purchase commitment report, shipping budget, and inventory projections in dollars. (See *APICS Dictionary*, p. 78.)

By the early 1980s, companies using MRP II had embraced using the automated costing roll-up structures to speed up closing their month-end financial statements. One of the promises of the technology was the elimination of middle-management positions to compile information manually. A standard cost roll-up system was fast, accurate (no computational errors), and could speed up month-end closing as well as eliminate accounting analyst positions. The routing, part, and product structure records were all formatted to accommodate automated absorption costing.

Manufacturing systems that were originally designed to capture standard routing time and usage inputs for manufacturing management are now focused primarily on being a costing system for GAAP. MRP II represents the combined system of hardcoded rules from the planning and costing areas described earlier and is a big nail in the coffin for providing relevant costing information to internal managers. It became the only source of accounting information after pressure to reduce the cost of middle management led many companies to strip out much of the management accounting capabilities of organizations.

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By 1990, MRP II had evolved into today's widely adopted ERP, a bigger, faster, more powerful, and more expensive information system. At the core of ERP products today, however, are MRP II and all of the unchanged and problematic unit cost rules and assumptions behind it. Management accountants' ability to provide relevant information for tactical decision making has nearly disappeared from the radar screen. This has gone on so long that most managers, executives, and even some accountants have come to accept the printout of GAAP costing information as relevant cost data for decision making. This problem has been pointed out repeatedly in accounting literature and many other forums for the last two decades.

The Push-and-Promote Problem

The rules embedded in the planning and costing areas combined to create a mode of operation known as *push and promote*. This mode is more supply- and unit-cost efficiency centric than demand-pull and flow efficiency centric. Those rules were more appropriate considering the circumstances and limitations under which they were created in the 1960s. Now they represent a real problem,

even a threat, to success in the New Normal. Companies that continue to operate using rules rooted in the outdated push-and-promote mode will put more in and get less back.

Getting Smarter—A Basic Blueprint for Change

Today's companies are drowning in an ocean of irrelevant data, irrelevant signals, and problematic conclusions. Without challenging the Deep Truth of unit cost and linear rule assumptions, there's simply no land in sight. In order to move away from that Deep Truth, a Deeper Truth must be revealed. How will this happen?

In the face of increasing system variability, maximizing flow in the New Normal will require change. Defining what to change and what to change into will require organizations to get smarter. Does that mean that today's organizations aren't smart? No. They have many talented and smart individuals, but collectively they're failing to recognize and address the real and fundamental needs for change. The blueprint for change is something we call "the smarter way," which has three simple steps.

Step 1: Install the Right Thoughtware in the Organization

Encourage and enable organizations to think systemically. In decades of combined experience with nearly 1,000 organizations, we've found that most people inside companies are prohibited from, discouraged from, and/or incapable of thinking about problems and solutions from a systemic point of view. To drive meaningful and rapid improvement, problems must be defined, and solutions must be developed from a systems-and-flow-based perspective with the New Normal in mind. Individuals and their organizations can be made capable, but organizations have huge obstacles standing in the way of removing the self-imposed variability of following inappropriate and outmoded rules.

Step 2: Become Demand Driven

The push-and-promote mode of operation must change, and the old rules based on cost-centric efficiency must go. Companies must embrace the new position-and-pull mode of operation and adopt new flow-centric efficiency rules that protect and maximize the flow of relevant materials and information. They will have to find a way to better align their resources and efforts with actual market and customer requirements in the more variable, volatile, and complex environment we have today.

Step 3: Deploy Smart Metrics

At this point you may be saying, "Wait a minute! If our organizations are full of the wrong rules, what are the right rules?" An appreciation for what the rules need to be requires Steps 1 and 2. The changes to sustain competitiveness in the New Normal require new rules, and measures always follow the rules. To embrace and deploy those metrics will necessitate the removal of some very ingrained, hardcoded assumptions, metrics, and rote behavior. Smart metrics are a function of understanding the fundamental principles of system flow, the causes of system variation, and the ability to think systemically. Unless people can think systemically and design operating models to fit the New Normal, these metrics will elude us. **SF**

Note: *Part 2 of this series will detail the solution to the problem: the position-and-pull model and a flow-centric efficiency strategy. Part 3 will offer a case study demonstrating the use of smart metrics and the results. Sections of this article are excerpted from* Demand Driven Performance *by Debra and Chad Smith (McGraw-Hill Professional, Hardcover, November 2013) with permission from McGraw-Hill Professional.*

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