FactoryPhysics

Know the Laws. Use the Tools. Profit.

Factory Physics® Principles for Managers—Second in a Series

A series of articles designed to help managers better control and optimize their operations through a solid understanding of the practical science that governs their environments.

The Problem with Productivity Initiatives

The problem with productivity initiatives is that they are initiatives. Merriam-Webster OnLine defines initiative as "an introductory step." Herein lies the problem. Companies are continually *introducing* ways to be more productive. Meanwhile, the drivers of productivity are fundamental laws of nature that *never change*. Companies constantly re-invent the wheel. In fairness, there are plenty of companies where years of neglect or a change of management warrants an initiative to get the company back on course. On the other hand, it *is* a problem that industry in general tends to lurch from one consulting initiative to the next looking for the "system constraint," the "perfect value stream," "six sigma levels of quality" a new information technology solution or any of a number of proposed silver bullets offered as "the answer."

In sticking to our stated purpose of using practical science to help managers better control their operations, we are helping companies establish a *permanent* operations management system. We do *not* recommend replacement of your company's existing management system. If you call your system Lean Manufacturing or Six Sigma or Lean Sigma, don't change the name. Constant name changes cause confusion and create cynicism. While productivity initiatives usually offer some very good tools, management generally encounters significant trouble applying the tools to a company's unique business environment (after all, we are not all Toyota!). The Factory Physics approach differs in that it applies practical science to determine: (1) how well your operations are performing versus how well your operations could be performing—what's the best possible you should expect?, (2) why your operations aren't performing as well as they could be performing and (3) what changes are needed to get to best possible performance. At that point, and only at that point, should one begin to discuss what tools to use. Attempting to apply the means before knowing the desired ends invariably results in confusing and wasted effort.

Moreover, a permanent operations management system is based on fundamental laws of nature so a new tool does NOT mean a new management system. We're not trying to create a new buzzword and aren't interested in "us versus them" arguments. There is no one else talking about a comprehensive, scientific framework for controlling and optimizing operations so there is no "them." We will focus on providing a set of relationships, measures and applications that will help managers fill in the gaps of current productivity initiatives. Additionally, we will provide quantitative indicators to point managers towards solutions and a permanent operations management system to help managers achieve their goals.

The Goal

The goal of most companies is:

Make money now and in the future in ways that are consistent with the company's core values. As an operations manager or executive, you have more immediate goals:

1. Make a product that customers want to buy with a quality level that meets or exceeds expectations

2. Make enough to satisfy all customers
3. Be a low cost producer
4. Provide quick responsiveness to customers
5. Minimize cash requirements

As much as we would like to be all things to all people, Factory Physics principles do not give us that pleasure. Factory Physics principles and applications will not tell you what your customers want or tell you the quality level that is needed to satisfy them but it will tell you how to make more, how to reduce cost, how to be more responsive, and how to minimize cash requirements.

The product mix that you chose (or is chosen for you!) is considered a boundary for production decisions. Factory Physics principles and applications will allow you to determine what mix of products gives you the most profitable use of your operation's resources. Your products' quality level is another condition that affects your production decisions. Given the choice, most customers would want perfect quality for free. Since we live in the real world, perfect quality for free is an unrealistic expectation and you have to decide what level of quality you will provide and what level of resources you're willing to invest to achieve those quality levels. Factory Physics principles and applications can show you where the biggest bang for the buck lies in improving your quality levels.

While Factory Physics principles and applications do not provide solutions for all your business problems, they do provide a solution for getting the best possible performance from your operations. As such, Factory Physics principles and applications provide major value in enabling your operations management system to successfully support the goals of your company.

Understanding Productivity

A large computer maker has a plant that makes 40,000 different kinds of circuit boards every year. Less than 10% of the part numbers represent over 90% of the total demand. Nonetheless, the other 90% of the part numbers are critical to the customer service mission of the corporation because many of these boards are for spare parts. Corporate management has dictated that every plant will have a pull system like Toyota's kanban system. It is clear that Toyota maintained a stock of all active parts on the floor at all times. Now plant management is scratching their heads trying to figure out how to implement such a system for 40,000 part numbers without increasing inventory.

A multi-national high tech corporation makes specialty components for aerospace and other markets. Almost every order has something that is unique about it, either in the part configuration or the service. The company fabricates all of the critical components, many non-critical components, and performs sub-assembly, final assembly, and final test. Whereas 20 weeks was an acceptable delivery time in the past, now the customer wants it in five. Not only that, but the customer wants a price reduction. Given who the customer is, he will get a price reduction. The company has been trying to use its existing MRP system and use "super" bills of material to forecast material requirements for component parts but this has proven disastrous. Currently inventory has skyrocketed, on-time delivery is approaching zero, costs are going up, and prices are coming down. Several customers have changed suppliers because of the poor on-time delivery. Now the company is considering Lean Manufacturing as a way to solve this problem. However, after the first set of Lean practitioners described how the implementation would go—implement 5S, setup reduction, standard work, and the like, and then productivity would go up—the

conclusion was that there was not enough time to clean up the fabrication operation before losing all the major accounts. Is there any other way to improve productivity?

These situations are real. Yet, in both cases, each company was able to implement a more productive solution—albeit one that did not look like the Toyota Production System.

So how do we improve productivity? As Bill Ross of Six Sigma Associates says—

- "We don't know what we don't know.
- If we can't express what we know in the form of numbers, we really don't know much about it.
- If we don't know much about it, we can't control it.
- If we can't control it, we are at the mercy of chance."

So to understand and improve productivity, we must be able to measure productivity in a way that helps us make decisions to control our operations environments. How do we make enough to satisfy all customers or can we? How do we keep costs low? How do we measure responsiveness? How do we minimize cash requirements? These questions are translated into direct measurement by a set of five measures. If we perform satisfactorily on **all** five, we will be as productive as we can be, we will produce as much as we are able to produce, and we will be responsive.

Thus, the five measures for outstanding operations performance are:

1. Bottleneck utilization of between 90 and 95% for a push system and between 90 and 100% for a pull system.
2. Critical WIP to Number of WIP Positions ratio of 85% or above.
3. WIP to Critical WIP ratio of five or less.
4. Operation between the Best Case and Marginal Case on the Throughput versus WIP curve and Cycle Time versus WIP curve.
5. Operation on the efficient frontier of the inventory investment versus customer service level curve.

Now there are a great many terms here that have not been defined. That is why this is a series of articles and not a one page flyer! We will address these in more detail in later articles. Nonetheless, these performance measures address all the key issues we have raised.

- Measure 1 says that we are getting as much as is practically possible out of our system. Factory Physics principles show that we do not want to get too close to 100% utilization, particularly in a push system, because to do so will blow up WIP levels and cycle times.
- Measure 2 says we are not wasting capacity at non-bottlenecks. In other words, we need to get enough out of all the other processes in our system (i.e., non-bottleneck processes) but not aim for too much non-bottleneck capacity. Non-bottleneck utilizations should be lower than bottleneck utilization but should not be too low. If we do not have sufficiently high utilization at non-bottlenecks, we are wasting money on capacity (capital equipment and labor). If non-bottleneck utilizations are too high, the process becomes unresponsive and very difficult to manage.
- Measure 3 measures responsiveness. Too much WIP causes cycle times to become too long to be responsive. Cycle time refers to the time for a job to complete a routing across a series of process centers or machines. Cycle time in the Factory Physics framework is *not* the time a product takes at one operation on one machine. Critical WIP is the minimum level of WIP required to keep the

bottleneck from starving, so maximum throughput is achieved, and keep cycle times at their minimum level under best-case conditions with zero variability. The ratio of five takes into account the reality of variability in most systems. Depending on the type of process, good performance for this measure can vary but five is a reasonable target for most discrete manufacturing processes. Continuous flow processes often do operate at less than Critical WIP with minimal cycle time but lose throughput as a result. These types of processes are not just lean, they are anorexic.

- Measure 4 indicates how much variability there is in the system that results in waste. If there were no variability then the system would be running at the "Best Case." If there were significant but not unheard of variability, it would be running at the "Marginal Case" A "good" system would be expected to run somewhere between Best Case and Marginal Case performance.
- Measure 5 is a measure of inventory performance. The tradeoffs here are:
  a. Customer service (i.e., percent of time having inventory on hand when an order is received)
  b. Average inventory investment (i.e., how much money is tied up in inventory)
  c. The average number of orders (or changeovers) to process per year (smaller lot sizes result in more orders/changeovers). More changeovers require more available capacity.

  For any combination of these, there is an "efficient frontier" which represents the minimum amount of inventory for a given customer service level and for a given number of orders per year. The system should be running exactly on or very close to this efficient frontier.

  If your company is able to achieve *all five* of these measures you will be both very efficient (with little waste) and very responsive. In fact, your company should be able to hit these levels of performance—remember, the goal is best possible performance not perfect performance. We leave perfect performance to those who do not actually have to manage in the real world. If your company combines high efficiency and high responsiveness with the first goal of "Make a product that customers want to buy with a quality level that meets or exceeds expectations", **your company will be very profitable**. The task before us now is how to apply these measures to your manufacturing environment in a way that helps you optimize the performance of your operations and provides improved control over your operations.

In next month's article we will discuss how to quickly assess how well your operations are performing and provide background on some of the measures discussed here. In the meantime, if you have questions about Factory Physics applications or have other topics you would like to have discussed, drop us a line at info@factoryphysics.com

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