SPEED TO MARKET

A Newsletter for
Job Shops–Niche Manufacturers–Focused Distribution Systems
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Measuring Productivity in Job Shops

Readers of *Speed to Market* know that an ongoing theme in these newsletters is the comparison of job shops to mass production businesses. We do this for a couple of reasons. One is to illustrate how (and why) concepts and tools coming from the mass production world can cause problems when applied to order-driven businesses…and to caution you accordingly. The other is that comparing these manufacturing models enables us to understand how to manage job shops more effectively. We take the same approach in this article by looking at how productivity is measured in these environments.

Generally speaking, productivity measures involve the relationship between the rate at which resources are consumed and output is produced. Labor is one of the primary resources over which management has some control, and is also one of the more expensive, so this is a good candidate for a resource to measure. When people use the term *productivity* they are generally referring to *labor productivity*, although you can apply the concept to other production resources as well.

Productivity in Mass Production: In a mass production system, a typical measure of output is "earned hours." These are determined by setting standards, and then comparing actual hours used to standard hours earned. For example, if you make a part in 10 hours that should take 10 hours (according to industrial engineering studies), you will have earned 10 hours and your productivity will be 100%. If it takes you 12 hours, you will only have earned 10 hours, and your productivity will be 83%. If you make it in 8 hours, you will earn the same 10 hours, and your productivity will be 125%. (If this looks odd, the function is not linear. The formula is Productivity = Standard Hours/Actual Hours.) The earned hour method does not apply to job shops because output is varied, runs are generally short, and standard rates are lacking. An estimator, not an industrial engineer, determines the time required to produce a part.

Not All Job Shops are the Same: Thus, we need a different measure of output, and measurement method, for job shops. However, not all job shops are the same, and we need distinct approaches for quick cycle and extended cycle shops. You may recall the discussion of quick and extended cycle shops in the *November 2006 Speed to Market Newsletter*. Quick cycle is similar to a traditional machine shop where orders flow through fairly quickly (days) vs. extended cycle shops (e.g., tool and die; specialty machine builders) where products are in production for longer periods of time (weeks, months).

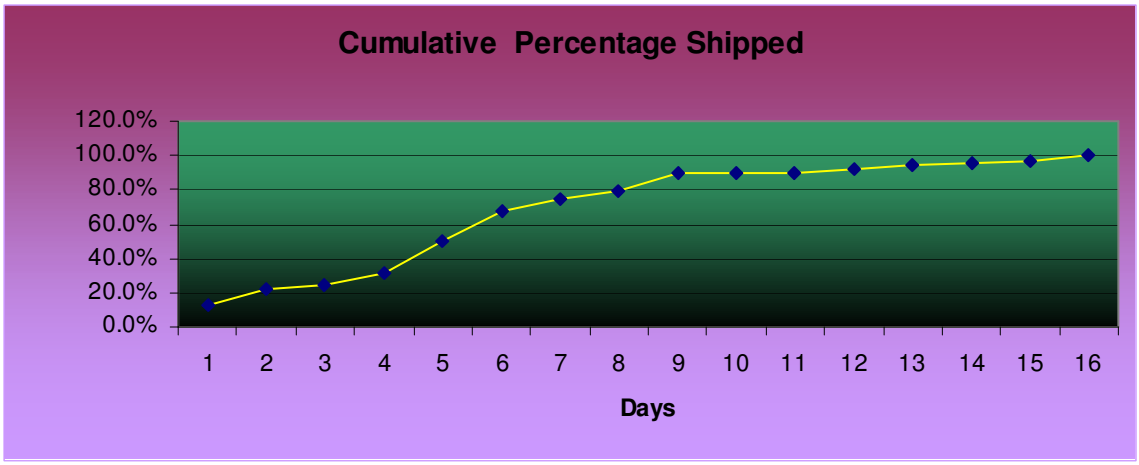
Not to overly complicate matters, but both quick cycle and extended cycle operations can co-exist in the same shop. For example, a die shop, which operates on an extended cycle, can also have a machining department that feeds the die-building process. It would make sense to measure productivity in the machining department with quick cycle methods, and die building with extended methods, rather than lump them together.

Measuring Productivity in Quick Cycle Shops: Many shops use the metric "revenue per FTE" (full time equivalent employee) as a measure of productivity. Let's say that you have a shop with 15 people and revenues of $2 million per year. Your revenue would be approximately $133,000 per FTE per year. You could monitor this number over time to see if it is improving (as a result of adding new equipment, redesigning processes, management and employee skills training, etc.).

Although you can use this metric, we find it a bit too coarse and would prefer a more precise measure. *Revenue dollars shipped per labor hour paid* is preferable. You can include this metric on your *Weekly Performance Report*, and this will show you productivity for the current week, how it compares to an average week, the direction in which it is trending, and whether your programs to improve productivity are working.

The problem with this metric is that dollars shipped are out of synch with the hours worked. That is, dollars shipped this week are associated with labor hours from two or three previous weeks (or however long it generally takes to process work through your shop). The other problem is that you may ship a lot of work in one week, and very little the next, so your productivity index will be low in one week, and off the charts in the next. Although this will average out in the long run, it lacks accuracy in the short term.

One way to deal with this problem is to use a rolling productivity metric. Let's say that you conduct a study of jobs shipped every day for a period of time and calculate the elapsed time from when those jobs were booked until they shipped. The following graph illustrates the results of one such study in a quick cycle shop. It shows that 80% of the orders shipped were processed in 10 days or less, and virtually all orders were shipped within three weeks of booking.



We can use this information to construct a three-week rolling productivity metric that relates labor costs to the orders associated with those labor costs. This three-week rolling "bracket" or window ensures a correlation between the revenues and the labor used to generate that revenue.

Once you have constructed this metric and calculate it on a weekly basis, you can monitor productivity levels closely, and should be able to see relatively quickly whether or not your efforts to improve productivity are working (i.e., training, closer supervision, etc.).

Measuring Productivity in Extended Cycle Shops: The problem in extended cycle shops is similar to quick cycle shops, except it is more severe. The problem is that money comes in clumps over a longer period of time while labor hours are consumed at a more or less steady rate. And because the process time is extended (weeks and months), it doesn't make sense to construct a rolling productivity metric as we did in the previous example.

A more practical approach is to estimate the percentage complete of each project or job in the shop, and compare this to the hours used as a percentage of the total hours estimated. Now you can compare project completion to resources consumed which is a way to measure productivity. Doing this on an individual job basis also lets you make comparisons among employees or teams working on these jobs. And of course, when the percentage of hours used exceeds the completion percentage, you have identified a problem, and need to take action to find out what's wrong, and get the project back on track (see red highlighted job below). It may be difficult to estimate the percentage complete on the floor in some cases, but your estimate will generally be close enough.

The following table illustrates this method. Job # 6802-06 is on budget; job # 6803-06 is behind; and job # 6804-06 is ahead.

Job #	Total Hours	Hours Used	% Used	% Completion
6802-06	3846	7692	20%	20%
6803-06	4785	1914	40%	33%
6804-06	5200	2600	50%	60%

You can calculate an overall productivity for the shop by multiplying the percentage complete for each project times the revenue that project will generate (the price). Add these up and divide by the labor hours (for the week and cumulatively) to get "Dollars Earned per Hour." If you do this each week, you will be able to tell if productivity is increasing or decreasing. Note that a cumulative metric will even out inaccurate weekly estimates.

Summary: Measuring productivity in job shops and order-driven businesses differs significantly from measuring productivity in mass production operations where standard times are determined, and earned hours are used in the productivity calculation. Measuring productivity in order-driven businesses depends upon whether it is a quick cycle or extended cycle business. In quick cycle businesses we can use a rolling time frame that embraces costs associated with revenues. In an extended cycle business, productivity is best determined by relating the percentage complete of the work to the percentage of hours or costs. This also provides an early warning system to let you know when a project is likely to be over budget so you can initiate corrective actions sooner rather than suffering a loss at the end. Remember the credo, "on time and on budget" as a guiding principle, and overall performance metric for order-driven businesses. (See *Speed to Market, November 2006* for more on this subject.)

Reducing Lost Time

Frank Covich, a business acquisition specialist and productivity analyst, sent us this suggestion for improving productivity in a precision manufacturing environment.

In considering overall shop performance, it's important to maintain a position of constant improvement. This includes being on the lookout for ways to help your operators perform better. In shops where accuracy is important, operator quality control is key. One place to look for improvement is in your "rag bag." What's the status of the rags that are used to clean off manufactured pieces to check a tolerance, size or condition?

Make certain that expensive machinists are not wasting time looking for a clean rag. Extra rags in several locations can help performance and benefit production by cutting down search time. An orderly approach for replenishing dirty rags will ensure a clean supply.

You might also consider providing a magnifying glass for each operator, preferably with a built-in light, to make checking tolerances easier and faster. Depending upon the age of your workforce, this could be a welcome addition to a machinist's toolbox.

By paying attention to what can do to help your machinists, you will improve the performance and quality of your shop. For example, one plant in Ohio made a simple change—they assigned a person to come in one hour early each day, and make certain that each machine station had everything required for production. We found the lowest paid employee in the shop supply room, was guarding the rags like they were gold, which only hurt production. Once we took this element out of the picture (high paid machinist wandering around looking for a clean rag), lost time improved and the extra rags paid for themselves 1000 times over.

A Note to Speed to Market Readers

As many of you know, *Speed to Market Newsletters* are not published every month on a routine basis. We only publish when we feel we have something to say that will benefit owners and managers of order-driven businesses. Also, we attempt to tie articles to ongoing work with clients. If we are working on how to measure productivity in a shop, you are likely to see an article on this subject in the Newsletter. This keeps the writing grounded in practice and hopefully more useful for our readers (which number in excess of 2700 at this point by the way). We constantly get requests from people to be added to the list, and we appreciate it when you refer others to be added.

Some people have questioned why we give away so much. We do this because we believe these Newsletters should have substance and not fluff if they are to be an effective marketing tool. This is a way of communicating to you (perhaps silently) that Delta Dynamics provides substance when you engage us to help you improve performance and profitability in your company.

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We also have another purpose…we believe that job shops and order-driven businesses have generally been ignored and misunderstood by the management education and training establishment. Often, no distinction is made between job shops and mass production operations (a constant theme readers will surely recognize). We seek to counterbalance this bias in some small way by putting job shops in the spotlight as unique business systems that require their own specialized concepts, processes, performance metrics, and management skills. *Speed to Market Newsletters,* along with the book, *Speed to Market: Lean Manufacturing for Job Shops, video training programs,* and other tools serve this purpose.

As we look forward to another year, we can expect manufacturing businesses to become increasingly competitive and more difficult to manage. Perhaps now is the time to give us a call at 248-333-0482 to see how we might be able to help you cope with these more demanding conditions.

A Primer of Job Shop Scheduling

Delta Dynamics' Primer of Job Shop Scheduling is a collection of published articles and Speed to Market management briefings on job shop scheduling, capacity management, reducing lead time, and related topics (eleven articles, 40 pages). It is intended as an educational resource to provide the perspective and information required to understand job shop scheduling and associated problems more fully.

One of the things we do extremely well at Delta Dynamics is to study and design scheduling and production systems. We can show you the hidden costs associated with scheduling problems, as well as design a better system that will improve on-time delivery, reduce current costs, and increase customer satisfaction. You can see a schematic of a scheduling system for a small shop in the *November Issue of the Speed to Market Newsletter,* or Call Vincent Bozzone at 248-333-0482 or 248-961-1389 (cell) for a candid discussion of your situation. There is no cost or obligation for this consultation...but study this Primer first.

This Primer of Job Shop Scheduling is available as a downloadable PDF file for $29.95. Proceeds will be used to support the publication of Speed to Market Newsletters, so if you find these valuable and want to see them continue, now's your chance to make a contribution.
See Details Here

http://www.deltadynamicsinc.com/Resources/Scheduling Primer/scheduling_primer.htm

Wishing you a shop full of high margin, hassle-free orders in the New Year!