
SPEED TO MARKET

A Newsletter for
Job Shops–Niche Manufacturers–Focused Distribution Systems
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How Much Do Schedule Changes Really Cost?



Speed to Market Readers know that scheduling is one of the most challenging aspects of managing a job shop. Typically, any job shop's schedule is in a constant state of flux, often with several changes occurring during the course of a day. We have written about this extensively in Chapter 8 in [Speed to Market: Lean Manufacturing for Job Shops](#), as well as in a wide variety of articles included in [A Primer of Job Shop Scheduling](#).

Given there is no line item on your income statement that says "The Cost of Jumping through Hoops to Satisfy Customers," it's easy to accept schedule changes as a way of life, taking them for granted. This can obscure an area for improvement with a potentially high return. The discussion in this article focuses on estimating the cost of unnecessary changes in make-to-order environments, and the savings that can be gained by getting scheduling under control. Tools are provided to help you determine the cost of schedule changes in your shop.

Types of Changes: We can make a distinction between changes that are planned or at least anticipated, and those that are not. Typically, planned changes are necessary and a normal part of running a shop. These changeovers take place when one job is completed in a work center, and the next job is set up to run. How many of these changes (or set ups) are necessary during the course of a day is a function of the number of steps in the manufacturing process, number of pieces per order, order volume, and other factors.

Note: The terms *changeover*, *set-up*, *change*, *schedule changes*, *unnecessary changes* are all used more or less interchangeably in this article.

A basic tenet of lean manufacturing is to reduce the number of set ups as well as the time it takes for each one (reduce frequency and duration). Fewer set ups that take less time will free up capacity that can be used for production, and the value of this improvement can be sizeable. One approach for reducing set up time is described in Chapter 5, [Speed to Market: Lean Manufacturing for Job Shops](#).

Changes that are not anticipated are typically reactionary. These are made to satisfy customers who change requirements, ship dates, and specifications, as well as to complete hot jobs, or avoid late shipments at the last minute. Unnecessary changes typically require additional set ups (re-set ups), and have a ripple effect throughout the shop, disrupting other work in process. Unnecessary changeovers are actually rework.

Note: Set up time is measured from the last piece of the previous job to the first good piece of the next job. It's the entire time the machine is unproductive.

Cost Factors in Set Ups: Unnecessary changes can be major or minor. A major changeover would involve breaking into a job that is already running. This requires a complete tear down of the existing set up, and re-setting up for the hot job. Making a change when a set-up is partially complete would be less extensive and less costly, but still unfavorable.

It would be a mistake to think that the cost of unnecessary changes is limited to the labor hours required to tear down an existing set-up and re-set up for the hot job. There are a number of other costs involved, many of them hidden:

1. The cost of stopping production, and lost time as you scramble around preparing to make the change.
2. Making sure proper materials are available; ordering or expediting if required.
3. Materials handling—moving materials away from the work site, and transporting new materials to the work site.
4. The cost of dismantling the existing set up (in whole or in part).
5. If a job is already running on a piece of equipment, there is the cost of lost momentum and lost productivity when you put that job back on the machine.
6. If you are in the middle of a set up, it's the cost of undoing the work that has been done, and starting over with the new set-up.
7. The cost of setting up a new job can include:
 - Preparing the traveler and associated documentation (e.g., prints, QC checks, special instructions)
 - Programming and calibrating QC devices.
 - CNC Programming
 - Availability of proper gauges at the machine to check tolerances and ensure quality.
 - Proper tooling, preset, and sequenced in the carrier.
 - Fixtures
 - Problem Solving—adjustments, calibrations, and correcting errors
 - Supervision—time required to ensure set up accuracy and completion
8. The cost of the delay in starting the new job.
9. The cost of dismantling this set up.
10. The cost of re-setting up the existing job.
11. The cost of errors as the operator re-starts the disrupted job, or rushes to complete the hot job.

12. There may be the cost of lost time if the operator has to wait for the new set-up to be completed, and is not assigned to productive work.
13. There is the cost of supervision— dismantling the existing job and setting up the hot job.
14. Opportunity cost. This is the value of work that could have been produced during the time required for the extra set-up. This is unnecessary idle time in this work center which has an opportunity cost because it could have been used to produce value.
15. The cost of the ripple effect. A change in one work center means downstream work centers may be starved for work, and may suffer lost productivity thus increasing production costs.
16. Other pieces of equipment may need to be re-set up to perform additional operations on the hot job. Dismantling existing set ups and re-set ups may be required on downstream operations.
17. The cost of extend lead times and making your shop less competitive

As you can see, the cost of unnecessary set-ups is extensive and goes far beyond the cost of the task time required.

Estimating the Cost of Schedule Changes: For argument's sake, let's assume it takes two people who earn \$20 an hour two hours to undo an existing set up, and re-set up a new job on a piece of equipment. Let's also assume that equipment is charged at \$77 per hour. In addition to this time, there is another hour lost in preparing the new job to run on that work center (i.e., materials movement, traveler, gauges, etc.). At this point, we have incurred the cost of four labor hours, and three hours of lost revenue associated with machine idle time, and maybe an additional 3 hours of lost time if the operator is not assisting in the changeover. This totals approximately \$300-\$400.

Intangible costs are likely to be far greater, but are not so easily measured. Lost momentum, lost productivity, the increased probability of errors, disruption of the downstream work flow, additional downstream re-set ups, lost capacity and extended lead time all can come into play. It would not be unreasonable to estimate the cost of an unnecessary changeover at three to four times the direct cost plus lost revenues. In this example, the total cost would be in the neighborhood of \$900—\$1,200.

How many times during the course of a week do you have unnecessary changeovers? If it is only three or four times (200 per year), the annual cost can be in the \$180,000-\$240,000 range, and this may be an under estimation.

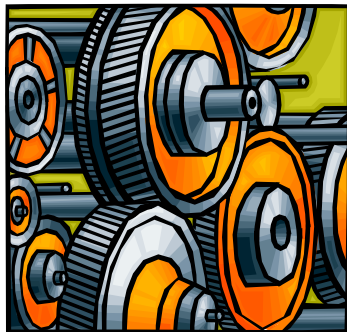
You might argue we are mixing apples and oranges here...costs with lost revenue which is true. And you might argue that the cost of a set up and tear down for a hot job should not be counted, as you would have to do it later anyway. We should only count the rework portion which is the tear down and set up of an existing job on a work center, plus the added time it takes to do an unanticipated set up which is also true.

But the point we are trying to make here is that the cost of an unanticipated changeover is a disruptive event that costs far more than the direct costs involved. And if you don't recognize the real costs, you are likely to accept schedule changes as normal, and fail to

initiate improvements. This will cost you far more than you know, or will ever see on your income statement.

The following matrix includes the costs identified previously, and provides a structure for you to capture and estimate these costs in your shop. Complete this matrix for a few unanticipated changeovers to get an average cost estimate.

Activity	Time Required	No. of People	Cost per Hour	Intangible Costs	Lost Revenue	Total Estimated
1. Stopping						
2. Dismantling old						
3. New set up						
4. Undoing new						
5. Re set up old						
6. Undoing old						
7. Lost productivity						
8. Lost time						
9. Supervision						
10. Opp'y cost						
11. Ripple effect						
12. Add'l set ups						
13. Lead time						
14. Lost capacity						
15. Other costs						
Grand Total						

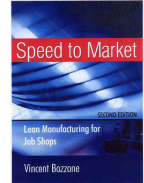

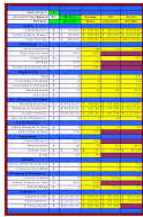


And Now a Word from Our Sponsor: If you are living with a situation where scheduling is out of control and are making far more changes than are actually required, it would make sense to have Delta Dynamics pay a visit and analyze your current system and methods. We have extensive experience in this area, and have developed specialized scheduling tools for job shops and make to order environments that incorporate dynamic capacity management with operator scheduling and shop floor control. Call Vincent Bozzone at 248-333-0482 to learn how we can help you.

Summary: The cost of unnecessary changeovers is difficult to estimate given all the intangible factors that come into play. However, it is clear that the cost is far more than merely the direct costs of the changeover. If you fail to recognize the true cost, you may not pay much attention to reducing the frequency and time required, and this would be a mistake.

In the next issue of the *Speed to Market Newsletter*, we will examine the causes of unnecessary changeovers, and how to reduce them. In the meantime, use the matrix provided above to estimate the cost of changeovers in your shop.

Don't forget to visit the Delta Dynamics Store where you will find

	<p>Speed to Market: Lean Manufacturing for Job Shops 2nd Edition</p>	<p>A Primer of Job Shop Scheduling Eleven Articles 40 Pages</p> <p><u>See Table of Contents</u></p>
	<p>Speed to Market Training Program</p> <p>DVD with Speed to Market book, plus a Companion CD with PowerPoint Slides & Implementation Guide</p>	 <p>Weekly Performance Report Software with Speed to Market book and Implementation Guide</p>