Waste Not Want Not

An overriding characteristic of lean manufacturing is its focus on reducing waste. In fact, many practitioners seem to think lean is only concerned with reducing waste. But as Speed to Market readers know, applying lean principles that were developed at Toyota in job shops is not a slam dunk. You have to understand both the lean concept and the job shop environment in which it is being applied.

One of the concepts central to lean is the Seven Wastes. These have been identified as typical sources of waste found in manufacturing operations, and their value is to provide a focus for improvement. Reducing waste is the opposite of improving productivity, and much more practical. If the waste associated with a given resource can be reduced, the productivity or efficiency of that resource is automatically increased. Waste exists in the present, is tangible, can be measured, and can be attacked; productivity improvement exists in the future and is abstract.

The Seven Wastes

- Overproduction: producing more, sooner and faster than required by the next process
- Excess inventory: this not only is a waste, but also creates waste
- Excess transportation: any transport that adds cost but no value to the product
- Excess processing: doing more work than necessary
- Waiting: operator or machine idle time
- Correction: repairs to products
- Motion: walking or wasted motion to pick up or store parts.

Let’s Look at these in Turn:

Overproduction: producing more, sooner and faster than required by the next process

The assumption here is a volume manufacturing process that encompasses several steps. If one of the steps can produce more than a downstream step, inventory will build up between the steps and this is waste. Why make it if it can’t be processed? A typical solution for this problem is line balancing where all the process steps are geared to the slowest operation.

How does this apply in your shop? Typically, it does not, especially where a shop is only making one or two, or a few items. However, some job shops produce high volume jobs with multiple processes. It is not uncommon for these shops to have significant amounts of work in process in containers that are moved from one work center to another.
However, the difference between volume production in a job shop and Toyota is that these inventories will only exist for a short time. They are not chronic. It may make sense to make parts in batches at each step in the production process rather than trying to achieve a one-piece flow, or balancing production at each step. Another consideration is that each job may require a different configuration. The actual production process from one job to another can involve a different set of operations or sequence of operations. Again, you have to understand the environment in order to know if overproduction is a significant source of waste.

**Excess inventory: this is not only waste, but also creates waste**
A primary focus of lean manufacturing is the reduction of inventories...raw materials, work-in-process, and finished goods. Finished goods are typically the greatest source of waste because they have the most value. If the cost to carry is 20%, then it costs $200,000 per year for every $1,000,000 of inventory. This 20% includes the cost of storage, insurance, materials handling, working capital, potential obsolescence, damage, shrinkage, and in some states, taxes.

What does it mean to say this is not only waste, but also creates waste? Finished goods that are built in anticipation of demand that never materializes are certainly waste. They create additional waste by the need to deal with them...handling, storage, etc.

**How does this apply in your shop?** Of course job shops make to order, as opposed to build to stock, and typically have no finished goods inventories because jobs are shipped upon completion. This may be different in a contract manufacturing relationship. (See Contract Manufacturing: A Variation on a Job Shop Theme in Speed to Market November, 2004.) Generally speaking, excess inventories are not a significant source of waste in job shops.

**Note:** Some lean followers want to apply a zero inventory policy without regard to the competitive conditions under which a company may be operating. For example, a key to reducing lead time in job shops is to have sufficient raw materials on hand or readily available to meet most production requirements. If your shop has to wait to receive materials from suppliers (e.g., you order long lead time materials after receiving an order from a customer), this will naturally reduce your ability to service your customers quickly. This means your lead time is dependent upon suppliers’ lead times and reliability in meeting promised ship dates. This can be disastrous for your business, so it makes sense to forecast demand, and keep some hard to get materials on hand.

**Excess transportation: any transport that adds cost but no value to the product**
Some plants are quite large and process steps can be far from each other. Moving work-in-process does not add value, and also has the added disadvantage of introducing delays into the work flow. There is also the cost of materials handlers, material handling equipment, the chance of damage, misplaced components, and potential injuries. It makes sense to use value stream mapping or a similar technique to see how the work moves through the shop, and then determine how the flow could be designed to be more efficient.

**How does this apply in your shop?** It depends on the size of your shop and the nature of the work. In a small shop that makes small items, excess transportation likely does not apply. However, in large shops that make large items, excess transportation can be a significant source of waste. The following diagram is from a large shop (about a square block) that makes industrial equipment. The red lines illustrate how work was transported all over the place. Later this was reconfigured to make it more efficient.
Excess processing: doing more work than necessary
This source of waste can certainly apply in a job shop environment. It can be particularly difficult to change, especially where crafts or trades are involved. Take tool-making for example. One issue is that customers are often unwilling to pay for the level of quality a die or mold maker wants to put into a tool. Some tools are destined for short runs and need not be built like tanks, or have the highest quality finish or components. Yet the tool maker has learned the “proper way” over a lifetime of experience, and so is not willing to sacrifice his standards. Sometimes this is no more than making cosmetic appearance changes like removing tool marks. Tool makers and other craftspeople have to understand the competitive environment has changed, and pricing will no longer support top end quality all the time.

Waiting: operator or machine idle time
This is certainly a source of waste that can be found in both production and job shops. In fact, it may be more prevalent in job shops because machines require more set-ups to process the variety of work coming through the door. However, it would be a mistake to use machine utilization as a performance measure in a job shop because not all machines will be fully utilized all the time. There are some pieces of equipment you need to have, but will be used infrequently. If operators are waiting for a machine to be set up, it is up to the foreman to assign them to productive work, or train them to perform, or assist in set-ups.

One way to reduce the amount of set-up time is to use a Pre-production Checklist we developed for a machining operation. It shows who is responsible for which production requirement. Operators know what is scheduled next on their machines, and are responsible for “checking on the checklist” to make sure these things are completed ahead of time. If not, they bring it to the
supervisor’s attention. Making sure all these items are taken care of when the previous job is running (not after it’s completed) reduces changeover time (machine idle time).

**Pre-production Checklist**

<table>
<thead>
<tr>
<th>Job #</th>
<th>Date</th>
<th>Materials</th>
<th>Traveler</th>
<th>QC Programming</th>
<th>CNC Programming</th>
<th>Gauges</th>
<th>Tooling</th>
<th>Fixturing</th>
<th>Problem Solving</th>
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**Correction: repairs to products**
Rework is the most expensive source of waste as the following slide illustrates. Some people make the mistake of calculating the cost of rework as only labor and scrap, and miss the opportunity cost and lost capacity involved. Recognizing these costs makes rework much more expensive that it may appear.

**Rework...The Great Satan of Waste**

1. First you pay to make it wrong
2. Then you pay to undo what has been made wrong
3. Then you pay to redo what has been undone
4. Plus the cost of delays (missed ship dates)
5. Plus the cost of lost capacity
6. Plus the opportunity cost of salable products
7. Plus the cost of scrap

**Motion: walking or wasted motion to pick up or store parts.**

We have all seen, or at least imagined, the efficiency expert/industrial engineer with clipboard and stopwatch in hand observing an operator on the line. Time and motion studies have been a staple of industrial engineering since the time of Frederick Taylor (1903), and make sense in a volume operation with repetitive tasks. It’s important to make sure each task takes the least amount of time because half-a-minute here and half-a-minute there, times thousands of repetitions of a cycle, can add up to significant costs.
How does this apply in your shop?  It’s not uncommon to see people in job shops walking around looking for tools, or prints, or parts, or consulting with a co-worker, or looking for the supervisor. There may not be a need for an industrial engineer to conduct time and motion studies, but and there is much to be said for workplace organization, and making sure each person has the information and tools he or she needs to do the job.

One of the lean tools used in this regard is the 5S.s. Each “S” represents a requirement in a work area to make it efficient. This creates an orderly work area with a consistent discipline for task accomplishment that is more efficient than a disorganized approach.

The 5 Ss

1. **Sort**: Clearing the work area

2. **Set in Order**: “A place for everything & everything is in its place.”

3. **Shine**: Cleaning and appearance

4. **Standardize**: Consistency in processes/tasks

5. **Sustain**: Maintain the other 4 Ss

Applying the Concepts: It’s one thing to be to identify waste, and another to actually reduce it. Each of the Seven Wastes requires a specific strategy with an action plan and a method for measuring results. A lack of follow through is often cited as a reason little improvement is forthcoming from lean and similar programs, so it’s necessary to develop a sound plan and follow up consistently.

Tip of the Iceberg: The Seven Wastes just may be the tip of the iceberg. How about the waste created when you promise your customers unrealistic delivery dates, and the chaos this creates on the floor? How about the time wasted in unproductive meetings, or meetings that last too long? How about the time and expense required to meet and maintain ISO requirements? How about improvement programs, like Lean, that are applied incorrectly? How about computer systems that are highly labor intensive? How about treatment of people? People who feel unrecognized and unrewarded can create all sorts of waste…or worse.

Note: Speed to Market readers may recall previous discussions of the need to deal with the total business process, not only the shop floor, to cut lead time. Reducing waste is similar…you
have to deal with the total organization, not just the floor which is the limited scope of the Seven Wastes.

**Summary:** The purpose of this article is to bring typical sources of waste in manufacturing environments to *Speed to Market* readers’ attention, as well as to interpret these in job shop terms. The Seven Wastes, a concept from lean manufacturing, provides a clear focus. However, not all seven sources of waste are equally applicable in job shops, and so must be re-interpreted before they can be applied effectively. It’s necessary to understand both the lean concept and the job shop environment in which it is being applied for any waste reduction effort to be effective. It is also important to recognize the Seven Wastes derive from the Toyota Production System, and so identify manufacturing-type waste. When all is said and done, the types of waste targeted by the Seven Wastes may only be a pale shadow of all the waste that exists in your company.