



improved for many years. The Toyota Production System is Toyota's unique implementation of Lean. Eiji Toyoda, founder of Toyota, took his inspiration from others and refined these ideas into the Toyota Production System. Toyoda greatly admired Henry Ford and in 1950 took a team of managers on a 12-week tour of US auto plants. He took the principles Henry Ford outlined in his two books (My Life and Work – 1923, and Today and Tomorrow – 1926), coupled them with Dr. W. Edward Deming's (another American) Quality Management principles and with Taiichi Ohno, refined these concepts into the Toyota Production System.

The five main lean principles are:

- **Specify value** from the standpoint of the end customer
  - **Identify all the steps in the value stream** and eliminate all non-value added activity
  - Create **flow** for value-creating process steps
  - Let customers **pull** value from upstream activity
- Pursue perfection** through continuous improvement

The ultimate goal of lean is to eliminate the waste between the time of request and delivery by utilizing our resources to do the work that our customer pays us for. Why focus on lead time? Because when you reduce lead time, you: improve productivity, reduce inventory, increase responsiveness, improve quality, reduce capital expenses, and improve delivery performance. No need to get bogged down chasing all of these objectives at one time. Focus on lead time and you will see positive gains in all of these metrics.

Key principles in lean manufacturing focus on producing exactly what the customer wants, when they want it, in the smallest possible quantities to gain efficiencies. You can achieve this when the processes have been designed for the workers success, as the worker is central to value creation. However, eliminating waste in the processes must first be identified which is often the most difficult step.



## Seven Forms of Waste

One of the primary focuses of the Lean Manufacturing process is on reducing waste. Waste can come from seven areas including: transportation, inventory, wasted motions, waiting, over-production, over-processing, and defects. Here is a tip to help remember these seven wastes – use the acronym Tim Wood - look back at the bold letters to see what it means.

- **T**ransportation waste occurs when materials are moved from one place to another. This type of waste is caused by the inefficient layout of machines and factories. For instance, any time a pallet jack, forklift or truck is used to move product from one location to another, this is classified as transportation waste. The result is non-value-added time between value added processes.
- Raw material, work in process, and standing inventory are all non-value-added, and therefore, have the potential to create **I**nventory waste. Excess inventory is the result of overproduction and it actually hides and even creates other forms of waste. For instance, space is wasted when stock rooms are filled with finished goods. And, although having a full inventory can give a sense of security, your cash is tied up in your stock. However, reducing your inventory waste is the best gauge of a lean transformation.
- Any movement of a person's body that does not add value is **W**asted motion. Excess motion, such as extraneous lifting, walking or reaching can result in fatigue, injuries, wasted time and frustration. A simple visual tool called a Spaghetti Map outlines the flow and pathways taken by people and materials throughout a facility, often resembling cooked spaghetti, hence the name. Spaghetti Maps can help a company reduce its wasted motion by quantifying distances traveled, in addition to helping identify the bottlenecks, poor layout and workarounds and inefficiencies in the process.
- **W**aiting occurs when a person or machine must wait to do needed work. Typically, 99% of a product's time is spent waiting. This waste also occurs when a worker watches a machine run automatically. Not only does waiting reduce productivity, it interrupts the flow of materials through the value stream. Additionally, waiting increases lead time, negatively impacts delivery performance and adds expediting costs.
- Companies will **O**verproduce a product before the customer wants it - or - produce more product than the customer ordered. Consequently, overproduction adds lead time, reduces productivity and hides other waste forms. Furthermore, it enables defects and causes scrap and must be eliminated to implement lean processes.
- **P**rocessing waste is an operation that the customer does not pay for. This can include an extra operation to hold an unnecessary tolerance or to rework

defective parts. “Just in case” operations, because customer needs are not truly understood, are also an example of processing waste. Moreover, over-automation, which drives overproduction, is another way a company creates processing waste.

- **Defects** result in scrap or rework and have the serious potential to lead to compromised customer expectations and poor delivery and productivity. Defects actually affect all of the other forms of waste and are often the result of not matching the process to the need.

Understanding the causes of waste will likely help you identify ways to minimize it. Our goal is not to be lean manufacturing experts, but to help you maximize your automation systems. By understanding the principles behind lean manufacturing, together we can help your company refine processes so you can be better at what you do, and ultimately, do it in a more profitable manner.

## Value Stream Mapping

Value Stream Mapping is a snapshot of the current state of a segment of the business at a 20,000 foot view. It helps to visually see where to tackle your next project improvements and challenges the paradigm of every member of your team. Part 4 of our Lean Manufacturing Series will help to address the basics of Value Stream Mapping so that you can fully understand how this powerful exercise can benefit your organization.

The purpose of the Current Value Stream Mapping is to understand the actual flow of your materials and information and, as a result, expose both value-added and non-value added activities. Material flow mapping shows the movement of all material from the raw material phase to the point of customer receipt. This involves inventory moves, production time and the movement of operators during the process. Information flow is the process that ensues between the customer’s initial call and the actual production launch. It outlines calls, faxes, emails and even foot traffic that has to occur before production begins. Both components are necessary when getting finished goods to your customers are made up of value-added activities (manufacturing the goods) and non-value added activities (running to get inventory before you begin the production run).

How do you get started with Value Stream Mapping?

- First, identify one value stream or product family to explore fully. Select one that will have the biggest impact to your organization once it has been optimized.
- Second, choose your team. The best choices are operators, supervisors, leads and engineers. Keep the same team on the value stream rather than breaking it up among multiple teams.
- Third, start walking the process...backwards. You will need a pencil (so that you can change things as

you go along), paper, and a stopwatch. Start with shipping and ask them, “What had to happen for you to get these finished goods to ship?” Observe and time them as they complete the shipping step, then move to the previous step. Moving backwards is much more likely to identify non-value added activities because you are not repeating a process by rote. You will be truly examining it as it occurs.

Once the non-value added activities become apparent, you can develop a Future Value Stream that has eliminated all non-value added activities. Most non-value added activities fall into the following categories: Scrap rate, lead time, change-over and excessive inventory. Eradicating each of these four items will begin to show you how lean your manufacturing process can truly be. The Future Stream will provide a goal but it will also reveal the gaps between your current and future value stream. These gaps will give you solid goals and an actionable plan. Create high level metrics so that you can be sure that your efforts are making an impact on the organization.

Value Stream Mapping helps you to create a vision of what is possible and challenges the current paradigms of your organization. The exercise will result in an actionable plan that is easy to communicate with all of the members of your team.



## Everything in Its Place – the 5 S’s

The 5 S’s lean manufacturing concept was introduced in Japan and has revolutionized the way that manufacturing facilities are organized.

The five components of the “5S’s” methodology are **Sort**, **Showcase**, **Set-in-Order**, **Standardize** and **Sustain**. The first three S’s involve general housekeeping and organization. The last two focus on the expectations that your staff will maintain that level of order. While the undertaking may seem daunting, the results are well worth it. The ‘5 S’s’ reduce frustration, decrease the likelihood of defects and create a safer, more productive work environment. Below is a breakdown of each of the 5 steps

### Sort

The first step is to evaluate what you have. Mark some empty floor space off with tape and label it into three categories: Tools to do the job, Inventory (raw materials, Work in Progress (WIP), and finished goods) and Area Support (brooms, trashcans, etc.). Once you have handled, evaluated and placed every item in the appropriate category, sort them by frequency of

use. Place a red tag on any items that are of no use to that workstation, and then move them to a “Red Tag” area. Next, sort the red tag area into categories. Decide if another department can use an item or should you auction, sell, donate or throw away the item. This will ensure that you only have the tools you absolutely need at each workstation.

### Showcase

The showcase step is simple – Get things clean! Once you have removed all the tools, deep clean the tabletops and even the machinery until it shines. Make the environment a place to be proud of, paint things in a lighter color and bring in better lighting. The idea is to create a space that you would be excited to show a customer if they dropped by for a tour.

### Set in Order

We’ve all heard the expression, “everything has a place”. In this step, you determine a place for each component needed for that operation. First, determine the best way to store the items. Small storage bins that stack on a tabletop may be best for small components while a pegboard would be perfect for tool storage. Restrict the use of drawers and toolboxes because the items are not visible to the operator and often become a catchall for items that don’t seem to have a place. Make it simple for the operator by keeping the most commonly used items close to them. Arrange the tools and equipment in order of the operation.

### Standardize

Once everything is in its place, post simple visual cues at each workstation so that the operators know exactly where each item goes. Print out a picture of the workstation in perfect order then laminate it and hang it at the workstation. Outline each tool on the pegboard to create a shadow and make it clear when something is missing. Color code item groupings and clearly label each bin. The idea is to make it simple for anyone to know where something goes and if something is missing. The true test is to bring in an outsider and ask them to put items away. If they can do it without assistance, you have accomplished your goal of standardization!

### Sustain

Keeping the environment clean and organized takes a commitment of staff and management alike. Here are three tips to keep you on track:

- *Be Consistent:* Address EVERY infraction so that workers know that management is serious about keeping things neat.
- *Be Persistent:* New behaviors take 30 days to become habit. Don’t give up too soon!
- *Be Assured:* This will soon become part of the natural flow of their day and your workers will maintain it without difficulty.

Even if you aren’t focused on lean manufacturing, the 5 S’s could be applied to any work (or even home) environment.



## Setup Reduction

Setup reduction is designed to eliminate wasted time and resources, while gaining valuable production time. While in the manufacturing setup mode, available capacity on equipment is reduced and you are producing no sellable product for your Customer. By improving setups, you not only increase your ability to run more sellable product, you also delay the purchase of additional, expensive capital equipment. For many years, companies ignored the fact that setups can, and should be, reduced. To compensate for long setups, companies would “amortize” the setups over long runs of product. While producing these long runs, two things happened: They ran more than they had orders for (overproduction created excess motion and excess inventory), and the product that they actually had orders for had to wait for all of the extra product to be done running on the machine (Waiting).

Setups in many companies have been reduced by 50% many times over, by implementing setup reduction strategies. A great example is a powdercoat system that used to take 35 minutes to change over. After the first setup reduction event it took 15 minutes to change over. After the second setup reduction event it took 7 minutes to change over, after the third setup reduction event it took 3 minutes to change over, and after the fourth and final setup reduction event it took 80 seconds to change over.

Furthermore, setup reduction doesn’t require a large capital investment. The powdercoat system example cost a total of \$500 to make those improvements.

### Longer setups cause more scrap

A majority of setup time on equipment is spent running a product, making an adjustment to the machine, running another product, making another adjustment, and so on. While running these “test” or “setup” products,

companies typically are creating scrap or rework. A good measure for setup reduction is “First Pass Yield” (FPY) of the setup. What percentage of the time is the first part out of the setup good? Most processes prior to setup reduction have less than 10% setup first pass yield. Many times it is zero.

### Setup is 100% Waste

As mentioned, while in setup, you are producing no products you can sell to your Customer. In many cases, setups are “necessary” to produce the myriad of products/services your Customer wants, it’s still waste and should be reduced. Even if you charge your Customer (and they actually pay you) for a setup, it is still waste. Look at it as a prime opportunity to increase your margin on setups and make more money. Additionally, you position yourself well in the future to be more competitive.

### Bottleneck Processes

One cause of bottleneck processes is that the need – or demand - exceeds the current capacity of the process. The goal to fix this bottleneck would then be to create more capacity. Capacity can be expressed as available run time x the production rate. The solution is to reduce setup time which increases available run time. Increasing available run time increases capacity. The result is that capacity is increased to meet demand without additional capital expenditure.

### Non-Bottleneck Processes

A good example of a non-bottleneck process is the need for more flexibility for mixed-model production. Reducing setup time allows you to increase the number of setups per period, which allows for smaller batch sizes, and ultimately more flexibility. The result is that daily model mix production is now possible which also creates a competitive advantage in that you have the flexibility to meet customer demand, and have shorter lead times for all models.

The main objective of setup reduction isn’t to achieve a certain percentage reduction in setup time—it’s to enable a specific manufacturing goal! However, there are many benefits of setup reduction, including:

- Reduces the defect rate. Typically, defects aren’t caught on the first piece. The larger the batch size, the greater the possibility that more defects have occurred before the defect is caught. Also, with a large batch size, the operator spends more time sorting back through the lot until they find where the defect occurred. Many times the defect in the batch isn’t caught until much later in the process, so the knowledge of what went wrong disappears. Eliminating adjustments as part of the setup, means the first piece is a good piece every time.
- Reduces inventory cost. Produce in daily batches, or less, and recover square footage.
- Increases production flexibility. Enables average daily production which is more responsive to customer

orders.

- Improves on-time delivery. Increases capacity to meet customer demand and shortens production lead time for mixed-model production.
- Keeps Value Stream Moving. Reducing setups keeps your Value Streams producing value for your Customer

Taking a hard look at setup reduction could have a quantifiable value on your bottom line. Our goal is to understand the principles behind lean manufacturing so we can help you better maximize your automation systems. Together we can help your company refine processes so you can be better at what you do, and ultimately, do it in a more profitable manner.

To learn more about Lean Manufacturing read our article “**Lessons Learned from the Toyota Way**” on our blog at <http://blog.bautomation.com/toyota-way/>.



## About Business Automation Specialists of Minnesota, Inc.

Business Automation Specialists leverages 25 years of practical business experience with software technology to help mid-sized manufacturers and distributors capitalize on their unique business strengths. We've built our business by helping clients build theirs; enabling them to become better, faster and stronger through improved management controls, cash flow and profitability.

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