What is Lean Manufacturing?

For an idea that has been around since 1991, lean manufacturing still garners plenty of attention. The term “lean manufacturing” was first introduced in the book *The Machine That Changed the World* by Womack, Jones and Roos. This book was based on a five-year, $5 million study of the automobile industry; specifically, the manufacturing systems used by the Toyota Motor Corporation.

Despite how often we hear about lean manufacturing these days, the term is still ambiguous and, often, difficult to explain.

Lean represents a high-level manufacturing philosophy that often encompasses myriad trends and programs, including common-sense manufacturing practices that have been around for years. A company that has adopted lean manufacturing may, for example, use Kanbans, demand flow and cellular manufacturing in their plant. Setup reduction, JIT, inventory reduction, waste reduction, product quality, real-time information and improved shop floor layouts are also all components of a lean manufacturing initiative.

Lean manufacturing today is similar to Total Quality Management (TQM) programs of the 80’s and 90’s. To cynics, lean is nothing more than a new slew of buzzwords, seminars and revenue for consultants. To the more charitable, lean is years of accumulated best practices under a single umbrella to help today’s manufacturers improve operations.

In the simplest terms, lean is a philosophy designed “to maximize customer value while minimizing waste”, according to the Lean Enterprise Institute, a lean manufacturing think tank.

In theory, lean creates reduced defects, increased uptime and streamlined operations, all of which can create desirable cost savings and cycle-time reduction. To realistically achieve these goals, however, an operation would need timely, reliable information from multiple areas of the shop floor to identify areas of waste, improve decision making, improve the ability to respond to customer needs and to ensure defect-free output.

When you eliminate waste and non-value added activities, you hope to reduce costs, lead times and inventory requirements. Lean systems emphasize the use of preventive maintenance, quality improvement programs, pull systems and flexible work forces (and production facilities) to increase overall efficiency.

According to research by the Massachusetts Institute of Technology’s Laboratory for Manufacturing and Productivity, lean systems also encourage designing and managing production processes that reduce waste. In fact, Lean production is aimed at the elimination of waste in every area of production. Its goal is to incorporate less human effort, less inventory, less time to develop products, and less space, to become highly responsive to customer demand while producing top quality products in the most efficient and economical manner possible.

Lean is a Journey, not a Destination

No matter how long you have been working on lean techniques, you will always be in the process of becoming Lean. Lean is a continuum which requires a consistent effort to monitor progress against measured goals.

Many North American manufacturers, eager for instant results, try to steal the “quick fix” parts of a Lean methodology. They awkwardly force the fixes into existing plants in attempted attacks on lean’s enemy—waste. Often called the “seven deadly wastes of manufacturing” or the “seven sins of manufacturing”, the MIT manufacturing and productivity lab describes waste as consisting of the following seven aspects:
1. **Overproduction.** The production of more goods than demanded or the production of goods before they are needed.

2. **Inventory or work-in-process (WIP).** Materials that are “in limbo” between operations due to large lot production or processes with long cycle times.

3. **Transportation.** The moving of parts back and forth from production to inventory or from process-to-process.

4. **Over-processing.** Unnecessary production steps. In other words, doing more “work” than is necessary to complete a process.

5. **Motion.** The movements of workers, machines, and parts more than needed.

6. **Waiting.** Time during which a process cannot be started or a product cannot be shipped because another process is still being completed.

7. **Making defective parts.** Creating any parts that cannot be sold as-is or that must be reworked.

### You May Have Tried Lean with ERP…and Failed

In the 1980s, most factories implemented some type of Manufacturing Resource Planning (MRP II) system to improve operational and financial planning. These systems worked wonders for planning but managers could not keep them accurate because they lacked real-time feedback from the factory.

Shop floor data collection has helped solve this problem somewhat by providing a path to quickly and accurately enter production feedback and keep the MRPII system up to date.

Over time, MRPII evolved into Enterprise Resource Planning (ERP), a system that grew to incorporate most of the departments within a company. ERP system functionality provides strong capabilities in costing, inventory control and transaction processing to handle key business systems.

Unfortunately, ERP systems usually cannot drill down to the shop floor to manage individual orders or individual workstations in real time. And without real-time feedback from production, managers are forced to use standard lead times for costing rather than actual times. Manufacturers often find that lead times at each work center may be much higher than needed, resulting in higher work-in-process, inaccurate delivery dates and waste, according to Why ERP is not Enough, a whitepaper by RSS Solutions.

Manufacturers need systems that provide real-time feedback on employees, orders and machines. Conventional enterprise systems don’t support managers and operators in their daily production activities. Without a specialized tool to manage the detailed operations on the shop floor, manufacturers will have difficulty applying lean principals; you can’t improve something you can’t measure.

ERP vendors have historically offered limited shop floor control and feedback functionality. Most point customers to expert partners to provide this missing but essential functionality.

### What is SFX? A Bridge to ERP and More

Designed to complement your ERP system, Shop Floor Execution (SFX) systems provide the missing link.

A new category of software, SFX automates and streamlines factory operations by combining three popular applications around a core of shop floor data collection:

- Labor management (time and attendance)
- Machine utilization
- Paperless dispatching

This execution-oriented combination provides the essential tools for real-time production process management.

Unlike Manufacturing Execution Systems (MES) that are costly and time consuming to implement, SFX systems...
offer a targeted approach designed to generate immediate results.

**How can SFX Help with Lean Initiatives?**

Sometimes, when managers begin to implement a lean initiative, the first thing they want to reduce or eliminate is data collection. We would argue that you can keep your data collection and still be lean. You can’t measure what you don’t track, and SFX systems are designed to make the measurement process easy and painless.

Like TQM, lean programs require data to feed decisions. You need to know your starting time and costs to see any improvement in these areas. For example:

- If you want to reduce set-up times, you must know how long set-ups take now
- If you want to eliminate scrap, you must know what the leading causes for scrap are
- If you want to improve throughput, you must know how long it takes for orders to move through the shop.

Beyond benchmarking and traditional labor collection, SFX can help eliminate waste and increase productivity.

Let’s look at the seven types of waste and how SFX can minimize or eliminate them.

1. **Over-production**

Factory operators are your key resource, and they need proper management to ensure their work is essential and timely. When operators arrive at work, they should have access to a dispatch list or ready-list of assignments with no option for deviation. When left unguided, operators may work on jobs they like best and may run out of materials on a given line because it is the easy thing to do. The result is a surplus of unnecessary inventory.

A dispatch list provides each operator with a clear view of “what to do next”. As the dispatch list is generated from the production planner’s most recent schedule adjustments, the dispatch list will always reflect the plant’s current priorities. A dispatch list also ensures that operators spend their time doing only what is required by the system to fulfill existing orders. It provides operators with a view of the entire routing and how their specific tasks fit into the big picture of larger operations. This visibility empowers employees so they can realize full impact of their contribution.

Operators take their assignments from touch screens that are continually updated with the most current schedule revisions. In addition to managing what tasks the operators are working on, an SFX system can also prevent operators from completing too many parts. SFX systems are tightly integrated with your ERP system and know the precise quantities required for each production order.

When an operator begins a job, he is reminded of the total quantity required. When he completes the job, real-time validation of order number, step, and quantity will prevent him from over-reporting by showing a warning message. If he ignores the warning, he must select from a list of appropriate reason codes. Over-reporting can be flagged as an exception for Supervisors to review and can even show up on employee report cards for performance evaluation.

2. **Inventory or Work-in-Process (WIP)**

Material caught between operations due to large lot production or processes with long cycle times must often wait until the entire lot is completed. This can increase already lengthy cycle times and take up precious floor space.

SFX systems can help in a number of ways. As soon as quantities are completed at one step, they are immediately available and ready at the next step. This “send ahead” functionality allows you to keep your production moving. Operators and Supervisors can see the entire routing online and track pieces as they move from one step to another. SFX systems can be used to create travelers and labels for partial lots. Orders can be partially completed and sent ahead to maximize your resources and prevent bottlenecks.

Tracking WIP becomes crucial in operations that outsource production to third party operations offsite. Often times, this outsourced operation becomes a black hole. SFX systems can help track the status of outside operations by reporting on the 5 states:
1. prep/stage for shipping
2. ship
3. received by third party
4. shipped back by third party
5. received and inspected

Every move is recorded, and at each step the status is tracked. SFX systems help orchestrate collaborative manufacturing.

A key function of an SFX system is help manage and track WIP. With a clear view of what’s in WIP and what the status is, your Supervisors can proactively manage operations. SFX systems can provide graphical views of all work centers, machines, orders and people scheduled to run them. This graphical sequencer can provide a clear view of all jobs, excess queues and bottlenecks. You can see how long something has been waiting and how far behind the expected due date it is.

Another way to reduce WIP is to minimize the disruption caused by downtime of machines and work centers. SFX systems provide graphical views of work centers, work points and machines. When key resources are scheduled down for repair or maintenance, they appear on the planner’s sequencer as “scheduled down” and unavailable. This way production can be re-routed to other areas and kept on schedule.

There’s a lot of talk about Lean Maintenance or Total Productive Maintenance (TPM) as it is also called. This provides for line operators to take responsibility for certain maintenance tasks like cleaning, lubrication, wear parts replacement, minor repairs and daily preventative checking. These activities don’t take very long and don’t require the machine be down for very long. SFX systems can help by providing a daily check list for ongoing maintenance tasks and tracking these activities by allowing operators to log their time as direct or indirect, so productivity reports accurately reflect their work.

3. Transportation:
Moving parts unnecessarily does not add value. In addition to improving the transportation, you can minimize or eliminate it (e.g. form cells). In theory, cellular production is a great idea for certain factories. But not every part of the typical fabrication/assembly plant or process plant can be completely organized in product-oriented cells. You may find yourself with cells in certain areas and not in others.

In typical cell manufacturing, the routing is condensed from multiple steps in several work centers, to multiple steps in one cell. SFX systems can still help track time, quantity and productivity in a cell environment quite easily. The cell operates like a crew, where the crew leader uses one badge to transact for the entire cell. Once a production standard or Takt time is established for a cell, SFX systems can calculate efficiency based on the number of people in the cell and the total hourly or daily output.

Here’s how SFX can help with incremental quantity reporting.

A given cell must box and label every 100 quantities produced. A button in the SFX system can be configured to print that label and incidentally report 100 parts complete—an easy way to calculate Takt time and keep the cell on target. Individual productivity can be derived by knowing how many are in the cell and how long it took to make those 100 parts.

SFX can also offer a scoreboard that would show WIP in a cell and its percent completion requiring minimal operator intervention. A status screen would stay up all the time and the operator can mark what is completed. In this manner, the system can track and manage WIP and the accounting department is satisfied with basic labor accounting.

Another way to reduce waste is to reduce the transportation of unfinished goods back and forth from inventory. SFX systems allow operators to easily indicate temporary on-floor storage locations for items that will be used again shortly. The ready list will even show where these parts are. The system will continue to track these parts as WIP and not finished goods, so that you can have fewer transactions and fewer moves.

Lean environments have systems in place that ensure all materials are available for production before beginning manufacturing. Take advantage of a planning and scheduling tool to ensure that all resources are available before issuing an order to production.

4. Processing waste:
Waste is a result of materials which are scrapped during production. This might have been due to poor quality raw materials or operators who are not properly trained or not properly supported with work instructions for specific operations.

Always make sure operators have everything they need right at their workstation. Lost travelers or paper packets can be eliminated with paperless manufacturing and electronic work instructions available with SFX systems.

SFX systems offer a transaction called the Gateway Operation. This is an essential step in restating the expected quantity based upon a new evaluation of raw material. For example, a cutting operation expects a given length to generate 10 pieces of a certain part. Those 10 pieces will go ahead to become a part of 10 separate assemblies. However, if a raw length is flawed somehow, and only produces eight pieces of that part, there needs to be an adjustment in the system to account for the reduction in expected finished assemblies. The Gateway Operation provides a means to reset the quantity after a certain step.

5. Motion:
Operator motion incorporates a few different things. There is the motion of the actual operation, which can be studied and improved via ergonomics. There is the motion of the operators looking for help with a particular assignment, and there is also the motion of the operator traveling to a data collection terminal which may be too far from his workstation.

The last thing you want in your Lean factory is confused operators wandering around looking for help on how to complete an assignment, how to decipher cryptic instructions, or where to find the necessary paperwork for a particular job. In a Lean factory, the operator does not leave his work area.

SFX systems offer a paperless approach to manufacturing, where all routings are electronically dispatched to touch screens. No more paper shop packets! All work instructions, pictures and diagrams are available online at each terminal. Operators have everything they need to begin work and be productive.

SFX systems can also help reduce operator travel time to and from data collection devices. A properly configured and installed system takes into account the kind of work done at each workstation i.e. number of operations per hour/shift and how that translates into number of transactions per hour. Proper placement of terminals will minimize travel time.

Further, data collection transaction prompts in SFX systems can be configured to reduce transaction time at the terminal. For example, a standard transaction for reporting quantity and labor can often be simplified to 3-5 screen touches and a total time at the terminal of 10 seconds.

In a Lean environment, the Material Handler is proactive. He can use the SFX system to be looking ahead and see what’s on deck. He can make sure that materials are delivered on time and that the machinist is busy and doesn’t have to wander looking for more work. He can use the SFX system to plan better and make sure the machinist doesn’t have to wait.

6. Waiting:
It is inevitable that workers wait for some portion of an operation to be completed before continuing with the next step. The key is to ensure that they are not waiting idly. There are many ways to maximize operator utilization.

Many cells can be configured such that operators can oversee multiple jobs running on several machines simultaneously. Operators can maximize their productivity and work on multiple jobs at once.

In many factories, machines often run unattended. SFX systems can support an unattended batch operation, where for example, parts are loaded into an oven, cooked and then unloaded. Many plants have given up trying to account for labor costs and efficiency for these kinds of operations. Using apportionment via earned hours, the time can be divvied accurately based on standards and quantity produced. This low cost method of capturing data can help identify bottlenecks. Remember, you can’t improve upon things you don’t measure.

Tracking unattended operations with meaningful input from operators at pre-determined intervals can maximize operator productivity and allow management to still track machine utilization and operator efficiency. SFX systems can be configured to prompt operators for occasional
feedback on the jobs they run, so that WIP status can be tracked and measured.

Tip: Many industries have a required changeover period, where a processing roll or coil needs to be replaced. This requires a disruption in operations. By establishing targets for these changeovers, and getting everyone to agree on the target, you can measure and monitor the downtime. Setting a standard for even these indirect production activities helps improve productivity and efficiency and reduce bottlenecks.

As mentioned earlier, Lean Maintenance is a great way to take advantage of gaps in operator productivity. Total Productive Maintenance (TPM) can transform maintenance from an annoying overhead activity into an integral part of the manufacturing process, where operators take part in routine maintenance to ensure machines run smoothly.

Beyond operator waiting, there is also the concern of idle machines. In addition to common Lean practices such as reducing set-up times, there are other ways to maximize machine/operator efficiency. SFX systems offer tools to help with machine/work center scheduling. A graphical sequencer can schedule shared set ups, jobs to run sequentially (take full benefit of the set up), and jobs to run simultaneously.

A key measurement in this area is line uptime. This is measured as the number of clock hours a line runs as a percentage of the number of hours it was scheduled to run. SFX systems are designed to help manage and track precisely this kind of data.

7. Making defective products:

Standards derived from ERP/MRP systems often fall short of real standardization. In a Lean environment, this standardization requires industrial engineering of tasks and times to ensure the exact same work is done at each operation in realistic times to discourage short cuts.

At The Toyota Production System, engineered work goes beyond specifying what is to be done to specifying how it is to be done in detail. These standardized detailed work instructions go a long way to ensuring consistent quality and eliminating the need for costly rework. SFX systems provide electronic delivery of paperless work instructions to help ensure all operators have the most current engineering specifications.

A key measurement for Lean in this regard is first time quality. This is measured as the number of usable parts transferred out of a work center as a percentage of total work center production.

Another tenet of Lean is Self-Inspection. A Lean process leaves little room for traditional after-the-fact inspectors. SFX systems offer a way to monitor in-line process checks to ensure proper execution. When an operator starts production, an SFX system can validate that all the correct components are being used (part types, quantities, lots). Additionally, SFX systems can be configured to require dimensional tests, and will create automatic rework loops if test fails.

In a Lean environment, the rule is that defective production is not allowed to pass on to the next operation.

A Lean workforce is one that is flexible to meet the demands of the business. Cross-training is powerful tool for the Lean enterprise. By having employees certified to do a number of jobs, you’ve built in the flexibility to have idle workers work elsewhere in the plant and be available for overtime on another line when needed.

SFX systems offer integrated Certification modules to track and manage what jobs employees are certified to do. Certification tools are easy to use and can help ensure compliance with regulatory bodies. By ensuring that only qualified operators do the work you can drastically cut down on scrap and rework.

What Now?

Shop Floor Execution Systems are designed to help expedite the communication of essential information between factory Planners, Supervisors and operators. The granular management capabilities of SFX.

So, how can SFX help you become more lean?

- Make it easy to capture operator feedback on jobs, material and status.
7 Ways Shop Floor Execution (SFX) Systems Help with Lean

- Require stringent quality reporting throughout the production process, not just at the end.
- Provide real-time feedback on production efficiency, by operator, Work Center, Machine or part.
- Track machine utilization to ensure resources are being used to their full capacity.

About Casco Development

Casco Development provides innovative software solutions that help manufacturers achieve best-in-class production efficiencies by effectively managing the real-time interaction of people, machines and orders. Many of our customers are Fortune 500 companies that depend on our systems for round-the-clock operations.

We are a group of manufacturing professional dedicated to delivering solutions to real-life problems. Our flagship product, ShopVue, evolves through ongoing input from our customers at all levels of the manufacturing industry. The result is a user-friendly, execution system that can guide non-computer-oriented factory personnel through the day’s work.

From the beginning, we recognized the potential to build a system that not only tracks orders, labor, and attendance in real time, but also integrates these components to provide a highly specialized tool to help factory Supervisors execute of efficiently. You can improve workflow and profits, and workers can readily access the information needed to do their jobs better.

Casco Development targets the job-oriented, discrete Fortune 2000—sized manufacturer seeking to enhance production efficiency. Our customers range from privately held North American manufacturers with 100+ employees to Fortune 500, multinational, multisite manufacturing organizations.

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