The following is a collection of 25 essential lean tools. Each tool is distilled into a simple description of what it is and how it helps. ([http://www.leanproduction.com/top-25-lean-tools.html](http://www.leanproduction.com/top-25-lean-tools.html))

<table>
<thead>
<tr>
<th>Lean Tool</th>
<th>What Is It</th>
<th>How Does It Help</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>5S</strong></td>
<td>Organize the work area:</td>
<td></td>
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<tr>
<td></td>
<td>▪ Sort (eliminate that which is not needed)</td>
<td>Eliminates waste that results from a poorly organized work area (e.g. wasting time looking for a tool).</td>
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<td></td>
<td>▪ Set In Order (organize remaining items)</td>
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<td></td>
<td>▪ Shine (clean and inspect work area)</td>
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<td></td>
<td>▪ Standardize (write standards for above)</td>
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<td></td>
<td>▪ Sustain (regularly apply the standards)</td>
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<tr>
<td><strong>Andon</strong></td>
<td>Visual feedback system for the plant floor that indicates production status,</td>
<td>Acts as a real-time communication tool for the plant floor that brings immediate attention to problems as they occur – so they can be instantly addressed.</td>
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<tr>
<td></td>
<td>alerts when assistance is needed, and empowers operators to stop the production process.</td>
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<tr>
<td><strong>Bottleneck Analysis</strong></td>
<td>Identify which part of the manufacturing process limits the overall throughput and improve the performance of that part of the process.</td>
<td>Improves throughput by strengthening the weakest link in the manufacturing process.</td>
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<tr>
<td><strong>Continuous Flow</strong></td>
<td>Manufacturing where work-in-process smoothly flows through production with minimal (or no) buffers between steps of the manufacturing process.</td>
<td>Eliminates many forms of waste (e.g. inventory, waiting time, and transport).</td>
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<tr>
<td><strong>Gemba (The Real Place)</strong></td>
<td>A philosophy that reminds us to get out of our offices and spend time on the plant floor – the place where real action occurs.</td>
<td>Promotes a deep and thorough understanding of real-world manufacturing issues – by first-hand observation and by talking with plant floor employees.</td>
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<tr>
<td><strong>Heijunka (Level Scheduling)</strong></td>
<td>A form of production scheduling that purposely manufactures in much smaller batches by sequencing (mixing) product variants within the same process.</td>
<td>Reduces lead times (since each product or variant is manufactured more frequently) and inventory (since batches are smaller).</td>
</tr>
<tr>
<td><strong>Hoshin Kanri (Policy Deployment)</strong></td>
<td>Align the goals of the company (Strategy), with the plans of middle management (Tactics) and the work performed on the plant floor (Action).</td>
<td>Ensures that progress towards strategic goals is consistent and thorough – eliminating the waste that comes from poor communication and inconsistent direction.</td>
</tr>
<tr>
<td><strong>Jidoka (Autonomation)</strong></td>
<td>Design equipment to partially automate the manufacturing process (partial automation is typically much less expensive than full automation) and to automatically stop when defects are detected.</td>
<td>After Jidoka, workers can frequently monitor multiple stations (reducing labor costs) and many quality issues can be detected immediately (improving quality).</td>
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<tr>
<td><strong>Just-In-Time (JIT)</strong></td>
<td>Pull parts through production based on customer demand instead of pushing parts through production based on projected demand. Relies</td>
<td>Highly effective in reducing inventory levels. Improves cash flow and reduces space requirements.</td>
</tr>
<tr>
<td></td>
<td>on customer demand instead of pushing parts through production based on projected demand. Relies</td>
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<tr>
<td>Tool/Methodology</td>
<td>Description</td>
<td>Benefits</td>
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<tr>
<td>Kaizen (Continuous Improvement)</td>
<td>A strategy where employees work together proactively to achieve regular, incremental improvements in the manufacturing process.</td>
<td>Combines the collective talents of a company to create an engine for continually eliminating waste from manufacturing processes.</td>
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<tr>
<td>Kanban (Pull System)</td>
<td>A method of regulating the flow of goods both within the factory and with outside suppliers and customers. Based on automatic replenishment through signal cards that indicate when more goods are needed.</td>
<td>Eliminates waste from inventory and overproduction. Can eliminate the need for physical inventories (instead relying on signal cards to indicate when more goods need to be ordered).</td>
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</tbody>
</table>
| KPI (Key Performance Indicator) | Metrics designed to track and encourage progress towards critical goals of the organization. Strongly promoted KPIs can be extremely powerful drivers of behavior – so it is important to carefully select KPIs that will drive desired behavior. | The best manufacturing KPIs:  
- Are aligned with top-level strategic goals (thus helping to achieve those goals)  
- Are effective at exposing and quantifying waste (OEE is a good example)  
- Are readily influenced by plant floor employees (so they can drive results) |
| Muda (Waste) | Anything in the manufacturing process that does not add value from the customer’s perspective. | Eliminating muda (waste) is the primary focus of lean manufacturing. |
| Overall Equipment Effectiveness (OEE) | Framework for measuring productivity loss for a given manufacturing process. Three categories of loss are tracked:  
- Availability (e.g. down time)  
- Performance (e.g. slow cycles)  
- Quality (e.g. rejects) | Provides a benchmark/baseline and a means to track progress in eliminating waste from a manufacturing process. 100% OEE means perfect production (manufacturing only good parts, as fast as possible, with no down time). |
| PDCA (Plan, Do, Check, Act) | An iterative methodology for implementing improvements:  
- Plan (establish plan and expected results)  
- Do (implement plan)  
- Check (verify expected results achieved)  
- Act (review and assess; do it again) | Applies a scientific approach to making improvements:  
- Plan (develop a hypothesis)  
- Do (run experiment)  
- Check (evaluate results)  
- Act (refine your experiment; try again) |
| Poka-Yoke (Error Proofing) | Design error detection and prevention into production processes with the goal of achieving zero defects. | It is difficult (and expensive) to find all defects through inspection, and correcting defects typically gets significantly more expensive at each stage of production. |
| Root Cause Analysis | A problem solving methodology that focuses on resolving the underlying problem instead of applying quick fixes that only treat immediate symptoms of the problem. A common approach is to ask why five times – each time moving a step | Helps to ensure that a problem is truly eliminated by applying corrective action to the “root cause” of the problem. |
closer to discovering the true underlying problem.

| **Single Minute Exchange of Die (SMED)** | Reduce setup (changeover) time to less than 10 minutes. Techniques include:  
- Convert setup steps to be external (performed while the process is running)  
- Simplify internal setup (e.g. replace bolts with knobs and levers)  
- Eliminate non-essential operations  
- Create standardized work instructions | Enables manufacturing in smaller lots, reduces inventory, and improves customer responsiveness. |

| **Six Big Losses** | Six categories of productivity loss that are almost universally experienced in manufacturing:  
- Breakdowns  
- Setup/Adjustments  
- Small Stops  
- Reduced Speed  
- Startup Rejects  
- Production Rejects | Provides a framework for attacking the most common causes of waste in manufacturing. |

| **SMART Goals** | Goals that are: Specific, Measurable, Attainable, Relevant, and Time-Specific. | Helps to ensure that goals are effective. |

| **Standardized Work** | Documented procedures for manufacturing that capture best practices (including the time to complete each task). Must be “living” documentation that is easy to change. | Eliminates waste by consistently applying best practices. Forms a baseline for future improvement activities. |

| **Takt Time** | The pace of production (e.g. manufacturing one piece every 34 seconds) that aligns production with customer demand. Calculated as Planned Production Time / Customer Demand. | Provides a simple, consistent and intuitive method of pacing production. Is easily extended to provide an efficiency goal for the plant floor (Actual Pieces / Target Pieces). |

| **Total Productive Maintenance (TPM)** | A holistic approach to maintenance that focuses on proactive and preventative maintenance to maximize the operational time of equipment. TPM blurs the distinction between maintenance and production by placing a strong emphasis on empowering operators to help maintain their equipment. | Creates a shared responsibility for equipment that encourages greater involvement by plant floor workers. In the right environment this can be very effective in improving productivity (increasing up time, reducing cycle times, and eliminating defects). |

| **Value Stream Mapping** | A tool used to visually map the flow of production. Shows the current and future state of processes in a way that highlights opportunities for improvement. | Exposes waste in the current processes and provides a roadmap for improvement through the future state. |

| **Visual Factory** | Visual indicators, displays and controls used throughout manufacturing plants to improve communication of information. | Makes the state and condition of manufacturing processes easily accessible and very clear – to everyone. |
JIT

JIT is a tool that enables the internal processes of a company to adapt to sudden changes in demand by producing the right product at the right time and in right quantities. It is a philosophy that seeks to eliminate all types of waste, including carrying excessive levels of inventory and long lead times. Just-in-Time (JIT) production system was founded by Taiichi Ohno (a Vice President at Toyota) and first successfully implemented at the Toyota Motor Company's plants in Japan. It works on a demand-pull basis, contrary to hitherto used techniques, which worked on a production-push basis. To elaborate further, under just-in-time manufacturing (colloquially referred to as JIT production systems), actual orders dictate what should be manufactured, so that the exact quantity is produced at the exact time that is required. Just-in-time manufacturing goes hand in hand with concepts such as Kanban, continuous improvement and total quality management (TQM).

Some characteristics of JIT are: *Pull method of materials flow*, *Consistently high quality*, *Small lot sizes*, *Uniform workstation loads*, *Standardized components and work methods*, *Close supplier ties*, *Flexible workforce*, *Line flows*, *Automated production*, *Preventive maintenance*.

Advantages

- Just-in-time manufacturing keeps **stock holding costs to a bare minimum**. The release of storage space results in better utilization of space and thereby bears a favourable impact on the rent paid and on any insurance premiums that would otherwise need to be made.
- Just-in-time manufacturing **eliminates waste**, as out-of-date or expired products; do not enter into this equation at all.
- As under this technique, only essential stocks are obtained, **less working capital** is required to finance procurement. Here, a minimum re-order level is set, and only once that mark is reached, fresh stocks are ordered making this a boon to inventory management too.
- Due to the aforementioned low level of stocks held, the organizations has **high return on investment** (referred to as ROI, in management parlance).
- As just-in-time production works on a demand-pull basis, **all goods made would be sold**, and thus it incorporates changes in demand with surprising ease. This makes it especially appealing today, where the market demand is volatile and somewhat unpredictable.
- Just-in-time manufacturing encourages the 'right first time' concept, so that inspection costs and cost of rework is minimized.
- **High quality products** and greater efficiency can be derived from following a just-in-time production system.
- **Close relationships** are fostered along the production chain under a just-in-time manufacturing system.
- Constant communication with the customer results in **high customer satisfaction**.
- **Overproduction is eliminated** when just-in-time manufacturing is adopted.

Disadvantages

- Just-in-time manufacturing **provides zero tolerance for mistakes**, as it makes re-working very difficult in practice, as inventory is kept to a bare minimum.
- **High reliance on suppliers** is required, whose performance is generally outside the purview of the manufacturer.
- Due to there being **no buffers for delays**, production downtime and line idling can occur which would bear a detrimental effect on finances and on the equilibrium of the production process.
- The organization would **not be able to meet an unexpected increase in orders** due to the fact that there are no excess finish goods.
- **Transaction costs would be relatively high** as frequent transactions would be made.
- Just-in-time manufacturing may have certain **detrimental effects on the environment** due to the frequent deliveries that would result in increased use of transportation, which in turn would consume more fossil fuels.
Precautions

- **Management buy-in and support at all levels of the organization are required**; if a just-in-time manufacturing system is to be successfully adopted.
- **Adequate resources should be allocated**, so as to obtain technologically advanced software that is generally required if a just-in-time system is to be a success.
- Building a close, **trusting relationship** with reputed and time-tested **suppliers** will minimize unexpected delays in the receipt of inventory.
- Just-in-time manufacturing cannot be adopted overnight. It **requires commitment** in terms of time and adjustments to corporate culture would be required, as it is starkly different to traditional production processes.
- The design **flow process needs to be redesigned** and layouts need to be re-formatted, so as to incorporate just-in-time manufacturing.
- **Lot sizes need to be minimized**.
- **Workstation capacity should be balanced** whenever possible.
- **Preventive maintenance should be carried out**, so as to minimize machine breakdowns.
- **Set-up times should be reduced** wherever possible.
- **Quality enhancement programs should be adopted**, so that total quality control practices can be adopted.
- **Reduction in lead times** and frequent deliveries should be incorporated.
- **Motion waste should be minimized**, so the incorporation of conveyor belts might prove to be a good idea when implementing a just-in-time manufacturing system.

Conclusion

Just-in-time manufacturing is a philosophy that has been successfully implemented in many manufacturing organizations. It is an optimal system that reduces inventory whilst being increasingly responsive to customer needs, this is not to say that it is not without its pitfalls. However, these disadvantages can be overcome with a little forethought and a lot of commitment at all levels of the organization.

Video Link

[http://www.youtube.com/watch?v=AqK8VcLOxH8](http://www.youtube.com/watch?v=AqK8VcLOxH8)
Kanban

A kanban or “pull” production control system uses simple, visual signals to control the movement of materials between work centers as well as the production of new materials to replenish those sent downstream to the next work center. A kanban is a card that is attached to a storage and transport container. It identifies the part number and container capacity, along with other information, and is used to provide an easily understood, visual signal that a specific activity is required. Kanban is a system to control the logistical chain from a production point of view, and is not an inventory control system.

The **main objectives** of Kanban include: *reducing costs by eliminating waste/scrap, try to create work sites that can respond to changes quickly, facilitate the methods of achieving and assuring quality control, design work sites according to human dignity, mutual trust and support, and allowing workers to reach their maximum potential.*

The **main characteristics** include: *A simple and understandable process, Provides quick and precise information, Low costs associated with the transfer of information, Provides quick response to changes, Limit of over-capacity in processes, Avoids overproduction, Minimizes waste, Control can be maintained, Delegates responsibility to line workers.*

**Kanban cards**

*Kanban cards* are a key component of kanban and signal the need to move materials within a manufacturing or production facility or move materials from an outside supplier into the production facility. The kanban card is, in effect, a message that signals that there is a depletion of product, parts, or inventory that, when received, the kanban will trigger the replenishment of that product, part, or inventory. Consumption therefore drives demand for more production, and demand for more product is signalled by the kanban card. Kanban cards therefore help create a demand-driven system.

The diagram below shows the details of how a Kanban system works.

**Application in IT**

Due to its affiliation with Agile development, Kanban has become a popular tool for software development teams. Kanban is different from other project management methodologies such as Scrum, Extreme Programming (XP) or the
Waterfall approach in that it does not use time-boxed iterations. A time-boxed iteration is a set period of time in which a project phase must be completed. Instead, the Kanban system relies on the continuous delivery of products that are geared towards meeting the expectations of customers.

One benefit of practicing Kanban is that, if the customer’s expectations are not being met, a team has multiple opportunities to give direction for course corrections during iterations. Kanban is based on iterative work, or work that is done in small segments so as to reduce the amount of re-work should any changes occur. For this reason, customers of a team practicing Kanban can provide honest feedback and request changes during a particular iteration while preserving the timeline and keeping the budget in check.

**Advantages**

- **Optimize inventory and reduce product obsolescence:** Since component parts are not delivered until just before they are needed, there is a reduced need for storage space.
- **Reduces waste and scrap:** With Kanban, products and components are only manufactured when they are needed. This eliminates overproduction and reduces storage costs.
- **Provides flexibility in production:** If there is a sudden drop in demand for a product, Kanban ensures we are not stuck with excess inventory. This gives us the flexibility to rapidly respond to a changing demand.
- **Increases Output:** The flow of Kanban (cards, bins, pallets, etc.) will stop if there is a production problem. This makes problems visible quickly, allowing them to be corrected ASAP. Kanban reduces wait times by making supplies more accessible and breaking down administrative barriers. This results in an increase in production using the same resources.
- **Reduces Total Cost:** The Kanban system reduces our total costs by: Preventing Over Production, Developing Flexible Work Stations, Reducing Waste and Scrap, Minimizing Wait Times and Logistics Costs, Reducing Stock Levels and Overhead Costs, Saving Resources by Streamlining Production, Reducing Inventory Costs,
- Other Advantages include **Improves Flow,** Prevents overproduction, Places control at the operations level, Improves responsiveness to changes in demand, Synchronization of supply and demand, Lead time is kept to a minimum, Totally customer driven demand, Better machine utilisation, Reduced or eliminated queues, Limit the spaces for WIP to hide, Quickly improve factory control and WIP reduction efforts.

**Disadvantages**

- It is less effective in shared-resource situations. Suppose the upstream station made several parts. Then a request to make more of the part needed by the downstream station will have to wait if other parts have to be made. A buffer is needed to ensure the downstream station doesn't run out meanwhile. And, because each part needs a separate signalling card, the system becomes more complex than if the resources were dedicated.
- **Surges in mix or demand cause problems** because kanban assumes stable repetitive production plans. It is less suited to industries where mix and volumes fluctuate.
- **Kanban in itself doesn't eliminate variability,** so unpredictable and lengthy down times could disrupt the system; poor quality in terms of scrap and rework also affect its good functioning.
- **Kanban systems are not suited for manufacturing environments with short production runs, highly variable product demand, poor quality products, and a multitude of product types.**
- A breakdown in the kanban system can result in the entire line shutting down.
- The throughput of a kanban system is not managed but is instead a result of controlled WIP and known cycle times.

**Video Link**

[http://www.youtube.com/watch?v=R8dYlb JITUE](http://www.youtube.com/watch?v=R8dYlbJiTUE)
Kaizen

Kaizen, Japanese for "improvement" or "change for the best", refers to philosophy or practices that focus upon continuous improvement of processes in manufacturing, engineering, and business management. Kaizen is a daily process, the purpose of which goes beyond simple productivity improvement. It is also a process that, when done correctly, humanizes the workplace, eliminates overly hard work ("muri"), and teaches people how to perform experiments on their work using the scientific method and how to learn to spot and eliminate waste in business processes. In all, the process suggests a humanized approach to workers and to increasing productivity.

The cycle of kaizen activity can be defined as:

- Standardize an operation and activities.
- Measure the operation (find cycle time and amount of in-process inventory).
- Gauge measurements against requirements.
- Innovate to meet requirements and increase productivity.
- Standardize the new, improved operations.
- Continue cycle ad infinitum

This is also known as the PDCA cycle (Plan Do check Act). Kaizen requires the logic and benefit of all improvements to be carefully evaluated before implementation. The concept of ‘5 whys?’ is employed to achieve this. Every planned improvement needs to be tested by questioning ‘why?’ at five levels to ensure that the logic and value of the improvement is clear. This reduces the risk of making changes without sufficient justification.

Advantages

- Teamwork, Increased Efficiency, Employee Satisfaction, Improved Safety
- Kaizen Improves - product quality, use of capital, production capacity, communications, Space utilization
- Provides Immediate results

Pifalls in Kaizen

- Resistance to change
- Lack of proper procedure to implement
- Too much suggestion may lead to confusion and time wastage
5S
5S is the name of a workplace organization method that uses a list of five Japanese words: seiri, seiton, seiso, seiketsu, and shitsuke. Transliterated or translated into English, they all start with the letter "S". The list describes how to organize a work space for efficiency and effectiveness by identifying and storing the items used, maintaining the area and items, and sustaining the new order. The decision-making process usually comes from a dialogue about standardization, which builds understanding among employees of how they should do the work.

Sorting (Seiri)
Eliminate all unnecessary tools, parts. Go through all tools, materials, and so forth in the plant and work area. Keep only essential items and eliminate what is not required, prioritizing things per requirements and keeping them in easily-accessible places. Everything else is stored or discarded. Organize the work area, leaving only the tools and materials necessary to perform daily activities. When “sorting” is well implemented, communication between workers is improved and product quality and productivity are increased.

Straightening or Setting in Order to Flow or Streamlining (Seiton)
The second stage of 5S involves the orderly arrangement of needed items so they are easy to use and accessible for “anyone” to find. Orderliness eliminates waste in production and clerical activities. Arrange the work, workers, equipment, parts, and instructions in such a way that the work flows free of waste through the value added tasks with a division of labour necessary to meet demand. This is by far the most misunderstood and incorrectly applied S and has been responsible for many lean transformations failing to produce the benefits expected. When applied correctly with flow established this step eliminates the majority of the non-value-added time and allows the rest of the zero defect philosophy to be enabled. Put simply, until you have an orderly flow, you cannot have an orderly flow of problems to solve and the notion of zero defects is impossible.

Shining (Seiso)
The third stage of 5S is keeping everything clean and swept. This maintains a safer work area and problem areas are quickly identified. An important part of “shining” is “Mess Prevention.” In other words, don’t allow litter, scrap, shavings, cuttings, etc., to land on the floor in the first place. At the end of each shift, clean the work area and be sure everything is restored to its place. This step ensures that the workstation is ready for the next user and that order is sustained.

Standardize (Seiketsu)
The fourth stage of 5S involves creating a consistent approach for carrying out tasks and procedures. Orderliness is the core of “standardization” and is maintained by Visual Controls. Ensure uniform procedures and setups throughout the operation to promote interchangeability.

Sustain (Shitsuke)
This last stage of 5S is the discipline and commitment of all other stages. Without “sustaining”, your workplace can easily revert back to being dirty and chaotic. That is why it is so crucial for your team to be empowered to improve and maintain their workplace. When employees take pride in their work and workplace it can lead to greater job satisfaction and higher productivity. Make it a way of life. This means commitment. Ensure disciplined adherence to rules and procedures of 5S to prevent backsliding.

Advantages
Increases in productivity:
- Reduces lead times thereby improving product delivery times
- Reduces equipment downtime, maintenance and cycle time
- Improves daily and shift start up times and reduces changeover time
- Reduces the amount of time wasted searching for tools and equipment

**Increases in quality:**
- Improves quality by reducing the amount of errors/defects
- Implements standardization thereby achieving output consistency
- The pleasantries of the simplified work environment increases employee moral

**Reduction in cost:**
- Provides cost-savings by reducing inventory, storage fees and space requirements
- Improves safety thereby reducing the cost of worker injuries
- Reduces the amount of scrap thereby reducing production cost

The system as a whole minimizes waste and improves efficiency by ensuring that workers are spending time doing productive task rather than looking for misplaced tools, sorting unnecessary through stacks of waste material or rearranging the work environment at the change of shifts. It also increases customers confidence An organization that has organized offices and factories, free aisles, equipment-specific locations and an excellent communication system reflects an image of high levels of efficiency and quality. All of this goes toward proving the company’s efficiency and performance potential to customers.

**Videos**
http://www.youtube.com/watch?v=B9IR8XBoJ8&feature=player_embedded
http://www.youtube.com/watch?v=nHutkkfUpDs&list=PL8731E3333900CF37
Heijunka

Heijunka means sequencing, or smoothing of production.

The objective of Heijunka is to absorb sudden fluctuations in market demand by producing several different models in small batches on the same line. It is the principle of “one piece flow”.

The practice of Heijunka also allows mudas to be eliminated by making it easier to standardise work. Good sequencing practice reduces the need for line side labour.

Why does the practice of Heijunka, a basic building block of lean manufacturing, provide a high productivity increase?

For better amortisation of fixed investments in lines, the use of resources (factories, shopfloor, machinery) has to be maximised by improving their use so that more is produced with existing resources. This is achieved by switching from a line dedicated to a single product - which is therefore sensitive to sales variations - to a flexible line capable of manufacturing several types of product. Variations in demand for each product are absorbed by the flexibility of the production tool: sudden fluctuations and variability are reduced.

A concrete example: a single-product mass production line on which demand drops by 30% suffers a sudden production variation of 30%. With variability at this level, it is impossible to standardise and improve a workstation by Kaizen.

On the other hand, if a lean manufacturing line used to assemble 4 models suffers a 30% drop on one of these 4 models, the line is only affected by 0.25 (one quarter) x 30% = 7.5%.

Disturbance is considerably reduced and may even be compensated by the possible increased demand for the other 3 models. There is less variability on a line like this and standardised work for added value is possible. The Kaizen attitude improves the standard continuously.

In short, Heijunka allows line loads to be smoothed by mixing the order of product manufacture. This assists stability and standardisation of work. The second objective of Heijunka is to assemble different models on the same line while eliminating Mudas by standardised work.

The application of Heijunka allows production in the same order as customer demand. The Heijunka practice distributes and balances production over all available means, rather than allowing dedicated resources to suffer from sudden fluctuation in demand.

Contrary to the perceived idea, it is easier to optimise workstation balance when the lines are multi-mode. Why is this so? Because by working more on one product, less work is required on the next: basic tasks are multiplied, broken down and therefore more easily divided into basic units.

By multiplying the tasks, and distributing them better, and by standardising them by carefully-studied smoothing, better use can be made of the working time available for creating value. Heijunka is therefore able to reduce the various mudas while assigning greater value to the Lean production line.

Video

http://www.youtube.com/watch?v=VSr0VG7peCA
Jidoka

Providing machines and operators the ability to detect when an abnormal condition has occurred and immediately stop work. This enables operations to build in quality at each process and to separate men and machines for more efficient work. Jidoka is one of the two pillars of the Toyota Production System along with just-in-time.

Jidoka highlights the causes of problems because work stops immediately when a problem first occurs. This leads to improvements in the processes that build in quality by eliminating the root causes of defects.

Jidoka sometimes is called autonamation, meaning automation with human intelligence. This is because it gives equipment the ability to distinguish good parts from bad autonomously, without being monitored by an operator. This eliminates the need for operators to continuously watch machines and leads in turn to large productivity gains because one operator can handle several machines, often termed multiprocess handling.

The concept of jidoka originated in the early 1900s when Sakichi Toyoda, founder of the Toyota Group, invented a textile loom that stopped automatically when any thread broke. Previously, if a thread broke the loom would churn out mounds of defective fabric, so each machine needed to be watched by an operator. Toyoda's innovation let one operator control many machines. In Japanese, jidoka is a Toyota-created word pronounced exactly the same (and written in kanji almost the same) as the Japanese word for automation, but with the added connotations of humanistic and creating value.

The Evolution toward Jidoka

2. Watch machine cycle.
The 3 Ms of Lean

When Japanese companies talk about waste they usually talk about the three Ms; Mura, Muri and Muda. While most people who have had contact with lean manufacturing will have been made aware of the 7 wastes and Muda they often have not been introduced to Muri and Mura at all. Yet these wastes are often far more important to tackle than Muda and often are the underlying causes of the Muda that you observe within your processes.

While Muda is the non-value adding actions within your processes; Muri is to overburden or be unreasonable while Mura is unevenness. I will discuss these terms below.

Muda, The Seven Wastes

Muda is any activity or process that does not add value; a physical waste of your time, resources and ultimately your money. These wastes were categorized by Taiichi Ohno within the Toyota production system, they are;

- **Transport**: the movement of product between operations, and locations.
- **Inventory**: the work in progress (WIP) and stocks of finished goods and raw materials that a company holds.
- **Motion**: the physical movement of a person or machine whilst conducting an operation.
- **Waiting**: the act of waiting for a machine to finish, for product to arrive, or any other cause.
- **Overproduction**: Over producing product beyond what the customer has ordered.
- **Over-processing**: conducting operations beyond those that customer requires.
- **Defects**: product rejects and rework within your processes.

To this list of the original seven wastes most people also add the following;

- **Talent**: failing to utilize the skills and knowledge of all of your employees
- **Resources**: failing to turn off lights and unused machines
- **By-Products**: not making use of by-products of your process

Many “lean” initiatives fail to see past the elimination of Muda and believe that the point of Lean is to just eliminate waste. This leads to implementations that initially appear to save money but quickly fall apart and revert as problems such as customer demand fluctuations and supplier problems occur. They have failed to tackle the other forms of waste identified by Toyota;

Mura, The Waste of Unevenness

Mura is the waste of unevenness or inconsistency, but what does this mean and how does it affect us?

Mura creates many of the seven wastes that we observe, Mura drives Muda! By failing to smooth our demand we put unfair demands on our processes and people and cause the creation of inventory and other wastes.
One obvious example is production processes where the manager is measured on monthly output, the department rushes like mad in the final week of the month to meet targets, using up components and producing parts not actually required. The first week of the month is then slow due to component shortages and no focus on meeting targets. This gives us the hockey stick graph of production as we see here on the right, far better to smooth out production and work at the demand of the customer.

Muri the waste of Overburden

Causes of Muri

- Working on processes you are not trained in
- Poorly laid out work places
- Cluttered workplaces
- unclear instructions
- Lack of proper tools and equipment
- Fluctuating demand
- Lack of proper maintenance/ unreliable equipment
- Poor communication routes
- Unreliable processes

Muri is to cause overburden, by this we mean to give unnecessary stress to our employees and our processes. This is caused by Mura and a host of other failures in our system such as lack of training, unclear or no defined ways of working, the wrong tools, and ill thought out measures of performance.

Again Mura causes Muda, the seven wastes are symptoms of our failure to tackle Mura and Muri within our processes not the root cause!

Remove Muda, Mura and Muri

Lean Manufacturing is about the removal of waste; but not just Muda (non-value adding steps), it is about removing Mura and Muri too. In fact by concentrating on solving Mura and Muri you prevent the creation of Muda. By working on Just in Time (JIT) principles with Heijunka, Kanban and other techniques you enable production smoothing and flow; removing the causes of Mura, unevenness. The other lean tools such as 5S and TPM help you to remove other causes of overburden removing Muri, overburden.

You should first concentrate on ensuring that your Mura is removed and creating a level predictable flow; this in turn highlights the Muri (unreasonableness) within your system which can then be eliminated. By following this route you will often eliminate the vast majority of Muda that is present within your system.
**PDCA**

A popular tool for doing just this is the Plan-Do-Check-Act Cycle. This is often referred to as the Deming Cycle or the Deming Wheel after its proponent, W Edwards Deming. It is also sometimes called the Shewhart Cycle.

Deming is best known as a pioneer of the quality management approach and for introducing statistical process control techniques for manufacturing to the Japanese, who used them with great success. He believed that a key source of production quality lay in having clearly defined, repeatable processes. And so the PDCA Cycle as an approach to change and problem solving is very much at the heart of Deming’s quality-driven philosophy.

The four phases in the Plan-Do-Check-Act Cycle involve:

- **Plan:** Identifying and analyzing the problem.
- **Do:** Developing and testing a potential solution.
- **Check:** Measuring how effective the test solution was, and analyzing whether it could be improved in any way.
- **Act:** Implementing the improved solution fully.

There can be any number of iterations of the "Do" and "Check" phases, as the solution is refined, retested, re-refined and retested again.

**How to Use the Tool**

The PDCA Cycle encourages you to be methodical in your approach to problem solving and implementing solutions. Follow the steps below every time to ensure you get the highest quality solution possible.

**Step 1: Plan**

First, identify exactly what your problem is. You may find it useful to use tools like **Drill Down**, **Cause and Effect Diagrams**, and the **5 Whys** to help you really get to the root of it. Once you’ve done this, it may be appropriate for you to **map the process** that is at the root of the problem.

Next, draw together any other information you need that will help you start sketching out solutions.

**Step 2: Do**

This phase involves several activities:

- Generate possible solutions.
- Select the best of these solutions, perhaps using techniques like **Impact Analysis** to scrutinize them.
- Implement a pilot project on a small scale basis, with a small group, or in a limited geographical area, or using some other trial design appropriate to the nature of your problem, product or initiative.

Our section on **Practical Creativity** includes several tools that can help you generate ideas and solutions. Our section on **Decision Making** includes a number of tools that will help you to choose in a scientific and dispassionate way between the various potential solutions you generate.

**Note:** The phrase "Plan Do Check Act" or PDCA is easy to remember, but it’s important you are quite clear exactly what "Do" means. ""Do" means "Try" or "Test". It does not mean "Implement fully." Full implementation happens in the "Act" phase.

**Step 3: Check**

In this phase, you measure how effective the pilot solution has been, and gather together any learnings from it that could make it even better.
Depending on the success of the pilot, the number of areas for improvement you have identified, and the scope of the whole initiative, you may decide to repeat the "Do" and "Check" phases, incorporating your additional improvements.

Once you are finally satisfied that the costs would outweigh the benefits of repeating the Do-Check sub-cycle any more, you can move on to the final phase.

**Step 4: Act**

Now you implement your solution fully. However, your use of the PDCA Cycle doesn't necessarily stop there. If you are using the PDCA or Deming Wheel as part of a continuous improvement initiative, you need to loop back to the Plan Phase (Step 1), and seek out further areas for improvement.

**When to Use the Deming Cycle**

The Deming Cycle provides a useful, controlled problem solving process. It is particularly effective for:

- Helping implement Kaizen or Continuous Improvement approaches, when the cycle is repeated again and again as new areas for improvement are sought and solved.
- Identifying new solutions and improvement to processes that are repeated frequently. In this situation, you will benefit from extra improvements built in to the process many times over once it is implemented.
- Exploring a range of possible new solutions to problems, and trying them out and improving them in a controlled way before selecting one for full implementation.
- Avoiding the large scale wastage of resources that comes with full scale implementation of a mediocre or poor solution.

Clearly, use of a Deming Cycle approach is slower and more measured than a straightforward "gung ho" implementation. In true emergency situations, this means that it may not be appropriate (however, it's easy for people to think that situations are more of an emergency than, in reality, they really are...)

**Takt Time**

**Lean Manufacturing Takt Time** is the pace of production manufacturing one piece every 34 seconds that aligns production with customer demand. In other words, it is how fast you need to manufacture product in order to fill your customer orders. Lean Manufacturing Takt Time is calculated as:

\[
Takt \ Time = \frac{Planned \ Production \ Time}{Customer \ Demand}
\]

Integrating the use of Takt Time into your manufacturing operations will:

- Help you to achieve a steady and continuous flow of production.
- Eliminate the waste of overproduction by producing to actual customer demand.
- Encourage the development of standardized work instructions, promoting quality and efficiency.
- Enable you to set real-time targets for production that show operators exactly where their work output should be at any given point of time.
- Make it easier to establish what-if scenarios for customer demand based on flexible manning.

The term Lean Manufacturing Takt Time comes from the German word Taktzeit, which loosely translates to “rhythmic time” or “keeping a beat”, similar to the ticking of a metronome or the movement of a conductor’s baton. Takt Time is a key concept in lean manufacturing. It is the heartbeat of a lean organization – matching actual production to customer demand. It is not a goal to be surpassed, but rather a target for which to aim:

- Producing faster than Takt Time results in overproduction – the most fundamental form of waste.
- Producing slower than Takt Time results in bottlenecks – and customer orders that may not be filled on time.

There are two different yet related ways to use Takt Time. Both are valid and useful – they simply look at customer demand from different perspectives:

- **Planning Perspective:** Use Takt Time to set goals for kaizen activities that focus on making improvements to your production process to ensure that it can meet customer demand.
- **Manufacturing Perspective:** Use Takt Time to drive a real-time target for production.

The following is a simple example of a Lean Manufacturing Takt Time calculation. To perform the calculation, two pieces of information are needed:

- What is your planned production time? Typically this is the shift length less planned downtime.
- What is the customer demand that needs to be met during the planned production time?

**Video**

[http://www.youtube.com/watch?v=KfunvqqXX1I](http://www.youtube.com/watch?v=KfunvqqXX1I)
Value Stream Mapping

Special type of flow chart that uses symbols known as "the language of Lean" to depict and improve the flow of inventory and information.

Purpose

Provide optimum value to the customer through a complete value creation process with minimum waste in:

- Design (concept to customer)
- Build (order to delivery)
- Sustain (in-use through life cycle to service)

Many organizations pursuing “lean” conversions have realized that improvement events alone are not enough. Improvement events create localized improvements, value stream mapping & analysis strengthens the gains by providing vision and plans that connect all improvement activities.

Value stream mapping & analysis is a tool that allows you to see waste, and plan to eliminate it.

Value Stream Mapping Steps

Apply Five Simple Principles

- Specify value from the standpoint of end customer
- Identify the value stream for each product family
- Make the product flow.
  - So the customer can pull
- As you manage toward perfection