



A Dictionary of LEAN, Manufacturing and Continuous Improvement

Andon - flashing lights used to indicate the flow of production at points in a production line. The number of lights and their colours can vary; however, the traditional colours and their meanings are:

* green - no problem

* yellow - situation requires attention

* red - production stopped; attention urgently needed

This high visibility indicator is aimed at both support staff and other members of the production line with a view to reacting early to head of breaks in the flow. Similar systems have been used to great effect in call centres with screen backgrounds changing colour depending upon flow. The status of the operation can be seen immediately by scanning the floor. See Visual Control.

Autonomation (Jidohka) – the automated inspection of items immediately after production, humans are notified of any defect. Toyota expands this idea to include the responsibility of all workers to check their own production – ceasing where defects are detected until the cause of the defect has been identified and corrected. This same principle can be applied to service operations to minimise acceptance and handover of incorrect data eg automated interface file verification; calculated reasonability checks.

Benchmarking - measuring products, services, and practices against those of leading companies. It focuses on best practices and methods of world class leaders, regardless of industry.

Cellular Manufacturing – an application of the principles of “single piece flow” and “travel” waste in which the production line is organised into centres [cells] that have all the capabilities needed to produce an item. This contrasts with the traditional approach of grouping work by similar equipment or capability which requires inventory to move around the plant. “Group Technology” is sometimes used to distinguish cells that produce a relatively large family [group] of similar items. The principles apply equally to service operations – “walking the work” frequently highlights items travelling between floors and even sites before completion.

Continuous Improvement - the fifth and final principle of Lean Production is the continuous pursuit of perfection by continually removing waste and delay.

Constraint - anything that limits a system from achieving higher performance or throughput. This includes beliefs held by management, traditions, unchallenged practices and non-customer focused or non-systemic measures.

Cross-Functional Management – this operating principle is the practical application of the idea that performance is a systemic quality. It is the major organizational tool for realizing TQC improvement goals. Having determined strategy, senior management sets objectives for cross-departmental initiatives that act across the whole system to deliver improvements. This operating principle puts a great deal of emphasis on follow-through to achieve the success of goals and measures.

Cycle Time - the normal time to complete an operation on a product. This is NOT the same “takt time” which is the allowable time to produce one product at the rate customers are demanding it.

Deming Cycle – W.E. Deming used the idea of a continuously rotating wheel to illustrate the need for constant interaction between research, design, production, and sales in order to drive improvement to quality that satisfy customers. See PDCA Cycle.



Flow - the third principle of Lean Production is the pursuit of the creation of value without interruption, detours, backflows, waiting or scrap. The end target is Single-Piece Flow.

Heijunka - a production scheduling / load levelling tool, essentially to distribute kanban cards in an efficient manner.

Hoshin Planning - also known as Management by Policy and Strategy Deployment. A means by which goals are established and measures are created to ensure progress toward those goals. HP keeps activities at all levels of a company aligned with its overarching strategic plans. The process typically begins with “visioning” which addresses the key questions: where do you want to be in the future? how do you want to get there? when do you want to achieve your goal? and who will be involved in achieving the goals? The goals and measures are then systematically devolved throughout the entire organization.

Improvement – in the context of Kaizen “improvement” is a mindset of maintaining and advancing standards. It embraces both Kaizen (or incremental improvements) and Innovation (radical advances).

Inventory - money invested in purchasing components of products it intends to sell. This includes raw materials and work in progress.

Just-In-Time (JIT) - a Toyota production technique for maximising capital efficiency by minimising inventory and the associated waste. JIT requires any item required in production to be available precisely at the moment it is required – not a moment earlier or later – whether raw material, finished item, or anything in between. JIT envisages very close cooperation with supply chain partners.

Kaizen – literally “revolution”, the principle that every process can and should be continually evaluated and improved in terms of duration, resource consumption and quality. Kaizen implies the involving everyone - managers and workers – to deliver improvement. It clearly delineates responsibilities: workers are to maintain standards, and managers are to improve standards. The Japanese perception of management boils down to one precept: maintain and improve standards.

Kaizen is not limited to work. The philosophy applies equally to personal life, home life, social life, and working life.

Kanban – developed by Toyota, kanbans are ‘flag’ used in a JIT operation. They relate to a specific point in the production line and are set when inventory is delivered and reset when more inventory is required. Kanbans can be cards, signboards, floor markings or other signals. Their purpose is to manage flow in an environment that seeks to eliminate buffering.

The amount of inventory in a kanban is determined by the demand rate for the item and the time required to produce or acquire more. Once established, this number generally remains unchanged unless circumstances change dramatically; keeping inventory under control while forcing production to keep pace with shipment volume.

When fully implemented, kanban work to ensure that all production and movement of parts and material takes place only as required by a downstream operation ie production is pulled by the end customer.

Lead Time - the total time a customer must wait between placing and order and receiving the product. When a scheduling and production is running at or below capacity, lead time and Throughput Time are the same. When demand exceeds the capacity of a system, there is additional waiting time before scheduling and production, and lead time exceeds throughput time. See Throughput Time.

Lean Manufacturing or Lean Production - the continuous application of techniques to reduce waste in all areas and in all forms; synonymous with “the Toyota Production System”.

Line Balancing – assigning workers and machines in order to equalisation cycle times for contiguous steps in the manufacturing process - aimed at smoothing production flow. A systemic view of capability is generally more practical than assuming 100% utilisation.



Maintenance - activities that are directed to maintaining current technological, managerial, and operating standards.

Mass Customization – manufacture of highly individualized products on a mass scale. Similar to Build-To-Order but with the distinction that Build-To-Order implies a standard specification.

Mixed-model production – a capability underpinning mass customisation and dependent upon JIT - the ability to produce different models (requiring different labour and materials), on the same production line. This level of operational flexibility allows for rapid response to customer demands.

Muda (waste) - Shigeo Shingo identified seven types of waste to be eliminated from operations:

1. Overproduction - excess and early production
2. Waiting - time spent at the machine; delays
3. Transportation - waste involved in the movement and transportation of units
4. Processing - waste in processing; poor process design
5. Inventory – partially completed work or materials not yet needed in production
6. Motion – activity by people or machinery that does not add value to the product
7. Defective units (failure demand) - production items that are scrapped or reworked

PDCA Cycle (plan, do, check, action) - an adaptation of the Deming wheel. While the Deming wheel stresses the need for constant interaction among research, design, production, and sales, the PDCA Cycle asserts that every managerial action can be improved by careful application of the sequence: plan, do, check, action.

Poka-Yoke - a simple defect warning system. An amusing example of poka-yoke the incorporation of a small target or fly decal into urinals as a means of minimising the cleaning requirement.

Policy (in Japanese management) - describes long- and medium-range management orientations as well as annual 'goals' and 'measures'. Goals are usually quantitative figures such as sales, profit, and market share. 'Measures' are the action programs necessary to achieve these goals. Goals without specific measures are merely aspirations. See Cross-functional Management and Hoshin Planning.

Policy Deployment - the process of implementing the policies of a Kaizen program directly through line managers and indirectly through cross-functional organization.

Pull System – the fourth principle of lean production is to manage inventory and activity based on real-time needs from downstream operations (ultimately final assembly) as distinct from a 'push' system which schedules operations according to projected downstream needs increasing the opportunity for error and waste.

Quality Function Deployment (QFD) - a visual decision-making procedure for multi-skilled project teams which develops a common understanding of the voice of the customer and a consensus on the final engineering specifications of the product that has the commitment of the entire team. QFD integrates the perspectives of team members from different disciplines, ensures that their efforts are focused on resolving key trade-offs in a consistent manner against measurable performance targets for the product, and deploys these decisions through successive levels of detail. The use of QFD eliminates expensive backflows and rework as projects near launch.



5S – seiri (sort), seiton (set in order), seison (shine), seiketsu (standardise), shitsuke (sustain) - principles of maintaining an effective and efficient workplace

- seiri – eliminate everything not required for the work being performed
- seiton - efficient storage, placement and arrangement of equipment and material
- seison – tidiness, cleanliness and maintenance
- seiketsu - ongoing, standardized, continually improving seiri, seiton, seison
- shitsuke – discipline with leadership

Sensei - one who provides information; a teacher.

Setup Time – that required to change over a machine or process from the current to the required operation. There are two types:

1. internal – that which requires the machine or process to be halted and
2. external: that which can be done concurrently.

See SMED.

Single Minute Exchange of Die (SMED) - the objective of performing setup activities in a minute or less of downtime. Like a Formula one pit crew changing tyres, the keys to success are preparation (convert internal- to external- setup time); frequent practice; readiness and appropriate design of the machinery.

Single-Piece Flow – meaning producing and delivering only one product at a time, to reduce inventory.

Specify Value - the first principle of Lean Production. It means to specify what about the product of service is or is not valuable in the eyes of the customer (as distinct from the perspective of individual companies, functions and departments). This is the gateway between marketing and operations and is fundamental to the customer centric organisation.

Standard Work - precise description of each work activity specifying Cycle Time, Takt Time, the work sequence of specific tasks, and the minimum inventory of parts on hand needed to conduct the activity.

Supply Chain Management (SCM) – the optimisation of the flow of products, services and related information from source to customer; it includes management of trading partners engaged in satisfying the end customer.

Supply Chain Planning (SCP) - the process of coordinating assets to optimize the delivery of goods, services and information from supplier to customer, balancing supply and demand.

Takt Time – the allowable time to produce one product at the rate customers are demanding it. NOT the same as cycle time, which is the normal time to complete an operation on a product (which should be less than or equal to takt time). From the German for rhythm.

Theory of Constraints - a lean management philosophy (advanced by Eliyahu Goldratt) that stresses removal of constraints to increase throughput while decreasing inventory and operating expenses.

Throughput Time - the time required for a product to proceed from concept to launch, order to delivery, or raw materials into the hands of the customer. This includes both processing and queue time. See Processing Time and Lead Time.

Total Productive Maintenance (TPM) - methods, originally pioneered by Nippondenso (a member of the Toyota group), to ensure that every machine in a production process is always able to perform its required tasks so that production is never interrupted.



Total Quality Control (TQC) - involving everyone in the company in a totally integrated effort to improve performance at every level. Effort is directed at satisfying cross-functional goals such as quality, cost, scheduling, manpower development, and new product development. It is assumed that these activities ultimately lead to increased customer satisfaction. (Also referred to as CWQC - Company-Wide Quality Control.)

Value-Added Analysis – the activity whereby a process improvement team strips a process down to its elements and isolates those activities which, in the eyes of the customer, add value to the product or service. The remaining non value-adding activities (“waste”) are targeted for extinction.

Value Stream - the second principle of Lean Production is the identification of all activities which are required to design, order and provide that which is valued by the customer - from concept to launch, from order to delivery, and from raw materials to the hands of the customer. The Value Stream crosses systems and departments. It is useful to divide activities into 3 different types:

Value Adding – that which the customer believes improves the product or service.

Non-Value Adding - that which the customer does not value ie waste to be eliminated.

Necessary Non-Value Adding – that which the customer does not value but which is necessary without radical change to the process. Such waste should be targeted for longer-term elimination.

Research from Lean Enterprise Research Center for Manufacturing or Logistics Flow, suggests that typical ratios for these three activities are - 5% Value Adding Activity; 60% Non-Value Adding Activity; 35% Necessary but Non-Value Adding Activity.

Visual Control – putting all tools, parts, production activities, and indicators of production system performance in plain view so that everyone understands the status of the system at a glance. Used synonymously with Transparency.