

LEAN SIX SIGMA

GLOSSARY

The glossary that follows is by no means exhaustive on the subjects of Lean Manufacturing (AKA Lean) and / or Six Sigma. However, we believe the mainstream terms have been included in this work. The glossary can be referred to at any time there is a question about how a term, topic, concept, subject or activity is generally defined by practitioners of Lean Six Sigma. Some elementary familiarity with common business language is assumed in selecting this list from the many in the Body of Knowledge.

A

Acceptable Quality Level (AQL). The maximum proportion of defective units that can be allowed as a tolerable average from any sample taken from a process output. The ideal AQL = 0 (zero defects) is always the goal.

Activity. The things people in organizations do that cause work to flow and products/services to be produced and delivered to one or more customers.

Activity Based Costing (ABC). A management accounting system that assigns costs to products based on the amount of resources they consume. This includes floor space, raw materials, machine hours and human labor necessary to design, order or make a product or service. This accounting system should replace **Standard Costing** in a fully integrated Lean Manufacturing program.

Activity Based Management (ABM). A systematic approach to planning, controlling and improving labor and overhead costs within a business. Activity Based Management (ABM) views the business as a series of activities related to creating value for its customers. Activity costs are measured, rather than the traditional departmental costs (or allocations) so that waste (non-value added activities) can be identified and eliminated.

Andon. A visual control device in a production area used to show the current status of the production process and/or system. The visual control usually takes the form of a lighted overhead display or series of lights that can signal normal and abnormal conditions in the production process.

Autonomation. The process of transferring human activity to machines such that they are able to detect the first defective part in a production process, immediately stop further processing and signal for help if/when the process goes out of control for any reason. This is the final stage prior to full Automation. Also see **Jidoka**.

Autonomous Maintenance. One component of TPM involving equipment operators in assessing and insuring the optimum condition of the equipment. This includes training operators in equipment systems and subsystems functions, establishing standards for regular cleaning and care of the equipment, elimination of potential contamination and managing/controlling the work process and environment of the equipment.

Availability. The ability of a resource to be ready to perform its designated function under defined conditions at a given time. Availability can be expressed as the ratio of Uptime (in active use or on standby) to Downtime (under repair, awaiting spare replacement parts, fluids, etc.).

B

Balanced Scorecard. A company-wide measurement system allowing an enterprise to act on its vision and strategic plan in a more prioritized, comprehensive fashion. It identifies metrics based on the current plan and gives weight to each based on their importance to the enterprise. Both financial and non-financial elements are included to establish lean performance measurements. Common metrics include customer relations, financial stewardship, internal business process performance, employee performance, and organizational agility (learning and innovation).

Baseline. A series of numerical or attribute values that describe the current performance level of a process or activity and serves as a starting point for any performance improvement initiative.

Batch-and-Queue. The production method of producing large lots of a product in a series of operations where the entire product in the lot is sent from one operation to a queue (hold area) before the next operation is started. Other terms for Batch-and-Queue are Mass Production and Large-lot Production. The mass-production approach is replaced by **One-Piece Flow** in a fully integrated Lean Manufacturing program.

Bottleneck. A location in the production process where the output will not meet the customer demand.

Brainstorming. A team problem-solving method of unlocking creativity and generating ideas involving two steps. Ideas are offered and recorded without critical evaluation or judgment in the first step. During the second step of the method, ideas are evaluated to select the most appropriate to resolving the problem.

Buffer Inventory. The amount of Finished Goods available to meet variations in customer demand due to fluctuations in ordering patterns or variations in Takt time. This is also called **Buffer Stock**.

C

Catchball. A give-and-take process occurring between different levels of an organization to insure that critical information related to its goals and objectives are fully understood at all levels of the organization. This is one phase of an organizations overall policy management process that helps insure all levels of the organization are aligned to the direction, strategy, resourcing and implementation process through regular assessment, measurement and feedback. Also see **Hoshin Kanri**.

Cause-and-Effect Diagram. A structured problem-solving tool involving identifying problems and causes of problems. Causes are grouped in one of six categories; manpower, methods, machines, materials, measurements and Mother Nature (Environment) in a network that resembles a “fishbone”. The resulting network is a balanced listing of brainstormed ideas that insures possible causes of a particular problem are not overlooked. The diagram thus created is also called an Ishikawa diagram.

Cells (Cell Arrangement). The layout of machines (resources) of different types, performing different operations in the sequence of processing operations to permit One-Piece Flow and flexible deployment of human effort to operate multiple machines (resources). **Cell Arrangement** is in contrast to **Functional Arrangement**.

Cellular Manufacturing. Manufacturing buy the use of cells to produce a family of products (or services).

Chaku-chaku. A method of One-Piece Flow (PULL) production in which one operator proceeds from process element to process element, taking a unit of production from the previous process element and loading in into the next process element.

Change Agent. An individual who functions as a catalyst facilitating organizational change. The individual may be an external or internal consultant or someone directly employed by the facility or organization undergoing change.

Changeover. The activity of converting a production device to perform a different operation. The activity involves removal of elements from the production device needed to perform a previous operation and installing elements necessary to perform the new operation. This term is also commonly called **Set-up**.

Common Cause. A chronic, usual and due to random/chance factors effect of natural variation in a process. See also **Special Cause**.

Control Chart. Specialized time plot or run chart showing process performance, mean (average), and control limits; helps determine process influences of common (or normal) and/or special (unusual, unique) causes for variation from the mean.

Cost of Poor Quality (COPQ). Dollar measures depicting the impact of problems (internal or external failures) in the process as it exists; included are labor and material costs for handoffs, rework, inspection and other non-value-added activities.

Critical To Quality (CTQ). Customer specific, measurable requirements (or characteristics) that can be used to develop/deliver products or services that better meet their needs. These requirements help better define the **Voice of the Customer (VOC)** and emphasize those needs over self-interests or perceived needs for the product or service.

Customer. Any internal or external person/organization who receives the output (product and/or service) of the process; understanding the impact of the process on both internal and external customers is key to process improvement.

Cycle Time. The actual time taken by an operator to process a piece of product or perform a service. This time is related to **Takt Time** such that if every operation in a complete process has a Cycle Time equal to or less than the Takt Time, the product or service can be made in **One-Piece Flow**.

D

Defect. Any instance or occurrence where the product(s) and/or service(s) fails to meet customer requirements. A defect is the result of an error in the execution of a process.

Demand Flow. A production process paced by customer demand rather than any predetermined production schedule. This method of production usually involves “Pull” concepts and the use of “Kanban” for production signals. See also **Kanban** and **Pull Production**.

DMAIC. An acronym for a Process Improvement/Management System which stands for Define, Measure, Analyze, Improve and Control; lends structure to process improvement, design and/or redesign applications.

DMADV. An acronym for the framework used in Design for Six Sigma (DFSS) which is a five-step process including Define, Measure Analyze, Design and Verify. Also see **DFSS**.

DFMA. An acronym for Design for Manufacture and Assembly which represents the use of cross-functional teams to address the ability to manufacture and assemble a product while still in the design process. This activity leads to simplified designs where fewer mistakes are made during the manufacturing/assembly process.

DFSS. An acronym for Design for Six Sigma which is a systematic method using tools, training and measurements to design products and processes that meet customer expectations as the Six Sigma Quality Level.

Dock-to Dock Time. The measure of the speed at which raw materials are received and transformed into finished goods for shipment to a customer.

DOE. Acronym for Design of Experiment that includes a body of knowledge around how to manipulate process and product design factors to discover the combination that is most effective, efficient and/or robust in actual operating conditions.

E

Economic Order Quantity (EOQ). The breakeven point between the changeover cost and the inventory carrying cost curves resulting in the smallest production “batch” size that optimizes these two costs. The goal of process improvement related to production batches is to reduce changeover time (and associated costs) to zero, thereby allowing an EOQ on one piece.

Economic Value Added (EVA). A financial performance measure which is the residual income of a business for a given performance period resulting from the difference between the cost of capital and net operating expense (after taxes).

Effect. The result of or outcome attributed to a cause (or causes).

Employee Involvement (EI). The participation of employees at all levels of the organization in structured continuous improvement of products, processes and business systems that lead to the organization becoming world class. This most often involves teams of employees with varying levels of control and influence on the total outcome of the company-wide continuous improvement process. This is often confused with **Employee Empowerment**.

Employee Empowerment. The act of transferring elements of the decision-making process, as well as the authority to implement decisions, to individual employees. Employees are then responsible for acting individually or as members of teams to maintain and improve the products, processes or business systems involved in the transfer.

Enterprise Resource Planning (ERP). The activity and actions that attempt to integrate the data for decision-making and actions of all departments and functions within a company into a common planning process. This is usually accomplished through installation of an ERP software package. **ERP** goes beyond **MRP** and **MRPII** by attempting to integrate all parts of the organization, not just the production and production planning aspects.

Ergonomics. A scientific discipline that studies the interface between people and their environment with a goal of reducing adverse effects on both elements. In the workplace ergonomic improvements optimize human performance while protecting safety and health.

Error. A condition where one or more of the necessary elements for successful completion of a task or process are missing or wrong. The result of an error in execution of a task or process is a Defect.

F

Failure Mode and Effects Analysis (FMEA). Failure Mode and Effect Analysis is an analytical tool used to predict and eliminate in advance any potential design defect(s) in a new product by analyzing the effects of failure modes of component parts on the final product performance. FMEA is also used for design review activities of a new production facility (called process FMEA).

Firefighting. Reacting to a problem by using time and resources without finding and fixing the real, root cause(s) of the problem.

First-pass Quality (FPQ). The rate at which the output of a process is produced to the defined Standardized Work for the process. This means all wasted activities such as scrap, rework, manual adjustments, etc. are excluded when the FPQ rate is 100%.

Fishbone Diagram. See Cause-and-Effect Diagram.

Five S's (5S). A checklist for good housekeeping to achieve greater order, efficiency and discipline in the workplace. It is derived from the Japanese words seiri, seiton, seiso, seiketsu and shituke. The English equivalents are sort, straighten, scrub (or shine), systematize and standardize. Another popular version of the five S's is sort, simplify, sweep, standardize and sustain.

Five "whys". A root-cause analysis technique used whenever a problem is encountered, to identify the true root cause of the problem for corrective action. The question "why" is asked a sufficient number of times to get to the level of the root cause.

Flow. The smooth, uninterrupted movement of a product or service through a process.

Flow Chart. A graphical representation of the steps in a process. This can take any of several forms using defined symbols to represent certain types of activities or elements.

Flow Production. One of the basic pillars of just-in-time (JIT) production systems. In flow production, machines (resources) are arranged in the order of processing so that the work piece flows between operation steps without interruption and/or stagnation.

Force-field Analysis (FFA). An study of the restraining and driving forces that effect change in an organization. The restraining forces are those that cause the current conditions (status quo) to be maintained. The driving forces are those that cause the organization to move toward

some future condition. These forces are usually displayed on a chart with corresponding driving force pointed at a corresponding restraining force.

Functional Arrangement. The grouping and co-locating resources performing like operations. **Functional Arrangement** is in contrast to **Cell Arrangement**.

G

Gainsharing. A system that provides financial rewards to a large group of employees in a business who work together on productivity improvements that achieve positive results. Thus gainsharing is tied to employee performance where a portion of the measured operational (and/or financial) gains resulting from the improvements are allocated to the employees involved in making the improvements.

Gauge Repeatability and Reproducibility (Gauge R&R). The evaluation of measuring instruments using production products rather than masters to determine the repeatability and reproducibility of the measurements. Repeatability is the term used for determining the variation in measurements obtained by one gauge user measuring one attribute. Reproducibility is the term used for determining the variation between more than one operator measuring one attribute. The accuracy (aim) of the gauge and operator in measuring the attribute is not considered in a Gauge R&R.

Gemba. The place where the actual process is being performed. Gemba is a Japanese word for “real place”. Therefore, “Gemba Kaizen” would refer to continuous improvement activities done to a process in the place where the process is actually being performed. Also, “Gemba Data” is real data gathered from the execution of a current, functional process.

H

Heijunka. Equalization of quantities and types of products/services demanded by the customer to better match the capacity of the process producing the products/services. This is sometimes referred to as load-smoothing or level-scheduling where day-to-day variations in scheduling are reduced or eliminated to complete the total demand for products/services in a given time period.

Histogram. A bar chart or graph that represents the frequency of a specific aspect of a collection of data. A typical example of a histogram would be a “Part-Quantity” chart that shows the frequency of production by part number for a family of parts produced by an organization for a given period of time (day, month, quarter or year).

Hoshin Kanri. A Japanese term used to the management of strong focused, insightful effort that can influence an organizations management policy. This is essentially translation of an organization's management strategy into meaningful intent.

House of Quality. A process matrix for translating customer requirements (CTQ's) into appropriate product characteristics that insures integration of customer input with well aligned product development, manufacturing and marketing of the final product. The process used to develop a **House of Quality** is called **Quality Function Deployment (QFD)**.

I

Inspection. The act of examining the output of a process to insure a specific level of quality by comparing the actual output with a standard (expected result). Inspection can only find Defects (those generated by errors) and is not prevention oriented, but rather detection oriented. Inspection is considered a wasteful activity is defect prevention activities such as Poka-Yoke are being applied to the design of the process.

Inventory. Material that is actually on hand that an organization uses to produce products (or provide services). Inventory can be in one of three forms; raw material (material with none of the work required to produce the product or service having been applied to it), Work-In-Process (WIP – material with some of the work required to produce the product or service having been completed on the material) and Finished Goods (material that has been completely transformed by all of the processes used to produce the product or service).

ISO. The International Organization for Standards. The most well known family of ISO standards describes quality management of processes within organizations (ISO9000 series). There is also a family of standards focused on environmental management (ISO14000).

J

Jidoka (Autonomation). A device that stops a machine or process whenever a defective product is produced. This device is an essential element (along with level-loading) in introducing JIT to a process.

Just-In-Time (JIT). A system designed to achieve the best possible quality, cost and delivery time of products or services to exactly meet customer(s) requirements by delivering the right products or services at exactly the right time. Important elements of **JIT** are **Flow, Takt Time, Pull and Standard Work**.

K

Kaikaku. Radical improvement over a short period of time. This is also called breakthrough kaizen, flow kaizen or system kaizen.

Kaizen. Continuous incremental improvement over a relatively long period of time (weeks or months), creating more value and less waste. When applied to a business enterprise, it means on-going improvement involving everyone, including both managers and workers. Kaizen is also a philosophy that assumes that our way of life (working, social or private) deserves to be constantly improved.

Kaizen Concepts. Major concepts that must be understood and practiced in implementing kaizen. The concepts include:

- Kaizen and management
- Process vs. result
- Implementing SDCA / PDCA to standardize and then improve
- Putting quality first
- Speaking with data
- Treating the next process as the customer for the previous process

Kaizen Systems. Major systems that must be established to attain a world-class status. These include the following:

- Total Quality Management (Total Quality Control)
- Just-In-Time production system
- Total Productive Maintenance
- Policy deployment
- Suggestion system
- Small-group activities

Kaizen Event. A focused problem-solving activity used throughout an organization to improve processes. The activity usually includes the steps of (1) selecting a problem (process to be improved), (2) defining and understanding the current situation, (3) analyzing data to find the root cause(s), (4) establishing measures to correct (or improve) the problem, (5) implementing the corrections (or improvements), (7) standardizing the new process, and (8) review of the activity for ways to improve the problem-solving activity for the next event. Also referred to as Kaizen Blitz, Accelerated Improvement Workshop, Action Workout, and Kaizen Workshop and Quick-Action™ Improvement Workshop.

Kanban. A communication tool or signal used to cause an upstream activity to start as a downstream product or service is consumed. **Kanban** means signboard in Japanese.

L

Lead Time. The total time a customer must wait to receive the product or service after placing a request (order). Lead Time is related to **Throughput Time**. When demand for products or services from a process is less than the process capacity, Lead Time and Throughput Time are the same. When demand exceeds capacity Lead Time is greater than Throughput Time because some of the demand must wait to be scheduled. Manufacturing Lead Time is the amount of time between ordering raw material and completion of the product or service.

Lean. Shorthand name for the set of Truths, Tenets and Tools known as Lean Manufacturing.

Lean Manufacturing. A production system that is focused on maximizing process output through continuous flow of product(s) or service(s) to a customer by eliminating any activity considered wasteful by the customer and linking all steps of the production the customer demand.

Level-Loading. See Heijunka.

Line Balancing. A process where work is distributed evenly to each task in a Value Stream and then paced to meet the Takt Time.

Lot. An amount of product that is produced under similar process conditions so that all units of product within the total amount is (or should be) homogenous in all significant characteristics. A single-piece would be one of the total amount of units within a Lot. Therefore, One-Piece Flow refers to a lot size one.

M

Maintainability. The probability that a given maintenance action for an item under given usage conditions can be performed within a stated time interval when the maintenance is performed under stated conditions using stated procedures and resources. Maintainability has two attributes: **Serviceability**, the ease of conducting scheduled inspections and servicing, and **Repairability**, the ease of restoring service after a failure.

Manufacturing Resource Planning (MRPII). An expansion of MRP that includes capacity planning, financial information and simulation tools in the computerized system to evaluate alternate productions plans, based on forecasted demand.

Material Requirements Planning (MRP). A computerized system used to determine the quantity and timing of materials used in a production process. Such systems use a master production schedule (MPS), a bill of materials (BOM) listing all items necessary to complete each product to be made, and information on current levels of inventory for each BOM item so that production and delivery of products ordered by the customer can be scheduled.

Mass Production. A production method where large batches of similar products are produced in a continuous process by either automatic or semi-automatic operations organized to exploit economies of scale. Also see **Batch-and-Queue**.

Mean. The arithmetic average of a set of data. It is calculated by adding all of the data values together and then dividing this result by the number of data values.

Median. The data value at the midpoint of a rank-ordered set of data. This value is the center value of an odd-numbered set of data or the average of the center two values of an even-numbered set of data.

Metric. A measurement. The term is most commonly applied to business financial measurements and overall production outputs.

Milk Run. The regular, planned route traveled by a supply/delivery resource (e.g. truck and driver) that makes multiple pickups and drop-offs at different locations of small quantities required by pull production (JIT) processes.

Mistake-Proofing. See Poka-Yoke.

Mixed-model Production. A production process that produces a family of similar products at random in a wide range of quantities without requiring changeovers or resetting of the processes.

Mode. The most frequently observed value of a set of data. There can be more than one mode describing a set of data.

Monument. Any processing technology resource (for design, scheduling or production) with scale requirements necessitating the elements for processing be brought to the resource and wait in queue for processing.

Muda. A Japanese word for waste. When applied to a business enterprise it refers to a wide variety of non-value-adding activities.

Mudi. A Japanese word for inefficiency. When applied to a business enterprise it refers to a wide variety of mixed value/non-value added processes that provide less than 100% value as an output of the activities forming the process.

Mura. A Japanese word for inconsistency. When applied to a business enterprise it refers to the variation in a process that provides less than 100% value as an output.

N

Non-Value-Added. The attribute of a task or activities that can be eliminated from a process without deterioration of the function, performance or quality of a product or service as viewed by the customer.

Normal Distribution. The distribution of random, independent data that is normally distributed and meets the requirement that 99.73% of the curve representing the data falls within ± 3 standard deviations of the mean of the data.

O

One-piece Flow. Only one work piece is allowed to move from process to process to minimize waste and improve value added activity. This concept is also commonly called **Single-Piece Flow**.

One-touch Exchange of Die (OTED). Ideal, zero-waste technique for changeover of production machinery where there is no time taken during changeover. Also known as **One-touch Set-up or Zero Set-up**. **One-touch Set-up** is the term applied to changeovers completed in less than one minute. **Zero Set-up** means changeover occurs instantaneous and do not interrupt continuous flow of product or service processing. These techniques were originally developed by Shigeo Shingo to reduce the waste of set-up time

Operation. An activity or task performed on a product or service by a single resource. An Operation is a component of **Process**.

Overall Equipment Effectiveness (OEE). The measurement of a process element's potential for adding value to the Value Stream. This is the primary metric used in Total Productive Maintenance programs. OEE is expressed as a percentage of the full value-added potential by multiplying the process element's availability by its performance and quality rate.

P

Paced Withdrawal. A method of level-loading that involves moving small lots of material through the value stream over time intervals defined by the pitch (See Pitch).

Pack-out Quantity. A small lot of material equal to the number of units that must be moved through the value stream to insure even flow from the upstream processes through the downstream processes. The may or may not be customer driven.

Paradigm. A fundamental idea or belief about reality held by an individual. This belief conditions the way an individual thinks and responds to external inputs to their decision-making and actions. The individual may or may not be able to “see” the true reality depending on how close their fundamental belief is to reality. One example of a paradigm is the Mass Production assumption that an organization must produce using Batch-and-Queue processes because they cannot reduce changeover times between lots of differing product models.

Pareto Chart. A graph or chart that ranks characteristics from the most significant to the least significant. It is based on the Pareto principle, first defined by J.M. Juran that suggests 80 percent of the significant characteristics come from only 20 percent of the total data.

Part-Quantity Analysis (P-Q Analysis). The process of developing and displaying the relationship of the total number of end items to the total volume of parts, products or services. The output of the analysis is most frequently displayed on a Pareto Chart. This analysis is one of the first steps in defining product families for focused value streams.

PDCA. Plan-Do-Check-Act. The basic steps to be followed in making continuous incremental improvements (kaizen). This is also called the Shewhart cycle, named after Walter Shewhart and popularized by W. Edwards Deming. **SDCA** must precede **PDCA** for meaningful improvement to occur.

Percent Loading Chart. A graphical representation of a series of operator / process activity cycle times within a process related to the TAKT Time (or required output rate).

Pitch. The amount of time required to deliver a pack-out quantity of Work-In-Process at the takt rate to a downstream process or customer. $Pitch = Takt \times Pack-Out \text{ Quantity}$

Poka-Yoke. A mistake-proofing device or procedure that builds safeguards into a process to prevent a defect from occurring. The English literal translation for poka is “error” and for yoke is “to avoid.” *Note: Poka-Yoke (mistake-proofing) was adopted in favor of Baka-Yoke (fool-proofing) as a more innocent, less personal means of defining this defect prevention concept.*

Policy Deployment. The process of implementing the policies of a Lean Manufacturing/Kaizen program directly through the managers in an organization and indirectly through cross-functional teams.

Process. An operation or group of operations taking raw material inputs, adding value and then providing the output(s) to either an internal or external customer.

Process Cycle Efficiency (PCE). The overall measurement (metric) used to evaluate the health of a process and represents the amount of value-added time spend performing the process divided by the total lead time of the process. This metric is sometimes referred to as the value-added ratio.

Process Mapping. The flowcharting of the operational steps in a process, including key measurements.

Process Route Analysis (P-R Analysis). The process of developing and displaying the relationship of a number of end items to the processing steps required to produce those items. The output of the analysis is most frequently displayed on a spreadsheet or matrix. Parts can then be grouped into “families” where each of the parts follows similar steps of the production process. This analysis is one of the steps in defining product families for focused value streams.

Product Family. A range of products or services that can be produced interchangeably in a production cell or through a series of common process elements.

Pull Production. One of the basic requirements of a just-in-time production system. The previous process produces only as many product units (or service elements) as are consumed by the following process. This type of production is customer-driven and is characterized by **Demand Flow**.

Push Production. The previous process produces as much as it can without regard to the actual requirements of the next process and sends them to the next process whether there is an existing need or not.

Q

Quality. A subjective term for which each person has his or her own definition. Technically speaking, **quality** has two elements: (1) the characteristic of a product or service that affects its ability to satisfy stated or implied needs and (2) a product or service free from defects. With regard to Lean Manufacturing and Kaizen, **quality** means anything that can be improved, including the people involved in the process of creating products and/or services.

Quality Assurance (QA). Discipline of maintaining product and/or service conformance to customer specifications; primary tools are inspection and **SPC**.

Quality Function Deployment (QFD). A structured method in which customer requirements are translated into appropriate technical requirements for each stage of product (or service) development and production. The **QFD** process is often referred to as listening to the voice of the customer.

Queue Time. The portion of time a product or service spends waiting for the next design, order processing, machining, fabrication or assembly process step during its creation.

R

Range. The difference between the largest and smallest values in a set of data. The Minimum Value is the smallest value in the data set and the Maximum Value is the largest value in the

data set. Therefore the Range can be determined by subtracting the Maximum Value from the Minimum Value.

Red Tag. A tag (or similar identification, usually red in color) applied to any item in an area undergoing improvement (production or administrative) for which there is no obvious use.

Reliability. The ability of a process to produce the same results (product or service) over time during repeated application of defined conditions without failure.

Repeatability. The expression of how consistent a number of measurements taken by the same appraiser on the same characteristic, using the same instrument is. It is one of the elements of a Gauge R&R (see **Gauge Repeatability and Reproducibility**).

Reproducibility. The expression of how consistent a number of measurements taken by different appraisers on the same characteristic, using the same instrument is. It is one of the elements of a Gauge R&R (see **Gauge Repeatability and Reproducibility**).

Root Cause. The fundamental or most basic cause of a problem which will resolve the problem when fixed. The root cause is sometimes masked by secondary causes which when fixed will not succeed in permanently resolving the problem.

Run Chart. A graphical representation that indicates a specific trend in information gathered over a specific time. The observed data are plotted in sequence and connected by a series of straight lines to show how the data “runs”.

S

SDCA. Standardize-Do-Check-Act. An approach, similar to PDCA that establishes and maintains the current status of a process.

Single Minute Exchange of Die (SMED). Techniques used for changeover of production machinery in less than ten minutes. This technique was originally developed by Shigeo Shingo in his attempts to reduce the waste of set-up time.

Single-Piece Flow. See One-Piece Flow.

Six-Sigma. A quality initiative that uses SPC, DOE and other Quality Improvement Tools as core elements to determine the causes of variation all business processes inside an organization. Control of variation is the goal of Six-Sigma. The Sigma level of the distribution of data is used to measure the effectiveness of controlling variation (6σ Level = 3.4 [or less] defects per million opportunities). Also described as a comprehensive system for achieving, sustaining and maximizing business success by disciplined use of fact, data and statistical analysis to manage and improve the business process for meeting customer needs.

Spaghetti Chart. A diagram of the path taken by a product (or service) as it travels through the value stream during its creation. This can also refer to the path taken by a person in performing process steps on the product (or service). The diagram derives its name from the way it commonly looks after mapping a mass-production process because the diagram looks much like a plate of spaghetti.

Special Cause. Sporadic, non-periodic, unusual and correctable variation in a process. See also **Common Cause**.

Standardization. Documenting the best method of completing a task or activity. Standardization is one of the three foundations of Kaizen (Standardization, Waste Elimination and 5s).

Standard Costing. A management accounting system that allocates costs to products based on the number of machine and labor hours available to a production department during a given period of time. **Standard Costing** focuses on efficient use of resources, rather than value-creating activity and therefore will typically cause the production of waste. See **Activity-based Costing** for the contrast.

Standard Deviation. A measure of the variability (dispersion) of observations that is the positive square root of the variance.

Standard Work. An optimum combination of people, machines (mechanical resources) and material for each task or activity of a process. These resource combinations are described using **Cycle Time**, **Takt Time**, the work sequence of the task or activity and the inventory required to complete the task or activity.

Statistical Process Control (SPC). The application of statistical tools and techniques to control a process. The term **Statistical Process Control (SPC)** is often used interchangeably with **Statistical Quality Control**.

Storyboard. A poster-sized graphical summary of the entire Lean Implementation Plan for a given value stream, including the summarized details of the eight steps of the Value Stream Leadership process.

Supermarket. A storage point where a set amount of Work-In-Process (WIP) or Finished Goods Inventory (FGI) is accumulated within a Value Stream to allow Pull production through the downstream processes where pure continuous flow from the upstream process through the downstream processes is not possible.

Supply Chain Management (SCM). The activity of managing the flow of product, information and knowledge to and from raw materials through the finished product.

T

Target Cost. The total cost associated with development and production of a product (or service) that cannot be exceeded if the customer is to be satisfied with the value of the product (or service) and still provide the producer with an acceptable return on invested resources.

TAKT Time. The theoretical time it takes to produce a one product (or service) ordered by a customer. Takt Time is determined by dividing the total production time available by the quantity required by the customer for a given period of time. Note: TAKT is a Swedish word that translates to measure, time or cycle in English.

Team. A set of two or more people who are equally accountable to accomplish a purpose or specific performance goal or set of goals. Also, a small number of people with complimentary skills who are committed to a common purpose.

Theory of Constraints (TOC). A theory developed to identify and manage constrained elements of a process. This is also known as the bottleneck theory that is used to find a bottleneck or bottlenecks in processes and instruct the bottleneck resource(s) to work faster.

Theory of Solution of Inventive Problems (TRIZ). A process of solving complex problems of a creative nature by putting them in order so that they may become more predictable and manageable. TRIZ is the Russian acronym for this process.

Throughput Time. The time required for a unit of product (or service) to move from concept to launch, order to delivery, or raw materials to finished product placed in the hands of the customer. Also, the velocity of product (or service) flow through the process.

Time Trap. Any process step (or activity) that inserts a delay into the process and adds no value to the process.

Total Employee Involvement (TEI). A program where employees at all levels of an organization participate in continuous improvement of products, services and processes necessary to become/remain world-class. A TEI program produces a learning organization where employees continually using operational experience and new knowledge to continually improve their environment.

Total Productive Maintenance (TPM). A series of actions designed to insure that every machine or piece of equipment in a production process is always able to perform its required task(s) without interrupting continuous flow of the production process. TPM attempts to maximize equipment effectiveness (and availability) throughout the entire life of the equipment.

Total Predictive Quality (TPQ). A system of tools and techniques designed to fully understand the output of a process in order to improve the quality of its output. There are seven basic tools that form the basis of TPQ, including cause-and-effect diagrams, check sheets, control charts, flowchart diagrams, Pareto charts and scatter diagrams.

Total Quality Management (TQM). An enterprise-wide management approach to long-term success through customer satisfaction. This is a term initially coined by the Naval Air Systems Command to describe its Japanese-style management approach to quality improvement.

U, V

Value. A feature provided to a customer at the right time and for an appropriate cost, as defined by the customer.

Value-Added. The attribute of a task or activity within a process that converts raw inputs into a product or service with function, performance and quality meeting requirements, as viewed by the customer

Value Stream. The specific activities required to design, order, and provide a specific product or service from the point of product (or service) concept, through launch, ordering raw materials, production and placing the product (or service) in the hands of the customer.

Value Stream Leadership. A 8-step, closed loop method of planning and managing lean six sigma improvement initiatives throughout the value stream using systematic data collection and analysis. This systematic method evolved from the Toyota Production System where the key objectives are to minimize the waste and variation that prevents a smooth continuous flow of product (service) along the value stream.

Value Steam Mapping. Identification of all the specific activities occurring along a value stream for a product or a product family.

Variance. A measure of variability (dispersion) of how far from the mean of a series of data values are. The calculation involves dividing the sum of the squares of the individual differences of each value's distance from the mean by the number of values minus 1.

Variation. Any difference that occurs between two or more product units, process outputs or service results. There are two types of variation that can occur. These are common cause and special cause. Common cause variation refers to random shifts in factors that are always present in the products, process or service (e.g. variation of a product diameter). Special cause variation (also called assignable cause variation) refers to variation above and beyond common cause due to factors that are not always present in the products, process or service (e.g. electrical power failure causing computers to crash and a delay of service).

Visual Management. An effective management method used to provide information and tangible objects in a clear, visible manner so that the current state of the process operations and improvement targets are clearly understood by everyone. **Visual Management** methods will also help identify abnormal conditions promptly.

Voice of the Customer (VOC). Data (complaints, surveys, comments, market research, etc.) representing the views/needs of a company's customers; should be translated into measurable requirements for process design/control.

W

Waste. Any task, activity or process that uses human resources without producing any value.

World Class Manufacturing (WCM). A business operation strategy combining Total Quality Management (TQM), Just-In-Time (JIT) production, Total Employee Involvement (TEI) and Total Productive Maintenance (TPM) to continually improve all elements of the organization. This equips the organization to successfully compete in the world's marketplaces over a sustained period of time. Quality products (and/or services) are produced at minimum costs that meet or exceed customer expectations by waste-free process managed and executed this "learning" organization.

Work-In-Process (WIP). Material that is in the process of being transformed into something the customer for it wants. The process of transformation has begun (i.e. the material is no longer raw material) but has not been completed (i.e. where the material would be considered finished goods).

X, Y, Z

Zero Quality Control. A comprehensive system of managing quality that incorporates the worker executing the process in controlling the variability of the process output. The system involves process improvement through mistake-proofing and validation of process control through self-audits. The auditing is done through self-inspection by the worker completing specific tasks and by successive inspection of the incoming quality of that work by the subsequent task worker.