Six Sigma Glossary Download

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Glossary Term	Description
3G's	See **Three G's**
5 whys	See **Five whys**
5S	See **Five S**
7 tools of quality	See **Seven tools**
7 wastes of lean	See **Seven wastes**
7QCD	See **Seven QCD**
A3 process	A method for use by a team in the workplace where the improvement project or problem solving process is written on an A3 sheet of paper on the wall in the workplace. The problem statement, current state and future state are built up on the A3 sheet with data and illustrations during the A3 process. Compare **kaizen blitz**.
AAR	After Action Review: Team recap after every activity small or large, to capture and share learnings to improve the activity next time.
ABC	Activity Based Costing. Costs are allocated to products via cost drivers for various categories linked to the costs of the manufacturing activities. Refer to an accountancy text. Conventional Accounting can make it difficult to calculate the benefits of Lean Six Sigma improvements. ABC is also problematic. Throughput Accounting (**Theory of Constraints**) has been developed to support flow processing.
Accuracy	Of a measurement, closeness to the real value. "Bias" is the distance from the true value.
Activity network diagram	A tool for helping manage projects and events to achieve an objectives. Activities are represented as blocks connected by arrows which show sequence of activities. The **PERT** diagram (Program (or Project) Evaluation Review Technique) is an example.
Activity sampling	For **office, transactional** and **service** lean, an analysis of how people are using their time in the workplace. Can be done by detailed diaries, surveys, and/or observation. See **interruptions log.**
Affinity diagram	To gather and organise ideas from a **brainstorming** session. Ideas are grouped into themes by the team. Is most easily done using sticky notes.
Agile	Able to respond quickly to changes in the market and external political, social and physical environment.

Agile software development	Development of software using lean principles by developing small chunks of code which are rapidly tested by the customer. The customer must be close to the software writer and can see how the functionality of the code is developing, avoiding mismatch between expectation and delivery at completion of the project e.g. Scrum method. Has benefits over the traditional V-model.
AIAG	Automotive Industry Action Group
Alias	A term used in **Design of Experiments** when two main effects (or main effect and an interaction) share the same table column, so that the effects cannot be distinguished i.e. are **confounded.** Used to generate **fractional factorial designs**
Analysis of Variance	See **ANOVA**
Andon	Japanese for light or signal. Any visual method (often coloured lights) showing the status of a process step e.g. green - normal operation; yellow - planned stop; red - breakdown.
ANOVA	Analysis of Variance. A statistical method for allocating the sources of variation in a process. Variation arises from controlled inputs (experimentally varied) and from random sources (noise). **Hypothesis testing** (F test) is used to find if the variation due to an input is statistically significant from the background (**common cause**) variation.
Attribute agreement	Attribute Agreement analysis is a method of **Measurement Systems Analysis** applied to subjective classifications by people. Examples of subjective classifications include: telephone help line appraisal on a 1-5 rating scale; inspection of product as "pass" or "fail"; food and drink tasting results; hotel comfort rating. These quality measures are subjective and several (human) assessors can be compared using Attribute Agreement Analysis. If assessors mostly agree, we can be confident that we have a useful measure. If assessors mostly disagree, the rating usefulness is limited. Attribute Agreement Analysis is used to assess the consistency of subjective classifications by examining the ratings within appraisers and between appraisers. If a standard is available (not always the case) then accuracy can also be assessed.
Attribute data	Discrete (i.e. non-continuous) data describing the attributes of an entity (object) which can be classified into two categories e.g. good/bad, go/no go, pass/fail, good/defective, or maybe more than two categories e.g. red, yellow, blue. The exact meaning varies with users. See **Data Types**.
Autonomation	See **Jidoka.**
Average	See **Mean**
Balanced design	In **Design of Experiments**, a balanced design is a two level design where every factor is run the same number of times at high and low settings.
Balanced line	See Line Balancing and also **Yamazumi**
Balanced plant	See **Heijunka**
Balanced scorecard	Financial measures of an organisation are balanced by measures of customer perspective, internal business processes, and employee learning and growth. These four measures are related to the vision and strategy of the organisation. Developed from 1990 by Robert Kaplan and David Norton.

Bar chart	A graphical method which depicts quantitatively how many data are in different categories by drawing bars of height proportional to the count in each category i.e. a bar chart compares the numbers of items in categories as bars with heights proportional to the numbers in each category. Compare **Pareto Chart** and **histogram.**
Baseline	Measurements of the **current state** (current condition, as is process)
Batch	A group of products of the same type and processed as a lot throughout the factory or workplace.
Batch and queue processing	**Batch production**
Batch production	The traditional manufacturing method of processing large batches in order to keep equipment and people busy and reduce the relative cost of down-time changing between products. **Inventory** causes extended **lead times** (see **Little's Law**) and slow response to customers. Contrasts with lean just-in-time small batch or single part working, enabled by right-sized equipment and rapid changeovers (see **SMED**).
BB	**Black Belt**
Benchmarking	The comparison of an organisation's measures with similar measures in other organisations typically including world-class organisations. Also comparison with other parts of the same organisation. Shows gaps for improvement.
Benefits	Benefits will be estimated at the start of project to justify going ahead; the estimate will be refined during the project; and the final benefits will be estimated at the completion of the project. Benefits can be tangible ("hard") (e.g. as money saved, full time equivalents saved, capital expenditure avoided) and intangible ("soft") (e.g. improved morale, improved problem-solving, improved team-working). Benefits may be one-off (e.g. capital avoidance) or ongoing (e.g. FTE saving, reduced operating costs).
Best practice	The way of working that is the best (however defined) that is known in the industry. Nowadays will be compared world-wide for "world-class" best practice.
Bias	See **Accuracy**
Bill of materials (BOM)	An organised list of all the parts in a finished product. Usually with number needed, code numbers and descriptions. Often an indented table to show relation of subassemblies.
Binomial distribution	A statistical distribution applicable to situations where there are two possible outcomes e.g. defective/not defective, and used for proportions. Hence is the basis of the P-chart **control chart**.
Black Belt	A Black Belt is generally a full-time Lean Six Sigma practitioner with three to four weeks of training and proven delivery of several successful improvement projects. Compare **Master Black Belt** and **Green Belt**. **Certification** is available.
Bottleneck	Any activity or process that limits flow or capacity. See **ToC** and **constraint.**

Box plot	Also known as a box-and-whisker plot. A popular way of graphically depicting groups of numerical data through their five-number summaries: the smallest observation (sample minimum), lower quartile (Q1), median (Q2), upper quartile (Q3), and largest observation (sample maximum). A boxplot may also indicate which observations, if any, might be outliers. A non-parametric descriptive statistic (i.e. makes no assumptions about the probability distribution of the population).
BPR	**Business process reengineering**
Brainstorming	Team activity to generate many ideas. Key rule is no criticism of any idea. All ideas have merit. Ideas often collected on flipchart or using sticky notes. Can be structured by asking team members in turn. Can be prompted e.g. by the categories of a fishbone/Ishikawa diagram (see 4P's and 6M's). See affinity diagram. Despite urban myth to the contrary, the term is NOT politically unacceptable.
Buffer	**Inventory** (work in process, work in progress) between process operations. The buffer stock allows variation of rate between processes without operations running out of input.
Business non value add (BNVA)	**Non Value Add but Essential**
Business process re-engineering (BPR)	The redesign of processes and flows in a business system to simplify, remove wastes, and improve customer focus. Often applied to transactional and service operations. Top down imposed BPR may be less successful than BPR by evolutionary lean transformation.
C&E	See **cause & effect**
C/O	See change over and **SMED.**
C/T	**Cycle time**. Compare **takt time** and **lead time**.
Capability	Capability is the inherent (**common cause**) variation in a stable process, as usually determined by a **control chart** ("**voice of the process**").
Capability index	Ratio used to compare process variation (voice of the process) to a customer specification (voice of the customer). Typically **Cpk** and **Ppk.**
Capacity	The maximum **throughput** of a **system, process,** or process step. Units are generally number of products divided by time.
Capacity analysis	For **service** industry and **transactional** processes, an analysis of the capability of the employees and organisation to deliver a high quality service to customers. The aim is to reduce **failure demand.**
CAST	Mnemonic used in change management. Champions, Agents, Sponsors, Targets.
Categorical data	Non-continuous non-numeric data that has categories but not order e.g. red/orange/green for colour, or scratch/dent/chip/blister for paint finish. Also called nominal (naming) data. Categorical data usually does not have an order but some users include ordinal data. Counts can be used in control charts. See **Data Types.**
Cause and effect diagram (C&E)	Fishbone Diagram / **Ishikawa Diagram.**

Cause and effect logic tree	A Why-Why Diagram. A logic diagram analysing the causes of problems (undesirable effects). A more rigorous alternative to the Cause and Effect Fishbone/**Ishikawa Diagram**. In the Logic Tree, the problem/UDE is written at the left or top of a large sheet of paper. The potential causes of the effect are then added, branching into more detail until root causes are found and solutions can be proposed. Essentially the same as a "5 Whys Diagram" which shows the branching logic of asking Why? repeatedly where there is more than one cause for each Why?
CE or C&E Diagram	See **Cause and Effect Diagram**
Cell (lean cell)	Physical layout of manufacturing or office equipment and staff to enable lean processing i.e. which reduces some of the 7 Wastes. A cell is set up for one product, or family of products, for which the equipment is often arranged in a U-shape with the operator moving anticlockwise.
Cellular manufacturing	Use of cells for individual products or groups of products.
Central limit theorem CLT	A statistical theorem: 1) The distribution of averages of sub-groups, from any type of distribution, will tend to a normal distribution. 2) The mean of the population of means is always equal to the mean of the parent population from which the population samples were drawn. 3) The standard deviation of the population of means is always equal to the standard deviation of the parent population divided by the square root of the sample size (N).
Central tendency	The point about which data values are clustered. **Mean, median** and mode measures of central tendency.
Certification	There is no international standard certification or registration for Six Sigma and Lean Six Sigma Green Belts and Black Belts. National bodies such as ASQ (American Society for Quality), BSI (British Standards Institute) and BQF (British Quality Foundation) offer certification. Major companies, quality organisations and training organisations offer certification, either set by themselves or via an external certifying body. Certification typically may involve attendance at training, successful completion of project(s), audited benefits, examination and interview.
Champion	A supporter of Lean Six Sigma who promotes progress and projects. Not consistently defined. See also **Change Agent** and **Sponsor.**
Change agent	Person who catalyses change in an organisation from current state to future state. Promotes a culture of continuous improvement towards the future ideal state (vision). May be a Lean Six Sigma Black Belt. See Champion and Sponsor.
Changeover time	See **SMED**
Charter	See **Project Charter**
Check sheet	A simple tabular sheet allowing the operator to tick off occurrences and then count them. A tally sheet. Not a measurement table or checklist.
CI	**Continuous Improvement** or **Confidence Interval**
CLT	See **Central Limit Theorem**
CNX	Control, Noise and eXperimental. Categories applied to factors affecting an output e.g. items on a fishbone/Ishikawa cause and effect diagram. Control factors can be held constant, experimental ones varied, and noise is not controllable. From PF/CE/CNX/SOP Methodology (Air Academy).

Coefficient of variation (CV)	For a dataset, the ratio of the standard deviation divided by the mean.
COGS	See **Cost Of Goods Sold.**
Common cause variation	Causes of variation that cause the "natural variation" of the process. The result of the accumulation of the many tiny things that are continually varying each time the process is run. Such a process is "in control" or "stable" as seen on a **control chart,** and the measures conform to a data distribution often the **normal distribution.** Contrast **special cause variation** and Out of Control.
Complexity	Characteristic of a system or process that results from for example a large number of: inputs, process steps, outputs, interactions, decision points and recycle loops. A complex system is difficult to understand and control. An essential tenet of lean is to drive for simplicity.
Computer-integrated-manufacturing (CIM)	Full computer control of all manufacturing activities and inventories. Now accepted by many that lean manufacturing is a better alternative or least needs to be implemented in combination with CIM..
Confidence interval (CI)	For an estimated statistic (measurement, parameter), the range in which the true value is likely to lie, to a given degree of confidence typically 95%.
Confounding	In **statistics** and **Design of Experiments**, a confounding variable is one that correlates with both the dependent and independent variable. The effects of individual factors or interactions cannot be isolated. A common example given is the correlation between ice cream sales and rate of drownings. Cause and effect may be attributed one way or the other, but the reason for the correlation is the confounding variable warm weather, when people eat more ice cream and swim more often.
Constraint	A process step or operation or other factor that is the limit to the overall throughput of whole system. See **Theory of Constraints.**
Contextual data	Contextual or context data refers to observations or statements about the environment where data came from. e.g. part numbers, machine number, time of day, locations, operator. It is essential to know the contextual data accompanying collected data.
Continuous data	Also know as variable or quantitative or measurable data. Data that can take any value i.e. can be to any degree of accuracy. Can be measured on a scale and compared with, added to or subtracted from other continuous data of the same type. E.g. weight, pressure, cost (with fractional GBP/USD), height, FTE (staff full time equivalents) (if fractional people allowed). See **Data Types**.
Continuous flow processing	Producing goods in small batches or single parts with continuous movement of each product through the manufacturing process. For process industries (e.g. oil, gas, cement, glass) the product may be a continuous stream. Uses just-in-time methods. See **Flow Manufacturing**. Contrast **batch manufacturing.**
Continuous improvement (CI)	An organisation with a continuous improvement culture is constantly striving to improve using the **kaizen** philosophy. Part of lean.
Control Chart	A chart showing how a process is operating over time, with time or successive items or batches as the x-axis. On the y-axis are plotted key measures of the process and the limits (upper and lower control limits) in which the process is expected operate. Applicable to all types of process: manufacturing, transactional and services. Used to highlight out of control behaviour due to

	special cause variation. See **Statistical Process Control.**
Control plan	A description of the **inputs** and settings of each process step that must be controlled and monitored to ensure satisfactory operation.
COPQ	**Cost of Poor Quality**
COQ	**Cost of Quality**
Correlation	An association between the change in one variable and the change in another. Does not necessarily show cause and effect. Statistically measured by the correlation coefficient, which ranges from -1 (high -ve correlation) through 0 (no correlation) to +1 (high correlation).
Cost of goods sold (COGS)	The direct cost of production, typically materials cost plus cost of direct labour. The definition varies with type of business. The COGS does not include sales, marketing, engineering and administration.
Cost of poor quality (COPQ)	See **Cost of Quality**. The cost of not right first time.
Cost of quality	The cost of NOT achieving good quality. Hence also called Cost of Poor Quality. Cost of Quality is all the costs in an organisation resulting from not doing things right first time. Includes rework, correcting faulty data, waiting for missing information, dealing with customer returns and complaints. Can be analysed as the cost consequences of internal and external failures, and the costs of prevention and appraisal. Cost of quality is generally not apparent or explicitly costed, and so constitutes the "hidden factory". The lowest cost way to reduce cost of quality is to build defect prevention into processes e.g. **poka yoke**, and to increase Sigma Level.
Count Data	Data from counting which is therefore whole numbers only i.e. integers (e.g. no. of defects, no. of defectives, no. of customer returns). See **Data Types.**
Counter-clockwise flow	Anticlockwise flow. See **Cell**
Cp	Process capability index for a centred process.
Cpk	Process capability index (process need not be centred) for short term performance. The ratio of the "voice of the customer" divided by the "voice of the process". Therefore larger is better. Ppk is long term process capability (allows +-1.5 sigma shift). Six Sigma equates to a process capability of 2.
Critical chain project management (CCPM)	A method for planning and managing projects which has been shown to reduce the total time to complete projects (compared with traditional project planning). The times planned for individual tasks are reduced typically by a half, and a project buffer is inserted after all the tasks (together with feeding buffers where simultaneous activities converge.) Progress is monitored via consumption of the buffers. CCPM manages resources better than critical path and PERT methods. It also aims to reduce multitasking (see **relay runner**), reduce effects of Parkinson's Law (work expanding to fill the available time), and avoid last minute rush working ("Student Syndrome").
Critical few	The subset, of all the input x's to a process, that has the greatest effect on the output y's.

Critical path (CP)	For a series of activities comprising a project, the CP is the longest path through the activities i.e. it is the shortest (theoretical) time within which all the activities of the project can be completed.
Critical to Customer (CTC)	The attributes of a process or product which are essential to meet the needs of the customer.
Critical To Quality (CTQ)	Similar to **Critical to Customer** if quality is defined in the Japanese sense as all the aspects of a product (e.g. competitive cost, defect-free, rapid delivery) needed by the customer.
Critical To Quality Tree (CTQ Tree)	The CTQ tree is a Six Sigma tool used to translate the needs of the customer into specific measurable components of the manufacturing or service process.
CTC	**Critical To Customer**
CTQ	**Critical to Quality**
Current state	The "as is", now, current condition of a process, system or work area under study. Lean Six Sigma improvements to the Current State lead to the Future State. The Future State then becomes the new Current State and focus for further improvement.
Customer	Anyone who pays for, and/or chooses, and/or uses a product or service. Can be internal or external to the organisation. The "customer" can be the adjacent downstream process step.
Customer delight	The result of delivering a product or service that exceeds customer expectations (see **Kano diagram**).
Customer satisfaction	The result of delivering a product or service that meets all customer needs (satisfies the **Voice of the Custome**r). Can be measured by surveys and interviews.
CuSum	Statistical method (cumulative sum) which is very sensitive to changes in the mean of a charted variable.
Cycle time	Cycle time is the time taken for one item to go through one cycle of one step of a repeated process activity. It is a repetition time: "the time between items coming off the end of the production line". Cycle time has units of e.g. minutes per widget, and is different from lead time. For a design studio completing a design every three months on average, the average cycle time is three months per project. **Lead time** is the time taken for a product or service to move through a series of operations i.e. how it takes the product or service to go from start to end of a series of process steps "down the production line". E.g. Door to door or order to invoice time. The lead time for product design with the cycle time of three months might be one year i.e. a year from order to delivery.

Data types	Continuous data is also called variable data, quantitative data or measuring data. For example, physical measurements such as temperature and height, and amounts of money if fractional units are allowed. Discrete data does not have a continuous range of values, but is limited to set values and can be counted. For Six Sigma, discrete data includes: count data (e.g. for counting defects per unit: uses Poisson statistics) and attribute data (usually binary yes/no for classifying e.g. defective/not defective, pass/fail: attribute statistics use the binomial distribution). Some Six Sigma workers use the term attribute data to include categorical and discrete data. Categorical data (also called nominal data) sorts items into non-overlapping groups which have no natural order e.g. red, yellow, blue; wood, metal, plastic; postcodes & zip codes. Ordinal data is discrete data that has an order e.g. 1st, 2nd and 3rd in a race; rating of good, middling, bad in a customer survey.
DBR	**Drum buffer rope.** A key tool of **Theory of Constraints** working. The drum indicates when more work is to be done, the rope controls the raw material or information entering the process, and the buffer allows for unexpected variation (Murphy) in the process.
Decision matrix, decision analysis	A **matrix method** for comparing the benefits of alternatives. Similar to **Pugh** method. Kepner-Tregoe Decision Analysis uses a weighted criteria decision matrix.
Decision tree	A tree diagram showing the routes that can occur through a series of decisions. Make be associated with benefit or risk calculations.
Defect	Anything out-of-specification in a product or process that causes it not to meet customer needs and specifications (e.g. scratch, incorrect assembly, missing data in a form, late delivery). Defects counts can be control charted on a U Chart. Compare defective.
Defective	An item of product or output containing one or more defects. The count of defectives can be control charted using a P chart. Compare defect.
Defects Per Million Opportunities (DPMO)	Standard measure of Six Sigma. An "opportunity" is a processing operation or an item produced.
Defects per Unit (DPU)	Defects per unit is a standard measure of Six Sigma. Can be control charted using a U-chart. Compare defectives.
Deliverable	A measurable component of the output of a project, plan or product.
Demand analysis	See **service demand analysis**.
Design for Manufacturability (DFM)	Design method to create manufacturing processes suitable for Six Sigma operation.
Design for Six Sigma (DFSS)	Similar to Design for Manufacturability.
Design of Experiments (DOE)	An efficient structured way to find the relationship between the input x's of a process and the measured y's of the output. Generates the equation (transfer function) y=F(x's). i.e. the inputs of a process are systematically varied to find their effect on the outputs.
DFM	**Design For Manufacture** or Design for Manufacturability.
DFSS	Design For Six Sigma. See **DMADV.**

Discrete data	See **Data Types**. Any data that is not continuous. Can only have a finite set of values. Can be counted. Typically counts of small numbers e.g. count of pass, fail, red, white, black, good, fair, bad, number of defects, number of customer returns. Includes attribute data, categorical data counts, and Count Data. We use the Poisson and the Binomial distributions for discrete data.
Distribution	See **Probability Distribution**
DMADV	Define, Measure, Analyse, Design, Validate. For **DFM** and **DFSS.**
DMAIC	Define, Measure, Analyse, Improve and Control. The well-established project management method for running Lean Six Sigma projects. Systematic, using standard methods and tools, based on facts and data, and capable of solving difficult problems and improving complex processes. The DMAIC process is often shown as linear but in practice it is iterative with PDCA cycles as the team move from Define towards Control. See PDCA.
DOE	Design of Experiments
DOTWIMP	7 Wastes
DPM	Defects per Million
DPMO	Defects per Million Opportunities
DPU	Defects per Unit
Drum buffer rope (DBR)	Concept used in Theory of Constraints (TOC) to control inventory and pace the process steps.
Economic order quantity (EOQ):	The optimal batch size for an order that minimizes the total cost over time, including cost of ordering, setup cost, inventory holding cost, and procurement cost. Based on a financial calculation. In lean organisations, superseded by the move to small batches and flow manufacture enabled by **SMED** and **kaizen.**
Efficiency	Measure of the proportion of resource being used for production or service provision. When used as a measure, needs to be defined carefully.
Eighty/twenty (80/20)	See **Pareto**
Enterprise Resource Planning (ERP)	ERP is the current industry term for a comprehensive system that uses computers to integrate internal and external management information across the entire organisation, including manufacturing, product development, finance, and office processes. The aim of an ERP integrated computer and database system is to manage the flow of information between all parts of the business and also maybe with external suppliers and customers. Lean Six Sigma Key Performance Indicators and other metrics may be visible through the ERP, which may handle performance data for the Lean Visual Workplace. Some proponents of Lean and Six Sigma have argued that application of Lean Six Sigma across the entire organisation gives a higher benefit per resource applied than complex computer systems.
EPE or EPEx	Every Product Every time interval x. See **Heijunka.**
Ergonomics	Ergonomics (or human factors) is concerned with understanding of interactions among humans and the other elements of a system, and aims to improve human well-being and overall system performance. The lean waste of Motion focuses on making the workplace physically easy to use i.e. to improve ergonomics.
ERP	**Enterprise Resource Planning**

Error proofing	See **Poka Yoke.**
External customer	A customer outside the organisation. See **Customer.**
Factorial design	A full factorial design in **Design of Experiments** is a design for an experiment where all combinations of factors and factor levels are systematically investigated. It gives information on all the interactions between variables on the response. **Fractional factorial designs** can be used for large numbers of factors to reduce the number of trials whilst also reducing information about interactions between factors.
Failure demand (hence failure demand analysis)	Term popularized by John Seddon for **service processes**, to describe additional work caused by failure to do something right first time for the customer. See **systems thinking, service** and **transactional** processes. Equivalent to the lean "**hidden factory**".
Failure Mode and Effects Analysis (FMEA)	A table-based method for teams to systematically identify and rank potential process or product failure modes, and their effects. All ways that the product, process or service can fail (the failure modes) are identified and their effects listed. Potential causes for each effect are then listed and ranked by Severity, Occurrence, and Detection factors. These SOD factors are multiplied together to calculate the Risk Priority Number (RPN) for each failure mode effect and cause. Effects and causes with high RPN's are the most significant risks to the product or system. FMEA is widely used in design and manufacturing and is now used increasingly for transactional and service processes. FMEA is an inductive (bottom up, brainstorming) method and is not good at identifying the effects of multiple faults or faults in complex systems. See also **Fault Tree Analysis**.
Fast Moving Consumer Goods (FMCG)	Fast Moving Consumer Goods (FMCG) are products that are sold quickly at relatively low cost to the general public. Examples include food, groceries, soft drinks, perishables, cleaning products and toiletries. Though the profit per item made on FMCG products may be relatively small, they generally sell in large quantities, so the overall profit can be large. In FMCG, Lean is being applied successfully to both manufacturing and to the overall supply chain.
Fault Tree Analysis (FTA)	A rigorous structured deductive (analytical, top down) method to analyse the effects of faults on complex systems. Uses a logical tree structure and is a proactive (before the event) root cause analysis method. Not generally in the Lean Six Sigma toolkit. See Cause and Effect Logic Tree and the Reality Tree for alternative LSS root cause analysis tools.
FIFO	**First In First Out.**
Finished goods	Refers goods that have been completed and are in stores awaiting sale and transport to the customer. Part of the **inventory** along with raw materials and work in progress.
First in first out (FIFO)	The lean preferred way of handling goods or office work awaiting processing. Ensures that items or tasks do not sit at the back of the container or bottom of the queue while more recent items or tasks are dealt with quickly (as in Last In First Out LIFO). Thus the goal of FIFO is to prevent earlier orders from being delayed in favour of newer orders.
First Pass Yield	**First Time Yield** or Throughput Yield.

First Time Yield	Same as rolled throughput yield. In both cases scrap and rework are not counted as output. The overall yield (over a defined time period) of a series of process steps. Found by multiplying together the individual first time right yields of each process step. Yield is (number of good units out first time) / (number of units in).
Fishbone Diagram	See cause and effect/**Ishikawa** diagram.
Five Focussing Steps (Five Focusing Steps)	In **Theory of Constraints**, the process to improve an organisation (specifically to increase **throughput).** 1) identify the system constraint, 2) decide how to exploit the system constraint, 3) subordinate all non-constraints to the system constraint, 4) elevate the system constraint, 5) repeat the process if the constraint is broken, while not allowing inertia to set in.
Five S (5S)	Sort, Store (Set in order), Shine, Standardise, Sustain. Workplace organisation as a basis for lean improvements.
Five whys (5 Whys)	The "Five Whys" is a root cause analysis method achieved by asking WHY in response to a problem statement until a root cause is found and a solution is suggested.
Five whys diagram	See **Cause and Effect Logic Tree/Why-Why Diagram.**
Flow production	Also called continuous flow processing, flow manufacture, single part working, one part working, one piece flow, just-in-time manufacture, **Toyota Production System** and other terms. The key idea of Flow Production is moving the product or information from one process step to the next as near continuously as possible. The capability to produce a single unit of a product at the same throughput and cost as volume production requires flow production, short setup times, and kanban supply of materials. The ideal is single part working, but in some cases small batches may move continuously e.g. pitch for "Fast Moving Consumer Goods" products. Flow production shortens the lead time from order to delivery, improves response to customers, and makes visible the wastes (non value added activities) in the system. Flow Production is the key method of lean processing and enables the many benefits of lean.
Flowchart, Flow chart	For a set of related process activities (steps), the flowchart is a diagram showing the logical relationship between process steps (activity boxes) with flow of time (arrows connecting boxes) and branching decision points (diamond shapes). Additional symbols may be used to show lean wastes e.g. Waiting, overProcessing.
FMEA	**Failure Modes and Effects Analysis**
FOR	Frame of Reference
Force field analysis	A useful graphical method for highlighting and comparing the forces for and against change. A line is drawn vertically and to the left of the line are listed forces for change (driving forces) with arrows pointing right. To the right of the line are listed the forces restraining change with arrows pointing to the left. A third column on the far right is use to list countermeasures to overcome the restraining forces if these are greater than the driving forces.
Four P's (4P)	People, plant/places, policy, procedure. Categories for the fishbone/Ishikawa diagram for office (transactional) processes.

FPY	**First Pass Yield**
Fractional factorial design	In **Design of Experiments**, an efficient way of finding the effects of a large number of variables, at the cost of loss of information about interactions between variables. A fractional factorial design is a subset of a full **factorial design**.
Frame of reference (FOR)	In change management, communications to individuals will be most effective if the message is appropriate for the cultural background, beliefs and experience of the person receiving the message i.e. their "frame of reference". Thus an effective argument for starting an LSS project will be different for the CEO as compared with an employee on the shop floor or in the back office.
FTA	**Fault Tree Analysis**
FTE	**Full Time Equivalent**
Full time equivalent	The amount of resource equal to one person employed full time in an organisation. Can be used in Lean Six Sigma to estimate benefits from waste reduction. One FTE saved can be converted into money using either direct employment costs or full employment costs with overheads (as advised by the finance department). As "FTE's saved" can raise prospects of redundancy and reduce morale, it may be better to express LSS savings as "capacity increase in FTE's".
Future state	See **Current State**
Gage R&R, Gauge R&R	see **Gauge (Gage) Repeatability and Reproducibility**
Gauge (gage) repeatability & reproducibility (Gauge/gage R&R)	A key method within **Measurement Systems Analysis.** Typically gage R&R separates the variation of a measurement into variation caused by repeat use the same instrument (repeatability), variation between different operators (reproducibility), and variation due to sampling differences.
GB	**Green Belt**
Gemba	The real workplace. Pronounced with a hard g as in "got". The Japanese term for the where it happens i.e. the workplace. A key idea in lean is to "go gemba": observe the workplace. The improvement team is based in or near the workplace (not in a remote conference room.)
Gembutsu	Japanese for the actual product.
Genjitsu	Japanese for the real facts and data. The truth.
GR&R	**Gauge (Gage) Repeatability and Reproducibility** (Gage R&R).
Green Belt	A Lean Six Sigma practitioner who has had about two weeks of training in Lean Six Sigma methods and tools, and who has participated in major projects and/or led smaller successful projects. Usually a part-time Six Sigma role shared with the day job. See **certification**
Hands off	A principle of lean is to use simple inexpensive automation of machines to allow people to do work that is more valuable. For manufacturing, one person can then supervise several machines e.g. in a lean cell. Complex automation is not a first aim of lean. See Jidoka (autonomation).

Heijunka	Production Levelling or Production Smoothing or **EPEx.** A key feature of the Toyota Production System. Heijunka is the levelling of the production schedule by averaging across both the volume and mix of different products. This may be for example within a day or within a week. The aim is to support standard consistent working and so minimise wastes. In heijunka, the aim is to manufacture all products in proportion to demand in the shortest time - also called EPEx (Every Product Every time interval x). Heijunka requires quick changeovers **(SMED).** A Heijunka Box is used to schedule work in a Heijunka way.
Herbie	Colloquial shorthand for a **constraint.**
Hidden factory	See cost of quality. All the activities that occur because processes are not right first time. Not added separately into the cost of goods and therefore not known by management. See **cost of quality.**
Histogram	A bar chart where the heights of bars in the y-direction are proportional to the number of data value in each non-overlapping interval (sub-range) across the *continuous* variable on the x-axis. Shows the frequency distribution of the data.
Ho	**Null hypothesis** in **hypothesis testing** (compare H1 or Ha the alternative hypothesis)
HOQ	House of Quality. See **Quality Function Deployment.**
Hoshin kanri	Hoshin Kanri (Policy Deployment) was developed by Ishikawa: "Top managers and middle managers must be bold enough to delegate as much authority as possible. That is the way to establish respect for humanity as your management philosophy. It is a management system in which all employees participate, from the top down and from the bottom up, and humanity is fully respected." The aim of hoshin kanri is to involve all employees in decisions and strategy. Proposals are cascaded to all in the workforce and all stakeholders, who all have the chance to influence decisions and strategy. Compare **Balanced Scorecard**.
House of quality (HoQ)	See **Quality Function Deployment**
Hypothesis testing	A statistical method used to find whether the observed differences between two or more samples are due to chance (as stated in the null hypothesis Ho) or are true differences in the samples (as stated in the alternate hypothesis H1). There are many different hypothesis tests for different data and situations. Essential for Six Sigma improvement projects, to assess whether changes are likely to be real or a result of random variation. See p-value.
ID	**Interrelationship digraph**
IDOV[E]	Identify Define Optimise Validate [Evaluate]. Also variations on this name. A Six Sigma method for new product design. See **Design for Six Sigma (DFSS)** and **Design for Manufacturability (DFM).**
Implementation plan	At the Improve phase of **DMAIC,** the implementation plan will detail how improvements are to be made to the workplace. May include physical, procedural and change management actions.
IMR chart	Individuals and Moving Range Chart. A type of control chart (See **Control Chart** and **Statistical Process Control**). Refer to Lean Six Sigma texts.

In-control process	A process where variation is consistent (stable) over time and only **common cause variation** occurs (typically checked using control charts).
Information flow	All processes require information feedback loops from the output in order to control the input, otherwise the process is uncontrolled and will stop, randomly vary, or speed up indefinitely. Information flow is shown in the upper part of a **value stream map.**
Input	Anything that goes into a **process** to contribute to making the output of the process. Inputs include people, physical things, and information such as equipment settings and transactional data.
Input Output Diagram (IPO)	A simple process map showing a central box representing the process with inputs coming in from the left and outputs leaving to the right.
Inspection	Human comparison of product and output against specifications. Unnecessary inspection is waste. In lean, inspection should be done immediately after any operation in order to avoid passing on defects. However, inspection itself can never be 100% reliable. Ideally in lean, inspection is replaced with **poka yoke** (mistake proofing) within the process step. Inspection is part of "appraisal" cost in **Cost of Quality**.
Interaction	In some processes the effects of two or more factors may be more than just additive i.e. more than the some of the parts. For example the difference between average female and male pay of a workforce becomes larger the older the mean age of the workforce. The sex factor has more effect in older workers. This is an interaction.
Internal customer	See **"Customer".** Within a series of process steps, the next (downstream) step in the process is always the internal customer of the previous (upstream) step.
Interrelationship digraph	Used where there is a workplace problem with several issues, but where the cause and effect relationships are not clear. In this graphical method the issues are written in a circle. Cause and effect arrows are drawn between the issues. The issue with the most cause arrows leaving it is a primary cause of the problem. The interrelationship digraph is part of the lean toolkit ("Seven New Tools of Quality" 1976).
Interruptions log	For **office, transactional and service lean**, an analysis of how much interruption is occurring during employee's work. Interruptions and excessive multitasking reduce **overall professional effectiveness** in the workplace.
Inventory	Inventory consists of raw materials, **work in progress** (WIP) and finished goods held within the organisation. Raw materials will be used to make product. Work in progress (or "work in process") is any product between raw materials and finished goods. "Work in progress" is not necessarily being worked on - it is usually sitting in bins or storage areas awaiting processing. Inventory may be visible in the workplace or it may be hidden in stores. In lean operations, inventory is very undesirable. Inventory extends lead times (see Little's Law) so reducing responsiveness to customers. Inventory costs money to manage and increases complexity. The vision for lean is to have just enough WIP for the processes to work, and no more. See also Flow Production. In office processes inventory is more difficult to see but may be present as batched orders and invoices for example. In service functions (such as a call centre) inventory is

	less relevant and have little meaning.
Inventory Turns	**Stock Turns**
IPO	Input --> Process --> Output diagram
Ishikawa diagram	Cause and effect diagram; fishbone diagram. A problem-solving graphic. The problem is written on the right hand side of a sheet. A "fishbone" of lines is drawn towards the problem statement, and labelled with groups of potential causes e.g. 6M (Man, Materials, Machines, Measurements, Mother Nature) or 4P (People, Processes, Policies, Procedures). Individual potentials causes are then added to the fishbone, for example by brainstorming.
ISO 9000 series	A family of quality management systems intended to ensure that organisations meet the needs of customers and stakeholders. There is debate about how well ISO 9000 series systems support or conflict with Lean Six Sigma continuous improvement. Strong views have been expressed both for and against the value of ISO 9001 for Lean Six Sigma.
JDI	**Just do it**
Jidoka	Jidoka (autonomation) is the application of automation but with the specific requirement of always building in self-checking so that defects are not possible ("automation with human intelligence in the machine"). Human effort and motion is replaced by using autonomation with many of the benefits of full automation but without the prohibitive cost of making fully automated equipment failure-proof. Autonomation is simpler, cheaper and more flexible than full automation. Autonomation allows one operator to look after several machines, so reducing labour costs. With jidoka, any problem stops the line and requires human intervention, increasing "respect for humanity".
JIT	**Just In Time**
Job shop	A job shop handles work where each order is different and may be unique. Each order is a bespoke product for each customer and application. For example, a print shop, tool and die making, or a machine shop making one-off prototypes. The opposite of repetitive manufacture and flow production.
Just do it	Improvements (generally small) which are simple and evidently beneficial and can be implemented immediately. See also **Quick Wins.**

Just in time (JIT)	Just In Time means "to produce the necessary units in the necessary quantity at the necessary time". JIT refers to single-piece flow pulled by the customer. JIT is managed by Kanban visual control flow. Autonomation prevents defective parts from moving down the production line. JIT is sometimes used as a synonym for the **Toyota Production System**, but is one of the pillars of TPS. Application of JIT reduces inventory to the minimum, and all parts in progress can be related to individual products.
Kaizen	Kaizen is the Japanese word for "a small change for the better". In lean, kaizen is the philosophy of process improvement. Many small changes add to up to large improvements. Kaizen is an evolutionary not revolutionary way to improve. Evolution can lead to highly efficient organisations with sufficient complexity to meet any customer need. 5S is the start of kaizen. Kaizen is continuous, involves all workers, and is for the customer (reducing costs, shortening lead times and improving quality).
Kaizen Blitz	An improvement event typically of three to five days' dedicated team work, preceded by a month of data collection and preliminary analysis. The team agrees to implement as much improvement as possible during the kaizen event, and to close out all actions within one month after the event.
Kanban	Kanban is Japanese for a signal. In lean, visual controls are used to manage the flow of parts and product for just in time operations. There two types kanban: 1) production kanban, controlling movement of product to prevent overproduction, and 2) supply or parts withdrawal kanbans which control supply of components. Kanbans can be for example cards, boxes (full or empty), and electronic signals.
Kano diagram	A model used to analyse what is delivered to the customer in terms of 1) basics (unspoken needs such as hot water in a hotel room), 2) performance items (for example perceived value for money) and 3) delighters which are unexpected but gain loyalty of the customer (for example, free fruit, chocolates and fresh flowers in a hotel room). In competitive industry, factors move from 3 to 2 to 1.
Key performance indicator (KPI)	A process measure (metric) which is critical for the business, and with other KPI's builds up to the high level metrics showing whether the organisation is meeting its objectives and satisfying customer needs.
Knowledge management	An essential set of tools for **office, service and transactional lean**.
KPI	**Key performance indicator**
L/T	**Lead time**
Last In First Out (LIFO)	See **First In First Out**
LCL	**Lower control limit**
Lead time	Also called throughput time and flow time. Lead time is the total time for product to move through a series of process steps. Lead times typically used are order-to-delivery, order-to-invoice, or door-to-door (i.e. goods in to goods out). For a transactional process (e.g. software development) then lead time might be order-to-delivery of completed work. For a lead time, the specific start and stop points must be defined. Lead time consists of value added time, non value added business essential time, and non value added time (pure

	waste). Lead time is proportional to inventory (**Little's Law**). Compare **Cycle Time** which is different.
Lean Six Sigma	The combination of the methods, tools and philosophies of Lean Thinking and Six Sigma. The two toolkits are largely complementary.
Lean, Lean manufacturing, Lean thinking	The term lean was used in the book "The Machine the Changed the World" by Womack, Jones and Roos. "Lean" has been described as "to produce only what's needed, when it's needed, using minimum resources" and "A manufacturing philosophy that shortens the timeline between the customer order and the shipment by eliminating waste" (John Shook). For any operation (manufacturing, transactional and service) lean thinking promotes flow to the customer, shortens lead times, drives out waste, and improves customer satisfaction. To "implement lean" is to apply the principles of the Toyota Production System, as appropriate, to one's own organisation (be it manufacturing, transactional or service) with a philosophy of continuous improvement.
Level production	See **Heijunka**
Line balancing	Line balancing is ensuring that all the steps of a production line have similar capacity, and each step is "balanced" with its upstream and downstream process steps. See also **Yamazumi.**
Little's Law	Little's Law can be stated as "The average number of things in the system is the product of the average rate at which things leave the system and the average time each one spends in the system" i.e. **WIP** = **throughput rate** x **lead time**, . This can be rewritten as: lead time = WIP x cycle time. This shows how lead time increases with inventory, and allows calculation of minimum WIP.
Logic tree	**Cause and Effect Logic Tree** or Why Why Diagram
Long term sigma	In Six Sigma, a time period over which all the inputs have shown their variability. A "worst case" for process capability estimation. See Sigma Shift.
Lower Control Limit (LCL)	The LCL is the lower line on a control chart. For normal data being charted the line is 3 standard deviations below the mean. Data points outside this line indicate out of control behaviour and are the effect of special cause variation. Part of Voice of the Process.
Lower Specification Limit (LSL)	For a given process output measure, the LSL is the lowest value that is acceptable to the customer. See Voice of the Customer.
LSL	**Lower Specification Limit**
LSS	**Lean Six Sigma**
Make to order	Production of products or deliver services to customer order, not for stock.
Make to stock	Production of products into store without specific orders i.e. into finished goods inventory. The opposite of make to order.
Master Black Belt	An experienced Black Belt with extensive project experience and who mentors Black Belts and senior staff. A full-time position which in a large organisation may be corporate and global. May have deep specialist skills e.g. in design of

	experiments or advanced lean applications.
Matrix diagrams	Tables used to compare two sets of ideas or criteria. Used in Quality Function Deployment, Pugh Matrix and Decision Matrix methods. Contrasts with **tree diagram** and tree methods.
MBB	**Master Black Belt**
Measurement System Analysis (MSA)	Measurement Systems Analysis (MSA) is the general method of analysing measured data to find the amount of variation due to measurement error as compared with the true variability of the process. All measurements of continuous data have some measurement error and this can be determined by repeated readings using a structured method to isolate measurement variation from true process variation. Measurement errors arise from measurement equipment, methods, operators, samples, drift, calibration et al. Gauge R&R is a popular structured method for MSA.
Metric	Any process measurement. Includes **Key Performance Indicators** (KPI's)
Milk run or milk round	A method of organising deliveries and collections between sites to satisfy just-in-time production with frequent van or lorry trips on a set schedule. To minimise waste of nearly empty vans and lorries, sharing of different types of products, and sharing with other companies, can be done.
Mistake proofing	Error proofing. **Poka yoke.**
MRP	Materials Requirements Planning (MRP). Computer systems used in most plants. Used to coordinate demand forecasts, ordering, bill of materials, stocks and WIP. MRP systems always have significant error at detailed shop floor level. JIT pull working can improve plant performance. See also MRP II and Enterprise Resource Planning.
MRP II	Manufacturing Resource Planning (MRP II) is defined by APICS as a method for the effective planning of all resources of a manufacturing company. Ideally, it addresses operational planning in units, financial planning in dollars, and has a simulation capability to answer "what-if" questions and extension of closed-loop MRP (Wikipedia).
MSA	**Measurement System Analysis**
Muda	Japanese for waste in manufacturing. Waste is any activity that uses resource and adds no value for the customer: also called non value adding activity. See **Waste.** Driving out waste is an aim of lean in order to promote flow and increase capacity. See also muri and mura.
Multi-Skilling	In the lean workplace, workers are required to be flexible and be able to move between different jobs, to make equipment settings, do basic maintenance, and use root cause thinking (5 whys). A skills matrix is used by teams to track status of training of individuals.
Mura	Unevenness and inconsistency in physical things and people's jobs. In the TPS, mura is undesirable. Pull systems (using kanbans) and heijunka reduce mura.
Muri	Unreasonableness, or overburden. Obviously undesirable, and reduced in the TPS by, for example, the use of standard work.
NGT	**Nominal Group Technique**

Nominal Data	See **Data Types**
Nominal Group Technique (NGT)	An idea-generation and decision-making technique for a group which enables a quick decision whilst taking account of the views of all the group members. Brainstorming/affinity and Six Thinking Hats have similar use.
Non parametric statistics	Statistics dealing with data that does not come from a known probability distribution. Very useful as the methods can be used in Six Sigma for any type of data. However, if used for parametric data, non parametric methods will give higher p values as less information (no knowledge of data distribution) is used in the hypothesis test.
Non value added	Activity which uses resources but which does not add anything which the customer wants to the product or service. Sometimes called Type 2 **Muda.** Compare Value Added.
Non value added business essential	"NVA but business essential" is work which does not add value for the customer but which is essential for the business. Examples: in the healthcare industry, collecting data for regulatory authorities e.g. FDA; in banking and insurance, following the requirements of the financial regulatory authorities. Sometimes called Type 1 **Muda**
Normal distribution	A common statistical distribution applicable to many natural and physical processes. Refer to statistics texts.
Normalisation	In statistics, converting data into unitless ratio data (e.g. dividing data values by the mean) so that statistical tables (e.g. the **Z table**) can be used.
Null hypothesis	In the test of a new condition against an existing condition, the assumption that the new condition equals the existing condition (i.e. no change) is called the null hypothesis.
NVA	**Non-value Added**
OE	**Operational Excellence**
OEE	**Overall Equipment Effectiveness**
OEM	**Original Equipment Manufacturer**
Office lean	See **transactional lean** and **service industry**
One piece flow	Single Piece Flow. See **Flow Manufacture**
Operational Excellence	Operational Excellence is a philosophy of leadership, teamwork and problem solving resulting in continuous improvement throughout the organization by focusing on the needs of the customer, empowering employees, and optimizing existing activities in the process (Wikipedia). Similar to Lean Six Sigma.
Ordinal data	See **Data Types**
Original equipment manufacturer (OEM)	OEM's are companies that make products for purchase by the end customer e.g. cars or computers for the general public.
Out of control	A process is out of control if it shows variations larger than its control limits or a systemic pattern of variation e.g. shift, trend or oscillation. An out of control process is subject to **special cause variation**.
Outlier	A data value which is unlikely to belong to a statistical distribution and so is likely to be the result of special cause variation. Statistical tests are available to detect outliers. The box plot shows any outliers.

Output	The product or service produced by a process step. May be physical (e.g. widgets), information (e.g. a report) or human (e.g. a cured patient). In Six Sigma the measures of outputs are called x's.
Overall equipment effectiveness (OEE)	A rigorous measure of how well capital equipment is being used in the workplace. The product of three ratios: availability x performance x quality rate, as a percentage. Typical values are 40-60%; world class is 85%.
Overall professional effectiveness (OPE)	An assessment of how effectively employees are working in **office, transactional and service processes**. Estimated for example as (fractional time at the desk) x (fractional uninterrupted time on the task) x (fractional right first time output) / 100 %.
p value, p-value	In statistics, the probability of getting the observed result (test statistic), or a more extreme one, if the null hypothesis were true. For example, the chance of accepting an improvement when there is really no change i.e. p=0.05 then if the experiment to compare two conditions was done 20 times then on one occasion (on average) a significant difference would be found even though there is no real difference between the conditions. Used in hypothesis testing. Often compared to an alpha significance level set at 0.05.
P/TOL	Precision to Tolerance ratio. A measure used in **Measurement Systems Analysis** (Gage R&R) which relates the measurement variation to the tolerance accepted by the customer.
Pacing process or pacemaker	The process in a production line, generally near the start, than signals the pace for all other processes in the line for supplies. In a lean plant the pace will be the takt time. Compare constraint (**Theory of Constraints**).
Paradigm	Belief of how things are and what can be done. New ways of working such as Lean Six Sigma may require a paradigm shift in management e.g. in the extent of employee involvement.
Pareto Diagram (or Pareto Chart)	The Pareto diagram enables improvement efforts to be focused on the few causes that have the greatest effect. A Pareto diagram is a bar chart that displays by frequency on the y-axis, in descending order across the categories on the x-axis, the number of defects in each category. See **Pareto Rule.**
Pareto Principle or Pareto Rule (80/20)	Pareto (~1900) observed that 80% of the land in Italy was owned by 20% of the people. Juran (~1950) proposed the Pareto Principle, that most effects come from relatively few causes (the "80/20 Rule"). Hence the Pareto Diagram. Similar to the "long tail" and power law relationships.
PCE	Process Cycle Efficiency
PDCA	Plan Do Check Act. Also known as the Shewhart Cycle or the Deming Cycle or Deming Circle. Also called PDSA (Plan do Study Act). PDCA is the fundamental way of doing improvement work using facts and data. Similar to the scientific method (hypothesis, experiment, evaluate). Seddon proposes Check Plan Do for service functions. The aim of PDCA and similar cycles is to deepen knowledge and understanding, and the PDCA approach permeates everywhere in Lean Six Sigma. The DMAIC process in practice operates as PDCA iterative loops rather than a once-through procedure.
PDPC	Process Decision Programme Chart (PDPC). Lean tool for project risk analysis.
PERT	Project (or Programme) Evaluation and Review Technique. See **Activity**

	Network Diagram.
PEST, PESTLE	Mnemonic used for strategic analysis. Consider: Political, Economic, Social, Technological, Legal, Environmental issues. See also **SWOT** and Porter's Five Forces.
PF/CE/CNX/SOP	From Air Academy Associates. 'A methodology that is used to reduce extraneous variation. It uses process flow diagrams (PF) and cause and effect diagrams (CE) to identify and sort the causes of variation. The causes are further categorized as controllable (can be held constant "C"), noise (too difficult or expensive to control "N") or experimental (factors which must be investigated to understand their impact "X"). Standard operating procedures (SOP) are used to establish methods for holding the "C" factors constant.'
Pie chart	A circular diagram to show the relative numbers in different categories. The whole circle (360 degrees) represents all the data, and the sectors are drawn with size proportional to the number each category.
PIF	Project Initiation Form. Similar to a Project Charter.
Plan Do Check Act	See PDCA.
Poisson Distribution	The statistical distribution applicable to count data i.e. small discrete values such as defects per unit, or phone calls in a given time period, or number of accidents in time intervals at a given location. It is the basis of the U-chart.
Poka yoke	"Mistake proofing". Applies to any process: manufacturing, transactional and services. Poka yoke is the design of parts, processes and procedures to prevent or minimise the likelihood of defects (errors) occurring. Each step of the work contains checks to prevent faulty work passing to the next step (to avoid adding value to defective product). For physical manufacture, poka yoke is an essential element of Jidoka (autonomation).
Policy deployment	Hoshin Kanri
Ppk	Long term process capability index. See Cpk.
PQ analysis	Product Quantity analysis
Precision	In Six Sigma, high precision is tight grouping (clustering) of measurements. Precision describes the spread of series of measurements of the same thing. However, the mean may not be close to the true value (low **accuracy, bias).**
PRINCE2	A process-based method for effective project management. A public-domain methodology developed by the UK Government for contracted projects, developed and supported across Europe, and now an international standard for project management used in more than 50 countries.
Prioritisation matrix	A team tool **matrix method** to analyse priorities for project selection and/or actions.
Probability distribution	In statistics, a probability distribution describes the range of possible values that a discrete variable (or interval of a continuous variable) can take, with the probability of the variable having a value within any subset of the range. The normal distribution (common "bell curve") describes the distribution of variables measured in many naturally occurring situations. Other distributions are used for example for small number counts of defects (Poisson distribution) and proportions of defectives (binomial distribution).

Problem statement	The description of a problem made before starting cause and effect analysis and root cause analysis. The problem statement should be specific and ideally covers who, what, where, when, and how the problem affects the organisation's goal.
Process	A process is a series of activities which produce a result. In Lean Six Sigma process thinking, a process transforms inputs to desired outputs for a customer. Individual activities are called process steps. Transformations can be mechanical (e.g. machining widgets), physical (e.g. boiling water), chemical (e.g. polymerizing plastics), information (e.g. checking a control chart, writing a procedure) or any human activity (e.g. hospital patient, person being trained). There are three flows that can be mapped in a process: material, information, and energy (rare in LSS). See Process Mapping, Process Flow Diagram, Systems and Systems Thinking. A process is part of a **system.**
Process capability	Comparing the Voice of the Customer with the Voice of the Process i.e. what is the ratio of variability accepted the customer (USL-LSL) divided the size of variability shown by the in-control process? Process Capability can be measured by, for example Ppk, Cpk, Sigma Level and DPMO.
Process capability index	A process capability measure which measures the ratio of the customer acceptable variation (tolerance=USL-LSL) to the spread of the process. Refer to Cp, Cpk, Pp, Ppk in Six Sigma texts.
Process capacity	The maximum amount of product that can be produced by process in a given period of time.
Process cycle efficiency	**Value Added Ratio.**
Process Decision Programme Chart (PDPC)	A lean quality tool with a cumbersome name. Used to check an implementation plan to identify what might go wrong and create countermeasures. The implementation plan is broken down into sub-tasks (plan elements) and each of these is assessed for potential problems. Countermeasures are then created.
Process Flow Diagram (PFD)	**Flowchart.**
Process industry	Various definitions. Typically process industries handle gases, liquid and powders in batch or continuous operations. Examples of process industries are food (ketchup, sauces, soups, frozen peas), brewing, paint manufacture, fine chemicals, oil refining, glass making, large-scale extrusion. Process industries have differences from industries which manipulate and assemble solids such as automobile manufacture and aerospace, and these differences affect selection of Lean Six Sigma methods and tools to use.
Process map	See **Process Mapping**
Process mapping	For Lean Six Sigma, process mapping is any diagrammatic representation of the operation of a **process.** Process mapping is essential for process improvement, and is a picture of how things happen.. High level mapping is done with the SIPOC Diagram and the Value Stream Map. The Flowchart shows the logical flow of materials and information. The spaghetti diagram shows the physical movement in space of operators, materials and maybe information. The **Value Added Timeline** shows the VA, NVA Business Essential, and pure NVA time. The **System Diagram** shows interrelationships between process

	steps for complex processes. Mapping can be done to any level of detail. The Lean Six Sigma practitioner must use her/his skill to judge the amount of detail needed.
Process yield	Over a given time period for a given process step, yield is the number of good (first-time) products, divided by the total number of products (good and bad). Same as Quality Rate in the **OEE** calculation.
Product Quantity Analysis (PQ analysis)	An analysis over say several months of the demand for different products from a plant. The volume and variety is shown on a **Pareto Diagram**. Products are sometimes classed into runners, repeaters and strangers. This information helps design the production method to suit the product e.g. high volume lower value routine production on a flow line, versus occasional low volume high value manufacture which can be done in a job shop.
Production smoothing	**Heijunka**
Productivity	Not uniquely defined. A measure of the amount of output from a process for the amount of input resource used. Needs to be specified for each particular use. For example, widgets per employee, widgets per dollar wage cost, new products per person in R&D.
Project charter	Also called Team Charter or Project Initiation Form. An essential document completed at the Define stage of **DMAIC,** and updated during the project. The Project Charter covers all the items to be addressed before starting a project, including: name, sponsor, leader, LSS facilitator, team, stakeholders, scope & SIPOC, current state, intended future state, outline plan, milestones/stage gates, costs & resources, benefits & measures, risk analysis, interrelationships with other projects.
Project Initiation Form (PIF)	**Project Charter**
Pugh matrix or Pugh Method	A **decision matrix** method for comparing the benefits of alternative concepts, solutions or products.
Pull system	In the Pull System, the customer pulls a required product and a signal (production **kanban**) for manufacture moves back through the production line. The product moves towards the customer, and work is only done when it is needed, to the amount that is needed. **Inventory** (WIP and finished goods) does not build up, and so the **lead time** is as short as possible for the given process steps. Materials (supplies) are provided just-in-time via supply kanbans.
Push system	In contrast to the Pull System, in the Push System materials are released according to a forecast schedule usually on computer and "pushed" into the process. The forecast is never exact (tests have shown 70% accuracy at best). Product is made as materials become available and tends to build up in inventory. Lead times extend (Little's Law) and costs increase.

p-value	p is the result of a statistical (hypothesis) test. Generally if p is less than 0.05 then we can reject the **null hypothesis** i.e. accept that we have a real change.
QCD	**Quality Cost Delivery**
QFD	**Quality Function Deployment**
QS9000	QS 9000: The automotive industry version of the ISO 9000 requirements.
Quality	In Lean, quality has a broad meaning (compared with the traditional narrow meaning about defects and defectives) and covers all the attributes of a product that must be met to satisfy the customer i.e. cost, quality in the traditional sense, and delivery time.
Quality cost delivery	Q C D: Quality, Cost, and Delivery are the three elements of customer demand. The Three Lean Drivers of customer satisfaction. Kaizen activity should be focused on improving QCD. The classic metrics of lean are the **Seven QCD**.
Quality Function Deployment (QFD)	For a new product or service, a team-based structured method for translating the needs of the customer (expressed in the customer's terms and hence probably qualitative and imprecise) into precise product specifications and measures for production. The QFD process includes comparison with competitors, assessment of costs, resolution of design conflicts, and assessment of production (manufacturability). QFD converts the Voice of the Customer into specific deliverables that can be made and delivered. The QFD diagram is called the House of Quality.
Queue time	The waste of Waiting. The amount of time a part, person, or signal, spends before being attended to, or having value added work done. In many factories and workplaces, queue time has been found to constitute 80-90% of the total lead time. See **Batch Manufacturing.**
Queuing theory	The mathematical study of the formation and movement of queues. Applicable to process steps where capacity constraint or variation produces build up of lines or queues.
Quick changeover	**SMED**
Quick wins	Improvements which can be implemented quickly to give obvious benefit. Useful to give momentum to a larger improvement programme.
R&D	Research and Development
RACI	A simple method of managing who does what for routine activities. The RACI table has people's names across the top, and down the left hand column are listed the tasks (things to be done). The table is filled in with the appropriate letter: R for Responsible; A for Accountable; C for Consulted; I for Informed. Each row must have one A and at least one R.
RCA	**Root Cause Analysis**
Reengineering	See **Business Process Reengineering**
Regression analysis	A statistical method for fitting an equation of the form **Y=f(x's)** in order to relate process output measure Y to process inputs (x's). The equation is a "model" that when validated allows the prediction of process behaviour i.e. Y can be predicted knowing the x's. Nomenclature: one x: linear regression; more than one x: multiple linear regression; more than one x and more than one Y: multivariate analysis. If the best fit line is curved, we can use curvilinear regression (quadratic or cubic).

Relay runner	A way of working where an employee works on one task only (without interruption) as fast as possible and then hands over to the next worker in the chain. See **critical chain project management**.
Repetitive manufacturing	Manufacturing of many similar products repeatedly at high volume typically on a production line in continuous flow and with no craft or job shop work. See **Flow Production.**
Rework	Activity to reprocess (work again) on defective parts or products to make them meet customer (internal or external) specifications. Pure **waste** of time and resources. In manufacturing, transactional and service industries rework has been found constitute about 30% of total effort on a process. See related topics **Hidden Factory, Cost of Quality,** and **Failure Demand**.
Right first time	In lean, great attention is paid to minimising defects and doing all tasks Right First Time. Not right first time causes Rework and **Wastes.** The vision is Zero Defects (100% right first time) by using Lean and Six Sigma methods and tools.
Right sized	In lean, the intention is to size machines and equipment to do just the amount of work that is needed to keep the process flowing. Lean equipment is simple, flexible, mobile, single purpose but adaptable. It is not considered lean to install large automated equipment with capacity well in excess of **takt** and needing frequent expert attention. See Autonomation.
Risk Priority Number (RPN)	A number calculated during **Failure Mode and Effects Analysis** (FMEA) to rank the various failure modes, effects and causes. See FMEA
Robustness. Robust design.	Process robustness is insensitivity to variations in inputs and changes such as temperature, wear, and quality of materials. Taguchi Design of Experiments can be used to establish robust processes. The aim is consistent product rather than more highly optimised but variable product.
Rolled throughput yield	See **first time yield.** In both cases **scrap** and **rework** are not counted as output.
Root Cause Analysis (RCA)	A structured method for finding the fundamental causes of problems, so that solutions can be implemented, at lowest cost, to prevent any recurrence of the problem. "Curing the causes not the symptoms." Applicable to any workplace, manufacturing, office or service. RCA is now required to be used for deviations and corrective actions in healthcare organisations.
RPN	Risk Priority Number. See **Failure Modes and Effects Analysis.**
RTY	**Rolled Throughput Yield**
Run chart	A simple graphical tool that tracks process data over time and can detect non-random behaviour (special cause variation). The **control chart** is a more powerful alternative.
s	Sample standard deviation
Sample	A small collection of items or material taken from a large population and intended to represent the population. Used to estimate the parameters (e.g. average, standard deviation) of the population. See guides to sampling and sample size calculation.
Scatter diagram or scatter plot	A scatter diagram is a graph with x and y axes on which data points are plotted according to their x and y values. Will show any correlation between x and y. (See Correlation).

Scrap	Material and product which was intended for use or sale but which must be discarded. The result of defects from process steps.
Screening design	A **fractional factorial design** to test a large number of factors. Interactions are not separated from main effects and so care must be taken.
SD	**Standard Deviation**
Sensei	An expert (guru) in lean/TPS who mentors, teaches and supports implementation of lean and the art of kaizen. Compare Six Sigma **Master Black Belt**, and the Theory of Constraints expert called a Jonah.
Service demand analysis	For **service industry** and **transactional lean**, an analysis of how demand varies across time and place, and by type of requirement. For example, a computer help line will have varying rates of calls (probably busy on Monday morning and quiet on Sundays). Callers will have very different types of requirements and personal capabilities. **See capacity analysis.**
Service industry and service functions or service operations	Service industries generally deal directly with customers and provide advice, information and tailored products. Examples include banks, insurance companies, restaurants, hotels, hospitals, call centres, educational institutions, and local government. Some manufacturing is tending towards a service function e.g. laptop computers tailored individually for the customer. Some service industries are becoming more product focused e.g. banks offering standard packages. Note that there are service functions in manufacturing (e.g. sales support, help desk) and that there are repetitive processes in service industries (e.g. cleaning in hospitals). See also **Transactional Processes.**
Service Level Agreement (SLA)	Documented agreement on what the customer expects from a service e.g. cost, quality, delivery, who does what **(RACI).**
Setup	All the activity needed to prepare a process step for a particular product or service. Rapid setup is essential for lean operations, to allow quick change between products. See **SMED.**
Seven QCD	The classic lean metrics. They are: 1 Not right first time (NRFT) [external & internal] 2 Delivery Schedule Achievement (DSA) [external & internal] 3 Overall Equipment Effectiveness (OEE) (OPE) 4 People Productivity (PP) 5 Stock Turn (ST) 6 Value Added Per Person (VAPP) 7 Floor Space Utilisation (FSU).
Seven tools of quality; seven quality tools; the "seven old tools"	These are: **Flow Charts, Histograms, Pareto Charts, Scatter Diagrams, Cause and Effect Diagrams (fishbone charts), Control Charts, and Check Sheets.**
Seven wastes	See **Waste.**
Short term sigma	See **Sigma Shift**.
Sigma (Greek letter σ)	Population standard deviation
Sigma level	The Six Sigma measure of **process capability**. The number of sigmas between the process mean and the nearer customer specification limit. Six Sigma equates to 3.4 **DPMO.**
Sigma shift	In Six Sigma, the long term process is assumed to vary by plus and minus 1.5 standard deviations (sigmas) as compared with the "short term" process. Thus the Six Sigma defect rate of 3.4 DPMO is actually the defect rate for true 4.5 sigma capability. Controversial. All capability data and defect rates should be labelled short-term (or "no sigma shift") or long term (or "with sigma shift").

Single part working	See **Flow Production**
Single piece flow	See **Flow Production**
SIPOC diagram	The SIPOC is a high level process map identifying Suppliers, Inputs, a few Process steps, Outputs and Customers. The SIPOC is done at the start of a project (Define phase of **DMAIC**) to set the scope of the DMAIC project. See Process Mapping.
Six M's (6M)	Man, Machine, Methods, Materials, Measurement, Mother Nature (Environment). Categories used for a **Ishikawa** (fishbone) analysis.
Six Sigma	Six Sigma is seen as many things, for example: 1) A metric of fewer than 3.4 defects per million opportunities, 2) A toolkit of statistical methods and the DMAIC process enabling substantial reduction in process variation, 3) A vision of nearly perfect processes, 4) An organisational and team culture for process excellence.
Six Sigma quality	Fewer than 3.4 **DPMO**
Six σ (6σ)	See **Six Sigma**
SLA	**Service level agreement**
SMART	A mnemonic for setting good objectives: Specific, Measurable, Achievable, Realistic, Timed (there are variations on this).
SMED	Originally, the ability to change dies (for different models) on auto manufacturing equipment in less than ten minutes, rather than hours or days as was previously the case. Now refers to any rapid changeover which enables lean operations and increases flexibility. For example, applicable to transactional processes where staff are changing between software systems and databases for different products.
SOD	Severity, Occurrence, Detection. See **Risk Priority Number** (RPN)
SOP	**Standard Operating Procedure**
Spaghetti diagram	A map of the workplace showing the movement of people (Motion Waste) and product or information (Transport Waste). To draw the spaghetti diagram, start with a plan of the workplace and follow the person by drawing a line on the plan showing where the person goes. Can do the same with a part and with information.
SPC	**Statistical Process Control**
Special causes	Special cause variation causes a process to go out of control, as typically observed on a **control chart**. Not present when the process in in-control. Special causes have specific root causes which can be found and corrected using **root cause analysis** (in contrast with common cause variation which is the effect of all the small unknown things that change each time a process is run).
Specification limits	Tolerance limits set by the customer. See **voice of the customer**. Not to be confused with control limits, the **voice of the process.**
Sponsor	Manager who agrees the resource (people and money) for a Lean Six Sigma project and champions the project, whilst usually not being full time on the team.
Stable process	An in-control process. Not subject to **special cause variation.**

Standard deviation	A measure of the variability of a set of data. In Six Sigma, termed sigma for the population and s for a sample.
Standard Operating Procedure (SOP)	A documented set of actions to be followed by a person doing a standard task. Similar to, but may be less detailed than, Standard Work.
Standard operations	An essential part of lean working. At Toyota, the three aims of Standard Operations are 1) to use the minimum manpower for production by using the Standard Operations Routine, 2) to achieve Line Balancing, and 3) to control inventory at the minimum. Standard Operations is the most effective combination of manpower, materials and machinery, for all tasks in the workplace. Standard Operations will result in low defects and high safety. For transactional processes, we can consider Standard Operations as the most effective combination of people, plant (equipment/places), policies and procedures. By "effective" we mean lowest cost, highest quality and shortest time. Detailed documentation of standard working will be visible in the workplace.
Standard work	Similar to **Standard Operations.**
Statistical Process Control (SPC)	A major and essential part of Six Sigma. Useful in all the steps of Measure, Analyse, Improve and Control in DMAIC. "Statistical process control (SPC) is the application of statistical methods to the monitoring and control of a process to ensure that it operates at its full potential to produce conforming product. Under SPC, a process behaves predictably to produce as much conforming product as possible with the least possible waste. While SPC has been applied most frequently to controlling manufacturing lines, it applies equally well to any process with a measurable output. Key tools in SPC are control charts, a focus on continuous improvement and designed experiments." (Wikipedia).
Statistics	Statistics is the science of making effective use of numerical data relating to groups of individuals or experiments (Wikipedia); “a body of methods for making wise decisions in the face of uncertainty” (Wallis). “Statistics” includes four meanings: 1 The subject or discipline (of a statistician); 2. The methods of collection, analysis and interpretation of data. 3 Collections of data about something. 4 Specially calculated values describing the data (“a statistic”).
Stock Turns (ST)	Also called **Inventory** Turns. A measure of how frequently stock is turned over in relation to annual sales turnover of a product. Stock Turn = (annual sales turnover)/(value of raw materials + WIP + finished goods). Units are "per year". A high value is good as it indicates low inventory. Varies enormously across different industries. Is roughly the reciprocal of lead time.
Storyboard	A display, usually on the wall, showing the progress of a DMAIC project, Root Cause Analysis investigation, or a change being implemented in the workplace. Intended for communication and engagement of staff.
STP	Situation Target Proposal: a quick way of describing a current condition, what the new condition should be, and how to make the change.
Stratification	The division of a data set by separating it into categories. For Voice of the Customer, dividing the customers into groups by category such as income, geographical location, purchase history, age and so on. Also used for stratified

	sampling to ensure that all categories are fairly sampled.
Supermarket	A system for managing a controlled level of inventory to supply the production line with raw materials, supplies and sub-assemblies. Located near the production line, and part of the pull system, the supermarket is replenished by a kanban system.
Supply chain	The entire process for movement of materials or information from raw materials (or raw data) through to finished product supplied to the final customer. For physical goods, the supply chain encompasses procurement, manufacturing, warehousing and transport. For transactional and service processes, the supply chain is all the process steps from start to finish across all organisations if more than one are involved.
SWOT analysis	Strategic analysis of a department or organisation: Strengths, Weaknesses, Opportunities, Threats. See also PEST, PESTLE, Porter's Five Forces.
System	"A set of interacting or interdependent entities forming an integrated whole." (Wikipedia). Systems have: 1) structure defined by components (entities) and their characteristics, 2) behaviour with inputs, processing, outputs, with flow of materials and information, 3) interconnectivity with functional and structural relationships between entities, and 4) in Lean Six Sigma, a system performs function(s) for customer(s). See **Systems Thinking.**
System diagram	Diagram of a **system.** See **Systems Thinking**
Systems thinking	See **System.** "Systems thinking is a discipline for seeing wholes. It is a framework for seeing interrelationships rather than things, for seeing patterns of change rather than static 'snapshots'. It is a set of general principles…spanning fields as diverse as the physical and social sciences, engineering, and management. It is also a set of specific tools and techniques, originating in two threads: in 'feedback' concepts of cybernetics and in 'servo-mechanism engineering' theory dating back to the nineteenth century....And systems thinking is a sensibility - for the subtle interconnectedness that gives living systems their unique character." Peter Senge 1990. Systems Thinking has more recently been promoted by John Seddon for service function improvement.
Taguchi method	A **Design of Experiments** method which aims to find how to set up processes that produce quality product whilst being insensitive (as far as possible) to variations in the input variables. Leads to **Robust Processes**.
Takt time	Takt (from the German word for "beat") is the time that must elapse between successive units of the same item in order to exactly meet customer demand. “The purpose of takt time is, first and foremost, to serve as a management tool to indicate at a glance whether production is ahead or behind. It serves as an alignment tool, aligning preceding with following processes, aligning resource requirements with demand, aligning corporate functions with real-time production needs.” John Shook. Takt time (e.g. minutes per widget) is total available production time (e.g. minutes) in a period divided by customer demand (e.g. no. of widgets required) over that period. Takt is typically measured over weeks or months not short time periods. For production to

	meet demand, all cycle times must be less than takt time.
Tampering	Making adjustments to a process that are not justified by the data, and so inducing rather than reducing variation. A result of not using control charts to monitor process variation. Term popularized by W Edwards Deming.
Theory of Constraints (ToC)	Developed by Dr Eliyahu Goldratt, a physicist, and popularized in the business novel "The Goal". A management philosophy based on finding, understanding and using the constraints (bottlenecks) in a system which limit the system throughput. Also includes a set of thinking tools for system improvement, and process & project management methods ("drum, buffer, rope", **critical chain project management**, **relay runner**) with benefits over conventional methods. The constraint step is not necessarily the same as the pacemaker step in lean processing, but if the output of a lean process is to be increased then constraint(s) will need to be broken. ToC was illustrated by the story of Herbie the boy scout (see "The Goal" by Eli Goldratt). ToC is equally powerful in manufacturing and in **office, transactional and service processes**.
Three G's (3G's)	**Gemba, Gembutsu, Genjitsu** (all pronounced with hard g as in "got")
Throughput	Throughput rate. Throughput velocity. The processing rate of a **system.** Throughput equals the rate of consumption of inputs and the rate of production of outputs. Measured as things or value per unit time e.g. widgets per hour, cash per month. In **ToC,** the rate at which an organisation generates money through sales. In a steady state process, throughput is the reciprocal of **cycle time**. See **Little's Law.**
Time management	A tool of **office, service and transactional** lean. The aim is to reduce interruptions and excessive multitasking and increase **overall professional effectiveness**.
Time value map (TVM)	Value Added Timeline
TOC	Theory of Constraints
Tolerance	The difference between the upper and lower specification limits i.e. the range of variation that the customer will accept. See **voice of the customer.**
Total Productive Maintenance (TPM)	TPM is a lean method to maximise **overall equipment effectiveness** and minimise process down time. A team based approach with operators, maintenance and management. In TPM, simple settings, maintenance and fault-finding (root cause analysis) on equipment can be done by the local operators; larger maintenance tasks are done by specialised staff with minimised effect on production. There is a culture of continuous improvement of equipment and safety.

Total Quality Management (TQM)	A comprehensive approach to quality developed from the early 1980's, building on the ideas of the quality gurus including, for example, W Edwards Deming (**PDCA**, "14 Points for Management"), Joseph M Juran (e.g. Quality Control Handbook), Philip B Crosby (e.g. "**Zero Defects**", Quality is Free) and Kaoru Ishikawa (e.g. **Ishikawa Diagram**). In TQM, quality is the responsibility of all in the organisation. Quality is defined as conformance to internal customer requirements. The TQM toolkit overlaps with Six Sigma. Six Sigma has a more project-based approach (**DMAIC**) than TQM. **Lean** focuses on flow of value to the customer. **Theory of Constraints** calls attention to constraints that limit the organisation achieving its goal.
Toyota Production System (TPS)	Toyota Motor Corporation invented the methods and tools now widely know as **"lean"** (lean is a term from Womack, Jones and colleagues). Development of TPS was led by Taiichi Ohno and Shigeo Shingo. The driver was to produce a range of products of high quality but using absolute minimum of resources (as available in Japan 1945-1950s). Ohno said that TPS is not a production system but is a *management system* that can be applied to any part of the organisation and to any business. TPS is built on the scientific approach such as systematic root cause analysis; development of TPS is evolutionary.
TPM	**Total Productive Maintenance**
TPS	**Toyota Production System**
TQM	**Total Quality Management**
Transactional process, transactional lean	A transactional process (in contrast to physical manufacturing) is one that transforms information and data. For example office activities, financial functions, credit card transactions, insurance industry, order processing, invoicing, and many **service functions** such as help lines and help desks.
Transfer function	See **Y=f(x's)**
Tree diagram	A graphically depiction of how a single topic or task can be broken down into a hierarchy of sub-topics or sub-tasks and then sub-sub-topics and so on. Can be used in Lean Six Sigma for project management (work breakdown structure); risk analysis (**Process Decision Programme Chart**); problem solving (**Why-Why Diagram/Logic Tree**); Reality Tree (**Theory of Constraints**).
TRIZ	"TRIZ" is the abbreviation in Russian for "Theory of Inventive Problem Solving". TRIZ was developed by Genrich Altshuller and his colleagues in the former USSR starting in 1946, and is now being developed and practiced throughout the world. TRIZ research began with the hypothesis that there are universal principles of invention that are the basis for creative innovations that advance technology, and that if these principles could be identified and codified, they could be taught to people to make the process of invention more predictable. The research has proceeded in several stages over the last 50 years. Over 2 million patents have been examined, classified by level of inventiveness, and analyzed to look for principles of innovation. The three primary findings of this research are as follows: 1 Problems and solutions were repeated across industries and sciences; 2 Patterns of technical evolution were repeated across industries and sciences; 3 Innovations used scientific effects outside the field where they were developed. In the application of TRIZ all three of

	these findings are applied to create and to improve products, services, and systems. TRIZ works! Large and small companies are using TRIZ on many levels to solve real, practical everyday problems and to develop strategies for the future of technology. TRIZ is in use at Ford, Motorola, Procter & Gamble, Eli Lilly, Jet Propulsion Laboratories, 3M, Siemens, Phillips, LG, and hundreds more. *Adapted from www.TRIZ-journal.com*
TVM	Time Value Map
UCL	Upper Control Limit
UDE	Undesirable Effect. A commonly used term similar to "problem". A UDE is the specific and measured result of a problem. In lean, a UDE is the result of non value-added activities or waste in a system.
Undesirable Effect	**UDE**
Upper Control Limit (UCL)	The UCL is the upper line on a control chart. For normal data being charted the line is 3 standard deviations above the mean. Data points outside this line indicate out of control behaviour and are the effect of special cause variation. Part of Voice of the Process.
Upper Specification Limit (USL)	See **Voice of the Customer**
USL	Upper Specification Limit
Utilization	The average fraction of the capacity of a process or activity that is used during the operation of the process step or activity.
VA	Value Added
Value added	Value added activity is the transformation (correctly for the first time) of materials, information or service for the benefit of the customer. Value added work is what the customer wishes to pay for. The opposite of value added activity is **waste**, which the customer does not want to pay for. Wastes are categorised in lean as the **Seven Wastes.**
Value added ratio	The ratio of total value added time over total lead time as a fraction or percentage. Also called Process Cycle Efficiency.
Value added timeline	A horizontal line labelled with elapsed time in a process, with the value added times drawn above the line, and the non value adding (business essential and pure waste) shown below the line.
Value stream	All of the steps, tasks and activities (both value added and non value added) which are required in the current process to progress a product from receipt of raw materials or new information through to finished product; from receipt of a customer's order to delivery of that product or service to the customer; or from research and development into routine manufacturing (rephrased from Womack and Jones).

Value Stream Map (VSM)	VSM. A value stream map is drawn as a high level graphical description of the steps between the start and finish of a process. Typically hand drawn in the workplace in pencil on A3 sized paper. Includes physical and information flows, key measures at each process step, and value added/non value added time. Standard symbols are used and are available in some drawing software. Value stream mapping was developed and popularized by Rother and Shook in the book "Learning to See".
Variability	VARIABILITY: The variations in any portion of an operation—demand, processes, activities, supplier performance, quality, etc.--See coefficients of variation.
Variable costs	VARIABLE MANUFACTURING COST: Those operational costs that vary with the production volume in contrast to fixed costs that are independent of production volume.
Variable data	See Data Types
Variance	A measure of the spread (dispersion) of a dataset. For the normal distribution, the square of the standard deviation. See statistics texts.
Variation	Change in a process with time. In-control variation is a result of *common cause* variation of inputs. Out of control variation is a result of *special cause* variation.
Vision	The ideal state of the organisation. The target condition when everything is working faultlessly and employees experience the "perfect day". The vision includes achievement of the strategy and mission of the organisation. The Future State moves the organisation from the Current State towards the Vision.
Visual controls	Visual Controls: Various tools of visual management such as colour coding, charts, andons, schedule boards, labels, and visual flow lines or production cells. All these tools are used to display the status (normal - abnormal) of an activity so every employee can see it and take appropriate action quickly.
Visual factory, visual workplace	See **visual management.**
Visual management	The use of visible graphs, charts, inventory arrangements and storage methods that aids in implementing and maintaining lean manufacturing within a plant. People understand and relate to visual cues and data better than to other communication means. Anyone can tell at a glance if workplace activities are proceeding normally or not. It is a communication, discipline, and pacing tool. Normal and abnormal state of workplace operations can be clearly and visually defined. Simple tools are used to identify any abnormal conditions, and response is rapid to rectify the situation.
VOC	Voice of the Customer
Voice of the Customer (VOC)	The quantified requirements of a customer which are used to assess whether or not the supplier is providing the correct cost, quality, and delivery. The minimum and maximum acceptable values of a VoC measure are called the Lower Specification Limit and Upper Specification Limit respectively.

Voice of the Process (VoP)	The long term performance of a process for example as indicated by a control chart showing average and variation of key process measures. Compared to Voice of the Customer by using capability indices such as Cpk.
VOP	Voice of the process
VSM	Value Stream Mapping
Waste	Waste in lean is any consumption of resources which does not benefit the customer. The **Seven Wastes** of lean are defects, overproduction, transport, waiting, inventory, motion and processing. The mnemonics are DOTWIMP or TIM WOOD (includes Overprocessing rather than Processing). An Eighth Waste has been added: the waste of human potential. Time taken in wasteful activity is called non value added time i.e. time spent which adds no value for the customer.
Water spider	A person in a lean manufacturing plant who ensures that all materials are replenished so that work can flow without interruption. May deal with any potential interruptions to flow, assist with changeovers, and provide help as needed. The water spider is a skilled position requiring good knowledge of all the process steps.
Why-Why diagram	**Cause and Effect Logic Tree**
WIP	Work In Progress.
Work in progress	WIP. Also called work in process. Product that is between the start and finish of a process i.e. partly finished product. Work in progress is either stored between process steps or being worked on. Together with raw materials and finished goods stock, makes up the *inventory.*
Work, value added and non value added	See **Value Added, Non Value Added, Non Added but Essential,** and **Time Value Map**
WOW	Way of Working. The procedure or description of how activities are done. See **Standard Operations.**
X, x	Mathematical label for the measure of an input variable: see *Input.*
XbarR, XbarS	A **control chart** plotting the averages of sub-groups in an upper graph and the range R or standard deviation S of sub-groups in the lower graph.
Y	Mathematical label for the measure of an Output Variable: see **Output.**
y = f(x's)	Mathematical equation (relation, transfer function) showing how the output measure Y is a function of the input measures called x. **See regression analysis.**
Yamazumi chart	A chart with stacked bars showing the breakdown of **standard work** within the **cycle time**, and comparing workloads between operators to enable work balancing (line balancing).
Yellow Belt	Lean Six Sigma practitioner who has had 2-5 days of Lean Six Sigma training, who assists on Green Belt and Black Belt projects, and who applies the ideas to their own work processes.
Yield	See **First Time Yield**
Z (in Z table)	The distance between the process average and the upper specification limit, measured in standard deviations i.e. for normalized data.

Zero defects	Term introduced by Philip Crosby (along with "right first time" and "quality is free"). A philosophy and method which includes: all products meet customer specifications; use of realistic customer specifications; prevention of defects at source rather than detecting and correcting; and awareness of the full costs of poor quality.