

Glossary of Lean Production Related Terms



The following contains a (sometimes commented) glossary of terms related to lean manufacturing or production management with a brief definition. The list includes a lot of Japanese terms, although almost all of them can also easily be explained using English terms, which are also given. This list is ever expanding but never complete, as the tendency to invent new terms or buzzwords outstrips the ability of any lexicographer. **While a lot of the 391 terms below are useful, many of them seem to have been invented solely to sell more products and services to industry using fancy buzzwords.** To make things easier for you I have marked which terms are (in my opinion) more or less relevant:

- A full bullet indicates a **more relevant** term. Those will help you in your daily Lean related work.
- A circle bullet indicates a **less relevant** term. Those are less useful to me, but can be used to bedazzle others with fancy language, or to avoid being bedazzled by others.

Please [let me know](#) if you think there are any terms missing.

- [A](#) - [B](#) - [C](#) - [D](#) - [E](#) - [F](#) - [G](#) - [H](#) - [I](#) - [J](#) - [K](#) - [L](#) - [M](#) - [N](#) - [O](#) - [P](#) - [Q](#) - [R](#) - [S](#) - [T](#) - [U](#) - [V](#) - [W](#) - [X](#) - [Y](#) - [Z](#)

#

- **3 K** (Kiken, Kitsui, Kitanai): Refers to unpleasant working conditions kiken (危険, dangerous), kitsui (きつい, difficult), and kitanai (汚い, dirty).
- **3 M** (Muda, Mura, Muri): Short for the words [Muda](#) (waste), [Mura](#) (unevenness), and [Muri](#) (overburden). Very rarely there is also a 4M and a 5M with Muchi (無知) for ignorance and Mushi (無視) for ignoring (yes, I now they are almost the same). However, I think you are perfectly fine with sticking to the original 3M.
- **3 P** (Production Preparation Process): Product design process developed initially at Volkswagen focusing in manufacturability. One of its key features is the use of models or prototypes for assembly tests. See also [DFMA](#).
- **3 R** (Three "reals"): Referring to Reality, Real Place (or more correctly actual spot), Real Thing, or [Genjitsu](#), [Gemba](#), and [Genbutsu](#) in Japanese. These

Japanese words all start with the Kanji 現. Sometimes one of these 3R is swapped with [Genchi](#) for the real place or [Genchi Genbutsu](#) for going and seeing the real place. See also my post on [Visit the Shop Floor or Your People Will Fool You! – Genchi Genbutsu](#).

- **4 M** (man, machine, material, method): Common structure for potential causes for [Problem Solving](#) methods, for example as the bones of the [Fish Bone Diagram](#). This is often expanded into 8M, including additionally management, milieu, measurement, and money. Other versions exist including product/service, price, place, promotion, people/personnel, process, physical evidence; or surroundings, suppliers, systems, skills, safety.
- **5 C**: Not so common English translation of [5 S](#), where the S's are translated into 1) Clear Out & Classify; 2) Configure; 3) Clean & Check; 4) Conformity and 5) Custom & Practice. Otherwise everything else is the same. See [5 S](#) for more.
- **5 S**: Workplace organization based on Seiri (整理, organize); Seiton (整頓 orderliness); Seiso (清掃, cleaning); Seiketsu (清潔 immaculate); and Shitsuke (躰 discipline); in English often translated as sort, systematic arrangement, shine, standardize, sustain or variations thereof. Toyota uses only 4S (the last one "Shitsuke" is a latter addition and somewhat redundant). I have seen up to 8 different "S" in use, but more does not mean better here. In English also sometimes translated into [5 C](#). See also my posts [How 5S Works](#) and [How to Make 5S Stick](#).
- **5 Why**: Japanese [Problem Solving](#) approach of asking "why" five times to determine the source of the problem.
- **6 σ** (Six Sigma): Originally a quality based approach to manufacturing, requiring six standard deviations (actually 4.5 standard deviations) between the mean and the tolerance limits to ensure quality. Has by now expanded to include all of lean manufacturing and is hence often called Lean Six Sigma. Six Sigma is well known for its lean training organization awarding green belts and [Black Belts](#), although a black belt does not automatically mean that the person has experience in lean. See also my post on [Six Sigma](#).
- **7 Management and Planning Tools**: Seven Management and Planning Tools (also known as *New Seven Tools* or TQC2) promoted by [JUSE](#). These tools are: [Affinity Diagram](#), [Interrelationship Digraph](#), [Tree Diagram](#), [Prioritization Matrix](#), [Matrix Diagram](#), [PDPC](#), and [Activity Network Diagram](#).
- **7 Types of Waste**: Traditionally, waste ([Muda](#)) is grouped into seven types. The seven types of waste commonly used in lean are (in the original sequence of Ohno starting with the worst) overproduction, waiting (of operators), unnecessary transport, over-processing, inventory, movement (of operators), and defects and rework. Many more types of waste have been added in the western world, most prominently wasted human creativity – although I am a fan of the original seven types from Toyota. See [Tim Wood](#) for an easy to remember

mnemonic, although the sequence is not in the original priority. See also [Mottainai](#). See also my post [The Seven Types of Waste \(Muda\)](#).

- **8 D** (Eight Disciplines Problem Solving): Method developed at Ford in 1987 for [Problem Solving](#) based on eight disciplines, although a ninth discipline (Number 0) has later been added. The disciplines in order are: (0) Plan; (1) Use a team; (2) Describe the problem; (3) Develop interim containment plan; (4) Determine, and verify root causes; (5) Verify if permanent corrections for problem will resolve problem for the customer; (6) Define and implement corrective actions; (7) Prevent recurrence; (8) Congratulate Your team. Sometimes also called Problem Solving Process ([PSP](#)). See also [PDCA](#). See also my overview of PDCA variants at [The Many Flavors of the PDCA](#).
- **8 R**: List of aspects that have to be *right* in supply chain management or purchasing. The exact content of the list varies, as there are also examples with 5R. Usually it includes the right quality, right quantity, right material type, right place, right time, right source, right price, right type of transport, right contract. The first five of these are usually the 5R, pick any of the nine in the list for the other 8R, as not everybody agrees on what is *right*.
- **14 Management Principles of The Toyota Way**: 14 Management Principles of The Toyota Way were published by [Liker, Jeffrey](#) as an attempt to summarize the [Toyota Production System](#) into 14 principles. Examples are 1: Base your decision on long-term philosophy rather than short term goals; 3: Use pull to avoid overproduction; 4: Level the workload; 7: Use visual controls; 11: Respect your extended network of partners and suppliers; 12: go and see for yourself; 14: Become a learning organization. While believe it is impossible to capture the Toyota production system in a few bullets, I do think he got the significant key points and do like the overview. Not to be confused with the [14 Points for Total Quality Management](#) by [W. Edwards Deming](#).
- **14 Points for Total Quality Management**: List of 14 key points developed by [W. Edwards Deming](#) to help managers with transforming and improving their business. Examples would be (1) Create constancy of purpose toward improvement of product and service; (6) Institute training on the job; or (10) Eliminate slogans, exhortations, and targets for the work force asking for zero defects and new levels of productivity. Not to be confused with the [14 Management Principles of The Toyota Way](#) by [Liker, Jeffrey](#).

A

- **A3**: Structured [Problem Solving](#) sheet named after the paper format DIN A3, which is small enough to carry around yet large enough to fit all the data. Ideally done by hand, but in the western world mostly done through computer files. Sometimes also called A3 report. See also my series of posts starting with [The A3 Report – Part 1: Basics](#).

- **A-B Control:** Type of process control, where multiple sequential machines are synchronized. If the subsequent machine B stops, machine A stops, too, even if there would be still space in the buffer in between. Similarly, if the first machine A stops, machine B also stops, even if there are still parts in the buffer in between. The goal is to reduce overproduction even more than with a normal [FIFO](#) in between. Sometimes also called AB control or *Full Work control*.
- **ABC Analysis:** Sequential ordering of product variants by quantity or value sold. The goal is to distinguish high volume parts from low volume parts. 80% of the units or sales are represented by only around 20% of the part types (the "A" parts). The next 15% of the units or sales are the "B" parts, and the last 5% with low sales of many different part types are the "C" parts. See also the [80-20 rule](#), the [XYZ Analysis](#), and the [ABC YXZ Analysis](#).
- **ABC XYZ Analysis:** Combination of the [ABC Analysis](#) and the [XYZ Analysis](#), where every part number is categorized in 9 categories, from AX for frequently and in large quantities ordered part types to CZ for infrequent and little ordered part types.
- **Active Period Method:** Method to find the [Bottleneck](#) in a simulation or data-rich environment. The momentary bottleneck is the process with the longest duration between interruptions by waiting (waiting for parts from an upstream process, waiting for a downstream process). Please be aware that the statuses of the machines need to be known at all times for this method to work. Hence, the method is well suited for simulations, but less suited for real shop floors. For real shop floors I recommend the [Bottleneck Walk](#). Disclaimer: Both methods developed by me. See also my posts [Mathematically Accurate Bottleneck Detection 1 – The Average Active Period Method](#) and [Mathematically Accurate Bottleneck Detection 2 – The Active Period Method](#).
- **Adaptable Manufacturing System:** Adaptable manufacturing supposedly considers unforeseen future events during factory planning. See also [Flexible](#), [Agile](#), [Reconfigurable](#), [Robust](#), and [Holonix](#) manufacturing systems. See also my post [Facing Change in Modern Manufacturing Systems](#).
- **Affinity Diagram:** Developed by Jiro Kawakita (川喜田 二郎) and hence also known as KJ Method (for Kawakita Jiro). Sort of a [Brainstorming](#) method that groups ideas. One of the [7 Management and Planning Tools](#) by [JUSE](#).
- **Agile:** Philosophy initially for software development, somewhat similar or competing with [Lean](#). It started as a counter-movement to a heavily regulated and inflexible software development approach that was (suggested to be) used before. Hence the name Agile as a counter-movement to the inflexible and rigid system before. Not to be confused with the [Agile Manufacturing System](#). At its core is the [Agile Manifest](#), which resulted in a number of principles like "customer focus", "trust", or "communication". One popular tool is for example [Scrum](#). Similar to (good implementations of) Lean there is a focus on practical solutions

over rigid methods, a focus on working **with** people, and a focus on value for the customer. One difference is that Lean uses more standardization, which is useful if you want to make many identical physical products, whereas Agile doesn't really have work standards and focuses on flexibly getting results, which is well suited for software development, where every software is different and rigid standards would not really help. Another difference is that Lean focuses on the production and Agile on the product. Agile would be more for the development of a product, Lean more for the manufacturing of it.

- **Agile Manifest:** Core philosophy of [Agile](#). It is refreshingly brief, hence listed here in full: *We are uncovering better ways of developing software by doing it and helping others do it. Through this work we have come to value: 1) **Individuals and interactions** over processes and tools; 2) **Working software** over comprehensive documentation; 3) **Customer collaboration** over contract negotiation; and 4) **Responding to change** over following a plan. That is, while there is value in the items on the right, we value the items on the left more.*
- **Agile Manufacturing System:** Agile manufacturing aims for a quick response to changes. See also [Flexible](#), [Reconfigurable](#), [Robust](#), [Adaptable](#), and [Holonic](#) manufacturing systems. See also my post [Facing Change in Modern Manufacturing Systems](#).
- **American System of Manufacturing:** Set of manufacturing methods that evolved in the 19th century America, first in the Springfield and Harpers Ferry Armories. It includes mechanization and the use of interchangeable parts. Also known as the American System. It is an improvement of the [English system of manufacturing](#), and the precursor of [Fordism](#).
- **Amoeba Management:** Management method created by Kazuo Inamori, founder of Kyocera, former Japan Airlines CEO, and famous Japanese manager. The Company is organized in small groups of 5 to 50 people, the Amoebas. These amoebas have to create profit. If they are successful and grow, they split up. If they are not successful, they are eventually swallowed by other amoebas. The idea is to better align small groups with the company objectives and to improve their contribution to the company's success. The name originates in biology, where Amoeba are single celled organism that split in two if they grow too big.
- **Andon** (行灯, paper lantern): Signboard in manufacturing that shows the current state of the operations including for example parts produced target and current, process breakdowns, etc. Sometimes also called andon board. Often in combination with [Andon Line](#). See also my posts [All About Andon](#) and [How to Use an Andon – and How Not To](#).
- **Andon Line:** Line, button, or switch that is pressed to indicate problems at a process. Can be more than one line for minor or serious problems. Sometimes also called Andon Cord. Often in combination with [Andon](#).
- **APQP** (Advanced Product Quality Planning): Product design method originating

from the US automotive industry with the goal to design products that satisfy the customer.

- **Arubeki Sugata** (在るべき姿 or あるべき姿 combination of two words for ideal; desirable; the way something should be; target; goal; and figure, form, shape, appearance, state, condition): Japanese phrase for how it/we should be /want to be. A company needs to be clear about where it wants to go before it can achieve its goals. In English often translated as [True North](#) or target state.
- **Assembly Cell**: Cell is used in many different and often overlapping contexts in manufacturing (e.g. machining cell, [Cellular manufacturing](#), etc.). An Assembly cell is a short assembly line with few operators (10 or less), often in an [U-Line](#), where the workers are multifunctional and are moving between the stations as needed. The speed is determined by the workers, not an external conveyor or similar.
- **Assembly Line**: [Flow Shop](#) for assembly of parts. Not invented but revolutionized by Henry Ford and his Model T. Two common variants are the [Moving Assembly Line](#) and the [Pulse Line](#) with constant or interval movement.
- **Autonomation**: See [Jidoka](#).

B

- **Ba** (場, place; spot; space): Concept from Seven Eleven to gain knowledge about their business at a certain time and space to generate and share this knowledge. The word Ba is the same as in [GemBA](#), and hence closely related to [Genchi Genbutsu](#).
- **Baka Yoke** (馬鹿ヨケ, idiot proofing): Creating products and processes that cannot be done incorrectly. Rephrased by [Shigeo Shingo](#) in the politically more correct mistake proofing [poka yoke](#).
- **Baton Touch**: Most common way to organize an [U-Line](#). Each operator handles a number of tasks in the line. The processes are handled in the direction of the workflow, and the worker always handles the same set of processes (which may include a switch to the "other side" of the U). See also [Bucket Brigade](#) and [Rabbit Chase](#).
- **Black Belt**: Originally from belts in martial arts, where black represents proficiency in the selected martial art. With respect to lean a type of degree awarded through [6σ](#), also intended to represent proficiency, although there are also many degree mills. There are also other colors like yellow and green belts below, and master black belts on top. See also my post on [Six Sigma](#).
- **Blame Game**: In many companies a deeply ingrained habit. After encountering a problem the first priority is to look for someone to blame. It doesn't matter if the person is truly to blame or not, important for the career is that there is "someone else" to blame for. This *blame game* often takes priority over actual [Problem Solving](#).

- Bottleneck:** Process in the system that limits the total quantity or the capacity passing through the system. In manufacturing this is usually a process, but sometimes also a supplier or even the customer (that does not buy enough of your products). Due to fluctuations like breakdowns etc. most bottlenecks in manufacturing are shifting bottlenecks, i.e. they change over time, sometimes even rapidly. Hence, I distinguish between a momentary bottleneck and a long term bottleneck. The momentary bottleneck is the process that right now limits the capacity, the long term bottleneck are the processes that influence the bottleneck overall more than others. There may be more than one bottleneck in the long term, and even more than one in the short term. Most industry bottleneck detection methods are flawed as they do not consider shifting bottlenecks. For shop floor bottleneck detection I recommend the [Bottleneck Walk](#) developed by me, for simulation based bottleneck detection I recommend the [Active Period Method](#), also developed by me. See also my posts on [About Shifting Bottlenecks](#) and [Common Bottleneck Detection Methods that do NOT work!](#) See also my series on [Bottleneck Management](#).
- Bottleneck Walk:** Method to find the momentary [Bottleneck](#) by observation of processes and inventories and deducing the direction of the bottleneck based on these observations. Very shop floor friendly, since it requires no math and no time taking. Disclaimer: Method was developed by me. See also my posts on [The Bottleneck Walk – Practical Bottleneck Detection Part 1](#) and [The Bottleneck Walk – Practical Bottleneck Detection Part 2](#).
- Bowling Chart:** A type of tracking sheet sometimes used in project management or for ramp ups of new systems. For each of one or more [KPI](#) there are two rows: the actual value for a selected time (monthly, weekly, daily), and the target value. This is often used for ramp-ups, and hence the target is not constant. For example, if your goal for a new production line is 100 pieces per hour in 5 months, your monthly target may be 0; 10; 30; 70; 90; and finally 100 pieces per hour for each month. If the actual value is better than the target, it is marked in green, otherwise in red. Yellow can be used for a close miss.
- BPMN** (Business Process Model and Notation): System for a graphical representation of business processes. Rectangles represent activities, diamonds are decisions and branches, and circles are events. Can represent all kinds of business processes, but may be suboptimal to [VSM](#) for manufacturing processes. See [Swim Lane Diagram](#) for an alternative or variation thereof.
- Brainstorming:** Idea generation process developed by Alex F. Osborn and Charles Hutchison Clark. Basically a group of people bring up ideas on how to solve a problem, which then are grouped and sorted. One of the most popular creativity techniques, although in my view there are often better methods.
- Brownfield:** General phrase for an already existing production system or factory that is updated or modified. These changes are usually subject to the constraints

of the already existing building or machines, like wrong layout, pillars in unpractical places, too narrow doors or driveways, etc. Often, it is nicely phrased that buildings or facilities that are no longer well suited to the needs of the system inside are “historically grown”. Opposite of [Greenfield](#).

- **Bubble Diagram:** Diagram showing only the material flow using bubbles for parts connected with lines. Unlike [VSM](#) this is not showing the information flow, and hence allows more detail on the material flow. See also my post on [Bubble Diagrams](#).
- **Bucket Brigade:** Sometimes also known as “bump-back” or “bouncing line”. Elegant self-organizing method to solve the problem of uneven workloads on a production line. Every worker walks with his part along the line, until he meets the next worker or the end of the line. Then the worker walks back until he meets the preceding worker (or the beginning of the line) and takes over the part. The cycle repeats. A worker with little workload will handle more processes, a worker with lots of workload fewer. If there is a problem the other workers can keep working until all of them arrive at the problem spot and can help. Requires (among other things) short cycle times, and hence is often used in pick-and-place or commissioning of materials. See also [Rabbit Chase](#) and [Baton Touch](#). See also my posts [The Lean Bucket Brigade – Part 1: Overview](#) and [The Lean Bucket Brigade – Part 2: Details and Caveats](#).
- **Buffer:** Used to decouple fluctuations or unevenness ([Mura](#)). Usually means a type of inventory or buffer stock, but could also be a capacity buffer. See also my post [The Three Fundamental Ways to Decouple Fluctuations](#).
- **Built-in-Quality** (品質の作り込み; hinshitsu no tsukurikomi; for 品質, hinshitsu, material quality and 作り込み, tsukurikomi, manufacturing.): Designing and manufacturing products in high quality. Producing good parts in the first place rather than checking for defective parts afterwards. No defective products are passed to the next station. See also [Poka Yoke](#) and [Baka Yoke](#).
- **Bullwhip Effect:** Effect of small fluctuations in demand magnifying along the value chain and generating losses through increasingly larger demand swings. Can be avoided through [Pull](#). Also known as demand amplification, or the Forrester effect after its first publication by Jay Forrester.
- **Burabura Shain** (ぶらぶら: Burabura: strolling, aimlessly, roaming, wandering; 社員: Shain: Company Employee): Concept from Seven Eleven where an employee is wandering around in the store interacting with customers to learn more about the customer’s needs, the stores performance, and general about the business. Part of the concept of [Ba](#).

C

- **C/O** (Change Over, also sometimes abbreviated CO): Change of the machine setting from one product to another product. The change over time should be

measured from the last part of the previous product produced at regular speed to the first part of the next product produced at regular speed. See also [SMED](#).

- **CAPM** (Certified Associate in Project Management): Certification offered by the Project Management Institute ([PMI](#)) with a particular focus on project management.
- **Cargo Cult Science**: Term coined by Richard Feynman for approaches that look scientific, but in reality have nothing to do with science but merely copy what other people do without understanding. There is usually little chance of success. Named after the cargo cult in Melanesia, where during World War II the Stone Age technology islanders built straw mock airplanes, straw airports, and straw radios in the hope that real airplanes land and deliver goods as they did for the American soldiers. Common but usually doomed to fail approach in [Lean Manufacturing](#). See also [Lean Religion](#).
- **CCPM** (Critical Chain Project Management): Method on managing the [Bottleneck](#) in project management. Developed by [Eliyahu M. Goldratt](#) (1947 – 2011).
- **Cellular manufacturing**: Workplace design based on similarity between part types, where all operations for a product family are in close proximity (the cell), greatly improving material and information flow. Machines are grouped based on the family of similar part types, and the manufacturing system is divided into cells of similar part types. See also [Assembly Cell](#).
- **Chaku-Chaku** (ちゃくちゃくライン, 着々ライン, "arriving", but also after the sound of the process): Type of production where an operator loads the machines and starts the process before moving to the next machine(s). The machine works independently and ejects the part afterwards before the worker loops back to the machine. A variant of [Multi Machine Handling](#). See also my post [The Chaku Chaku Line](#).
- **Chalk Circle**: Also called "circle exercise" or "standing in the circle". Exercise and teaching method famous with [Taiichi Ohno](#). At a location of interest a circle is drawn on the ground using chalk. A person (engineer, lean trainee, etc.) is put in there, with the instruction to watch. Every now and then the coach stops by and asks what the person has seen. This exercise usually takes a few hours before the coach is satisfied with what the person has seen. See also [Kizuki](#). See also my post [Taiichi Ohno's Chalk Circle](#).
- **Change Agent**: Person in charge of driving a lean transformation ([Kaizen](#)). Often suboptimal Western concept, since one person – often with little management power – can rarely change an organization. Often an outside expert in lean. At Toyota, Kaizen is part of their culture; hence they usually do not have a dedicated change agent.
- **CONWIP** (Constant Work in Progress): A type of production control similar to [Kanban](#), but without a fixed part number assigned to the card. See also my series of posts starting with [Basics of CONWIP Systems](#).

- **Customer Takt:** [Takt Time](#) of the customer, calculated by dividing the total work time during a period by the number of parts requested by the customer (prediction or historic data). See also [System Takt](#).
- **Cycle Time:** Fastest repeatable time of a process (not the average time for a process). This cycle time does not include any losses. Can be determined for example by taking the 10th or 25th percentile of a set of measurements, although this is not clearly defined. If losses are included the resulting time is a [Takt Time](#). See also my posts [How to Measure Cycle Times – Part 1](#), [How to Measure Cycle Times – Part 2](#), and [Cycle Times for Manual Processes](#)

D

- **Dantotsu** (mashed-together word from Danzen 断然 for firmly, absolutely, definitely, extremely; and the English word Top using Japanese pronunciation.): Internal program at Denso to become the best of the best. Trying to never be in the second place whatever you do. This is especially applied to Lean. Please note that Dantotsu is a Denso-internal word, and not part of the western lean vocabulary.
- **Dashboard:** Also known as cockpit. Summarizing all relevant [KPI](#) of a process or system on one page. May contain different charts. Often used by middle and higher management to get a view of the current state on the shop floor. Has the risk of incorrect or manipulated data. [Genchi Genbutsu](#) is needed to verify if the data is correct.
- **DBR** (Drum-Buffer-Rope): Scheduling and production planning approach based on [TOC](#). Developed by [Eliyahu M. Goldratt](#) (1947 – 2011). See also my post on [DBR](#).
- **DDMRP** (Demand Driven [MRP](#)): Supposedly a method combining [MRP](#) and pull systems, although it seems to be mainly a software package. Promoted with claims that seem to be too good to be true to me, although I have not yet tried it myself.
- **Delivery Performance:** Delivery performance aims to measure the reliability of satisfying customer orders both by quantity and timewise, i.e. *in full on time*. It is usually given as a percentage of e.g. 93% of the deliveries were delivered in full and on time. Disagreement exists in industry if a too early delivery is counted as good or not, which tolerances are allowed around the scheduled delivery date, and if the scheduled delivery date is the first date requested by the customer or the date agreed on between customer and supplier based on the suppliers capabilities. Overall, it is a frequently fudged number.
- **Deming, W. Edwards** (October 14, 1900 – December 20, 1993): Quality management expert. Very influential in teaching quality control to the Japanese after World War II and hence influencing the [Toyota Production System](#). Better known but in my view less influential than [Joseph M. Juran](#). The famous

Japanese quality award "Deming prize" awarded by [JUSE](#) is named after him.

- **DFMA** (Design for Manufacturing and Assembly): Development approach where the manufacturing and assembly problems are already taken under consideration when designing the part. Sometimes also only for assembly (DFA) or manufacturing/manufacturability (DFM).
- **DFSS** (Design for Six Sigma): Tool of [6 \$\sigma\$](#) to design a product in a way to ensure good quality. See also [DFMA](#).
- **Diseconomies of scale**: Opposite of [Economies of Scale](#), where costs go up as companies become bigger. This is usually due to the effort of keeping all employees and processes aligned and informed, and also the increase of inter-organizational politics, where career building is more important than the company's success. The more employees a company has, the more difficult it will be to keep everybody informed and motivated. Larger corporations have whole departments that seem to be mostly busy with themselves or even creating more work for others, e.g. the department that is in charge of the company color and logo.
- **DMAIC** (Define, Measure, Analyze, Improve and Control): Improvement cycle similar to [PDCA](#), but more focus on analyzing the available data. Originated from the [6 \$\sigma\$](#) set of methods. See also my overview of PDCA variants at [The Many Flavors of the PDCA](#).
- **DOE** (Design of Experiments): Design of experiments to maximize the understanding of the system with the minimum number of experiments needed using statistical tools. Very similar and overlapping with Taguchi method by Genichi Taguchi.
- **DPM** (Defects per Million): A measurement of defect rates as number of defects per million parts. Pretty much synonymous with [PPM](#).
- **DQC** (Delivery, Quality, Cost): Variant of [QCD](#), where the sequence is changed to emphasize the priority of delivery performance. Promoted by lean consultant Hitoshi Takeda.

E

- **Economies of Scale**: Cost benefits from increasing the size of an operation (production, service, etc.). The constant fixed costs are distributed across more products sold and hence become smaller on a per-product basis. May also include more market power when bargaining with suppliers or customers. Opposite of [Diseconomies of scale](#), which may outweigh the economies of scale for very large companies.
- **ECR** (Engineering Change Request): Also Engineering Change Order ECO or Engineering Change Instruction ECI. Request or order to implement an engineering change to a product to improve the product (reduce cost, fix a problem, or generally improve). A large number of ECR can create havoc with a

manufacturing system.

- **ECRS** (eliminate, combine, rearrange, simplify): Framework within [TWI](#) to optimize and improve processes. Was (one of) the inputs for the Toyota [QDC](#) method, which was renamed by [Shigeo Shingo](#) into [SMED](#).
- **EFQM Excellence Model** (European Foundation for Quality Management Excellence Model): European non-profit organization with the aim to improve quality management that developed a framework for quality management and general [Operational Excellence](#). It uses a whole set of different models including eight core values that a company should have (Adding value for customer, creating sustainable future, and so on ... all true but very fuzzy and in my view not of much use for a practical approach), nine different criteria (leadership, people, strategies, ... again rather fuzzy) and a [PDCA](#) variant called RADAR for Results, Approaches, Deployment, and Assess and Refine. So far I am not impressed, but there are lots of trainings and a EFQM Excellence Award.
- **English System of Manufacturing**: First approach to [Mass Production](#) during the industrial revolution in England. Significant use of mechanization, but without interchangeable parts. Often still extensively based on the skills of the machine operators. Made obsolete by the [American system of manufacturing](#).
- **EOQ** (Economic order quantity): Mathematical approach to minimize total inventory holding costs and ordering costs. Theoretically perfect, but in practice hampered by uncertainty, fluctuations, and rapid change of customer demands or process capacity. In lean manufacturing [Pull](#) is often considered a better alternative.
- **ERP** (Enterprise resource planning): Business management software to track all data related to business, including production, development, marketing, shipping, etc. This is a further development of [MRP](#). Major companies/Software tools are SAP and Oracle.

F

- **FACTUAL** (Focus, Approach, Converge, Test, Understand, Apply, Leverage): Problem solving approach of the [Shainin System](#), somewhat similar to the much better known [PDCA](#). See also my overview of PDCA variants at [The Many Flavors of the PDCA](#).
- **Fake Lean**: Activities that look like [Lean](#), but lack understanding and commitment, and are often done primarily to please higher-ups with activities while not having the knowledge, time, or resources to actually do real improvement. See also [Lean Religion](#).
- **Fayolism**: (Outdated) management theory by Henri Fayol (1841–1925), a contemporary of [Frederick Winslow Taylor](#). In the spirit of the time the theory is geared very much towards command and control, lacking nowadays important aspects like employee development, employee empowerment, or an idea

suggestion system.

- **FBS** (Final Build Sequence): At Toyota the sequence of the cars to be built in the next week. This is a fixed short term version of the [TBS](#). Based on the FBS, a [FRS](#) is generated.
- **FIFO** (First In First Out): A type of material flow with a defined upper limit and a FIFO principle used for [Pull](#) systems. Opposite of the much less common [LIFO](#). See also my posts on [FIFO](#).
- **Fish Bone Diagram**: Also known as Cause and Effect diagram or [Ishikawa Diagram](#). Tool to determine the possible root causes of an effect. Usually, it is drawn with the effect under consideration on one side (the head of the fish), a horizontal line going out from the effect (the spine), and different lines going out from the spine (the bones). The bones represent different possible causes. These can be based on a standard set, e.g. man, machine, material, method; or can be customized. See [4 M](#) for this and other possible standard sets. Each "bone" is discussed in the group and possible causes are added to the individual bones. For example, when looking for the cause of quality problems, one bone machine could have comments like "insufficient maintenance", "broken tool", etc.
- **Fixed Repeating Schedule**: Production program pattern that is repeated unchangingly for a number of iterations before the pattern is adapted to changing demands. Part of [Heijunka](#). Closely related and sometimes synonymous with Every Part every Interval (EPEI or EPEX). See also my posts [Theory of Every Part Every Interval \(EPEI\) Leveling, Also Known as Heijunka](#) and [The Folly of EPEI Leveling in Practice](#).
- **Flexible Manufacturing System** (FMS): A flexible manufacturing system aims to produce different products on the same system. See also [Agile](#), [Reconfigurable](#), [Robust](#), [Adaptable](#), and [Holonc](#) manufacturing systems. See also my post [Facing Change in Modern Manufacturing Systems](#).
- **Flow Shop**: General name for a type of manufacturing where the production processes are arranged primarily in a sequence that is needed for the production of the parts. Well suited for [Low Mix High Volume](#) and easier to organize and improve than its opposite [Job Shop](#). See also [Project Shop](#). Sometimes also called flow production or process sequence layout. See also my post [Organize Your Production Sequence – 3: Flow Shop](#).
- **FMEA** (Failure Modes and Effects Analysis): Method to estimate the probability, severity, detection likelihood and impact of problems with products in order to focus on the most serious problems first.
- **Fordism**: Type of [Mass Production](#) established by Henry Ford, in particular for his Model T. Focus is on relentless optimization for [Mass Production](#) of one good (e.g. the Ford Model T). Its weakness is its inflexibility.
- **Forming Storming Norming Performing**: Phases of group development first used by Bruce Tuckman 1965 (1938-2016). Seems to be valid for many group

developments. Forming is the creating of the group, with the members being quite independently. Storming is the creation and exchange of opinions on the goals and approach. This may include clashes within the group. In Norming these clashes are resolved and the group learns how to work together. Finally performing is then a group that works together towards a common goal. Not all groups reach the performing stage.

- **Four Line Diary** (4行日記 yon gyo nikki: four line diary): Similar to [YWT](#), this is a sort of diary entry developed by Yoshihiro Kobayashi to learn and improve every day. It includes 4 main points: 1) **Facts**: What happened. 2) **Discovery**: What insights did we get from the facts, what did we notice? 3) **Lessons Learned**: What did we learn from the insights and facts; and 4) **Declaration**: What do I want to do in the future
- **FRS** (Final Requirement Sheet): List of required parts to produce according to the [FBS](#).

G

- **Gantt Chart**: Bar chart to visualize a project schedule. Named after Henry Gantt, a protégé of [Frederick Winslow Taylor](#), but also independently and earlier developed in Poland by Karol Adamiecki. Also known slightly modified and expanded as [PERT](#) or Activity Network Diagram.
- **Gemba** (現場, actual spot, scene of the crime, shop floor): Actual place where the action occurs, usually in contrast to paper presentations and number data. In manufacturing this usually refers to the shop floor. Sometimes also written as Genba. See also [Gemba Walk](#). While the word is somewhat similar to [Genchi](#), Gemba is more an actual location whereas Genchi is closer in meaning to *locally*.
- **Gemba Walk**: Western term for visiting [Gemba](#). Usually refers to a visit to the shop floor to see the actual situation rather than an Excel sheet or PowerPoint slide claiming to be the actual situation.
- **Genbutsu** (現物, actual article or object): Philosophy to see the actual items, rather than have data and presentations about it. Sometimes also written as Gembutsu.
- **Genchi** (現地, actual place, actual location, local, on-site, locally): Part of [Genchi Genbutsu](#) for the actual place. Sometimes also part of the [3 R](#).
- **Genchi Genbutsu** (現地: actual place; 現物: actual article or object): [Toyota](#) philosophy to go and see the actual place where the events happen and the actual items/goods/machines. Sometimes also written as Genchi Gembutsu. Based on the words [Genchi](#) for actual place and [Genbutsu](#) for actual article. See also my post on [Visit the Shop Floor or Your People Will Fool You! – Genchi Genbutsu](#).
- **Genjitsu** (現実, Reality): Referring to the real or actual situation. [Toyota](#) philosophy to go and see the actual facts and conditions.

- **Goldratt, Eliyahu Moshe** (March 31, 1947 – June 11, 2011): Israeli business management guru, famous for [Drum Buffer Rope](#), [Critical Chain Project Management](#) and [Theory of Constraints](#). Some consider him to be a genius; others are more skeptical about his achievements. Regardless of which, he had the ability to explain complex ideas in simple terms.
- **Good Thinking, Good Products** (よい品よい考, yoi shina, yoi kangae): Well-known Toyota company slogan introduced by [Eiji Toyoda](#) to promote the Toyota Creative Ideas and Suggestions System (TCISS). In a philosophical sense represents the [Toyota Production System](#).
- **Gozinto Graph** (Cacography of "goes into"): Sort of a bubble diagram to show which parts go into which sub components, components, and eventually final products. The graph includes quantities and therefore gives an overview of what is needed for which products. See also [Gozinto Matrix](#).
- **Gozinto Matrix** (Cacography of "goes into"): Matrix with a row for each part and a column for each final product. Used to determine which parts (purchased or produced) are most relevant for the production system. This was created by the mathematician Andrew Vazsonyi, who gave as source a fictitious italian mathematician Zepartzat Gozinto, which means nothing else than "The Part that Goes Into". See also [Gozinto Matrix](#).
- **Greenfield**: General phrase for a new production system or factory, where everything is designed from scratch. Gives more freedom and possibilities to suit the buildings and facilities to its exact purpose, since often quite literally at the beginning there is only a green field on which a new factory is constructed. The higher flexibility usually comes with a higher initial cost compared to the opposite [Brownfield](#).

H

- **Hanedashi** (はね出し, to jump; to leap; to spring up): Automatic unloading of items. See also [Chaku-Chaku](#).
- **Hansei** (反省, reflection): Sequence of self-reflection, taking responsibility, and committing to improvement.
- **Harada Method**: Method to enhance employee development. Actively promoted and containing some useful ideas in self-management, but high buzzword value. Named after Takashi Harada (原田 隆史), a former middle school track and field coach in Osaka. Includes 33 questions for self-reliance, a 64 field chart, and other diagrams.
- **Hawthorne Effect**: Effect of a system improving merely because it is observed. Often generates the appearance of improvement, but will revert to its former performance soon after the project is over. Also known as the observer effect. Named after its first study at the Hawthorne Works in Illinois.
- **Heijunka** (平準化, leveling, harmonization): Leveling or production smoothing,

with the goal to minimize fluctuations. Different methods can be used to smoothen production. See for example [Fixed Repeating Schedule](#). See also my posts on [Leveling](#).

- **Heijunka Box:** Box in which [Kanban cards](#) are put to [visualize](#) the [leveling \(Heijunka\)](#) pattern. Disconnected managers believe they are running a lean plant if these boxes are on the shop floor.
- **Hidden Factory:** Two overlapping meanings. (1) Processes that are not part of the standard or officially sanctioned, but done anyway by the operators to make the system work or their life easier (e.g. keeping a hidden stock of parts that are often short in supply, which makes the life of the operator easier, but in this case the overall situation worse). (2) Friction and losses in the [Value Stream](#) that create cost but cannot be clearly measured or attributed to any cause. Often simply defined as “overhead”.
- **High Mix Low Volume (HMLV):** Production program with many different variants in small quantities. Opposite of [Low Mix High Volume](#).
- **HIPPO's** (Highest Paid Person's Opinion): Usually what everybody agrees to at the end of a meeting (In case you're wondering – Yes, that is sarcastic, but unfortunately all too often true).
- **Hitozukuri** (人作り, making people): Philosophy of developing people. Rather than education, this approach considers the lifelong education, training and coaching of people as part of any excellent workplace. See also [Monozukuri](#) and less commonly [Kotozukuri](#). See also [Takumi](#).
- **Holonic Manufacturing System:** Autonomous and self-reliant manufacturing system. Initially used in 1990 for systems that can adapt to new products, research now talks about self-adjusting systems. See also [Flexible](#), [Agile](#), [Reconfigurable](#), [Robust](#), and [Adaptable](#) manufacturing systems. See also my post [Facing Change in Modern Manufacturing Systems](#).
- **Hoshin Kanri** (方針管理, policy management): Policy deployment, or how to set consistent targets throughout the hierarchy levels of an enterprise. Sometimes also called strategy deployment. In contrast see [Nichijou Kanri](#) for daily management.
- **Hyōjun Sagyō** (標準 Hyōjun: Standard, Level, Norm; 作業 Sagyō: work; operation; manufacturing): Japanese Term for [Standardized Work](#). The kanji shown here are used by Toyota, but other companies as for example Nissan use slightly different kanji.

I

- **Improvement KPI** (Improvement Key Performance Indicator): [KPI](#) to measure improvement of projects. Can be based on [Monitoring KPI](#). Seems to be redundant with just plain old “KPI”. Expression is rarely used. Difference between Monitoring KPI and Improvement KPI often ill-defined and confused. In my view

using just KPI is good enough for most cases.

- **Industry 4.0:** German government program to promote new developments related to computers in industry. Exact content is a bit fuzzy, but includes especially the internet of things and cyber physical systems. A major buzzword in Germany since 2013, but often with little to show for. See also my post [A Critical Look at Industry 4.0](#)
- **Information Flow:** Flow of the information through the [Value Stream](#). One of the key points to optimize in [Lean Manufacturing](#), for example to achieve the goal of [Pull](#) production. Often combined with [Material Flow](#). Note that the material flow can also overlap with the information flow, as for example in a [FIFO](#) the material is also the information on what to produce next.
- **Interrelationship Digraph (ID):** Variant of cause and effect diagrams. One of the [7 Management and Planning Tools](#) by [JUSE](#).
- **Ishikawa Diagram:** Named after Kaoru Ishikawa (石川馨), but pretty much the same as a [Fish Bone Diagram](#). Most such diagrams have 4, 6, or 8 standard "bones". See [4 M](#) for details.
- **ISO 18404:** Standard developed by the International Organization for Standardization (ISO) to certify organizations and individuals in [6 σ](#) and/or [Lean](#). In my view like similar ISO norms (e.g. ISO 9001 for quality) it seems to be mostly a money making thing by selling certificates without really changing the quality of the underlying Lean or Six Sigma. Luckily, so far this is not (yet) accepted by the Lean community, and hopefully never will be. See also my post [Lean Standard ISO 18404 – A Questionable Idea ...](#)
- **Item Specific Dunnage:** Dunnage in general is inexpensive filler material for packaging. Item specific dunnage is cut to fit exactly one type of part. This could be blisters (similar to the plastic trays for pralines where each praline has a indent fitting this praline), or cut out foam to match the shape of the parts. With this item specific dunnage it is easy to get exactly the right number of parts in a box. Hence it is also a way for [Visual Management](#).

J

- **Jl (Job Instructions):** [TWI](#) component focusing on how to train inexperienced workers faster.
- **Jidoka (自動化, Autonomation):** (Semi-) intelligent machines or processes that stop by itself if a problem occurs. It is a Japanese play on words on automation, which sounds identical, but has slightly different kanji, 自動化, where for automation the middle kanji has an additional radical indicating people.
- **Jinbou (じんぼう or 人望 for popularity):** One of the aspects of [Toyota](#) for the evaluation of its managers is Jinbou, or trust, also often translated as "personal magnetism". This represents the level of trust subordinates have in their manager, and how much trust a manager is able to win from its subordinates. By its nature,

this aspect is hard to quantify. This aspect contributes 10% to the overall manager evaluation. See [Toyota Manager Evaluation](#) for more.

- **Jinzai Katsuyou** (人材 or じんざい for human resources or personnel; and 活用 or かつよう for practical use): Ability not only utilize but also develop the available human resources. The goal is to make the best out of its employees. One of the five aspects of the [Toyota Manager Evaluation](#).
- **Jishuken** (自主権, autonomy): Management driven improvement activities. Managers identify the areas of improvement.
- **JM** (Job Methods): [TWI](#) component focusing on how to evaluate work and how to suggest improvements.
- **Job Shop**: General name for a type of manufacturing where the production processes are not arranged in a sequence that is needed for the production of the parts. Instead, they are often arranged by their primary function (e.g. a welding department, a milling department, the lathe department ...). Usually found with [High Mix Low Volume](#) and more difficult to organize and improve than its opposite [Flow Shop](#). Sometimes also called process village layout. See also [Project Shop](#). See also my post [Organize Your Production Sequence – 2: Job Shop](#).
- **JR** (Job Relation): [TWI](#) component teaching supervisors on how to deal with workers fair, respectfully and effectively.
- **Jundate** (順建て jundate: Picking parts; short for 順序建て junsho date: order, sequence, procedure and commitment): Japanese term at Toyota for the *way of setting up parts for assembly*. Usually involves [Kitting](#). See also [SPS](#).
- **Juran, Joseph M.** (December 24, 1904 – February 28, 2008): Quality management expert. Very influential in teaching quality control to the Japanese after World War II and hence influencing the [Toyota Production System](#). While less known than [W. Edwards Deming](#), in my view Juran was more influential.
- **JUSE** (Japanese Union of Scientists and Engineers): Japanese group for the advancement of science and technology, founded after World War II. Awards the famous [Deming](#) prize.
- **Just in Sequence** (JIS): Delivery of products in the exact sequence they are needed.
- **Just in Time** (JIT): Delivery of goods exactly at the time when they are needed, in the quantity they are needed, and in good quality. In proper English grammar this would be *just on time*, but in Lean *just in time* is used. See also my series of posts starting with [What Is "Just in Time"?](#)

K

- **Kadai Souzouryoku** (課題 or かだい for subject; theme; issue; matter; and 創造 or そうぞうりょく for creative power; creativity.): Ability to identify core problems. One of the five aspects of the [Toyota Manager Evaluation](#).

- **Kaiaku** (改悪, changing for the worse): Making things worse despite best intentions to improve. Unfortunately all too common with lean manufacturing in the west.
- **Kaidai Suikou** (課題 or かだい for subject; theme; issue; matter; and 遂行 or すいこう for accomplishment; execution;): Ability to carry out tasks and see them through to the end. One of the five aspects of the [Toyota Manager Evaluation](#).
- **Kaikaku** (改革, reform): Fundamental and radical changes. See also [Kakushin](#). Part of [Kaizen](#).
- **Kaizen** (改善, Continuous improvement): Japanese philosophy of continuous improvement. Sometimes also abbreviated as CPI for continuous process improvement.
- **Kaizen Blitz**: Two meanings: 1) Short and fast improvement ([Kaizen](#)) activities to solve easy-to-solve problems. Introduced by the AME (association for manufacturing excellence) in 1994. Most often found in the [6σ](#) brand of lean. Sometimes, this is also called a "5-day Kaizen", based on Japanese experts visiting the US for a one-week trip. While there are some problems in Lean that can be solved quickly, most require more time for analysis, implementation, and especially confirmation that it works. Hence, a Kaizen Blitz or Kaizen Event may work, but most of the time would be insufficient to solve a problem. 2) Marker on a [Value Stream Map](#) to indicate an improvement idea.
- **Kaizen Event**: Generally any type of event or activity aimed towards improvement ([Kaizen](#)) of the situation. Also called Kaizen workshop. Usually applied to events related to [Lean](#). Term coined by the AME (Association for Manufacturing Excellence) in the 90's.
- **Kaizen Group**: Small team focusing on improvement ([Kaizen](#)).
- **Kakushin** (革新, reform or innovation): Indicates larger and more radical changes. Often translated as revolutionary changes, but in my view this would be [Kaikaku](#). Generally part of the improvement process, or [Kaizen](#).
- **Kamishibai** (紙芝居, paper drama): Originally Buddhist paper theater performance for children. At [Toyota](#) tool for visual management, where cards with audit or problem related information are on a board. If a card has been turned over, then it is completed. Not turned over cards indicate that the problem has not been solved (yet) or the audit has not yet been performed. Sometimes used together with [T-Cards](#). Sometimes misspelled as Kamishabi.
- **Kanban** (看板, signboard): Initially describing the signs above Japanese shops, but with respect to lean nowadays better known as the information in a pull system, usually as kanban cards. Often works with [Supermarkets](#) and [FIFO lanes](#). Sometimes further detailed [Production Kanban](#), [Transport Kanban](#), or (less frequently) [Triangle Kanban](#).
- **Karakuri Kaizen** (usually written as からくり, but sometimes also as 絡繰り or 絡繰 (Karakuri) for gimmick, mechanism, machinery, contrivance or device; and

改善 (Kaizen) for Continuous improvement): Using creative but inexpensive mechanisms to transport material without the use of human muscle (but may be initiated by a human movement). Key part here is not the use of mechanics, but rather an ingenious technical trick or gizmo. Usually uses little or no electronics. A mere gravity slide would be too simple for Karakuri [Kaizen](#), whereas a full blown automated system with sensors and actuators would be too complex. In Japan outside of lean the word Karakuri is better known as Karakuri ningyō for (usually historic) mechanical doll.

- **Karoshi** (過労死, Death from overwork): (Mostly) Japanese phenomena of death from overwork, sort of an extreme form of burn out.
- **Kata** (型, pattern, form): Originally a choreographed movement in martial arts to teach students behavioral reflexes. In lean an approach coined by the book of the same name by Mike Rother, sometimes also called "Improvement Kata". The four steps are 1) Understand the challenge/define the long term target; 2) Understand current condition; 3) Define the short term target; and 4) move towards the short term target. This approach should be used for every problem; its repeated usage is the equivalent of the martial arts Kata. A set of questions have been developed to reinforce this approach. The method is loosely based on [TWI](#).
- **Katashiki** (型式: Katashiki: Vehicle type or model): General model or type, often used with automobiles. For example Toyota has an alphanumeric code called Katashiki that details exactly what model and options make up the vehicle. See also the [Katashiki Card](#).
- **Katashiki Card** (型式: Katashiki: Vehicle type or model): Print out at Toyota showing the different options and settings for a specific vehicle. The Katashiki card may indicate if it is a two or four door, if it has a sunroof, the type of entertainment system, the color, etc. Based on the [Katashiki](#).
- **Keiretsu** (系列, grouping of enterprises): Japanese industry groups of different legally independent companies that are closely connected through both mutual shareholding and business relation. Originated from [Zaibatsu](#), but rather than a controlling family at the top has mutual relationships. There are "horizontal keiretsu" that are financially connected, usually involving a major bank; and vertical keiretsu that link different companies along the [Supply Chain](#) (but not to be confused with [Kyoryokukai](#)). These systems are rare outside of Japan. Keiretsu reduce the risk of hostile takeovers and limits the influence of stock market fluctuations.
- **Kingman's formula** (sometimes also Kingman's approximation or – less accurate – equation): Formula to estimate the mean waiting time (or [Throughput](#)) of a single process based on the mean and variance of the [Cycle Time](#) and arrival time as well as the utilization. Very handy if you need to estimate the waiting times e.g. in a hospital or for a call center. The system has to be steady state, but there are no limitations on the type of distribution for arrival or cycle time. Please be aware

that the output is only an approximation, not an exact result. Developed by John Kingman in 1961.

- **Kitting**: Providing material to the assembly line in kits. The kitting is the actual process of picking different parts in a larger supermarket (often near the assembly line) in order to provide a set of needed parts to the assembly line. Often used if there are many different part types and space around the assembly line is an issue. See also [SPS](#).
- **Kizuki** (気付き, Awareness, Realization): Japanese term for the ability to notice. Based on a verb Kitsuku (気づく, to notice, to recognize, to realize). See also [Chalk Circle](#).
- **Kotozukuri** (事作り, making stories): Term used at Nissan to represent “brand storytelling”, with the goal of entering in a dialogue with the customer. Little used outside of Nissan. See also [Monozukuri](#) and [Hitozukuri](#).
- **KPI** (Key Performance Indicator): A measurement of performance to understand the overall performance of the system. Abbreviation less commonly also used as “Key Process Improvement” focusing on the most important processes only, or even “Key Process Improvement Indicators”. See also [KPR](#), [KPI Tree](#), [Monitoring KPI](#), and [Improvement KPI](#). Furthermore see [OKR](#) for a slightly different approach. See also my posts on [KPI](#).
- **KPI Tree** (Key Performance Indicator Tree): Hierarchical structure of [KPI](#), where lower level KPI are aggregated into higher level KPI.
- **KPR** (Key performance Resource): Little used term referring to the most significant resources (man, machine, material) needed to achieve [KPI](#).
- **KPT** (Keep, Problem, Try): Approach to summarize learnings at the end of a session/project/day: Keep are the good things that happened and that you want to keep. Problems are issues that are not yet resolved but have to be addressed, and Try are ideas and approaches to resolve these problems. It is longer than a [YWT](#), and can easily take 30 minutes. It is often done in writing on a flipchart or whiteboard.
- **Kyoryokukai** (協力会, Suppliers Association): Japanese term for supplier association, where the suppliers of a major customer (often an automotive firm) work closely together to improve [Material Flow](#), [Information Flow](#), quality, and many other aspects of production. They also coordinate improvements activities. They originated with [Toyota](#) in the 1930’s. An important difference to western suppliers is that the major customer is not in charge of the group. Instead, these groups are organized by the suppliers. This requires the major customer to give more control to the suppliers. It is claimed that Kyoryokukai outperform traditional western supply chains.
- **KYT** (Abbreviation for 危険 kiken: Danger, Hazard; 予知 yochi: prediction; 訓練 kunren: training): Standard approach in Japan to find and resolve potentially dangerous [OHS](#) issues. While there are different approaches, 4 steps seem to

be popular: 1) Understand the current situation: Point out potential health and safety issues; 2) Understand the causes of the danger.; 3) Plan countermeasure; 4) Set targets and goals

L

- **LAMDA** (Look, Ask, Model, Discuss, Act): Sort of a [PDCA](#) with particular focus on product development. See also my overview of PDCA variants at [The Many Flavors of the PDCA](#).
- **Lead Time**: Total time a part is in the system, also time a part needs to pass from the beginning to the end. Significant as this is usually also the minimum time needed to produce a product for the customer. Usually the average value is used. Can be calculated using [Little's Law](#).
- **Leader Standard Work**: Aims to improve leadership behavior to foster a culture of [Kaizen](#). Also known as or similar to kaizen for management, lean management, or lean leadership. In my view the [Toyota Production System](#) is not excellent because of its methods but because of the excellent management at [Toyota](#). See also [Kata](#).
- **Lean**: More general term than [Lean Manufacturing](#), which originates in the [Toyota Production System](#). Also applies outside of manufacturing, e.g. lean banking, lean office, lean government, lean military, lean service, lean accounting, lean logistics, lean management, lean product development, lean startup, lean maritime, or anything other type of industry or sector that you can think of with the word "Lean" added.
- **Lean 2.0**: Part of the general trend to rejuvenate a buzzword (in this case [Lean](#)) by simply adding another "version" number to it (Internet 2.0, industry 4.0, web 2.0, ...). While lean has been around for decades, it is still in my view the best approach to organize and improve manufacturing and related systems. Lean 2.0 also has no real changes except for a vague promise to fix everything that is wrong in lean (See for example [Lean Religion](#)), or simply promise to be better without going into detail on how it actually will be better. In my view this term is not needed, and luckily seems to be little used by real practitioners.
- **Lean consumption**: Opposite of [Lean Manufacturing](#) or lean production. Sort of [Lean](#) for retailing or service providers. Tries to provide the customer exactly what he wants, when he wants it, where he wants it, in good quality, and without wasting the resources of the customer. Possibly a buzzword.
- **Lean Enterprise**: Attempt at a re-branding of lean with the goal to provide lean not only in manufacturing, but for the entire enterprise. See also [Lean Religion](#)
- **Lean Manufacturing**: Both generic term for and based on the Toyota Production System ([TPS](#)). Usually used synonymous with [Lean Production](#), although lean manufacturing is more common. Term coined by John Krafcik. Versions of Lean manufacturing outside of Toyota often flawed (see [Lean Religion](#)). Sometimes

also called lean production, and also often abbreviated to Lean.

- **Lean Production:** Same as [Lean Manufacturing](#), which is more common.
- **Lean Religion:** Implementation of the methods of the [Toyota Production System](#) (lean manufacturing) without understanding the causes or reasons. Usually leads to waste due to lots of improvement effort with little results; or even worsening the situation. Example would be management requiring the use of [Kanban](#); hence the shop floor calls every piece of paper Kanban without any resemblance to a [Pull](#) system. In effect Lean is treated like a religion, you don't need to know the details, as long as you do whatever the guru says you will be fine. See also [Cargo Cult Science](#) and [Fake Lean](#).
- **LIFO** (Last in, First Out): Opposite of [FIFO](#). Also type of material flow with a defined upper limit. The sequence, however, is last in first out, i.e. the last part that arrived is the first one that is removed. This approach is rarely used, since it has a high risk of parts staying in the system for a long time. Usually only used if storage conditions force this system. I.e. if parts are stacked, the last part stacked on the top is also the first part removed, since it would be difficult to remove the part at the bottom of the stack. Another example: A pile of material (coal, stones, etc.) is both filled and emptied from the top. Hence the material at the very bottom was the first to be added, but will be the last to be removed.
- **Lights out Factory:** Vision of a factory that is so highly automated that there are normally no workers present at all. Hence, you can turn off the light and the factory keeps on working. Japanese Robot maker FANUC runs lights out factories for up to 30 days at a time, turning off not only the light but also the heating and air conditioning.
- **Liker, Jeffrey:** Jeffrey K. Liker is a Professor of Industrial and Operations Engineering at the University of Michigan and a well-known expert on the [Toyota Production System](#). Among others he published the [14 Management Principles of The Toyota Way](#).
- **Line Balancing:** Process of evenly distributing the work across the stations on the line with the goal that every process/worker has approximately the same cycle time. Overall speed (the [System Takt](#)) should match the [Customer Takt](#). The difference to the target [Cycle Time](#) is the [OEE](#). See also [Yamazumi-chart](#) if you prefer a fancy Japanese name. The chart is also sometimes called an "Operator Balance Chart" (OBC), or "Operator Loading Diagram".
- **Little's Law:** Relation between the [WIP](#), the [Lead Time](#), and the average time between parts. The lead time is the WIP multiplied by the average time between parts. Named after John Little, and also used in many instances of probability theory outside of manufacturing. See also my post [A Eulogy for Little's Law](#) for more details.
- **Low Mix High Volume** (LMHV): Production program with few product variants

which are produced in high volume. Opposite of [High Mix Low Volume](#).

M

- **Make to Order (MTO):** General term of products that are produced only for a specific customer order. Often for [High Mix Low Volume](#) production. Often produced in a [Job Shop](#), but [Flow Shop](#) production is also sometimes possible. Opposite of [Make to Stock](#). Since you do not have finished goods stock, you cannot decouple fluctuation through finished goods stock, hence the customer usually has to wait until the product is completed, hence decoupling through time.
- **Make to Stock (MTS):** General term of products that are produced for an inventory rather than a customer order, and the customer satisfies his demand by taking a part out of the inventory. Possible only for products where a customer demand for this product can be expected, mostly [Low Mix High Volume](#) production. Usually produced in a [Flow Shop](#). Opposite of [Make to Order](#). The Advantage of MTS products is that you can decouple fluctuations through your inventory (your stock).
- **Mass Customization:** The vision to create individually customized products at mass production cost and prices. I.e. to get a fancy bespoke suit for the price of a mass produced warehouse suit. Usually still requires large quantities to have some efficiencies of scale. See also my post [Strategies for Mass Customization](#).
- **Mass Production:** Production of large number of identical parts. Through the large quantity it is possible to benefit from the [Economies of Scale](#). Started in the late 19th century in the USA, for example with matches, cigarettes, and canned food. Often uses an [Assembly Line](#).
- **Material Flow:** Flow of the material through the [Value Stream](#). One of the key points to optimize in [Lean Manufacturing](#), for example to achieve the goal of [One Piece Flow](#). Often combined with [Information Flow](#).
- **Matrix Diagram:** Matrix that shows the relationship between items. Not to be confused with the [Prioritization Matrix](#). One of the [7 Management and Planning Tools](#) by [JUSE](#).
- **MBO (Management by Objectives):** Leadership by giving numerical targets to the subordinates, giving the subordinates the means to achieve this target, and then let the subordinate work to achieve the target results. Method developed by management guru Peter Drucker. See also [SMART](#).
- **MBWA (Management by Walking Around):** Leadership approach that involves walking around through the supervised area for random checks and suggestions.
- **MCE (Manufacturing Cycle Efficiency):** Ratio of the [Value Add](#) time to the total [Lead Time](#) (although some sources on MCE confuse [Lead Time](#) with [Throughput](#)). It is the percentage of the time of the lead time that a part is really worked on. Loosely related to the [OEE](#).

- **Mieruka** (見える化 or みえるか for visualization or making it visible. Consists of 見える or mieru for being able to see and 化 or ka for the action of making something): Term at [Toyota](#) for [Visual Management](#). The idea is to make the process or system easier to understand and observe.
- **MIFA** (Material and Information Flow Analysis): [Toyota](#) method for a structured diagram showing the current or future state of the [Material Flow](#) and [Information Flow](#) of the [Value Stream](#), often on the shop floor. This was the original basis for the [VSM](#) and [VSD](#), but with slightly different icons. The method is also much less prominent at Toyota compared to the western World, where VSM and VSD are often almost considered mandatory for any [Lean Manufacturing](#) projects. At Toyota, it is also sometimes called [MIFD](#).
- **MIFD** (Material and Information Flow Diagrams): Other name for [MIFA](#).
- **Mikara Unpan** (Probably ミカラ運搬 or 身空運搬. 身: mi: Main part, meat, body; 空: kara: emptiness, vacuum, blank; 運搬: unpan: transport, carriage): Loaded-empty container exchange system (or packaging in general). Also sometimes abbreviated mikara (実空). In contrast to [Minomi](#). Rarely used outside of Japan.
- **Milk Run**: Material provider that delivers material to different stations in sequence and has a fixed schedule similar to a bus timetable.
- **Mind Map**: Diagram to visualize information. The core theme is usually drawn in the middle, with different branches extending, splitting, and connecting again to visualize the connections in between. In my view sometimes quite a useful tool to grasp a problem with many complex interactions.
- **Minna Shuyaku** (みんな主役 for all; everyone; everybody and leading part; leading): Common phrase at Toyota management that everybody is a leader. There are no unimportant people or employees. You are in charge of your own work.
- **Minomi** (みのみ or ミノミ for minomi; or also possibly 身: mi: Main part, meat, body; のみ: nomi: only, nothing but): Approach to deliver material to the point of consumption (e.g. an assembly line) without any packaging or containers. The delivery could be e.g. through a dedicated mobile rack (*minomi cart*), or hanging from hooks. This approach reduces handling of packaging material. See also [Mikara](#). Rarely used outside of Japan.
- **Mizusumashi** (水澄まし, water strider or water spider): Person in charge of supplying materials to a set of processes in random order. In English also often called [Point of Use](#) provider. Different from a [milk run](#), the point of use provider does not have a fixed schedule and route, but provides material for a small area (e.g. one process or a short line) on an as-needed basis. The area covered must be small enough so that the point of use provider can still track all needs, respond quickly, and keep everything in sight.
- **Monitoring KPI** (Monitoring Key Performance Indicator): A [KPI](#) that is measured on the lowest level of hierarchy and can be observed, measured, or counted

directly. Expression is rarely used. Difference between monitoring KPI and [Improvement KPI](#) often ill-defined and confused. In my view using just KPI is good enough for most cases.

- **Monozukuri** (物作り, or more often ものづくり, making things by hand, craftsmanship): Spirit and mindset in producing the best products that you are able to and to constantly strive to become better at it. Fundamental part of Japanese values and ethics. See also [Hitozukuri](#) and less commonly [Kotozukuri](#). See also [Takumi](#).
- **MOST** (Maynard Operation Sequence Technique): [Predetermined Motion Time System](#) common in Asia. Compared to [MTM](#) common in Europe and America, MOST handles recurring steps better, whereas MTM often overestimates the time. Both measure times in [TMU](#). See also [TVAL](#) for a related system used at Toyota to measure fatigue.
- **Mottainai** (もったいない or 勿体無い for wasteful): Common Japanese expression also used in Lean as a sort of regret concerning waste. A good English translation would be "What a waste!". See also [Muda](#).
- **Moving Assembly Line**: Type of [Assembly Line](#) that is constantly moving while the processes are running. Often also called a continuously moving assembly line. Suited for shorter cycle times, otherwise a [Pulse Line](#) may be better. See also my post [Pacing of Flow Lines 2 – Continuously Moving Line](#).
- **MQB** ("Modularer Querbaukasten", German for Modular Transversal Toolkit): Platform strategy at Volkswagen with the goal to reduce the number of part types for many of its cars. See also [TINGA](#).
- **MRP** (Material requirements planning): Production planning and scheduling software to keep track of the mass of data in manufacturing. A later version that tracks all manufacturing data was called Manufacturing resource planning. Since it has the same abbreviation MRP it is also called MRP II. Term is still used but superseded by [ERP](#), although many use these terms as synonyms.
- **MTBF** (Meantime Between Failures): The average time between the breakdowns of a process until the process is repaired again. However, there are different definitions, and sometimes it is defined as the average time between breakdowns including repair time ([MTTR](#)), which would actually make more sense based on the abbreviation MTBF. In this case, a different abbreviation [MTTF](#) is used for the time between breakdown and repair. Usually, the underlying statistical distributed is right tailed, meaning that you will have a lot of short times between failures and a few very long times. See also [MTBF](#) and [MTTR](#).
- **MTM** (Methods-Time Measurement): Popular [Predetermined Motion Time System](#) developed around 1940 and published 1948 in a book with the same title by Maynard, Stegemerten, and Schwab. There are nowadays different flavors, e.g. the original MTM 1, MTM 2, MTM 3, and MTM-UAS. It measures times not in seconds, but in [TMU](#). See [MOST](#) for a system common in Asia that evaluates

recurring tasks better, and [TVAL](#) for the Toyota system that is particularly good at including the effect of fatigue.

- **MTTF** (Mean Time To Failure): The average time after a process is repaired until the process breaks down again. Used if [MTBF](#) is defined as the time between failures. See also [MTBF](#) and [MTTR](#).
- **MTTR** (Mean Time to Repair): The average time after a breakdown of a process until the process is up and running again. Usually, the underlying statistical distributed is right tailed, meaning that you will have a lot of short repair times and a few very long times. See also [MTTF](#) and [MTTR](#).
- **Muda** (無駄, waste): Key concept of the [Toyota Production System](#), with the goal to reduce waste, usually categorized in [7 Types of Waste](#). One of the [3 M](#). See also [Waste Walk](#) and [Mottainai](#). See also my post [The Seven Types of Waste \(Muda\)](#).
- **Multi Machine Handling**: System where one operator handles more than one machine. Ideally, the operator loads and sometimes also unloads parts and starts the machine. While the machine processes the parts, the operator proceeds to the next machine. After handling two or more machines, the operator comes back to the first machine to repeat the cycle. It is important that if possible the machines wait for the operator, not the other way round. For a variant with loading only see [Chaku-Chaku](#). It is usually a [Low Mix High Volume](#) type of production. While somewhat similar, working at different machines in a [Job Shop](#) does not include a cycle, as the next machine or process may be different depending on the required products in a [High Mix Low Volume](#) production.
- **Mura** (斑, unevenness): Key concept of the [Toyota Production System](#), with the goal to reduce unevenness or fluctuations in material flow, information flow, or any other activities or items, and increase leveling (heijunka). One of the [3 M](#). Often done through [Buffer](#). See also my posts [Muda, Mura, Muri: The Three Evils of Manufacturing](#) and [The Three Fundamental Ways to Decouple Fluctuations](#).
- **Muri** (無理, unreasonable, overdoing): Key concept of the [Toyota Production System](#), with the goal to prevent unreasonable demands on the workers, machines, or material. One of the [3 M](#). See also my post [Muda, Mura, Muri: The Three Evils of Manufacturing](#).

N

- **Nagara Fixture** (乍ら or ながら for while, during, as.): Fixture for a [Moving Assembly Line](#), in particular in automotive, that carries parts or tools. This fixture moves along with the assembly line while the worker is working. When the task is completed the nagara fixture moves against the direction of the assembly line to the next part (automobile). These nagara fixtures are often either trolleys that are pulled along the assembly line (often nicknamed *pirate ships*), or tool racks hanging from above the line (often nicknamed *space ships*). See also [Nagara-](#)

[Switch.](#)

- **Nagara-Switch** (乍らスイッチ or ながらスイッチ, literally “While-Switch”): Flexible rod switch designed for swiping rather than pressing to allow faster actuation. Can be used easily and quickly while walking past the switch without stopping. See also [Nagara Fixture](#). The Nagara switch is described in my post on the [The Chaku Chaku Line](#).
- **Nemawashi** (根回し, making arrangements): Informal process of getting support from coworkers and others before starting a project in order to increase the chances of success. See also [Tatakidai](#).
- **Nichijou Kanri** (日常: ordinary, regular, everyday, usual; 管理: control, management): Daily management. Sometimes also spelled Nichijo Kanri. In contrast see [Hoshin Kanri](#) for longer term policy deployment.
- **Nomikai** (飲み会 or のみかい for drinking party or get-together): Common event in Japan where the employees of a company group meet after work to drink together. This helps bond the group, but also takes away even more personal time from the workers, reducing their work-life balance. May involve larger quantities of alcohol. More common in large cities like Tokyo, where the employees go home using public transport, less common in smaller towns where the employees have to drive home. Also seems to be more common with office workers, less common with shop floor workers.
- **NUMMI** (New United Motor Manufacturing Inc.): Joint venture between GM and Toyota 1984 – 2010 in Fremont, California. Known for its spectacular success in introducing the [Toyota Production System](#) in the Western World.

O

- **OAE** (Overall (production) Asset Efficiency): Rarely used variant of the [OEE](#), but renames the “Equipment” in OEE to the more general Asset.
- **Obeya** (大部屋, big room): Space assigned for a project team where all members work together, not only for meetings. Over time the room usually fills with data and charts on the wall. A western term would be “war room”. See also my post [Visual Management during World War II – A Visit to the Lascaris War Rooms in Malta](#).
- **OEE** (Overall Equipment Effectiveness or Overall Equipment Efficiency.): Measures a sort of [Utilization](#) of a process or a system, and also allows the analysis of the different losses. The OEE is the ratio of the number of good parts produced to the theoretical maximum number of parts, which is identical to the ratio of the [Cycle Time](#) to the average time between parts. The OEE cannot exceed 100%, unless it is manipulated (as it frequently is). The remaining percentage between the OEE and 100% are usually called the losses, and can be further divided into availability losses (machine stopped), speed losses (machine slower than target speed), and quality losses (bad parts). There are many

variants and flavors of the OEE, including [MCE](#), [OFE](#), [OLE](#), [OTE](#), [OAE](#), and – not a joke! – [PEE](#). See also my series of posts starting with [What is OEE? – Definition of OEE](#), and my articles tagged as [OEE](#).

- **OFE** (Overall Factory Efficiency; also Overall (semiconductor) Fab Effectiveness): Rarely used variant of the [OEE](#) with the goal to represent not only one process but the relationship of the processes of an entire factory. I personally think it is difficult to combine multiple processes meaningful into an overall “factory” metric, and this is probably why these luckily never has caught on. See also [OLE](#) and [OTE](#) for near-identical system wide variants of the OEE.
- **OHSA** (Occupational Health and Safety): Abbreviation often used for the large issue of workplace safety, with the goal to reduce accidents and injuries. The World Health Organization WHO defines this as follows: Occupational health deals with all aspects of health and safety in the workplace and has a strong focus on primary prevention of hazards. See also [KYT](#).
- **OKR** (Objectives and Key Results): Variant of [KPI](#) with a stronger focus on objectives than only results. Objectives are defined for the team/employees as part of a management by objectives ([MBO](#)) approach. First used at Intel. In my view primarily a change in semantics compared to KPI’s to nudge the user more towards useful metrics.
- **OLE** (Overall Line Efficiency): Rarely used variant of the [OEE](#) with the goal to represent not only one process but the relationship of the processes of an entire factory. I personally think it is difficult to combine multiple processes meaningful into an overall “factory” metric, and this is probably why these luckily never has caught on. See also [OFE](#) and [OTE](#) for near-identical system wide variants of the OEE.
- **OMCD** (Operations Management Consulting Division): Internal consulting group of [Toyota](#), helping to develop, promote, and spread the [Toyota Production System](#) both within the Toyota group and with its suppliers. They are seen as the disciples of [Taiichi Ohno](#) and guardians of the Toyota Production System.
- **One Piece Flow**: Production in its ideal state according to lean. The lot size is one, there are no change over times, and no inventory whatsoever between the processes. Closely related and sometimes used similarly to continuous flow or single piece flow. The original Japanese term is Ikko-Nagashi (一個流し), literally translated as one piece draining or pouring. One Piece Flow is common misunderstood as continuously moving of parts. However, the parts may as well pause and wait. Focus is more on small lot sizes and small inventories. See also my post [Toyota’s and Denso’s Relentless Quest for Lot Size One](#) for some good examples.
- **On-the-job training** (OTJ or OJT, both abbreviations are in use): Training of new workers directly on the job, i.e. learning while doing. On its own often not optimal, should be enhanced with off the job training. But both are needed to train an

employee.

- **OODA** (Observe, Orient, Decide, Act): Approach for strategic decision making in the US military. (Very) loosely related to the [PDCA](#). See also my overview of PDCA variants at [The Many Flavors of the PDCA](#).
- **OPDCA** (Observe, Plan, Do, Check, Act): Variant of the well-known [PDCA](#) with an additional "O" for "Observe". See also my overview of PDCA variants at [The Many Flavors of the PDCA](#).
- **OPE** (Overall People/Process Effectiveness): Measures a sort of [Utilization](#) identical to [OEE](#), except that it is not for processes but for people. It was initially named Overall People Effectiveness, but this ruffled some feathers with workers and unions. Hence, it is now more general called Overall Process Effectiveness. It is also sometimes called Overall Labor Effectiveness (OLE). For more details on the method see [OEE](#).
- **Operational Excellence**: New term promoted to replace the older term [Lean Manufacturing](#), although the meaning is pretty much identical.
- **Order Penetration Point**: Point along the value stream where a generic product becomes assigned to a specific customer order. For [Make to Stock](#) this happens only in the finished goods warehouse when the customer orders an item. For [Make to Order](#) products this may be already in construction before a single part is made. In the automotive industry it is often the paint shop where a generic car body is painted in the color choice of the customer. A late order penetration point gives more flexibility in reacting to the customer demand, but an earlier one may reduce buffer inventories.
- **OTE** (Overall Throughput Efficiency): Rarely used variant of the [OEE](#) with the goal to represent not only one process but the relationship of the processes of an entire factory. I personally think it is difficult to combine multiple processes meaningful into an overall "factory" metric, and this is probably why these luckily never has caught on. See also [OFE](#) and [OLE](#) for near-identical system wide variants of the OEE.

P

- **Pacemaker**: In manufacturing this has two different meanings which are often confused. For one, the pacemaker is the process that defines the production sequence. I.e. in a [Kanban](#) or [CONWIP](#) loop it would be the first process. Another meaning of pacemaker is not based on the type of product but the quantity, where the pacemaker is somewhat synonymous with a non-shifting [Bottleneck](#). However, since in my experience bottlenecks almost always shift in manufacturing, a stationary pacemaker/bottleneck is rare.
- **Pack by Light**: Similar to [Pick by Light](#), but for the packing process. The box or container to be packed is put on top of a monitor, and the operator can see the monitor through holes in the bottom of the box. Alternatively, a projector projects

an image down onto the box. The place where the item is to be put in the box is marked in color (often red) after the item is scanned by the operator. This allows the computer to optimize packing of multiple items in one box, and also reduced packing errors. Not yet common, but used sometimes in Japan.

- **Pareto Analysis:** Named after Italian economist Vilfredo Pareto (1848-1923). Ordering of data by a quantity. For example, part numbers are ordered by quantity or value sold, errors are ordered by number of occurrences. Frequently, the [Pareto Principle](#) holds true for the resulting graph.
- **Pareto Principle:** Named after Italian economist Vilfredo Pareto (1848-1923). General rule of thumb that many data sets can be split in 20%/80% groups. E. g. 20% of your products make 80% of your revenue; or 20% of your products will be 80% of the work, 20% of your customers will give you 80% of your orders, 20% of the land is owned by 80% of the people, etc. This holds true surprisingly often. Also known as the 80/20 rule.
- **Parkinson's Law:** (somewhat unscientific but often true) statement that work expands so as to fill the time available for its completion. Named after Cyril Northcote Parkinson in an essay in the Economist.
- **PCE** (Process cycle efficiency): Ratio of the [Value Added](#) time compared to the [Lead Time](#) (total time of the part in the system), often used in [6 \$\sigma\$](#) . For simplicity the processing time is often used as the value added time, even though the process may not always be value adding. If for example the operation takes 30 seconds, but the part was waiting for 100 minutes before being processed, the PCE would be 0.5%. PCE values below 1% are common in industry, unless there is a batch process that takes time (e.g. heat treatment of 1000 parts together for 8 hours). A PCE of 25% is often considered world class.
- **PD** (Program Development): Overarching [TWI](#) course to teach the trainers for the other courses [JI](#), [JR](#), and [JM](#) in [Problem Solving](#).
- **PDCA** (Plan-Do-Check-Act): Also known as Shewhart Cycle or [Deming](#) circle after the inventor and promoter. A method to enforce not only planning and implementing (P&D), but also checking if the actions really improved the system and act if not (C&A). The latter two are more difficult and often neglected, resulting in nice presentations but actual little improvements. There is a multitude of similar but slightly different acronyms: [PDSA](#), [DMAIC](#), [LAMDA](#), [OPDCA](#), [FACTUAL](#), [OODA](#), RADAR as part of [EFQM Excellence Model](#), [YWT](#), [KPT](#) and [SDCA](#). See also my series of posts starting with [The Key to Lean – Plan, Do, Check, Act](#).
- **PDPC** (Process Decision Program Chart): Variant of the [Tree Diagram](#) specially adapted to structure tasks. One of the [7 Management and Planning Tools](#) by [JUSE](#).
- **PDSA** (Plan, Do Study, Act): A variation of [PDCA](#) with more focus on the metrics and to understand the meaning of the process. In practice pretty much identical.

See also my overview of PDCA variants at [The Many Flavors of the PDCA](#).

- **PEC** (Process Evaluation Checklist): Not so frequently used term for a checklist to evaluate a process. Contents of the checklist may be do we have the right people for the project team; are the people trained; do we have the required documents/information; do we have stakeholder support; do we have KPI to measure success; and so on. While the underlying idea is not bad, PEC is also often thrown around like a buzzword.
- **PEE** (Production Equipment Efficiency): Not a Joke! Very rarely used variant of the [OEE](#), which weirdly enough introduces different weights for availability/speed/quality losses. In my view this makes it worse than a simple and plain OEE. Luckily, I haven't seeing anybody *PEEing* in the shop floor yet 😊 .
- **PERT** (Program evaluation and review technique): Sometimes also *Project* evaluation and review technique. Also known as Activity Network Diagram. Project management tool developed by the US Navy based upon and very similar to the [Gantt Chart](#).
- **Peter Principle**: Management theory that every manager is promoted until the position exceeds his/her abilities. "Managers rise to the level of their incompetence". The principle is named after Laurence J. Peter, who observed it.
- **PFEP** (Plan for every Part): Term is used somewhat confusingly. The way I know it is an (usually Excel) list with every part number, including data relevant for pull production, i.e. how many kanban, data related to the kanban calculation, locations, container size, weight, replenishment times, etc. As such, it is actually NOT a production plan as the name would indicate. I have also seen other definitions that vaguely claim the PFEP is a detailed plan for *everything relevant to managing the production process*.
- **Pick by Light**: (sometimes also "Pick to Light") Approach for manual picking of items for shipment or assembly, or commissioning. The items are stored in a shelf by part number. A computer analyzes the packing list and turns on a light at the shelf slots where parts have to be picked. This reduces the searching of the operator. The confirmation of the pick is either by pressing a button or through a light barrier detecting a hand going into the shelf slot. When all items are picked another light may turn on or blink to indicate completion of the picking process. Common in industry to reduce picking errors. See also [Pack by Light](#).
- **PLM** (Product Lifecycle Management): Idea to manage the product over its entire lifecycle, from design over production use, and disposal or recycling.
- **PMI** (Project Management Institute): US nonprofit organization focusing on project management. Offers a wide range of certificates and trainings, e.g. [PMP](#) and [CAPM](#).
- **PMP** (Project Management Professional): Certification offered by the Project Management Institute ([PMI](#)) with a particular focus on project management. Includes concepts from critical path (part of [TOC](#)), communication, risk,

stakeholders, and budget management. In my view, however, classroom theory can take you only so far, and (for both lean and project management), practical experience is the key here.

- **Point of Use:** Operation or process that consumes and actually uses the material. Sort of the end point for the logistics or [Supply Chain](#) of a part type.
- **Pointing and Calling:** Method requiring pointing with the finger or hand and calling out the observation to reduce observation errors. Used extensively in Japanese railroads, and sometimes also in construction and production. In Japan also known as Shisa kanko (指差喚呼); Shisa kakunin kanko (指差確認喚呼); Yubisashi koshō (指差呼称); and Shisa koshō (指差呼称). See also my post [Japanese Standard Pointing and Calling \(Video\)](#).
- **Poka Yoke** (ポカヨケ, mistake proofing, error proofing): Creating products and processes that cannot be done incorrectly. Termed by [Shigeo Shingo](#) based on [baka yoke](#). Sometimes misspelled as Poke Yoke. Also known as error-proofing, or mistake proofing. See also my post on [Poka Yoke](#).
- **POLCA** (Paired-cell Overlapping Loops of Cards with Authorization): Variant of [Kanban](#), where the value stream is divided into different cells. It claims to be a hybrid push/pull system. POLCA was invented by the American professor Rajan Suri as a possibility for a [Quick Response Manufacturing](#) system.
- **PPAP** (Production Part Approval Process): Process of approving a new part for production to ensure quality and performance. The idea originated from the automotive industry and hence is especially used there. This may for example include a checklist with 19 required points, including e.g. the design records, master sample parts, a Design – [FMEA](#), performance tests, and so on.
- **PPM** (Part per million): A measurement of defect rates as number of defects per million parts. Pretty much synonymous with [DPM](#).
- **Predetermined Motion Time System** (PMTS): Method to break down the human work in a process into short, elementary movements. Movements may be for example “reach out with hand 20 cm”, “grab small part”, “move hand with part 30cm”, “put part in small hole”, etc. Standardized tables are used to look up the times required for these movements. The sum of these times then constitutes the total time needed to work the process. Often, percentages are added for rest, other functional tasks (e.g. talk to supervisor), and personal tasks (e.g. toilet break). This approach has the advantage that there is a neutral way to set the target times, hence avoiding many labor conflicts on how fast the worker should work. It has the additional benefit of being able to determine times theoretically before the process is established. It is also excellent in providing ideas how to make the work easier and hence faster and more ergonomically. Probably the first such method was the [Therbligs](#) by Frank Gilbreth, although they have fallen out of use. Popular methods nowadays are [MTM](#), the Work-Factor-System, and the “Motion-Time-Analysis” (MTA) used by [REFA](#).

- **Prioritization Matrix:** Useful management tool to prioritize possible actions or projects on a two-axis diagram. These two axes are often but not always cost and benefit. Not to be confused with the [Matrix Diagram](#). One of the [7 Management and Planning Tools](#) by [JUSE](#).
- **Problem Solving:** Fundamental part of every lean operation: You have problems, you solve them. Sometimes abbreviated as PSP. Common sense dictates to start with the most urgent problem first, and to make sure the solution addresses the problem, not only the symptoms (see [Root Cause Analysis](#)). Numerous tools have been developed for this, most importantly [PDCA](#) or one of its variants, the [A3](#), [4 M](#), [5 Why](#), and [FMEA](#) to name just a few. Toyota also uses a Toyota [Six Step Problem Solving](#) method.
- **Process Map:** A type of flow diagram used by [6 \$\sigma\$](#) showing a sequence of processes. In my view [VSM](#) is more useful.
- **Production Kanban:** [Kanban](#) used to reproduce goods. Most frequently used type of Kanban, the main other variant would be a [Transport Kanban](#).
- **Project Shop:** Manufacturing system where the product does not move, and machines, material, and workers come to the product to add value. Common for large project as for example oil tankers, and other large products. Usually more expensive than a [Flow Shop](#) or a [Job Shop](#), and many large products like commercial jets are now also produced on an assembly line. Sometimes also called *fabrication shop* or simply *project*. See also my post [Organize Your Production Sequence – 1: Project Shop](#).
- **Pull:** A type of production system where the total [WIP](#) is limited. Examples are [kanban](#) and [CONWIP](#). Often works with [Supermarkets](#) and [FIFO lanes](#). This approach is usually much better than its opposite [push](#). The definition of pull is disputed. Often, it is claimed that a Pull system is a system where the signal to produce comes from the customer. However, I strongly disagree and believe Pull systems have a limit on the WIP. See also my posts [The \(True\) Difference Between Push and Pull](#) , [Why Pull Is So Great!](#), and my series on [Different Ways to Establish a Pull System](#)
- **Pulse Line:** Type of [Assembly Line](#) where the parts are not continuously moving but are moved one slot after each interval. Common for assembly lines with larger cycle times as for example machine tool making, where all parts move every few hours one slot down the line. The alternative would be a continuously [Moving Assembly Line](#) or a line without any synchronized timing at all See also my post [Pacing of Flow Lines 1 – Unstructured and Pulse Line](#).
- **Push:** A type of production system where the signal to produce comes from the outside, e.g. a planning department. The opposite of [pull](#). See also my post on [The \(True\) Difference Between Push and Pull](#).

- **QC** (Quality Circle): Also known as QCC (Quality Control Circle). Regular meeting of workers to identify, understand, and improve quality related issues. First established in Japan 1962, most popular in the west around 1980, but still used occasionally. Some research claims QC works, other stated it does not.
- **QCD** (Quality, Cost, Delivery): The three key dimension in a manufacturing system. Usually, you cannot optimize one alone, but you have to find a trade-off between these three. Sometimes expanded to [QCDF](#) or [QCDMS](#). An alternative sequence [DQC](#) is also sometimes used.
- **QCDF** (Quality, Cost, Delivery, Flexibility): Based on [QCD](#), with flexibility added as an additional factor.
- **QCDMS** (Quality, Cost, Delivery, Morale, Safety): Based on [QCD](#), with morale and safety added as additional factors.
- **QDC** (Quick Die Change): Toyota method to improve the duration of change overs. Known in the west as [SMED](#). See also my post [Quick Changeover Basics – SMED](#).
- **QFD** (Quality Function Deployment): Quality management approach aiming to determine the true customer requirements in order to maximize the [Value Add](#) and minimize over-processing (see [Muda](#)).
- **QRM** (Quick Response Manufacturing): Program aimed at reducing lead times. As such somewhat similar to elements of [TOC](#), but seems to be focused more on low volume high variety products. Quite a bit of overlap with [Lean Manufacturing](#), with in my view not much new value add. Developed in the late 1980s by Rajan Suri at the University of Wisconsin. For my taste a bit too much singular focus on lead time, although they also include some other lean tools. See also [POLCA](#).
- **Quality Assurance Matrix** (QA Matrix): Structured approach to identify causes of quality issues and prevent their occurrence. Used at Toyota.

R

- **Rabbit Chase**: Also known as "Caravan Approach", "Operators-in-Motion", or "Nagara cell" (not to be confused with the [Nagara-Switch](#)). Used for [U-Line](#) where the operators "chase" each other in direction of the material flow. I.e. each worker after finishing one process always works on the next process in line. At the end of the line he starts again at the beginning. Requires not too many operators in the U-line to avoid traffic jams. See also [Bucket Brigade](#) and [Baton Touch](#). See also my post [The Lean Rabbit Chase in a U-Line](#).
- **RACI** (Responsible, Accountable, Consulted, and Informed): List of roles for project management, often combined in a matrix. The columns are usually the different people involved, and the rows are the tasks or steps needed for the project. The fields of the matrix are filled with R, A, C, or I (or kept blank) to show who is responsible, accountable, consulted, or informed. Hence this is also known as the responsibility assignment matrix, RACI-Matrix, ARCI matrix (terms

rearranged) or linear responsibility chart. In the many variants of the approach, P is added for perform, S for support or signatory, C for control or contributor, Q for quality review, V for verifier, O for out of the loop or omitted, D for driver. For sake of clarity usually only 4-7 terms are used in a matrix. This results in a whole bunch of acronyms including PACSI, RASCI, RASI, RACIQ, RACI-VS, RACIO, CAIRO, DACI, RAPID, ARCI, and the unfortunately named RATSI. If you don't like them, invent your own by mixing these 10+ letters in a new order 😊 .

- **Raku-Raku seats** (楽楽 or らくらく for comfortably, easily): Seats attached to a moving arm or similar to give workers a comfortable position when assembling products (in particular cars). It is commonly used for assembly work inside of the car (e.g. the dashboard), where the worker on a movable seat can comfortably slide in the car body. Otherwise this would require the worker to crouch and bend over for the work. See also [TVAL](#).
- **Reach**: Also known as inventory reach. With average production speed, how long does your inventory last? This can be calculated for an individual part number, or for the entire inventory. If calculated for the entire inventory it is usually done based not on pieces but on the value of the goods. You divide your average inventory value by the value consumed per year/month/day, and you get your inventory reach in years/months/days. In my experience many western plants have a raw material reach of two weeks or more, whereas at Toyota it is more likely to be two hours. The inventory reach in years is the inverse of the [Turnover](#).
- **Reconfigurable Manufacturing System**: Reconfigurable manufacturing systems are able to adjust rapidly to changing circumstances. See also [Flexible](#), [Agile](#), [Robust](#), [Adaptable](#), and [Holonc](#) manufacturing systems. See also my post [Facing Change in Modern Manufacturing Systems](#).
- **Red X**: When analyzing the cause and effect relationships in problem solving in the [Shainin System](#), the "Red X" (also sometimes called the "Big Red X") is the cause with the largest effect. In [Lean](#), this would be called the [Root Cause](#), although Shainin uses more statistical tools to determine the result, somewhat akin to [DOE](#).
- **REFA** (Originally German "Reichsausschuß für Arbeitszeitermittlung" for "Imperial Committee for Work Time Analysis", but now no longer an abbreviation but only REFA): German organization for the analysis and optimization of work, founded in 1924 when the [Taylorism](#) wave swept into Europe. Very prominent in Germany and also the rest of Europe for ergonomics and [Predetermined Motion Time System](#) based on the "Motion-Time-Analysis" (MTA).
- **Resident Engineer**: Also known as *guest engineer*. Engineer from the supplier sent to the customer for a longer period of time to work on projects or help in fixing problems. Common approach at [Toyota](#) that requires mutual trust and close cooperation between supplier and customer.
- **Respect for Humanity** (人間性尊重, ningenseisoncho; humanity & Respect): Key

theme in the [Toyota Production System](#) (but unfortunately much less in [Lean](#)), where respect for the human nature is important. This includes e.g. making workplaces that are ergonomic, but also using the ideas generated by the people and use the full potential of the person (both intellectual and manual), as well as treating them with respect. Since it is respect for all of humanity, it includes all people, no matter if they work at your company, are a supplier, customer, or anybody else. Includes the [Respect for People](#).

- **Respect for People** (人間尊重, ningensoncho, People & Respect): The idea to treat people with respect, value their opinion, and treat them well. People include not only your own employees, but also your customers, your suppliers, and pretty much everybody else. At [Toyota](#), the larger idea of [Respect for Humanity](#) is more commonly used and includes respect for people. See also my series of posts [Employee Motivation and Lean Implementation – Part 1: Carrot and Stick](#), [Part 2: Money](#), [Part 3: Lack of Respect](#), and [Part 4: Respect for People](#).
- **Robust Manufacturing System**: Robust manufacturing systems are insensitive to problems. See also [Flexible](#), [Agile](#), [Reconfigurable](#), [Adaptable](#), and [Holonc](#) manufacturing systems. See also my post [Facing Change in Modern Manufacturing Systems](#).
- **Root Cause Analysis** (RCA): Another word for [Problem Solving](#) with the requirement to get to the ultimate cause (root cause) of a problem so as not to merely fix the symptoms. Popular methods that have this goal are for example [5 Why](#) and [Ishikawa Diagram](#). The root cause analysis is often part of an [A3](#).

S

- **Sankey diagram**: A type of flow diagram where the width of the connecting arrows represent the quantity flowing through (material, cost, energy). These arrows can merge into larger ones or split into smaller ones. Due to the high demand on graphic accuracy it is difficult to make by hand and usually requires software support. Named after an Irish engineer with the impressive name of Captain Matthew Henry Phineas Riall Sankey (1853–1926), who used it to show the energy flow in a steam engine. However, it was used already earlier, e.g. by French engineer Charles Minard in 1812 showing the flow of troops of Napoleon in Russia.
- **Scrum**: Framework for project management, often part of the [Agile](#) philosophy. The name comes from the Scrum formation in Rugby, which got its name from the English word "scrum" for a tightly packed crowd. Used often but not only in software development. Is based on five activities (Plan a step (called "Sprint"); Daily Scrum meeting; End of Sprint Review; End of Project Review; Backlog refinement) , three artifacts (Product Backlog, Sprint Backlog; List of completed Sprints) , and three roles (Owner; Developer; Scrum master). Not part of the original Lean tool set.

- **SDCA** (Standardize, Do, Check, Act): Variant of the [PDCA](#) cycle with a stronger focus on standardization.
- **Seiban** (製番, product number): An identifying number for inventory, orders, tasks, projects, etc. to help track and assign these to a certain product, customer, or project. Made its way into [MRP](#) software like SAP or Oracle. Personally I haven't heard of this number outside of MRP.
- **Seisan Hoshiki** (生産: Seisan: Production, manufacture; 方式: Hoshiki, form; method; system; formula): General Japanese term for production system. For example, the Toyota Seisan Hoshiki is the [Toyota Production System](#). Sometimes also called Seisan System (生産システム).
- **Sensei** (先生, Teacher): Expert and teacher, professor, coach. The expression in lean is often overlapping with mentor (先輩, Senpai).
- **Sequential Pull System**: Production system for high mix low volume production, where a scheduling department defines the sequence of the production. Also known as *b-type pull system*. Often presented as a [Pull](#) system, but I strongly disagree. For me, a Pull system requires an upper limit on the WIP. Hence a sequential pull system is not necessarily a pull system, even though the name describes it as pull.
- **Setsuban Kanri** (節番管理, periodic turn management): Japanese production management method focusing on make-to-order. Popular in Japan up to the 70's especially for railroads, it seems to have a revival in Italy.
- **Shadow board**: Location for (usually) hand tools, where the location of each tool is clearly defined and the "shadow" of the tool is painted behind the tool location. Makes for an easy assessment of what tools are currently missing. Common tool for [Visual Management](#).
- **Shainin System**: Set of statistical [Problem Solving](#) tools developed by Dorian Shainin (1914-2000), in particular the [Red X](#) concept and [FACTUAL](#).
- **Shikumi** (しくみ or 仕組み for structure, construction, arrangement, contrivance, mechanism, workings, consisting of 仕 for doing, official; civil service and 組 for group or set): Used sometimes in Japanese to describe the overall view of the material and information flow, set up in a way as to achieve the desired actions and responses on certain conditions. You could call it smart design. The words "shikumi diagram" are sometimes used for [VSM](#) or [MIFA](#).
- **Shingo, Shigeo** (新郷 重夫, 1909 – 1990): Management guru from Japan popular in America. Promoted many of the techniques of the Toyota Production System. There are claims that he invented large parts of the Toyota production system, but I believe this is a wild exaggeration. See also my post on [Shigeo Shingo and the Art of Self Promotion](#).
- **Ship to Line**: Material flow approach where the incoming goods are no longer brought into a warehouse, but directly from the truck to the point of consumption (the line, or the manufacturing process). A cross dock may be in between to re-

arrange the items. This reduces handling of material, as it no longer has to be stored in a warehouse and taken out again. However, for this to work it needs smaller lot sizes, otherwise there would be too much material at the line.

- **Shooter** (Also: Flow Rack Shooter): Type of a flow rack where through the press of a lever or button an empty box is moved to the return flow rack and replaced with a full box in the incoming flow rack. Overall, the exchange of empty boxes with full boxes in a flow rack is mechanized (sometimes also automated).
- **Shojinka** (少人化, literally "few people production"): Sometimes also spelled Shojinka. Japanese term at Toyota for a flexible manpower line. Sometimes also called Shojinka line. The number of workers in the production line can be adjusted to match the demand. If there is high demand, additional workers join the line and production goes up, if there is low demand the workers are reduced again. Related but different from [Shoninka](#) and [Shoryokuka](#).
- **Shouninka** (省人化, labor saving): Sometimes also spelled Shoninka. Japanese term at Toyota for manpower or labor saving where the improvement is large enough to reduce at least one worker. General reductions are called [Shoryokuka](#) and may also apply to improvements equivalent to less than a full worker. Originated at Toyota, where e.g. a final assembly line needs to reduce an entire worker to reduce labor cost. Reducing a partial worker would still require the worker to be present and paid.
- **Shouryokuka** (省力化; labor saving): Sometimes also spelled Shoryokuka. Japanese term for manpower or labor saving, i.e. small changes and improvement to manual work to reduce the overall workload. Effectively you can do more with the same number of people or the same quantity with fewer work hours. Reducing the work in the equivalent to an entire worker would be [Shoryokuka](#). Related but different from [Shojinka](#).
- **Shunji Yagyu** (born 1974 in Osaka): Lean Guru, mostly active in Europe. Started his career at Isuzu, eventually responsible for change management. Trained by Toyota while at Isuzu/General Motors. Very influential, helped to shape the ideas of lean for many successful European companies.
- **Six Step Problem Solving**: [Problem Solving](#) Method at Toyota. 1) Identify or select problem; 2) Analyze; 3) Generate (multiple) solutions; 4) Select best solution; 5) Implement; and 6) Evaluate and verify.
- **Skills Matrix**: Table with an overview of the employees and their respective skills or trainings. Makes it easy to find out which operator is qualified to operate which machine. Sometimes also called *Plan for every Person* in analogy to [PFEP](#).
- **SMART** (specific, measurable, attainable, relevant, time bound): Set of conditions for targets. A good target has to be specific, measurable, attainable, relevant, time bound. Originally defined by management guru Peter Drucker, although the "ART" are sometimes also worded differently. Used for example for [MBO](#). Due to the cool mnemonic acronym this abbreviation also has lots of other

definitions.

- **SMED** (Single Minute Exchange of Die): Method to improve the duration of change overs, also known as quick change over. Term coined by [Shigeo Shingo](#) based on the identical method at Toyota called [QDC](#). See also my posts [Quick Changeover Basics – SMED](#), [The History of Quick Changeover \(SMED\)](#), [SMED – Creative Quick Changeover Exercises and Training](#), [What to Do with SMED: Reduce Lot Size or Increase Work Time?](#), [The Phases of a Changeover](#), [On Running Changeovers](#), [Changeover Sequencing – Part 1](#), and [Part 2](#).
- **Soshiki Management** (組織 or そしき for organization or structure; and マネジメント for management;): The ability to manage (part of) the organization. One of the five aspects of the [Toyota Manager Evaluation](#).
- **Spaghetti Diagram**: Chart where the path of a worker or material is followed on the shop floor. The result usually looks like spaghetti on a map, hence the name. Used to optimize walking distances. Sometimes also called Spaghetti Chart.
- **SPC** (Statistical Process Control): Quality control method using statistical methods in monitoring and controlling processes.
- **SPS** (Set Part Supply): Approach by Toyota to handle and manage a wide variety of part types on an assembly line. In effect it is what we would call [Kitting](#) in the west. Closely related to [Jundate](#)
- **SQDC** (Safety, Quality, [Delivery](#) and Cost): Four important metrics on any shop floor. Often summarized in a SQDC board reporting the status on all four variables.
- **SQPC** (Safety, Quality, Productivity, Cost): List of generally relevant [KPI](#) in any production system.
- **Standard Work Type 1-3**: Western "[Lean](#) refinement of [Standardized Work](#), distinguishing three types of work standards based on the repeatability of the work. Standard Work Type 1 is the most repetitive, where the work repeats itself pretty much identically every cycle. Standard Work Type 2 has short cycle times, but the work content varies from product to product, as for example a mixed model assembly line. Standard Work Type 3 is similar to standard work type 2, but with longer cycle times and hence more additional tasks like changing a pallet or so. Personally, I never had the need to use this distinction in type 1, 2, or 3; but if it helps you, go ahead.
- **Standardized Work**: Idea that the work is described in precise detail so that the worker merely follows the instructions to create good parts. In my view, you have to find a trade-off between framework of the standard and worker flexibility. Workers can follow high quality standards, but following low quality or not regularly updated standards to the letter is usually a mess. Unfortunately, many western standards are low quality and not regularly updated. Also called "Standard Work" or "Work Standard". There is a finer grading called [Standard Work Type 1-3](#), distinguishing three types of work standards based on the

repeatability of the work.

- **Stock Keeping Unit (SKU):** Refers to a unique type of products that usually have their own part number. E.g. "we have 20.000 SKU" means that they have (or should have) 20.000 different products in their inventory, even though each individual SKU can be in the inventory multiple times.
- **Suggestion System:** System that collects improvement ideas from the employees. The ideas are not (only) from the employee that are usually in charge of improvement changes, but also from others that "only" work with the system, i.e. the operators. Good suggestion systems also encourage idea generation. Excellent suggestion systems are also fast in implementation. The latter two are usually lacking in the western world, where often ideas are treated more as a nuisance and are implemented slowly or not-at-all. Toyota has about one idea per employee and week, whereas western companies struggle to get one idea per employee and **year**, let alone getting them implemented. Toyota got the idea for its suggestion system from Ford.
- **Supermarket:** Material storage where the goods are separated by part number, maintaining the First In First out principle for each part number. The supermarket usually has a defined upper limit, and sometimes a minimum level which acts as a warning signal for stock outs. In effect a number of separate [FIFO lines](#) in parallel. Often used with [Kanban](#) for [Pull](#) systems. See also my posts on [Theory and Practice of Supermarkets – Part 1](#) and [Part 2](#).
- **Supply Chain:** Sometimes also Value Chain. Transformation of material from raw materials to finished goods through the supply and demand interaction of different companies or plants. Supply chains usually start with natural resources like agriculture or mining, and end with recycling, which is often the start of another supply chain. See also [Value Stream](#)
- **Swim Lane Diagram:** used for [Value Stream Mapping](#) in administrative areas, where each process/department has one lane on the paper, and the progress of the task is displayed. It is named swim lane diagram since it looks like the lanes in a swimming pool. In Japanese it is also known as Makigami (巻紙, Paper Roll). Also known as process mapping, functional bands, or Rummler-Brache Diagrams after the authors of a book describing these diagrams. See [BPMN](#) and [VSM](#) for alternatives or variations thereof. See also my post [All About Swim Lane Diagrams](#).
- **System Takt:** [Takt Time](#) of the system calculated by dividing the total work time during a period by the number of parts produced by the system (prediction or historic data). Also known as line takt. See also [Customer Takt](#).

T

- **Taiichi Ohno** (大野耐一, Ōno Taiichi, February 29, 1912 – May 28, 1990): Engineer and manager at the [Toyota Motor Company](#). Main driver behind the

[Toyota Production System.](#)

- **Takt Time** (German for pulse or beat): Measure of the speed of a manufacturing system or its demand in time per piece or quantity. It is the inverse of the [Throughput](#). Two common takt times are the [System Takt](#) for the ability of the manufacturing system, and the [Customer Takt](#) for the demand of the customer. The system takt should be slightly faster than the customer takt (smaller takt time or higher throughput). Originated during aircraft assembly in WWII Germany, hence the German word Takt. See also my posts [How to determine Takt Times](#) and [Pitfalls of Takt Times](#).
- **Takumi** (匠, master craftsman or artisan): Highly specialized expert craftsmen at [Toyota](#) with a deep focus on one particular manufacturing technique, e.g. painting, electronic welding, sewing, or automotive body quality. They do a major part of their work by hand rather than using robots to get a deeper understanding of the process. They are used to train others, solve problems, and help program robots and machines worldwide. There are reportedly around 500 takumi at Toyota. Toyota strongly believes that they cannot use robots only but need people to understand the process in detail and keep the [continuous improvement](#) going. While not an official job title, Toyota invests significant time and effort in training these takumi. See also [Monozukuri](#) and [Hitozukuri](#).
- **Tatakidai** (叩き台, chopping block or springboard for discussion): Seeking consensus and informing others when the project is 80% complete to improve chances of acceptance. See also [Nemawashi](#).
- **Taylor, Frederick Winslow** (March 20, 1856 – March 21, 1915): Management theorist and one of the first management consultants and gurus. [Taylorism](#) is named after him. Also invented one of the first useful tool steels that is still in common use, the HSS (High Speed Steel).
- **Taylorism**: Also called Scientific Management. A theory to analyze and manage work processes developed by Frederick Winslow Taylor. The concept is controversial as it was often used to put more pressure on the worker, even though it was not intended that way. See also my post on [Frederick Winslow Taylor](#).
- **TBS** (Temporary Build Sequence): At Toyota the sequence of the cars to be built in the next few weeks (e.g. three to four weeks in advance). The TBS gets updated to the [FBS](#).
- **T-Cards**: T-cards are cards shaped like a T, so they can be inserted in slotted boards, but without falling too deep into the slots due to the "T"-bar. The US Emergency services for example use them to track resources and personnel (ICS Form 219). Sometimes also used for [Kamishibai](#).
- **Team Leader** (班長, hanchō; squad leader; team leader; group leader): A shop floor worker at Toyota that is leading a group of around 4-5 operators, although without disciplinary authority. This team leader has no fixed workstation per se,

but covers absences for e.g. toilet breaks, helps to solve problems that pop up, and prepares and organizes the work of his team. They also support or initiate some of the improvement activities and can moderate the group meetings.

- **TEEP** (Total Effective Equipment Performance): Measurement of machine [Utilization](#) similar but not identical to [OEE](#). TEEP is always based on 24 hour 7 days per week 365 days per year, whereas with OEE scheduled downtime can be excluded.
- **Theory X**: Theory by Douglas McGregor that people are by their very nature lazy and unhappy with their work. Applies to some employees, and is the opposite of [Theory Y](#). In reality, employees usually fall somewhere in the extremes between Theory X and Theory Y.
- **Theory Y**: Theory by Douglas McGregor that people are by their very nature motivated, ambitious, and want to do a good job. Applies to some employees, and is the opposite of [Theory X](#). In reality, employees usually fall somewhere in the extremes between Theory X and Theory Y.
- **Theory Z**: Expansion of [Theory X](#) and [Theory Y](#) by other researchers with sometimes different meanings. One version of Theory Z focuses on increasing loyalty to the company and tries to represent a (somewhat idealized) Japanese management style.
- **Therbligs**: System of 18 fundamental motions for motion studies developed by Frank Bunker Gilbreth and named after him (roughly Gilbreth spelled backwards). Was the first method for the [Predetermined Motion Time System](#), but has fallen out of use, with [MTM](#) being much more prominent now. See also my post on [The Tale of Taylor and Gilbreth](#).
- **Throughput**: Production rate measured in parts or quantity per hour. Inverse of the [Takt Time](#).
- **TIM WOOD**: Mnemonic for remembering the [7 Types of Waste](#); standing for Transportation, Inventory, Motion, Waiting, Overprocessing, Overproduction, Defects. Sometimes also used as Tim Woods, with the last "S" standing for skills. The sequence is different from the original sequence of [Taiichi Ohno](#), who listed them in descending order of priority as Overproduction, Waiting, Transport, Overprocessing, Inventory, Motion, Defects. To Ohno, Overproduction was the worst evil of em all. But OWTOMD doesn't make a good mnemonic...
- **TMC** (Toyota Motor Corporation): Japanese and the world's largest automotive manufacturer. Its production system [TPS](#) is the basis of all [Lean Manufacturing](#). The company name Toyota is slightly different from the name of the founders Toyoda.
- **TMU** (Time Measurement Unit): Time unit used by [MTM](#), a [Predetermined Motion Time System](#). One TMU is 1/100.000 hours, or exactly 0.036 seconds. Personally, I would have much rather preferred to just use seconds, since I always have to calculate it into seconds at the end.

- **TNGA** (Toyota New Global Architecture): Modular platform for mid-sized [Toyota](#) cars. Introduced around 2015 it aims to use more similar parts across multiple models in order to reduce product variants. See also [MQB](#).
- **TOC** (Theory of Constraints): Approach to capacity improvement by focusing on improving the constraint or [Bottleneck](#). Developed by [Eliyahu M. Goldratt](#) (1947 – 2011). See also [DBR](#) and [CCPM](#).
- **Toyoda, Eiji** (豊田 英二, Toyoda Eiji, 12 September 1913 – 17 September 2013): Relative of [Sakichi Toyoda](#), and president of the [Toyota Motor Company](#). One of the drivers behind the [Toyota Production System](#).
- **Toyoda, Kiichiro** (豊田 喜一郎, Toyoda Kiichirō, June 11, 1894 – March 27, 1952): Son of [Sakichi Toyoda](#) and founder and president of the [Toyota Motor Company](#). One of the drivers behind the [Toyota Production System](#).
- **Toyoda, Sakichi** (豊田 佐吉, Toyoda Sakichi, February 14, 1867 – October 30, 1930): Japanese industrialist nicknamed “King of Inventors”, known especially for its automatic looms. Founder of Toyota Industries, and thereby the entire [Toyota](#) group. Father of [Kiichiro Toyoda](#). See also [Eiji Toyoda](#).
- **Toyota**: Usually refers to [TMC](#) and its products, but can also mean the entire Toyota group including TMC, Denso, Aichi Steel, Daihatsu, and many more.
- **Toyota Manager Evaluation**: Evaluation of managers at [Toyota](#). This includes five aspects, all of them hard to measure, but designed to ingrain the Toyota DNA into managers. These are (1) [Kadai Souzouryoku](#) for Ability and creativity to identify problems; (2) [Kaidai Suikou](#) for ability to carry out tasks; (3) [Soshiki Management](#) for Organizational management abilities; (4) [Jinzai Katsuyou](#) for Ability to utilize and develop people; and (5) [Jinbou](#) for trust of the subordinates.
- **TPDS** (Toyota Product Development System): Toyota Approach to design and develop new products.
- **TPS** (Toyota Production System): Philosophy and Culture at Toyota towards its production system and other processes. Archetype of [Lean Manufacturing](#).
- **TQC** (Total Quality Control): Name for a quality control (QC) approach. Other names for very similar and overlapping approaches are SQC (Statistical quality control), SPC (Statistical process control), TQM (Total Quality Management), TPM (Total Preventive/Productive Maintenance) and [6 σ](#). While a highly relevant topic, it seems to me some of these terms were primarily invented as new buzzwords to sell the same methods in a new and fancier package. In terms of industry attention the topic seems to have peaked around the year 2000, and is now slowly becoming less prominent.
- **Traceability**: The idea to trace the production history of every single product sold. Of interest are process parameters, testing results, and especially the production history of every individual component that goes in the product, and its subcomponents. The idea is to improve quality by understanding what type of process parameters can cause failures, and also to know exactly which products

to recall in the case of a recall.

- **Transport Kanban:** [Kanban](#) used to order more goods from an upstream [Supermarket](#) or warehouse. Name used to distinguish it from a [Production Kanban](#).
- **Tree Diagram:** Basic hierarchical diagram where one main point is split into smaller sub points. Often used for organizational charts, but also e.g. cost contributions etc. One of the [7 Management and Planning Tools](#) by [JUSe](#).
- **Triangle Kanban:** Special type of [Kanban](#) system with only one kanban. The triangle kanban is used if a lower limit on inventory is reached. In this case, the triangle kanban indicates reproduction of a fixed quantity of parts. The remaining inventory after the triangle kanban is large enough to cover the replenishment time. Very simple and easy to use system loosely similar to reordering points of [Economic Ordering Quantity](#). Often used for batch size production. Named after its originally triangular shape at Toyota (since it was cut from scrap metal, which did not yield good rectangular shapes). See also my post on [Simple Triangle Kanban System for Office Supplies](#).
- **True North:** Expression for the ideal desired end state of a lean system. An example would be [One Piece Flow](#). Based on True North as the geographic North Pole compared to the magnetic North Pole. The corresponding Japanese expression would be [Arubeki Sugata](#).
- **Tsurube Houshiki** (釣瓶: Bucket of a well; 方式: System): Also known as Tsurube System. Like a well with two buckets, where pulling up one bucket lowers the other one. Used for manufacturing processes that are physically distant or remote from the main process line. In fixed time intervals a delivery of parts is made to the remote process, and the same number of parts is also brought back from the process. This is a solution if it is physically not possible to place a process within the main material flow.
- **Turnkey Project:** Project where the customer receives a completed product with no further assembly required. The name comes originally from construction, where upon completion the customer only had to unlock the door (turn the key) to use the product, but nowadays also used for other products like cars or machines.
- **Turnover:** Also known as inventory turns. Measures how often in a year in average you sell your entire inventory and replace it with new material. Usually, this is calculated by value. i.e. by dividing the annual sales or the value of the material consumed by the average value of the material. The turnover is the inverse of the [inventory reach](#) in years.
- **TVAL** (Toyota Verification of Assembly): Similar to a [Predetermined Motion Time System](#), but rather than determining the time for the work like [MTM](#) in USA and Europe and [MOST](#) in Asia, TVAL determines the physiological stress (workload and fatigue caused by the work). TVAL includes both the weight of the part/tools

handled, required forces, as well as the posture of the worker e.g. squatting).

This results in a TVAL value that estimates the physiological stress. Toyota uses this approach to make the work easier for the workers.

- **TWI** (Training within Industry): US Effort to improve production speed and quality during World War II. Some of the key components are [JI](#), [JR](#), [JM](#), and [PD](#). Elements of TWI made it into the [Toyota Production System](#) and hence into [Lean Manufacturing](#).

U

- **U-Line:** Production line arranged in the shape of an U. Sometimes also called U-cell. Usually, the workers are inside the U, whereas the majority of the material is provided from the outside. This gives the flexibility to ramp up capacity by adding or removing workers, who can cover multiple machines. The material supply from the outside does not interrupt the worker's activities. See also [Baton Touch](#). See also my post on [Line Layout Strategies – Part 2: I-, U-, S-, and L-Lines](#) for this and other line layouts.
- **Utilization:** Percentage of the total time a machine or process is planned to work. Sometimes also called the "operating rate". The similar "Operational availability" measures the percentage of the time a machine is running properly. This differs from the more commonly used [OEE](#), as the OEE sometimes excludes scheduled maintenance or scheduled downtime from the total time, and defects (quality loss) and slow work (speed loss) from the output side.

V

- **Value Add** (VA): Actions and activities that add value for the customer. Everything else is waste ([Muda](#)), or non-value-adding. Waste can be further divided in unavoidable waste that should be reduced, and avoidable waste that should be eliminated completely. Waste is sometimes also called non-value-add. Usually most activities working on the product is value add, whereas everything else is waste, including all indirect and overhead areas (hence the finer distinction in unavoidable waste, since they cannot be eliminated completely). The exact classification of the elements of an activity is often difficult, since it is difficult to assign the value to the customer (does the customer pay for screwing in a screw, or only for tightening it, or could you remove the screw altogether?).
- **Value Network Map:** Type of diagram that is a crossover of a flow chart and a mind map aiming to understand the connections between different roles in order to improve the value generation.
- **Value Stream:** Process of increasing the value of the goods, i.e. enhancing raw materials through different steps into more valuable finished goods. Often represented using [Value Stream Mapping](#). Value streams across different companies are a [Supply Chain](#).

- **Visual Management:** Workplace environment where the status of the environment can easily be seen due to markings and/or structure of the environment. For example a [Shadow board](#) shows quickly which tools are missing; or all materials of one type are in one location so the inventory can be assessed with one glance, etc. See [Mieruka](#) for the Japanese term. I like to distinguish four types of visual management. 1) Data displays and charts; 2) markings on the floor, equipment and other places, 3) the way you organize your tools and parts, and 4) the layout on the shop floor. I especially prefer the last two since they are automatically up-to-date and less likely to have mistakes. See also my posts [Visual Management](#) and [Visual Management during World War II – A Visit to the Lascaris War Rooms in Malta](#).
- **Volvoism:** Attempt by Volvo to reverse the idea of [assembly lines](#) back to work station based assembly. Tried out in its plants in Kalmar and Uddevalla, Sweden around 1980. Resulted in low productivity, quality, and worker satisfaction, and was stopped soon thereafter.
- **VSD** (Value Stream Design): Structured diagram showing the future [Material Flow](#) and [Information Flow](#) of the [Value Stream](#), often on the shop floor. Popularized by the book “Learning to See” by Mike Rother and John Shook. See [VSM](#) for the analysis side thereof. See also [MIFA](#) for the original Toyota version.
- **VSM** (Value Stream Mapping): Structured diagram showing the current state of the [Material Flow](#) and [Information Flow](#) of the [Value Stream](#), often on the shop floor. Popularized by the book “Learning to See” by Mike Rother and John Shook. See [VSD](#) for the design of the future state thereof. See also [MIFA](#) for the original Toyota version. The abbreviation also sometimes stands for value stream management. See [BPMN](#), [Process Map](#) and [Swim Lane Diagram](#) for alternatives or variations thereof.

W

- **Waigaya** ((ワイガヤ for Waigaya, which is not really any Word in Japanese but was picked for its sound)): Meeting style at Honda, known for their spontaneous and unplanned nature if there are problems on the shop floor.
- **Waste Walk:** Visit of the production system (or general the processes of interest) with the goal to find waste and eliminate waste ([Muda](#)).
- **WCL** (World Class Logistics): Somewhat vague phrase that aims for competitive logistics in the global market. An extension to the better known [WCM](#). See also [Dantotsu](#).
- **WCM** (World Class Manufacturing): Somewhat vague phrase that aims for competitiveness in the global market. To distinguish manufacturing from logistics, [WCL](#) is also used. See also [Dantotsu](#).
- **WIP** (Work in Progress): Inventory in the system who's processing has started but is not yet completed. Depending on the usage can also include finished

goods or raw materials.

X

- **X Matrix:** Matrix showing instructions, objectives, measures & targets, and action programs for policy deployment ([Hoshin Kanri](#)). Hence also known as Hoshin Planning Matrix. For my taste too complex, also sounds like a buzzword, although I have not yet used it.
- **XYZ Analysis:** Similar to the [ABC Analysis](#), but ordering of part types by number of individual orders rather than units ordered or value sold. An alternative version measures the standard deviation of the time between orders to determine the stability of the orders. The goal is to distinguish frequent regularly ordered parts from erratically ordered parts. 80% of the orders are usually around 20% of the part types (the "X" parts). The next 15% of the orders are the "Y" parts, and the last 5% are the "Z" parts. See also the [80-20 rule](#), the [XYZ Analysis](#), and the [ABC YXZ Analysis](#).

Y

- **Yamazumi-chart** (山積み-chart; Leveling chart, literally Heap or Pile): Stacked bar chart used to balance the workload of different operators/stations in a production line. Fancy Japanese name for [Line Balancing](#). Sometimes also called Yamazumi board.
- **Yokoni Tenkaisuru** (横に or よこに for horizontally; flat; across; crossways; crosswise; sideways; and 展開 or てんかい for development; evolution; progressing; unfolding; and する for to do. Together it means to unfold or open sideways.): Spreading information across the Organization, both the results but even more importantly the process how the results were achieved. The term is usually abbreviated to [Yokoten](#). A similar term with the same abbreviation is [Yokotenkai](#).
- **Yokoten** (横展 abbreviation (not a proper word) for unfolding sideways): Abbreviation for either [Yokotenkai](#) or [Yokoni Tenkaisuru](#), which mean pretty much the same: Exchange of information across different structures and hierarchies.
- **Yokotenkai** (横展開, horizontal development): Spreading information across the Organization, both the results but even more importantly the process how the results were achieved. The term is usually abbreviated to [Yokoten](#). A similar term with the same abbreviation is [Yokoni Tenkaisuru](#).
- **YWT** (やったこと yatta koto: What we did; わかったこと wakatta koto: What we learned; つぎにやること tsugi ni yarukoto: What we will do next): Approach in Japan and used by Toyota to summarize learnings and to improve. The Y summarizes a concrete experience, the W tries to get the lessons learned and insights, and the T aims to see where to apply this learning to a new situation. Used as a quick feedback and insight round, often done within one minute, often

after a session or at the end of every day in a project. Can be done verbally, but often also used with written notes. See also [KPT](#), [Four Line Diary](#), and [PDCA](#).

Z

- **Zaibatsu** (財閥, industrial group): Business conglomerates in Japan prior to World War II, where one family controls the entire business empire. The “big four” were Sumitomo, Mitsui, Mitsubishi, and Yasuda. After the war, they were dissolved and mostly turned into [Keiretsu](#).
- **ZD** (Zero Defects): Management program with the highly unrealistic goal to reduce defects to zero. Popular in America in the 70’s. Still pops up every now and then in manufacturing. See also my post [Lean is Zero Defects? – I don’t think so!](#)
- **Zentenatamadashi** (全点 頭出し for all items, all parts, all points; and sticking out their heads): Material supply for assembly station, which can be translated as Single-Piece Presentation. For each part type exactly one part (the first one) is accessible to the worker. Ideally, the smallest front is facing the worker. Therefore each part takes up a minimal amount of space around the worker, reducing overall space requirements and increasing efficiency. When a part is taken, the next one should slide into place.