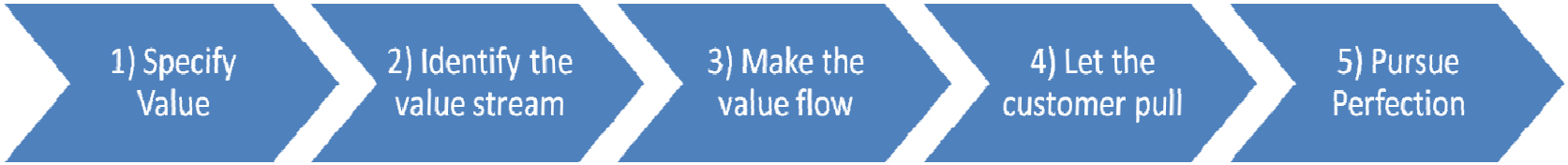
What is Lean?

Lean is a word used in an attempt to characterise the approach to manufacturing developed by the Toyota Motor Company in the 1950's, to enable the company to compete with the Western automotive industry with far fewer resources. At its heart it is a method of producing what a customer/client wants when he/she wants it with a minimum of waste and to a high level of quality. It was first applied to the automotive manufacturing environment but due to its success its principles are now being applied in many fields from construction to health care. It is not a strategy but a powerful tool to help a company improve its performance. A great advantage of the Lean approach is that, with a little help, people at all levels can contribute and find ways to work smarter rather than harder.

The principles of Lean and the series of steps for their application are summarised below.



1. **Value.** This element can only be specified by the customer/client

2. **The value stream**. The core actions required to produce a product/project or service.

3. **Flow.** The method of aligning the process in order to facilitate the critical path.

4. **Pull.** Customer/clients should be able to pull the product/project or service on an as needed basis

5. **Perfection.** Develop and amend the process continuously in pursuit of perfection.

"Lean Thinking" Womack & Jones

The focus of these principles is on analysing processes in terms of customer/client value and eliminating waste. This is done by mapping processes and analysing them rigorously to determine what is value adding and what is not on the basis that value is defined as something a supplier considers a customer/client, internal or external, is prepared to pay for. The rest is waste and processes are redesigned to try and eliminate this. In practice the analysis of processes normally show three categories "Added Value", "Non Added Value but Essential" and "Non Added Value" (or "Waste").

In Lean applications, the HA identifies eight types of waste:

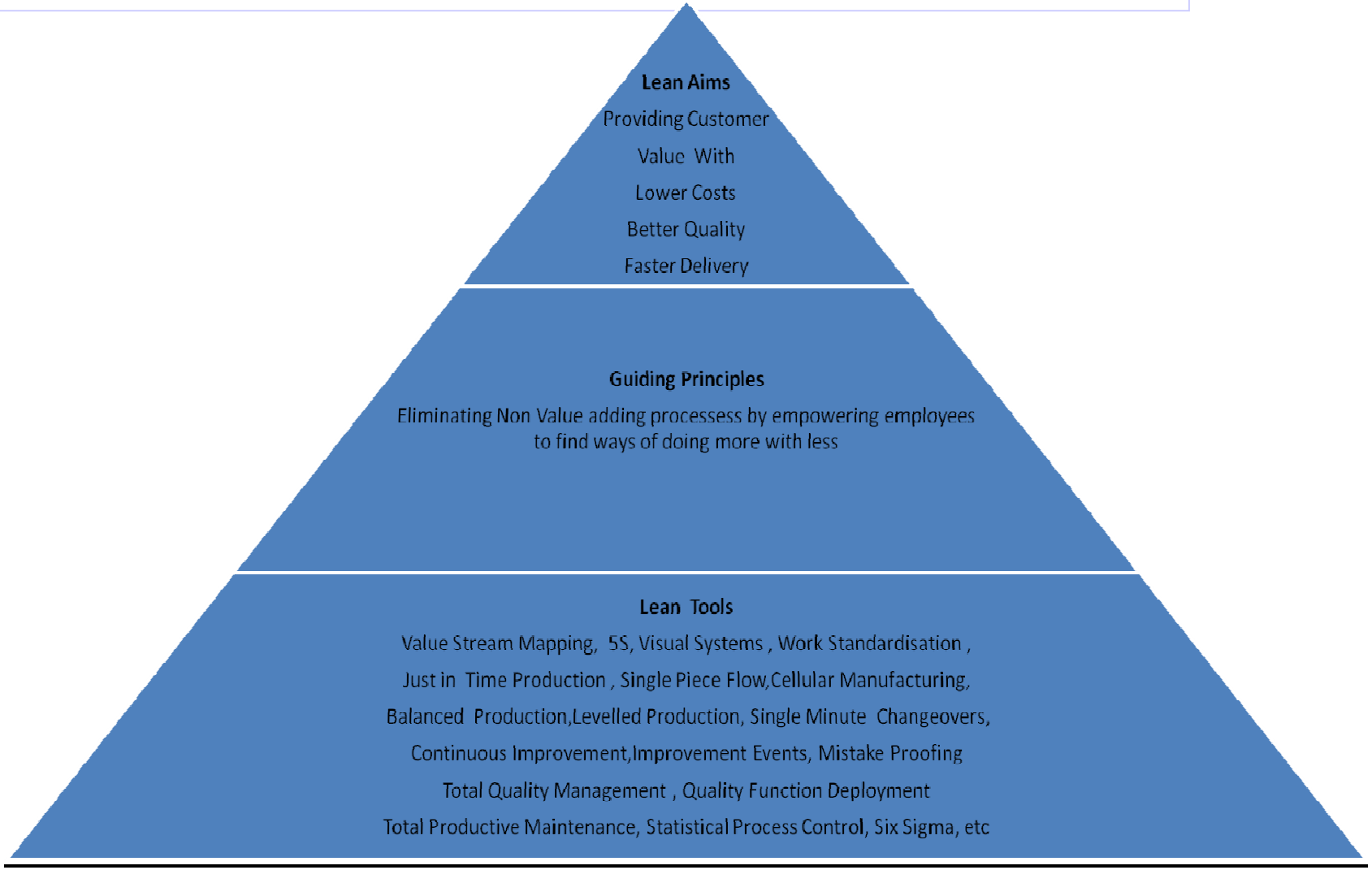
- Transportation.
- Inventory (Stock) excess.
- Motion excess.
- Waiting time.
- Over production/construction.
- Over processing and extra process steps.
- Defects / rejects.

- Skills misapplication.

The aim is to minimise these wastes and develop new processes to maximise the added value. The definition of these wastes will vary depending on the type of process being analysed. For example, when manufacturing doors it will be obvious if more are being produced than is being demanded. However, in planning a project going through several iterations to ensure the best plan may look like over production/construction but in fact reviewing the plans several times may well result in a better plan and therefore adding value. In addition, inventory (stock) in construction projects could be physical things e.g. materials/ equipment etc. or could equally be “float” time in a programme. In summary, the aims of Lean are simple and achieved by maximising the capability of all employees using a range of tools depending on the process being investigated.

Successful implementation of Lean thinking has shown very significant results, improvements in excess of 25% in the areas of Time, Cost and Quality often being demonstrated whilst improving employee satisfaction. In construction these tools will not be effective unless a sound system of project management is in place. In addition, there must be employee engagement created and a change culture nurtured and encouraged for success.

Lean transformation is the process by which organisations take these Lean principles and progressively, through a planned programme, ensure they are adopted to provide a more competitive capability. A simple summary of these principles and some of the tools by which they can be applied is shown below.


Lean Aims
Providing Customer
Value With
Lower Costs
Better Quality
Faster Delivery
Guiding Principles
Eliminating Non Value adding processess by empowering employees
to find ways of doing more with less
Lean Tools
Value Stream Mapping, 5S, Visual Systems , Work Standardisation ,
Just in Time Production , Single Piece Flow,Cellular Manufacturing,
Balanced Production,Levelled Production, Single Minute Changeovers,
Continuous Improvement,Improvement Events, Mistake Proofing
Total Quality Management , Quality Function Deployment
Total Productive Maintenance, Statistical Process Control, Six Sigma, etc

There are many books on Lean, for an initial understanding the following may be useful:

- "Lean Thinking" - James P Womack and Daniel T Jones, Simon and Schuster, initial publication 1996.
- "Learning to See" - Mike Rother and John Shook, the Lean Enterprise Institute, 2000
- "The Lean Toolbox"- John Bicheno and Mattias Holweg, Pisces Books 4th edition 2008

Glossary of Terms

Activity – A unit of work that has a beginning and an end, occurs over a period of time, and consumes input(s) and produces output(s).

Backflow – A condition in which a part, product/project or design is returned to a previous stage due to a defective condition.

Balanced Scorecard – An analysis technique and management instrument that translates an enterprise's mission and strategy into a comprehensive set of performance measures to provide a framework for strategic action. The scorecard may gauge organisational performance measures across several perspectives such as: financial, customer/clients, internal business processes, learning and growth.

Consensus – A state where group members support an action or decision, even if some do not fully agree with it. A consensus decision is made after aspects of an issue, both positive and negative, have been reviewed or discussed to the extent that everyone openly understands, supports, and participates in the decision.

Cross Functional Management – A process designed to encourage and support interdepartmental communication and cooperation throughout an organisation, as opposed to command and control through

narrow departments or divisions. The purpose is to achieve organisation targets, such as quality, cost, and delivery of product/projects and services by optimising the sharing of work. (Ref.6)

Culture – Shared characteristics such as values, behaviours and beliefs that distinguish the members of one group from those of another. Organisational culture includes the common set of beliefs, sentiments, priorities, attitudes, perceptions, operating principles and accepted norms shared by individuals within an organisation. **Cultural change** is a major shift in these organisational characteristics.

Customer/client – A stakeholder who is a recipient of a product/project or service produced by an organisation. Customer/clients may be internal or external to the organisation. External customer/clients, those in the marketplace, are the reason an organisation exists. Internal customer/clients are the reason a functional area or department exists – an interdependent department, or a downstream user in the value chain. When services rather than product/projects are provided, customer/clients are often called clients.

Customer/client Value – Essentially customer/client value is something a customer/client is prepared to pay for, a product/project (which might be a road) or service, which will provide the means to satisfy the outcome that the customer/client wishes, i.e. something the customer/client is prepared to pay for.

Cycle Time – The time required to complete one cycle of an operation. If cycle time for every operation in a complete process can be reduced to equal the demand (takt) time, product/projects can be made in single-piece flow.

Enterprise – Any corporate or business-unit organisation with a distinct mission, market segment, suite of product/projects or services, customer/client base, profit/loss responsibility and set of competitors. The purpose for the organisation's existence is to perform its mission and achieve associated goals.

Supply chain – All businesses along the value stream that contribute to providing value to a customer/client – this SPECIFICALLY includes the organisation's suppliers involved in providing value to the customer/client.

Five S (5S) or Five C (5C) – This is a five step process developed by the Japanese as an essential step in organising a workplace to enable standard processes to be introduced to enable sustainable continuous improvement. The English interpretation of the original Japanese 5S words for the five steps are Sort, Set in Order, Shine, Standardise and Sustain. The 5C's are an alternative English version the five steps being Clearout, Configure, Clean and Check, Conformity and Custom and Practice.

Flow – The progressive achievement of tasks along a value stream so that a product/project or service proceeds from design to delivery providing materials or information into the hands of the customer/client with no stoppages, rejects or backflows.

Continuous Flow Production/construction – Items or information are produced and moved from one processing step to the next one unit-at-a-time. Each process makes only the one piece that the next process needs, and the transfer batch is one. Also called "single-piece flow" or "one-piece flow". Contrast with batch-and-queue.

Improvement Event/Intervention – Part of the Lean toolkit and provides a mechanism for making radical and incremental changes to current processes and activities. They are often carried out within very short timescales focused on a particular problem or process. They are structured events carried out off the job where a small group of employees with relevant knowledge of the process or problem collect data and analyse it to determine an improved process or method and implement it. The events are often assisted by a trained facilitator.

Integrated Product/project Team – Construction requires design and manufacturing process design. An integrated product/project team carries out these processes as far as possible in a concurrent way. An

integrated team therefore will consist of personnel from a range of functions designers, architects, project managers, purchasing experts, manufacturing engineers, key suppliers etc. jointly working together to achieve the desired outcome minimising waste and maximising value by ensuring that all factors are considered at the earliest possible stage and issues resolved.

Innovation – The practical transition of ideas into new product/projects, services, processes, systems and social interactions. This would include for example on site value engineering etc.

Just-in-time – Conveying only the items or information that are needed by the next process when they are needed and in the quantity needed.

Lead-time – The total time a customer/client must wait to receive a product/project or service after placing an order. In a manufacturing or construction system is running at or below capacity, lead-time and throughput time are the same. When demand exceeds the capacity of a system, there is additional waiting time before the start of production/construction or the next stage of say a design process, lead-time exceeds throughput time.

Lean Change Agents – People who have a good knowledge of Lean principles and their application. These people also have the capability to guide and instruct employees to develop their own capabilities in their own situation to apply appropriate Lean techniques to improve their processes.

Lean Daily Meeting – A term used in construction to describe a routine daily or weekly meeting of a group or cell of employees in order to communicate information and to track safety, programme progress, quality, cost, discuss problems and identify issues and resolve using problem solving techniques .

Mistake Proofing – People are human and cannot be expected to do everything like a machine, exactly the same each time. It is also not necessarily their fault, as poorly-designed processes that require a great deal of attention can contribute severely to problems. The basic principles of mistake proofing (Poka yoke) advocate

designing or developing tools, techniques and processes such that it is impossible or very difficult for people to make mistakes. It is a simple principle that can lead to massive savings.

Thus, for example, a plate that must be screwed down in one orientation only could have the screw holes in non-symmetrical positions so that it can only be screwed in the right orientation; or a petrol filler on a car not being able to receive a diesel nozzle. The principle can also be used in non-manual situations such as project management.

Non-value added – Any product/project, process or service that does not add value to the ultimate customer/client. (It is important to know that non-value added is not the same as “not necessary”, since some activities are required by law or are necessary for process control, such as inspection. These may not add value but are used to assess processes for control and improvement.

Overall Equipment Effectiveness – is a measure of the quality and availability of an organisation's equipment. It is not restricted to operations alone as it can measure any facility such as an IT system. The measure is Equipment Availability x Performance Efficiency x Output Quality and is used to measure the effectiveness of TPM.

Partnerships – A working relationship between two or more parties. Partners can include suppliers, distributors, joint ventures and alliances.

Performance Measure – A dimension of an activity or process – quality, cost, cycle time, or other characteristic – that can be used to judge the effectiveness of efficiency of the process against a target or standard value.

Process – A sequence of activities which results in a product/project or service by producing required outputs from a variety of inputs.

Process Variation – Every process has variation. Some variation may be the result of causes which are not normally present in the process. This is **special cause variation**. Some variation is simply the result of numerous, ever-present differences in the process. This is **common cause variation**.

Process Stability – Process stability is defined as a state in which a process has displayed a certain degree of consistency in the past and is expected to continue to do so in the future. This consistency is characterised by a stream of data falling within control limits which are set specifically for the process being monitored, using statistical techniques to measure data to ensure that processes are maintained within those limits.

Productivity – An overall measure of the ability to produce a good or service. It is the actual output of production/construction compared to the actual input of resources. Productivity is a relative measure across time or against common entities. In economics, the ratio of output in terms of dollars of sales to an input such as direct labour in terms of total wages.

Pull System – A planning system based on communication of actual real-time needs from downstream operations – ultimately final construction or the equivalent – as opposed to a push system.

Push System – A planning system that schedules upstream operations according to theoretical downstream needs based on a plan, which may not be current – as opposed to a pull system.

Root Cause – Underneath the (apparent) cause of a problem, the real cause is often hidden. In every case we must dig up the real cause by asking why sufficient times to find the root cause. Otherwise countermeasures cannot be taken and problems will not truly be solved. E.g. my car won't start, cause is a flat battery, why? Faulty alternator, why? Poorly adjusted fan belt etc,

Single-Piece Flow – A situation in which units proceed, one at a time, through operations in design, order-taking and production/construction, without interruptions, backflows or scrap.

Stakeholders – All those who have an interest in an organisation, its activities and its achievements. These may include customer/clients, partners, employees, shareholders, owners, government and regulators.

Strategic Plan – This is a comprehensive statement of an organisation's overall mission, objectives and strategy. A detailed road map of the direction the organisation intends to follow in conducting its activities. Provides direction, concentration of effort, consistency of purpose, and flexibility as a business moves to maintain and improve its competitive position.

Strategic Planning – The top-level management decision process that focuses on the overarching, long-range direction of the organisation and establishes the means by which that direction is reached. Includes defining top-level and subordinate missions, goals and supporting objectives, i.e., how the enterprise sees its purpose and where it wants to go. Provides the "big picture" along with a description of how goals and objectives are to be achieved and the indicators that will be used to measure performance and outcomes.

Statistical Process Control (SPC) – an *optimisation philosophy* concerned with *continuous process improvements*, using a collection of (statistical) tools for data and process analysis and making inferences about process behavior in order to take action to maintain process stability. It is used, for example, in the concrete industry to ensure consistency of mix. SPC *does not* refer to a particular technique, algorithm or procedure.

Takt Time – The available production or construction time divided by the rate of customer/client demand. For example, if a customer/client demands 40 soil nails per day, and a contractor operates 8 hours per day, takt time is twelve minutes; if customer/client wants two new projects designed per year, takt time is six months. Takt time sets the pace of production/construction to match the rate of customer/client demand and becomes the heartbeat of any Lean system.

Total Product/productive Maintenance (TPM) – Based on the experience that equipment and process problems are the root cause of many of the unplanned events that reinforce a reactive Management style. Delivering reliable equipment alone, however, is not enough to deliver world-class organisation performance. TPM encompasses monitoring and improving the total integrity of the organisation's facilities by delegating as much maintenance work down through the people who add value - production/construction and maintenance personnel alike. Its effectiveness can be measured by Overall Equipment Effectiveness (OEE) see above.

Training (formal) – The acquisition of knowledge, skills, and competencies as a result of formal teaching of vocational or practical skills and knowledge that relate to specific useful competencies. Training has specific goals of improving one's capability, capacity and performance. It can be carried out either on or off the job. Such training is recorded against the individual(s) who have undertaken it.

Value – A product/project or service's capability provided to a customer/client at the right time, at an appropriate price, as defined in each case by the customer/client.

Value-added Activity – An activity or step in a process that adds value to an output product/project or service. Such an activity merits the cost of the resources it consumes. These are the activities that customer/clients would view as important and necessary. A value-added activity contributes directly to the performance of a mission, and could not be eliminated without impairing the mission.

Value-added Time – Time for those work elements that transform information, product/project or service into value the customer/client is willing to pay for.

Value Stream – The specific activities required to design order and provide a specific product/project, structure or service from concept to delivery into the hands of the customer/client.

Value Stream Mapping/Analysis – Involves defining a product/project family'/business processes' material and information flows from beginning to end utilising a visual representation of every process identifying value adding and non value adding processes. This facilitates understanding of current state and the development of the proposed future state. The difference between the two states becomes the basis for the Lean Transformation plan.

Waste – Any product/project, process or service which does not add value to the ultimate customer/client. In Lean applications, the Highways Agency identifies eight types of waste:

- Transportation (e.g. moving aggregate from depot to site)
- Inventory (Stock) excess (e.g. raw material, work in progress including design work and finished work not yet required and float in the programme, unused plant)
- Motion excess (e.g. excessive haulage roads on site)
- Waiting time (e.g. excavating plant waiting for spoil removal vehicles to become available)
- Over production/construction (e.g. making more than the customer/client wants)
- Over processing and extra process steps (e.g. unnecessarily high quality paint finish)
- Defects / rejects (e.g. fixing defects or scrap)
- Skills misapplication (e.g. appointing inappropriate people to business improvement roles)