16 Lean production

The Toyota Production System (TPS)

TPS is the basis of modern manufacturing. It was developed at Toyota at the end of the 70s and during the 80s, but is now used right across industry. TPS focuses on two things: adding value and eliminating waste. Value is defined as any item or feature for which a customer is willing to pay. Anything else is waste and has to be removed. TPS identifies seven categories of waste:

1. Overproduction: producing too much, or too soon, or too quickly. Overproduction is minimized by using a 'pull' system; this means that work isn't performed unless the part is required downstream – so in the end products are made only as a direct result of customer activity.
2. Materials handling: inside and outside the plant.
3. Movement: performing tasks manually that could be automated.
4. Waiting: idle time between work stations along the production line.
5. Over processing: doing more than the customer required or is willing to pay for.
6. Inventory: exceeding one-piece flow. One-piece flow (also known as 'continuous flow') is when items are processed one at a time and then moved directly to the next process.
7. Defects: rework, repair, or waste in its simplest form. Defects are rigorously analyzed to make sure that they don't happen again (ie 'error-proofing' the system).

Just-In-Time (JIT)

JIT is a closely related concept. Here, parts and components are delivered only as they're needed: at the right time, in the right amounts and in the right sequence. Delivery to the factory gate should be JIT, as should delivery to individual work stations on the assembly line. The aims of JIT are: minimizing inventory, producing items at a rate set by the customer, eliminating any unnecessary lead time, and generally optimizing the flow of materials from suppliers through production and up to the point of sale of the finished product.

All of these ideas are recycled in the modern concept of 'lean production' (lean = with little fat). A lean manufacturer is constantly trying to reduce manpower, materials, money, machines, time, space, mistakes and effort.

Kaizen

Behind all the techniques described above lies the idea of 'kaizen'. This is Japanese for 'continuous improvement' – making changes in small, incremental steps. This is seen as being done through teamwork, personal discipline and involving workers directly in the process of improving quality. A practical implementation of kaizen is 'the five S' approach to workplace organization. See below. This is derived from five Japanese words beginning with 'S', and English translations have tried to find five 'S' words.

The five Ss

Principle: a place for everything, and everything in its place

Key ideas: discipline, simplicity, pride, standardization and repeatability

S1: Sort
Review everything in the work area, separating what is needed from what is not. Remove anything unnecessary.

S2: Set In Order
Arrange everything in a neat, tidy and easy-to-use manner.

S3: Shine
Once the work area has been sorted and set in order, clean it up so that everything shines! Clean the area itself, as well as equipment and tools.

S4: Standardize
Create clear, simple and visual standards for S1–S3.

Example 1: shadows on work surfaces and inside storage boxes show which tools should be where.

Example 2: a re-order card (called a 'kanban') is attached to an item and placed somewhere after the item is used. This gives a visual signal when a new item is needed.

S5: Sustain
Continue to operate and improve S1–S4.

Exercises

16.1 Find a word in the text opposite that matches each definition below. The words appear in order.

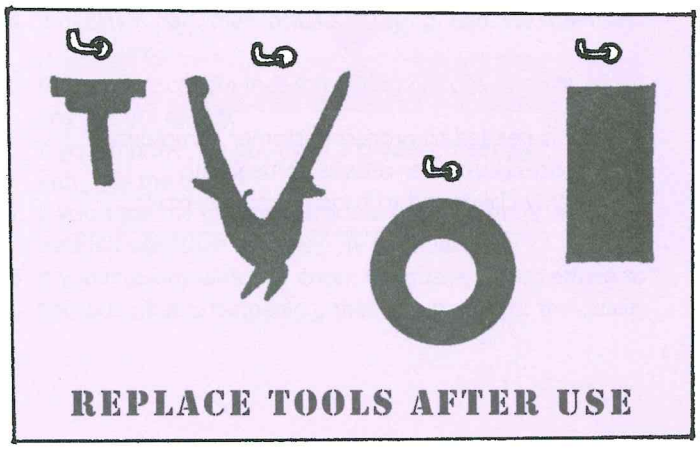
1 *(two words)* time when a machine isn't working or being used _____
2 the continuous movement of something _____
3 faults in the way something is made _____
4 making something again _____
5 trying to avoid (or protect against) future mistakes _____
6 taken to a place (eg house, office, factory) and given to someone _____
7 *(two words)* time that must be allowed for completion of an operation or process _____
8 all the workers that are needed to do a particular kind of job _____
9 increasing gradually _____

Now do the same for the words in 'The five Ss' opposite.

10 have a bright, attractive appearance; produce (or reflect) light _____
11 things that you hold in your hand and use to do a particular job _____
12 *(two words)* containers where things are kept until they're needed _____

16.2 Make phrases by matching an item from each column.

1	add	waste (from a process)
2	be willing	a task (manually)
3	deliver	value (to a product)
4	eliminate	parts (to the factory gate)
5	make sure	to pay for something
6	perform	something doesn't happen again
7	attach	inventory (using JIT)
8	clean up	the flow of materials (using JIT)
9	error-proof	materials (inside a plant)
10	handle	the equipment so that it shines
11	minimize	a system (by rigorous analysis)
12	optimize	a kanban card to an item



16.3 Fill in the gaps with a different form of the word in brackets. The new form may be a noun (singular or plural), verb or adjective.

1 TPS has had a big impact on _industrial_ (industry) processes in many sectors of the _____ (economic). Generally, it has made manufacturing much more _____ (produce).
2 It is important to make a detailed _____ (analyze) of which items and features add value, and which don't. There is no point making _____ (improve) if the customer isn't willing to pay for them.
3 In a badly run factory, many processes are _____ (waste) and levels of inventory are _____ (exceed).
4 With JIT, _____ (deliver) to the factory gate or the _____ (assemble) line is made only when it's needed.

16.4 Complete the text about the 'Theory of constraints' with the words in the box.

bottleneck branch customized shape straight sub-assemblies synchronization

The 'Theory of constraints' (TOC) is another approach to maintaining flow in production. A 'constraint' is a [1] _____ in a system – something that limits further progress. TOC has identified four possible plant layouts, where the production lines inside the plant are arranged in the [2] _____ of different letters of the alphabet (I, A, V and T).

An I-plant is the simplest. Here, the work is done in a [3] _____ line. The constraint is simply the slowest operation.

Next is an A-plant. Many [4] _____ converge for a final assembly. Here, the problem is [5] _____, with converging lines arriving at the final point.

With a V-plant, one raw material is made into many final products. Here the problems occur immediately after the divergence point – any operation along one [6] _____ of the V can rob (= steal) material meant for the other branch.

Finally, we have a T-plant. A number of basic units are produced on a line and then [7] _____ at the end. There is a wide variety of final products. This type of plant combines the problems of most of the others!

See page 147 for some discussion topics.