World Class Manufacturing – An overview

World Class Manufacturers are those that demonstrate industry best practice. To achieve this, companies should attempt to be best in the field at each of the competitive priorities (quality, price, delivery speed, reliability, flexibility and innovation). Organisations should therefore aim to maximise performance in these areas in order to maximise competitiveness. However, as resources are unlikely to allow improvement in all areas, organisations should concentrate on maintaining performance in 'qualifying' factors and improving 'competitive edge' factors.

The priorities will change over time and must therefore be reviewed.

Factors to be aware of:

Though costs will still be monitored and controlled it must be ensured that cost reduction does not remain the overriding priority, as is often currently the case. Organisations should give attention to all of the priorities as stated in the definition of World Class Manufacturing and concentrate on your SWOT. You need to be selective about what you improve.
Control of operations

Before commencing implementation of control systems there are always five beneficial things to do which will make any method of control easier to implement and make the system work better operationally: (Generally world class manufacturing businesses have done these things).

1. Reduce time wasted in setting and reduce set up times

Particularly true for Period Batch Control because the technique requires every part to be made every period, but it is beneficial in all circumstances to reduce batch sizes by reducing set up times on the bottleneck processes. There is little extra benefit in reducing set up times on non-bottleneck processes.

The technique "Single Minute Exchange of Die" or "SMED" provided a structured approach to doing this.

2. Form Natural Groups (cells)

The processes are divided into groups of families of products or services using Group Technology. This technique was later to be reborn as cellular manufacturing. The technique can be applied wholly or partially, i.e. to the whole of the factory or to part of it (usually the runners) and is always beneficial except in pure job shops where product family cells are unstable.

3. Reduce throughput times

By far the easiest way of reducing throughput times is to reduce Work in Process (WIP). It may be fat and comfortable for the production supervisors to keep lots of Work in Progress.

By the same token if there is less WIP, what is in process can be focused on and move more quickly. Typical results of starving the issue of work until a resource is available to work on it are halving of WIP and manufacturing lead-times at a stroke with no loss in output.
Secondly by only completing parts when they are required to be dispatched and invoiced, WIP tends to only contain parts which are required to be finished and are therefore not likely to be overtaken by more urgent work and left behind in WIP or in finished stock.

There is almost never a case for sub-assembly stocks, unless there is very high commonality of sub-assemblies and long sub-assembly lead-times. Whole-assembly kitting can reduce assembly WIP by 50% against sub-assembly kitting and manufacture. Stocking sub-assemblies is almost always an open invitation to rob kits and cannibalize built sub-assemblies for more urgent jobs with corresponding total loss of stock control and rampant WIP.

Other methods of reducing throughput time include:

Redistributing resources to work the bottleneck harder.
Reducing the number of operations per part by either combining operations to form one, or including manual operations inspection or de-burring in the working cycle of automatic machines.

4. Postpone product mutation

If this technique is considered at the design stage, the mutation induced by customer requirements can be deferred until the final operation rather than at an early manufacturing stage. This makes sophisticated control of mass customisation unnecessary. A common example of this is packaging where it is often beneficial to stock unpacked items and pack into customer livery to order. I.e. convert to assemble to order from make to order.

A shorter-term possibility is to consider the trade off between lead-time and stock variety. This is a method of reducing end product variety (SKU's) stocked by deliberately stocking common sub-assemblies instead of final assemblies. For example if there are common sub-assemblies it may be possible to reduce the final assembly stock holding significantly by stocking instead the common sub-assembly. If lead-time is a key selling success factor this may not be acceptable, but if lead-time is not an order winning criteria it may be practical, to stock sub-assemblies.
5. Remove the trivial many, to focus on the vital few

Using Pareto Analysis increase batch sizes of the low volume value "C" items and preferably employ "Supplier Top Up"

We have taken the view that the above should be viewed as prerequisites in almost all situations, until they are proven to be impractical. The beauty of this approach is that all steps are beneficial in their own right and can in most cases be implemented separately (as different projects).
WORLD CLASS MANUFACTURING

Waste vs. Value Added

**Principles:**

- The major problem within industries Today is **Waste**.
- One way of identifying waste is to check whether your operation (or activity) add any **value** to the product or service.
- **Waste** is defined by Mr. Fujio Cho (Toyota Company, Japan) as "Anything other than the **minimum** amount of equipment, materials, parts, space, and worker's time, which are absolutely essential to **add value** to the product."

**Categories of Waste:**

In most organizations, the following items are claimed as the major sources of Waste:

- Overproduction.
- Waiting for materials, machines, or instruction.
- Transportation or movement.
- Machine processing.
- Excessive inventory.
- Inefficient operations.
- Producing defects.
- Model or line changeover or setup machines.
- No housekeeping.
- Miscommunication or misinstruction.

**Discussion Questions:**

1. Among the above categories of waste, which is (are) the most critical one (ones) in your organization (your daily operations)?
2. Please identify at least five examples of waste from your daily operations? Why do you think they are kind of wastes? How can you eliminate or reduce these wastes?
3. Why overproduction is a kind of waste? What is its impact on organization's competitive advantage? How can you avoid or reduce it?
4. Why inventory is a kind of waste? What is its impact on organization's competitive advantage? How can you reduce inventory level?
5. Why producing defect is a kind of waste? What is its impact on organization's competitive advantage? How can you reduce defects?

**What is 5S?**

5S, abbreviated from the Japanese words Seiri, Seiton, Seison, Seiketsu, and Shitsuke, are simple but effective methods to organize the workplace.

The 5S, translated into English are: housekeeping, workplace organization, cleanup, keep cleanliness, and discipline. They can be defined as follows:

- **Housekeeping.** Separate needed items from unneeded items. Keep only what is immediately necessary item on the shop floor.
- **Workplace Organization.** Organize the workplace so that needed items can be easily and quickly accessed. A place for everything and everything in its place.
- **Cleanup.** Sweeping, washing, and cleaning everything around working area immediately.
- **Cleanliness.** Keep everything clean for a constant state of readiness.
- **Discipline.** Everyone understands, obeys, and practices the rules when in the plant.

**Potential Benefits of 5S**

Implementing 5S methods in the plant would help the company to reduce waste hidden in the plant, improve the levels of quality and safety, reduce the lead time and cost, and thus, increase company's profit.

The potential benefits of 5S can be summarized by five English S or PQCDS:

**Five English S:**

- Sales - Increase sales (market share).
- Savings - Save costs.
- Safety - Provide a safety working environment.
- Standardization - Standardize the operating procedure.
- Satisfaction - Employees and customers satisfaction.

**PQCDS:**

- P - Increase productivity.
- Q - Improve product quality.
- C - Reduce manufacturing costs.
- D - Ensure on-time delivery.
- S - Provide a safety working environment.
Implementation Procedure of 5S

Depending on company's situation, the 5S can be implemented in different manners. However, many companies felt that the following **PDCA** procedure is quite effective:

1. Organize the program committee. **(PLAN)**
2. Develop a plan for each S. **(PLAN)**
3. Publicly announcement the start of the program. **(DO)**
4. Provide training and education to employees. **(DO)**
5. Select a day and everybody cleans up his/her own working area. **(DO)**
6. Select a day and everybody organizes his/her own workplace. **(DO)**
7. Evaluate the results of 5S. **(CHECK)**
8. Self-Examination and Take corrected actions. **(ACTION)**

Guidelines for Practicing 5S

**Guidelines for Practicing Seiri**

- Separate needed items from unneeded items.
- Remove unneeded items from working areas:
  - Items never used: discard.
  - Item not needed now: store them.
- Remove all excess items from working areas, including workpieces, supplies, personal items, tools, instruments, and equipment.
- Use red tag to get rid of unneeded items.
- Store items needed by most people in a common storage area.
- Assign a person to organize and manage the common storage area.
- Store items only needed by each individual in his/her own working area.
- Organize working / storage area.

**Guidelines for Practicing Seiton**

**Objectives:**

- Needed items can be easily found, stored and retrieved.
- First-in first-out (FIFO).
- Save space and time.

**Guidelines:**

- A place for everything and everything in its place.
- Place tools and instructional manual close to the point of use.
- Design the storage areas such that the entrance is wider and the depth is shallower.
- Layout the storage area along the wall to save space.
- Place items such that they are facing toward passage for easily access.
- Store similar items together. Different items in separate rows.
- Don't stack items together. Use rack or shelf if possible.
- Use small bins to organize small items.
- Use color for quickly identifying items.
- Clearly label each item and its storage areas (lead to visibility).
- Use see-through cover or door for visibility.
- Use special designed cart to organize tools, jigs, measuring devices, etc., that are needed for each particular machine.

**Guidelines for Practicing Seiso**

**Objectives:**

- Cleanliness ensures a more comfortable and safe working place.
- Cleanliness will lead to visibility so as to reduce search time.
- Cleanliness ensures a higher quality of work and products.

**Guidelines:**

- Use dust collecting covers or devices to prevent possible dirt or reduce the amount of dirt.
- Investigating the causes of dirtiness and implement a plan to eliminate the sources of dirt.
- Cover around cords, legs of machines and tables such that dirt can be easily and quickly removed.
- Operators clean their own equipment and working area and perform basic preventive maintenance.
- Keep everything clean for a constant state of readiness.

**Guidelines for Practicing Seiketsu**

- Use dust collecting covers or devices to prevent possible dirt or reduce the amount of dirt.
- Investigating the causes of dirtiness and implement a plan to eliminate the sources of dirt.
- Cover around objects to prevent from dust.
- Keep everything clean for a constant state of readiness.
What is Visual Control?

Visual control are **means, devices, or mechanisms** that were designed to manage or control our operations (process) so as to meet the following purposes:

- make the problems, abnormalities, or deviation from standards visible to everyone and thus corrective action can be taken immediately,
- display the operating or progress status in an easy to see format.
- provide instruction.
- convey information.
- provide immediate feedback to people.

Visual control (VC) has known to people in several other terms. For instance, visibility management, management by visibility, management by sight. The use of VC can be found in the following categories of tasks:

- Awareness Revolution.
- Combined Use with 5S.
- Office/service Management.
- Operations and Engineering Management (e.g., dispatching, shop floor control, project management).
- Management, control, and Maintenance of Tools and Equipment.
- Quality Management (e.g., control charts, cause-effect diagrams, histograms, etc.).
- Safety warning and Management of Working Environment.
- Cost and Profit Evaluation.

Potential Benefits of VC

Implementing VC in the plant would help the companies to exposing abnormalities, problems, deviations, waste, unevenness, and unreasonable to people, thus corrective actions can be taken immediately to:

- correct the problems,
- reduce manufacturing costs,
- reduce possible waste,
- shorten production lead time and thus keep the delivery due date.
- reduce inventory.
- ensure a safe and comfortable working environment.
- increase company's profit.
**Guidelines for Practicing Visual Control**

The main purpose of visual control is to organize the working area such that people (even outsiders) can tell whether things are going well or are amiss without the help of experts. Visual control can be implemented using either the actual or analog items.

**Actual Items:**

- Designate a Location (position) for each item.
- Indicate Quantity (or maximum level of inventory).
- Distinguish Item from each other.
- Specify Form (Document).

**Analog Items:**

- Colors.
- Shapes (Contour).
- Symbols.
- Characters (Verbal).
- Numbers.
- Graphs.
- Electronic Lights.
- Sound.
- Touch.
- Smell.
- Taste.

**Implementation Procedure of VC**

Depending on company's situation, the VC can be implemented in different manners. However, many companies felt that the following procedure is quite effective:

1. Organize the program committee. *(PLAN)*
2. Develop a plan and budget. *(PLAN)*
3. Collect and develop examples and cases.
4. Publicly announcement the start of the program. *(DO)*
5. Provide training and education to employees. *(DO)*
6. Select a day and everybody apply VC in his/her own working area. *(DO)*
7. Evaluate the results of VC. *(CHECK)*
8. Self-Examination and Take corrected actions. *(ACTION)*
SMED - Setup Reduction

What is SMED?

SMED, stands for Single-Minute Exchange of Die, is a theory and techniques for performing setup operations in under ten minutes, i.e., in a number of minutes expressed in a single digit. The SMED method was revolutionized by Mr. Shingo since 1950 in Japan. The concepts and techniques became available to other countries started around 1974 in West Germany and Switzerland and in 1976 in Europe and United States. However, not until 1980s, the SMED technique getting acceptance to companies outside Japan.

Components of Lead Time

In manufacturing, lead time was considred starting from design until deliver the products or services to the customers. Thus, the lead time consists of the following time elements:

- Product Development (Design) Lead Time.
- Sourcing (Purchasing) Lead Time.
- Manufacturing (Production) Lead Time.
- Order Processing Lead Time.
- Distribution Lead Time.
- Other (e.g. decision making, coordination) Lead Time.

Clearly, Production lead time is only a small portion of the whole lead time, but it is the only component which is controllable by production function.

The production lead time can be further divided into:

- Queue Time Before Processing.
- Setup Time.
- Run (Processing) Time.
- Waiting Time after Processing.
- Move Time.

Among these time elements, run time is the only portion that adds values to the products. Others can be considered as a waste.
Effects of Setup Reduction

Setup reduction may bring the following impacts to the shop floor:

- Lot-size can be reduced.
- Help to reduce inventory.
- Reduce the cost of setup labor.
- Increase the capacity on bottleneck equipment.
- Help to eliminate the setup scrap.
- Reduce the potential Quality problems and obsolescence.

Alternatives for Setup Reduction

SMED is not the only approach for reducing setup time. Some other alternatives are:

- Production Planning - reduce the number of setups.
- Group Technology / cell formation - reduce the number of setups
- Design Standardization - reduce the number of setups.
- Use Standard Module - reduce the number of setups.
- Work Simplification.
- Mechanization or automation - an expensive option.

Procedures for Setup Reduction

SMED can be conducted according to the following steps:

1. Form the setup reduction team.
2. Conduct training and education.
3. Study the setup process (e.g., use video tape).
4. Classify setup operations into waste, internal setups (IED), and external setups (OED).
   - Waste - Operation which do not add values to the setup.
   - Internal Setups - Operations that can only be performed while the machine is shut down.
   - External Setups - Operations that can be performed without shutting down the machine.
5. Eliminate the waste.
6. Convert as many internal setups as possible to external setups.
   - Use standard insert module.
7. Improve internal setups (include adjustment).
   - Use specially designed cart to organize tools.
   - Use quick-release fasteners instead of bolts and nuts.
   - Use stoppers to quickly position the jigs.
   - Use rolling bolsters instead of cranes.
   - Use overhang mechanisms to handle heavy jigs.
   - Use locating pins and holes (socket) to eliminate the adjustment.
8. Improve external setups.
   - Apply visual control principles.
   - Use checklist to avoid omission.
   - Use specially designed cart to help organize tools.
   - Organize workplace (5S) to reduce search.

9. Develop the standard operating procedure (SOP).
10. Evaluate the performance of setup reduction.
11. Prepare for the next setup reduction project.

**Toolkits for Setup Reduction**

Many toolkits can be applied to help setup reductions. For instance:

- Visual Control.
- Checklist.
- Specially designed setup cart.
- Workplace organization (5S).
- Railed cart.
- Standardized base plate and socket.
- Attachment plate.
- Overhang tools.
- Quick fasteners -- clamping cam, crank, clamping (lock) lever.
- Standardized die height.
- Locating pins.
- Stopper.