Innovation Tools for Lean Practices *(Part 1)*

by Ir. Oh Seong Por

Note: This article is the first of two parts. Part two of the article would be published in the March 2011 issue.

1. INTRODUCTION

The principle of lean production is to create value (product or service) according to customer need and which the customer is willing to pay for it. All forms of wastes like material, delay time, human effort, equipment or space which do not add value must be continuously reduced and eliminated. Only the right resource with the right amount is required. Successful attainment of this objective will bring about speed and reduction in cost to enhance the business competitiveness of an organisation.

According to Simon and Zokaei (2005), the success of lean production is formed from the combination of practices, policies and philosophies, commonly known as 3P which is summarised in Table 1.

Lean practices represent the practical techniques or tools, capable of streamlining the value stream and moving it closer to achieving lean principle. There are varieties of innovation tools with each having the specific ways to tackle non value added activities. Therefore Allen, Robison and Stewart (2001), suggested that selecting and systematically implementing the right innovation tool, can and will bring an organisation to becoming lean. Brief explanations of the popularly used tools are included in the following sections.

Table 1: 3P – Lean practices, policies and philosophies (Simon and Zokaei, 2005)

Lean Practices (Tools / Innovation)	- 5S - Single Minute Exchange of Die (SMED) - Standardised Work - Kanban (visual signal) - Cellular Manufacturing
Lean Policies	- Total Preventive Maintenance (TPM) - Enhanced problem solving ability of employee 5 Why - Enhance employee participation (Small Group Activity – SGA) - Long term relationship with customer - Cooperation and transparency across the supply chain - Visual management and control
Lean Philosophies	- Waste elimination - Continuous incremental improvement (Kaizen) - Striving for perfection

2. 5S

5S is a methodology to transform and maintain a work environment that supports lean implementation. It is also a methodology that promotes a culture of order and efficiency in the workplace. Better organised workplace can speed up task, avoid unnecessary delay and improve safety to worker as well as product quality. The term 5S is derived from the five Japanese characters that represent the vital elements, necessary to drive the transformation in the workplace.

i) Sort (Seiri) means to clearly distinguish between the necessary and the unnecessary, to make the hard decisions and to implement stratification management (based on level of importance) to get rid of the unnecessary. It requires the identification as well as prioritisation of what is needed to perform a particular operation or task. All other unnecessary items like materials, machines, tools etc are to be removed out from workplace

ii) Set (Seiton) means to neatly arrange the necessary items and create the right places for each item so that they can be retrieved for use in a hurry. It is a way of eliminating the need to search for item, a kind of non value adding task. The arrangement of item is based on the frequency of use and search elimination. In addition, visual aids such as location lines, label makings and signage are applied for easy identification thus averting the time to search.

iii) Shine (Seiso) means to perform regular cleaning and inspection of equipments, tools and work places. Fundamental cleaning approach is from top to bottom and from inside to outside. Cleaning indirectly brings employees nearer to equipments, create awareness to the workplace surroundings and, promote early detection of potential problems and better quality since contaminant is removed.

iv) Standardise (Seiketsu) means to establish visual management method that allows employees to continually and repeatedly maintaining the conditions of the earlier stages: sort, set and shine.

v) Sustain (Shitsuke) means to sustain the gains and to create a culture for continuous improvement. The main emphasis is to develop the right procedures conduct training and compliance follow up through planned audit exercise. The goal is to instill discipline and develop the right habit to effectively control all the 5S stages. Also encourage total participation of employees to contribute improvement ideas.

3. SINGLE MINUTE EXCHANGE OF DIE (SMED)

Almost all manufacturing lines require setup time for changeover activity to re-configure machine and process settings before another product can be made. Each time

changeover is performed either machines or material inputs or both must be stopped temporarily. This discontinues the flow of piece by piece, one of the conditions essential for achieving lean production goal. The longer the setup time, the higher the losses are incurred in term of production opportunity. Therefore, the endeavor to reduce setup time either through reducing the number of setup or improving setup procedure, is an important approach to becoming lean.

Shingo (1985) who has over many years working as consultant to Toyota has developed a methodology to reduce setup time which is known as Single Minute Exchange of Die or SMED. The meaning of SMED is to complete changeover within a single digit minute or less than 10 minutes. There are four stages to reduce setup according to SMED approach.

Stage # 1: Distinguish Internal and External Setup

External setup is the changeover activity, which can be performed even when machine or main operation line is running while internal setup can only be carry out when machine or main process is completely stopped. Methods to separate these two types of setups are:

i) checklist that records every setup procedures,
ii) work sampling study
iii) interviewing shop floor members who are directly involve in change-over tasks in order to listen to their feedback or suggestions.
iv) videotaping setup activity so that man and machine motion can be thoroughly investigated.

The main target is to identify the time consuming internal setups from the entire changeover activities so that the right improvements can be developed.

Stage # 2: Convert Internal Setup to External Set-up

Reexamine all internal setups to determine if any of them can be converted to external setup. For example early preparation of parts, pre-assembly or pre-adjustment of components which are needed for changeover and off line preliminary processing before transferring to the main line.

Stage # 3: Improve All Aspects of Set-up Operation

The emphasis is to decrease internal setup time. This may be realised through simplifying and standardising procedures on existing machine. Setup procedures must be simplified enough so that eventually every machine operators are capable to conduct changeover. In addition, by modifying the parts, joining method to reduce the assembling and disassembling time can greatly drive down internal setup. For example changing of bolt fastening to clamp gripping, replacing normal flat washer to U-shaped washer, using shorter bolt, etc. To speed up adjustment to parts, special jig, fixture or reference guiding tools are also widely used.

Stage # 4: Abolish Set-up

One way to eliminate setup is to use the same, standardised parts and components for different products. The fewer the differences between things to be produced, the faster the changeover can become. Application of group technology and production by part families can also cut down setup time since similar geometry parts can be processed using the similar machine setting conditions. The advanced development of computer programming to control machines such as program logic control or PLC has enhanced the flexibility of machine to respond quickly to setting changes for handling

different types of products. The success has created flexible manufacturing system which is capable to process different products simultaneously involving minimal re-adjustment. As such internal setup can be conveniently abolished.

4. CELLULAR MANUFACTURING

Cellular manufacturing is a concept of performing all of the necessary operations to make a part, component, subassembly or finished product in a work cell. Cellular manufacturing exhibits the pull production concept which is one of the important principles of lean thinking. According to Schonberger (2008), a large-scale pull production process can be created by stringing together many work cells.

Each work cell produces specific parts, components and subassemblies which are assembled into the final finished product later at the final process. Since each work cell is capable of producing a variety of parts or components, the overall production system eventually is capable of making multi products.

The primary objectives of implementing cellular manufacturing are to reduce setup times (by using part family tooling and sequence) and flow time (by reducing setup time, motion time, waiting time, delay time and using small lot production). Through these, unnecessary inventory can be avoided and production system could response quickly to market demand which actually fits well with lean principle. Another unique benefit of cellular manufacturing as argued by Davis (1999) is that it represents sociological unit conducive to develop strong teamwork among cell fellow workers. This means that worker motivation factor for process improvement can be naturally developed in the work cell.

The basic building blocks of a work cell consist of workstations (places where operations are performed), machines, workers and material transferring system. In a work cell, these items are located as near as possible and in proper routing sequence for a product or product family. The reasons are to reduce human and material movement as well as allowing smooth flow of processing activities. Basically there are two types of work cell, namely assembly cell and machining cell. Generally the operation tasks in an assembly cell are difficult or costly to automate and as such the tasks are performed manually. In contrast, machining cell involves work tasks which are usually simpler and more easily automated. Designing the work cell capacity is important so the pull production system is flexible enough to fulfill varying demands without creating unnecessary stock. Factors which determine work cell capacity are number of workers, number of machines, skills of workers and flexibility of material transferring systems.

Cellular manufacturing concept is said to be able to contribute to quality improvement through the active involvement of worker (Davis, 1999). Normally workers are trained to handle multi tasks essential to transform work piece to the finished good stage or semi complete stage. This means workers are responsible to build parts, components or finished products. Psychologically, the workers are indirectly forced to take the ownership to ensure that parts, components or finished products made by them are acceptable. No item identified at a work station as defective is allowed to proceed to the next station. It empowers the workers to make quality product.

Implementing cellular manufacturing not only involves shifting machines to a new layout (grouping into cell) and drafting new procedures but also changes to the shop floor organisation. Direct workers who are operating inside a work cell are more empowered to handle productivity and quality while the roles of supervisors are focused more on supporting. Supporting roles can be the forms of providing training to work cell operator, providing on demand technical guidance and performing tasks that require higher level expertise. This opposes the division of labor concept, introduced by Adam Smith in which the entire operations needed to make a product are divided into smaller division tasks or smaller work elements with each one handle by specific workers. In short, workers are trained to perform only tasks assigned to them repeatedly. Workers are expected to handle same tasks as instructed by supervisors. This division of task and labor force has increased the efficiency for large volume production and has been widely applied for mass assembly production. However it kills the creativity of worker to contribute idea of improvement since every worker has been trained to do specific task repeatedly. It is the stereotype that requires workers to leave their brains at the factory gate. Just follow the given instructions and perform the repeating task. No empowerment to worker to involve in improvement activity. In the principle of lean thinking, it is considered as the waste of human creativity and talent. ■

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Love Yields Much

Happiness cannot come from without. It must come from within. It is not what we see and touch or that which others do for us which makes us happy; it is that which we think and feel and do, first for the other fellow and then for ourselves.

Helen Keller