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INDUSTRIAL APPLICATION OF VALUE STREAM MAPPING IN DEVELOPING BEST PRACTICES FOR PRODUCTIVITY IMPROVEMENT

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ABSTRACT

The purpose of this paper is to provide a review of how a manufacturing company developed the best practices for productivity improvement in production areas by using Value Stream Mapping (VSM). VSM was used to identify bottlenecks in the plant that limits the throughput and to identify wastes which included non value added activities in the constrained production areas. Results of VSM application have revealed the plant's overall bottlenecks and means of increasing the throughput. The study findings are originated from a composites technology company which practiced lean manufacturing system and the results may not be applicable to other types of industry. VSM is considered a very useful tool for productivity improvement that it is easy to be used by plants' management to help them identify and manage bottlenecks, and to eliminate wastes from the production system. This paper offers practical and easy-to-use productivity improvement tools to assist manufacturing managers to boost-up the productivity.

Keywords*: Value Stream Mapping, Productivity Improvement, Lean Manufacturing, Manufacturing Company*

INTRODUCTION

Since its establishment at the end of year 1990, it was understood that many productivity issues have been recognised. Until now, the company still facing problem in maintaining and improving their overall productivity. However, since the company implementing lean manufacturing in early year 2004, records shown that the company had increased the productivity to approximately 10% by reducing set-up time, job over time, work-in-progress inventory (bottlenecks), scrap and rework activities. The company is one of the leading composites technology companies in Malaysia which is situated in Melaka. As a global supplier for aircraft industries and others composite products, the company is always looking the best of ways in improving their productivity.

Productivity, as a concept, has had a renaissance of late [1]. For a time, it was relegated well behind quality as the exhorting force for organizations and individuals. All were urged to pay attention to customer needs and desires; to satisfy those needs and desires indeed to go beyond mere satisfaction towards customer delight and joy. The culture that such a "movement" would engender would take care of the costs, less waste of materials, better customer retention, etc.

According to Barnes [2], productivity is a term that has number of different meanings although it is most commonly associated with labour effectiveness in industry. In a broad sense productivity is the ratio of output to some or all of the resources used to produce the output. To profit from productivity improvement, management needs measurement procedures for monitoring productivity performance and identifying improvement opportunities [3].

This study was performed to identify the application of value stream mapping (VSM) (as a lean's tool) in developing best practices for productivity improvement in the manufacturing company. Furthermore, it will describe the analysis of productivity improvement strategies, analysis of model of productivity improvement by using VSM and analysis of successful factors for VSM.

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VALUE STREAM MAPPING

Value stream mapping (VSM) is a method to depict current and future, or ideal states of the manufacturing system. It depicts both the material flow and the information flow and is used as an aid to develop the implementation plan for installing a lean system [4].

It is a very visual concept, which uses simple icons to represent key manufacturing functions and encourages quick pencil diagrams on large sheets of paper to illustrate the whole manufacturing process. VSM helps to visualize flows, identify areas of work, create a common language for talking about the manufacturing process, pull together lean thinking principles, illustrate relationships between information and physical flows and create buy-in from the senior team undertaking the 'bigger picture'.

In this approach, all activities, inventories, and information flows are carefully "mapped" and analysed. The approach is similar to the heavily used process mapping, but adds a careful analysis of inventory (size, functions, and costs) and information flows, both into and out of various process operations [5].

This tool really works best for repetitive operations, especially where a single product or family is made. However, where a variety of product exist (i.e. before rationalization or cell groupings) focus on a specific value stream (or product) will avoid confusion over the different process routes, and will serve to highlight the issues of waste.

VSM enables the analyst to follow a products' production path from customer to supplier, carefully drawing a visual representation of every process in the material and information flow. A set of key questions can then be asked and a 'Future State' map constructed to show how value should flow. To create value adding flow, analyst needs a 'Vision'. Mapping helps the analyst to see and focus on flow with a vision of an ideal or improved state. Figure 1 illustrates the value stream mapping steps.

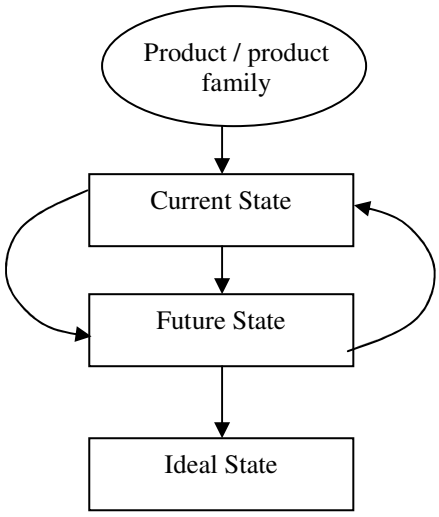

Figure 1: VSM steps

The facility layout and distribution of responsibility in many manufacturing companies currently will probably mean that the mapping activity will take the analyst across many functions and departments. In order to understand the 'complete' picture, one person is needed to understand the total value stream of product and to be responsible for improving it.

VSM is best performed as a cross-functional plant team activity with members experienced in their discipline, familiar with the product, and trained in the use of value stream mapping. Figure 2 shows the example of a current state VSM while figure 3 shows the example of a future state VSM.

The current state VSM is used as a measurement method to measure the current performance of an operation on the floor which covered all processes including data from external and internal customer and suppliers. The current VSM is continuously updated to monitor the progression of overall processes and the productivity. The future state VSM is used as a future improvement plan or action should be taken by the floor for productivity improvement. The Kaizen Burst at the future state VSM (see figure 3) is shown as focus points for improvement with the appropriate techniques can be used inside. There are two types of improvement. First, minor improvement which is conducted by floor leader to solve any simple problem at the floor and usually not involve too much cost such as applying Kanban system for managing inventory at warehouse, standard work procedure review for the particular area, etc. Second, major improvement such as factory re-layout, business operation re-arranges, etc. which commonly involved highly cost and long term effect.

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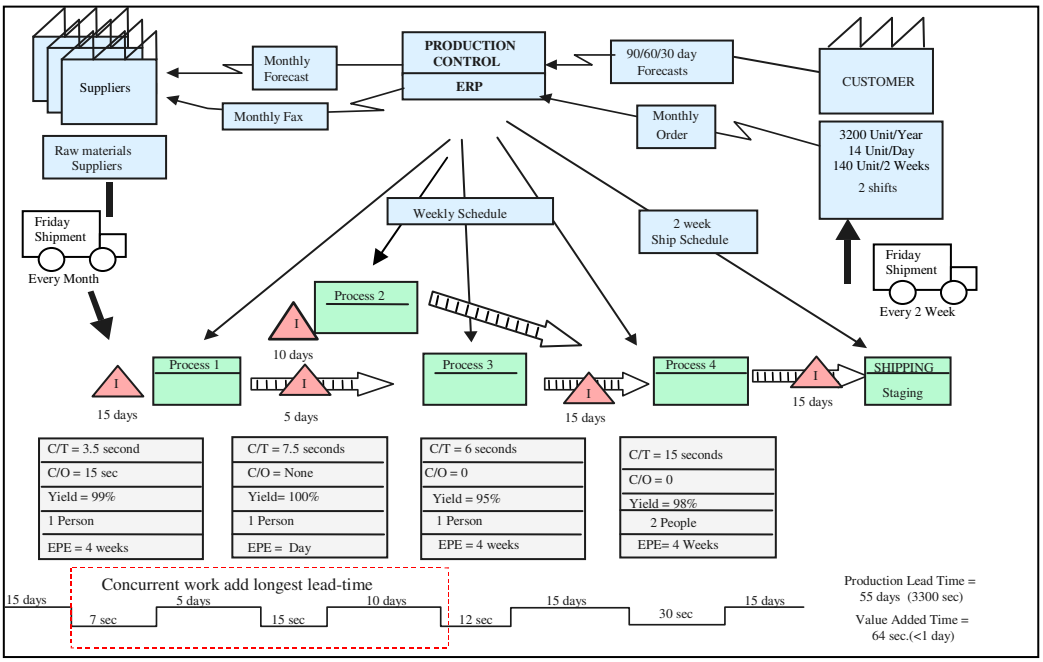

Figure 2: An Example Of A Current State VSM

The Scope Of The Value Stream

The scope of the value stream can be expanded or reduced, depending on how advanced the focus will be. For example, the value stream for a product could be shown to include multiple tiers of suppliers or simply tier one supplier. The goal is to develop a value stream with lean flow by having a process do only what the next process needs, when it needs it not to simply optimize one step in the system. This is only possible when production at every value stream step is directly linked to upstream steps. Thus, it is imperative to analyze not only the process flow, but also the material and information flows.

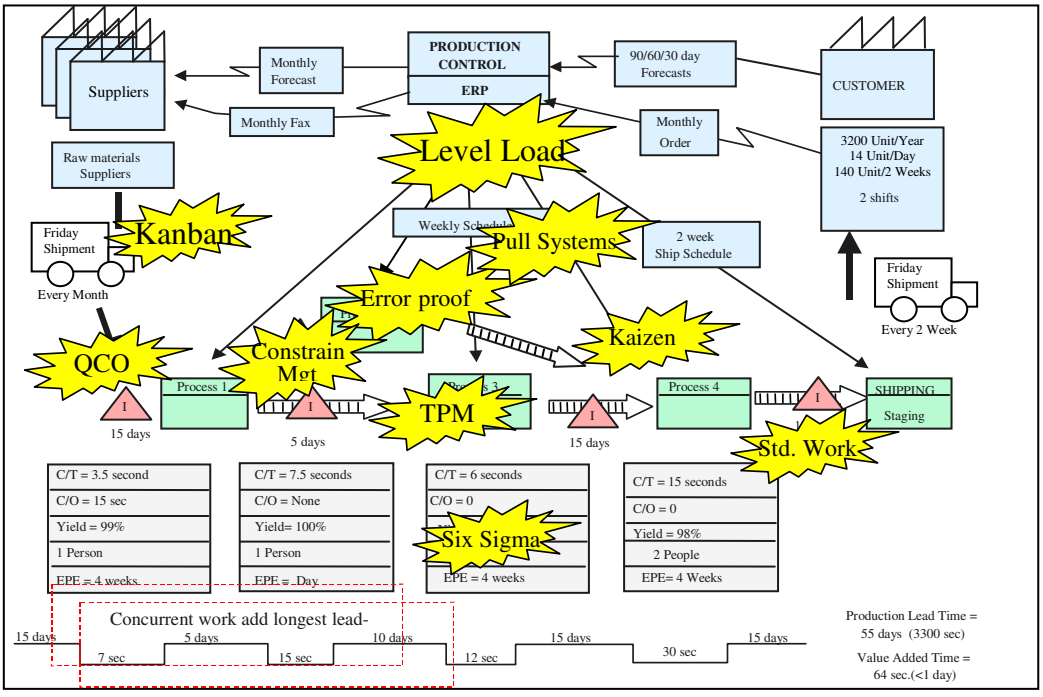

Figure 3: An Example Of A Future State VSM (with minor improvement)

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The Goals Of Value Stream Analysis:

1. Identify and then eliminate all types of waste
2. Flow comes first (link all steps)
3. Flow includes not only process, but also material and information
4. Help to clearly understand and communicate all the steps in a process.
5. Enable to identify the value added and non value added steps – the non-value added steps that are wastes within the process are highlighted.

RESEARCH METHODOLOGY

One of the authors is currently undergo industrial attachment and spent almost 6 months researching on productivity improvement at the company. This study was performed on May 2006. Semi-structured interviews were used with top management, focus group discussion with 15 shop floor leaders in the plant and direct observation of the plant in operation to collect primary data. In addition, the interviews were conducted not only dwell on the past implementation, but also focus on the future plans and developments. Secondary data was obtained from company reports, local literature and local newspapers.

RESULTS / FINDINGS

Analysis of Productivity Improvement Strategies

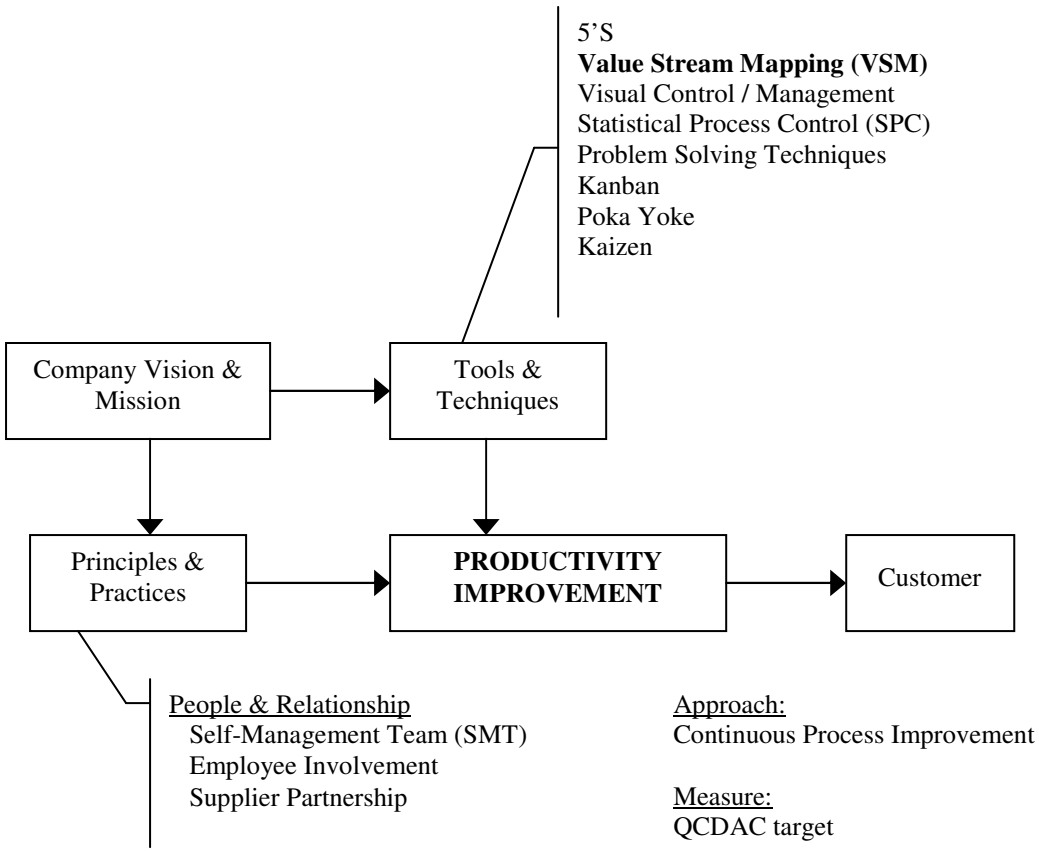

Figure 4: Productivity Improvement Framework

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Figure 4 shows the company framework for productivity improvement strategy. It begins with the company vision and mission by top management. From figure 4, it is understood that company vision and mission will influence the development of principles and practices and/or the tools and techniques. Principles & practices is referred to the philosophy / basic of leadership (Self-Management Team), customer satisfaction, employee involvement, continuous process improvement, supplier partnership and performance measures (based on Quality; Cost; Delivery; Accountability; Continuous Improvement: QCDAC target) which influence the productivity improvement in the company. Meanwhile, tools and techniques consist of 5'S, VSM**,** Visual Control / Management, Statistical Process Control (SPC), Problem Solving Techniques, Kanban, Poka Yoke, Kaizen etc., which are used for evaluating and improving lean application for the company. Some of these tools and techniques are used in product and/or service realization activity. Feedback from internal / external customers or interested customers or interest parties provides information to continually improve the company system, product and service.

Analysis of Value Stream

The company has decided that the value stream for manufacturing systems includes all elements (both value added and non-value added) that occur to a given product from its inception as raw material through delivery to the customer. Non-value added steps are waste and the goal is to eliminate them. Figure 5 shows the internal value stream's focus on the company which includes incoming material until finish product. Beside, it also included the customer and supplier value stream information which consider affected the overall company's productivity.

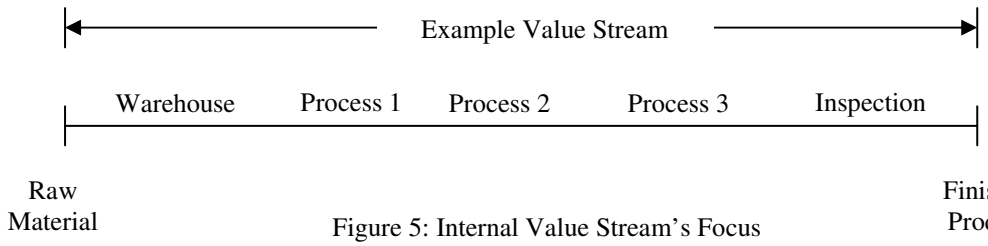

Figure 5: Internal Value Stream's Focus

Waste only adds cost and time. There are eleven (11) types of waste considered to be highlighted in the company shown in Table 1 below:

Table 1: Types of Waste (T.I.M.E.To.S.C.O.L.D.S)

No	Types of waste	Highlight
1	Time	For unnecessary time of: Interdepartmental delivery, inspection, machine warm up, changeover time, maintenance, receiving raw material etc…
2	Inventory	Raw material, WIP, finished product, replacement parts, tools & supplies, product-in-transit to warehouses or customers etc..
3	Materials	Scrap, trim, excess, bad material
4	Energy	False scale efficiencies, excess power utilization, unproductive operation etc…
5	Transportation	Interdepartmental delivery, from supplier, to customer
6	Space	Poor arrangement of: Machines, people, conveyor, workstations, etc..
7	Complexity	Difficult to find simple solutions in place of complex one, complex solutions tend to produce more waste and harder for people to manage.
8	Overproduce	Any production beyond customer demand, interdepartmental, making more than what is needed, making earlier than needed, etc…
9	Labour	Unnecessary movement and steps by people, other unnecessary non-value added activity.
10	Defects	Mistake, rework, defects, etc…
11	Safety	Any unsafe condition, which might cause harm to any personnel in the area or machine downtime.

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Analysis of Model Of Productivity Improvement By Using VSM

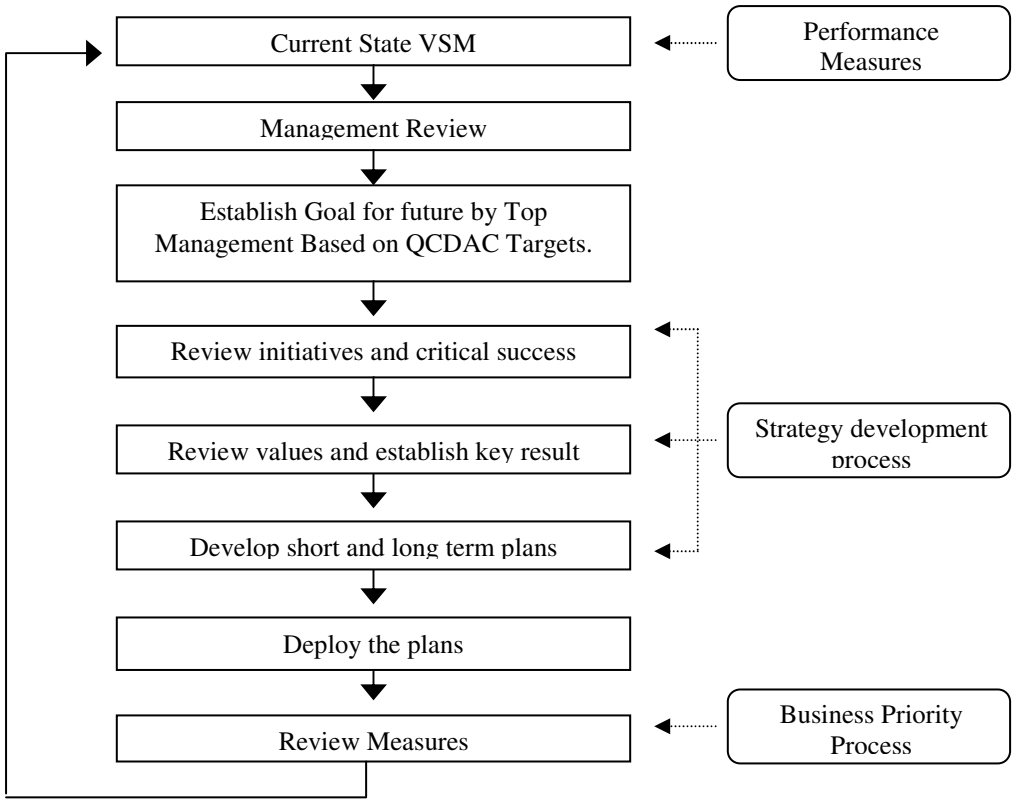

Figure 6: Model Of Productivity Improvement By Using VSM

Figure 6 shows the model of productivity improvement by using VSM used by the company. The VSM process is started with current state VSM to measure the current performance of production systems on the floor. This is because, without the current VSM, the opportunities of improvement are difficult to identify. After that, it was followed by management review performed by Lean Steering Committee (LSC). LSC consists of all top management of the company and representatives from production floor. The representatives were selected by head of company. LSC will analyse the result to establish goal of the future improvement based on QCDAC target through future state VSM. The strategy development process will be developed with initiatives and critical success factors review, the value and key result indicators in terms of short and long term plans through future state VSM. As the continuity of the VSM program, the plan (future state VSM) will be deployed on the floor. The result of the planning will be measured again by using new current state VSM. The process of VSM is continuously updates until the companies achieve the ideal state of operation system without waste or non value added activity.

Analysis of successful Factors for VSM

VSM is best performed as a cross-functional plant team activity with members experienced in their discipline, familiar with the product, and trained in the use of Value Stream Mapping. The company was created a VSM team (also called VSM committee) which included the representatives from the following areas so that nothing lacks visibility the value stream:

a. Program / Project Planner
b. Business System Operation (BSO)
c. Manufacturing Department
d. Production Schedule & Control
e. Quality
f. Other disciplines as necessary

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The team is led by a VSM Champion. The VSM Champion is responsible to maintain the group's work output and monitors the VSM project plan. The team's focuses are:

a. Analyzing VSM current state and eyeing for waste;
b. Identifying value added and non value added activities;
c. Eyeing for flow (process, material and information)
d. Suggestions of lean tools utilization for VSM future state;
e. Continuous improvement for VSM ideal state through periodical updates.

The other success factors that influence the VSM includes:

a. Top management support for any activities on productivity improvements.
b. Intensive VSM training and education.
c. Employee involvement in all VSM activities and events.
d. Employee knowledge on lean tools.
e. Senior staff supports.

CONCLUSIONS

The authors conclude that the VSM is a very simple yet highly effective standard visual tool that allows individuals to develop eyes for waste and to see and understand the flow of not only the processes, but the information and material throughout the product value stream. The current state helps expose the roadblocks in the way of lean flow by diagnosing the existing system's condition. Each roadblock is a source of waste and will be a springboard for improvement when eliminated. The future state helps by showing solutions or alternatives to achieve flow in the transition from the current state implementation of a true lean flow system. Everyone needs to "step out of the box" and view their value stream with a fresh perspective that eliminates waste and does not accept bad habits or methods that are only hinder lean implementation.

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APPENDIX

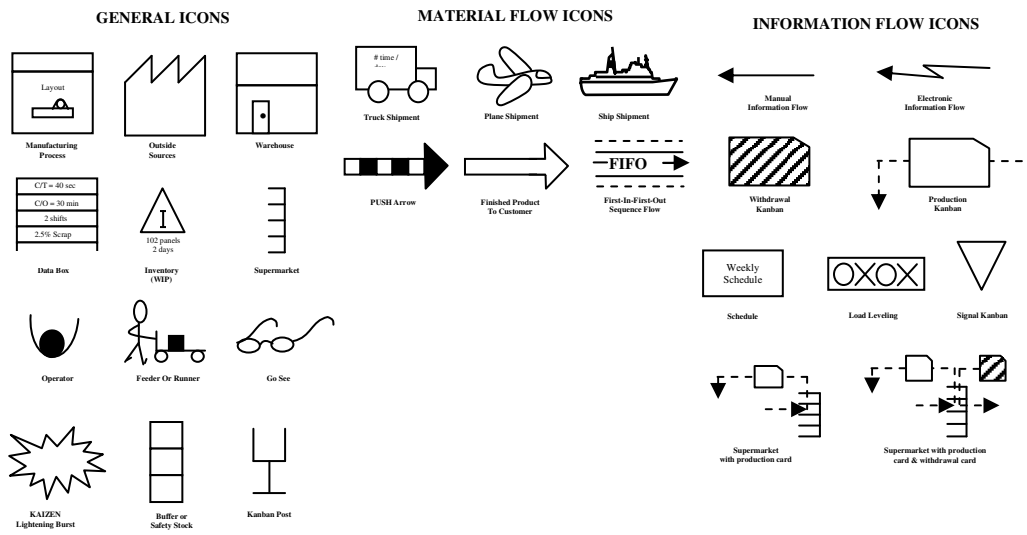

Figure 7: Basic Icons of VSM

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