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Value stream mapping of information system activities

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Abstract

Industries and organizations struggle to remain viable and competitive. Toyota Motor Company developed Lean Thinking and its continuous incremental improvement of processes through relentless elimination of waste to ensure its survival. As Lean Thinking gains momentum in non-manufacturing settings, businesses benefit from applying lean principles to their organizations. This paper presents an overview of lean methodologies with a focus on Value Stream Mapping (VSM). It discusses the benefits that might be realized when an IS organization supports lean methods and shows how VSM can play an important function in evaluating current and future Information System processes.

Introduction

Roughly 90% of all applications development and maintenance, help desk administration and call center customer service is currently outsourced overseas (Hoffman and Thibodeau, 2003). By 2015, 3.3 million jobs, along with $136 billion in wages, will be outsourced to such countries as India, the Philippines, Russia, China, Israel, Ireland, and Canada (Hoffman and Thibodeau, 2003). Industry experts estimate IT/IS outsourcing saves companies 50% in labor (Hoffman and Thibodeau, 2003). Cost savings, time savings, and the difficulty of training internal staff quickly or effectively fuels the push to outsource domestically held positions (Hoffman and Thibodeau, 2003). An American systems programmer costs on average $63,331 whereas an equivalently skilled employee in India earns $4,800 to $8,000 (Hoffman and Thibodeau, 2003).

It may make financial sense for most companies to outsource standardized services, but some environments must maintain their own IT/IS support services. For example, Dell brought some technical support work back to the U.S. after corporate customers complained about the quality of service they received from workers in other countries (Krazit, 2003). In addition, many academic environments use their own support services as training environments for students. Lean thinking can be used to maintain reasonably cost effective and efficient services.

Lean thinking has wide applicability. Many manufacturers have benefited from its application. Lockheed Martin reduced manufacturing floor space used to produce F-16s by 50% and improved cycle time by 60-80% (Salzman, 2000). General Electric improved on-time deliveries 100% by applying lean principles (Salzman, 2000). Non-manufacturing companies such as those in telecommunications, IT, retail, government, and construction also have begun to apply lean methodologies. Companies are driven by the desire to standardize work, synchronize flow, and eliminate or reduce the number of non-value added activities necessary to deliver a product or service to customers. Increasingly, many consulting firms use Lean Thinking methodologies to identify a client's value streams to provide recommendations

for Business Process Reengineering (BPR), new system implementation, alignment of technology initiatives with business goals, and elimination of projects that do not improve the value stream. Ninety-seven percent of lean implementations convert existing operations (Wilson, 2002).

Regrettably, many IT/IS departments have yet to consider lean systems. While other organizational departments reap the benefits of lean operations, IT/IS costs, inefficiencies, and increasing customer dissatisfaction spiral out of control. This situation inevitably leads top management to consider outsourcing IT a cost effective alternative. However, by applying lean thinking to internal support services, outsourcing becomes less attractive.

This paper introduces Lean Thinking concepts and the idea of utilizing Value Stream Mapping (VSM) to improve IT/IS support services. VSM assists in eliminating wasteful activities. This ultimately lowers costs, increases efficiency, productivity, and customer satisfaction. This paper demonstrates how VSM streamlines inefficient and costly non-value added IT/IS activities. VSM maps the current state and subsequently maps the desired future value stream in order to achieve organizational objectives. VSM includes developing an implementation plan.

Lean Thinking

Toyota Motor Company developed Lean Thinking and continuous incremental improvement of processes through relentless elimination of waste in order to survive (Mastroianni and Abdelhamid, 2003). Taiichi Ohno, Toyota's Chief Engineer, invented lean methods and tools to reduce costs, time, and wastes (Salzman, 2002). Ohno identified seven wastes or "muda:" overproduction, waiting, transport, inappropriate processing, unnecessary inventory, unnecessary motion, and defects (Hines and Rich, 1997). Lean eliminates waste within processes, isolates value added activities, and places those value added activities in a form of continual flow to meet customer demand (Salzman, 2002). Eliminating wastes lowers costs, reduces floor space, decreases over production, increases product quality, increases output, and improves cycle time. Different strategies can be applied to reduce or eliminate each type of waste, thereby improving overall performance, quality, and final customer satisfaction (Mastroianni and Abdelhamid, 2003). Originally, lean thinking philosophies, methods, and tools were developed and applied to manufacturing. Appendix A shows the approaches, techniques, company cultures, and tools associated with Lean Thinking (Value Innovation Partners, 2003). However, the universal appeal of lean entices many non-manufacturing and service companies to examine how to incorporate it into their own organizations. The broad applicability of lean stems from its five important and underlying principles: value, value stream, flow, pull, and perfection (Salzman, 2002, p. 74).

Although implementing lean creates many benefits, certain criteria must be met before an organization pursues it. Like most initiatives, lean requires the backing and continuous commitment of top management. "Lean is intolerant of failure, failure of suppliers, processes, people to perform, machines to operate and most important, uninspired leadership" (Value Innovation Partners, 2003). Without leadership, organizations will revert back to earlier operating methods (Bane, 2002). Hence, it is important to have clearly identified the need or reason to change. Implementing lean is an ongoing process that takes months, even years, and requires commitment. Lastly, educating employees enhances the chances of success and involving them creates a sense of commitment and community that minimizes resistance.

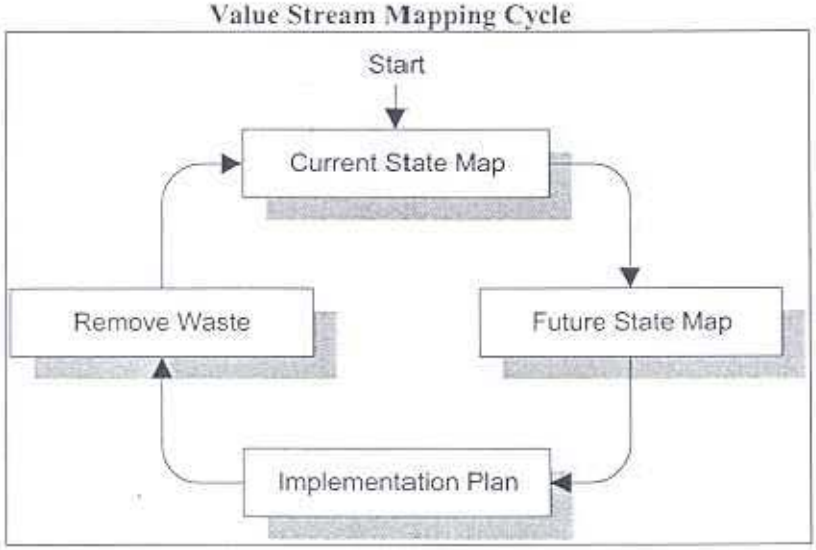
Value Stream Mapping (VSM)

VSM, the second principle of lean thinking, identifies all steps in a process. Three types of activities within the value stream are identified: (a) steps that create value, (b) unavoidable steps that create no

value, and (c) avoidable steps that create no value. The third type, the low hanging fruit, should be targeted for immediate elimination. VSM helps employees understand the proper flow of a product or service, maximizes value, and shows where costly errors can be eliminated (Lovelle, 2001).

VSM involves developing a current state map, a future state map, and an implementation plan. The current state map highlights existing waste. The team's vision of the ideal condition is captured in a future state map. Paper and pencil are adequate to create initial value stream maps. After value stream maps stabilize, using software enhances productivity since changes can be made quickly. Microsoft's Visio, IBM's Rational Rose, eVSM, eLean, and ValueStreamDesigner are examples of software that can be used to create value stream maps. The implementation plan is a detailed action plan that will help make the future state a reality, prioritized according to costs and benefits (Industry Forum). Figure 1 shows the VSM cycle (Industry Forum, 2003, p. 3).

Figure 1 **Value Stream Mapping Cycle**



VSM Symbol Set

VSM includes a large number of standard modeling symbols. Originally, these symbols were developed from the need to visualize a manufacturing environment and its processes as shown in Figures 2 and 3. (Johnson and Tappel, 2000, p. 10, 18). Nevertheless, most of these symbols can be easily adapted to any type of organizational environment. New symbols have also emerged to analyze business and office processes as shown in Figure 4 (Djumin, Wibowo, and Irani, 2003, p. 10). Nothing prevents companies from creating their own symbols that more closely match their individual requirements. Organizations can also use other types of modeling symbol sets to "accomplish the same fundamental objectives" such as process flow diagrams, data flow diagrams, and the Unified Modeling Language (UML) (Salzman, 2000, p. 79).

Figure 2 **Sample Current State Map Icons**

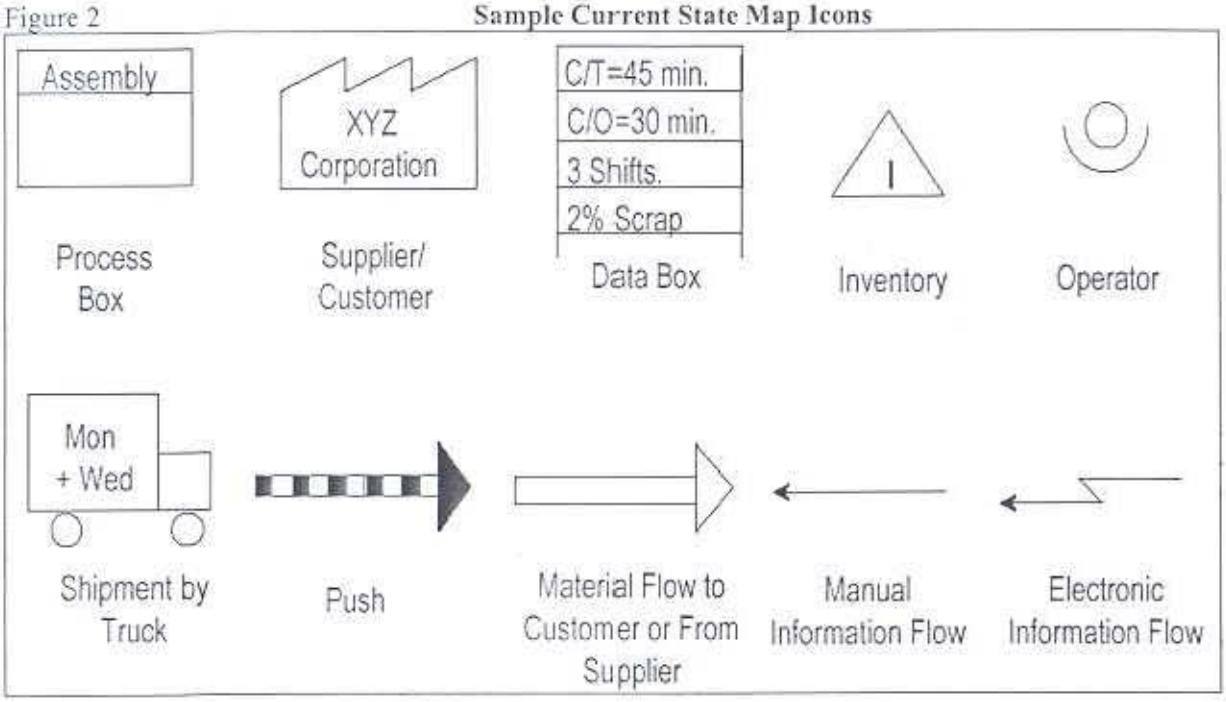


Figure 3 **Sample Future State Map Icons**

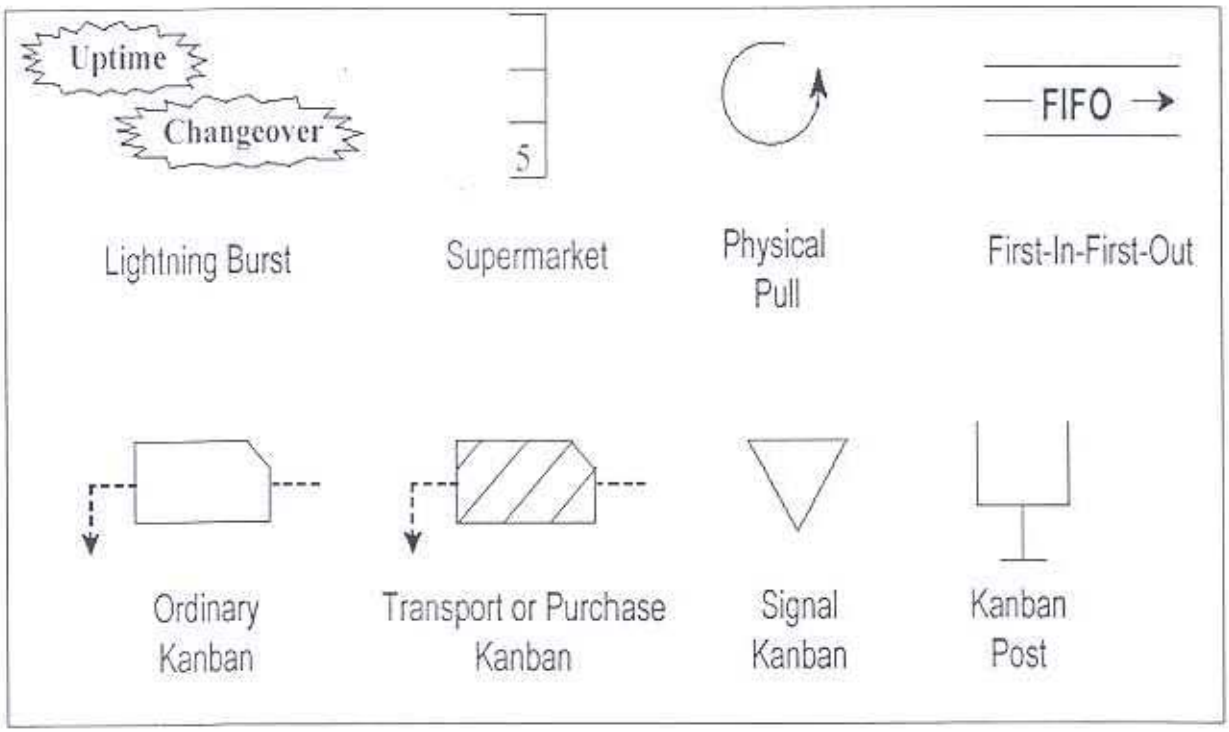
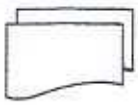
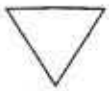
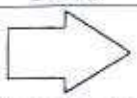
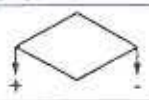


Figure 4 **Sample Business and Office Process Charting Icons**

Icons	Description
 OPERATION	Used when one performs some function such as matching or reviewing or filling an order, data input to a computer, etc.
 FORM	Used when one generates a form or a document. If more than one copy of the form is used, another page is shown behind the first page for each copy.
 FILE	Used when one files documents. A "T" could be placed inside the triangle to indicate a temporary file or a follow-up file and a "P" could be placed inside for a permanent file or completed file.
 TRANSPORTATION	Used when one physically moves objects other than paperwork (e.g. material, furniture or document carts).
 DECISION	Used when one represents a Yes/No, Go/No Go decision at any point in the process flow where the direction of flow might change depending on the situation or system status.
 APPROVAL	Used when one requires management approval to execute a process step.
PAPERWORK FLOW	Used to show flow of information.
 TELEPHONE	Used to show flow of information by telephone or computer.
 PROCESSING	Used to show computer processing.
 DELAY	Indicates delay in a process, such as waiting for approval.

How VSM Differs from Data Flow Diagrams (DFDs) and Process Maps

There are many ways to "map" processes. A comparison between DFDs/process maps and VSM shows a stark contrast. DFDs document how data enters and leaves the system, the processes that manipulate the data, and how they are stored. VSM, on the other hand, examines the entire process, incorporating other factors such as the steps taken by the flow of materials, flow of information, and time factors. DFDs have rigid rules, whereas VSM allows more flexibility and creativity. In addition, the limited number of DFD symbols (only four) does not show where value or non-value added activities exist. In comparison, VSM has many more symbols (see Figures 2, 3, and 4) when compared to the standard four DFD symbols. VSM looks at not only how data flows, but also how raw material is transformed into a good or service. VSM allows its users to see the entire flow beyond a single-process level. Unlike process mapping and DFDs, its primary objective is to identify where to focus future improvement efforts, and that tends to be at a higher level than process maps.

Benefits of VSM

VSM helps identify non-value added steps. Montana Manufacturing Center (http://mmec.montana.edu) says that VSM is a good place to begin when unsure of where to start making lean changes to a production or service process. VSM helps an organization understand what lean improvements will provide the most benefit since the visual representation facilitates communication of an organization's processes and makes it easier to understand the need for improvements. Appendix B (Johnson and Tappel, 2000, p. 78) demonstrates the visual importance of mapping the current state to identify the non-value added steps, creating a starting point to decide on a future state. VSM establishes priorities for improvement efforts and provides a common language to talk about the processes. Some additional VSM benefits are:

- It helps identify waste and its sources;
- It focuses on no or low cost improvements;
- It is based on objective information;
- It forms the basis of an implementation plan; and
- It shows the link between information flow and material flow, and no other tool does this. (http://www.theaccessgroupllc.com/services/lean-manufacturing/lean-manufacturing-value-stream-mapping.html)

Appendix C (Johnson and Tappel, 2000, p. 78) provides an example of a future state developed from the current state map (Appendix B) and the improvements realized by eliminating waste such as cutting lead-time from 23.5 days to 4.5 days. It shows a more streamlined production flow.

In a compelling example, the state of California realized significant cost and time reductions by applying VSM and lean principles to eliminate waste in many of its governmental departments as shown in Table 1. (Bane, 2002, p. 247). In another example, the elimination of 3,943 non-value added hours and an 18% improvement in telephone service levels was reached by a Southeastern customer service center that applied lean concepts (Bane, 2002).

Table 1 **Waste Elimination/Value Stream Mapping in State Government of California**

Department	Waste	Results
Parks	Water Main Leaks	Realized $60K/Yr Savings
Administration	Office Space Steps	129 steps reduced to 45
DEO	Check Processing	Days: 44 reduced to 25
DMV	Check Processing	Days: 77 reduced to 23
State Hospital	Patient Injuries	50% Reduction in injuries

Shortcomings of VSM

Some organizations have found that VSM is not applicable to every process. According to some lean experts, difficulties lie in the application of VSM to product development and engineering design processes, since it may be difficult to understand a customer's requirements during design (Hines, Rich, Bicheno, Brunt, and Taylor, 1998). Problems arise when no tangible product or service exists to follow in the mapping process.

Applying VSM to Academic IT/IS Helpdesk Service Processes

Although the trend to outsource IT/IS support services continues to grow for nearly all industries, it may be better kept in-house. Academic IT/IS helpdesk support services are unique in that they are utilized as learning and work opportunities for students. Although the risk of outsourcing is minimal due to the department's importance to students, streamlining operations is important in order to make operations viable and cost effective. Waste reduction may create less need for student employees, thus reducing opportunities for work programs or learning opportunities. However, exposing students to well run operations provides other higher-value learning opportunities.

Rochester Institute of Technology's (RIT) IT/IS department has many processes that are potential candidates for VSM. With the ability of VSM to look at the current state, a future state can be developed that allows the formation of an implementation plan that more closely aligns with customer needs. The following illustration of one such process that RIT employs in its Information & Technology Service (ITS) Helpdesk Client Support Service clearly demonstrates the benefit of VSM.

In order to show how to apply VSM to a service process, interviews were conducted with the student staff of the ITS helpdesk to determine which service processes were wasteful. In conducting the interviews, one of the first issues that became obvious was the lack of specific tracking data and metrics concerning requests for services by faculty and students. Further investigations revealed password resetting as one of the most inefficient processes because it requires a helpdesk staff member to complete the process. This process can be greatly simplified by developing more state-of-the-art approaches to the password reset process such as allowing users access to a password reset site on RIT's web site.

For example, in a discussion with Marianne Wilcox, Regional Chief Technologist for EDS (personal communication, October 30, 2003), she provided an example of how EDS implemented a web portal system named evalue for Xerox. Evalue allows a client to use his or her own computer for service instead of making a helpdesk call. Examples include allowing the client to go to the evalue website for password

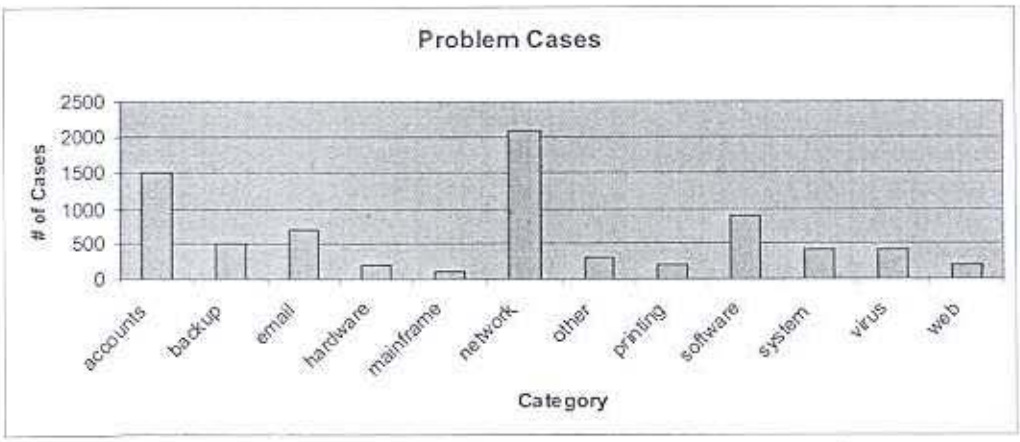
resets and for mapping printers. If a client working in another building needs to print to a network printer, the evalue web portal is used; the client selects which building they are in, and selects a printer. The correct driver is then installed on the client's computer and the mapping is done. In one month, 743 users had used evalue, and only seven people called the help desk for printer mapping. That equates to a savings of 736 calls, speeding up the process, reducing waste, improving productivity, improving client satisfaction, and reducing costs.

The following illustration examines the existing procedure for password resets at RIT and the problems it generates. At the end of every quarter, RIT faculty inundate the ITS helpdesk with frantic phone calls concerning forgotten passwords. Teachers must use their RIT computer accounts to submit student grades to the Student Information System (SIS) by the grade-posting deadline. This system allows students to view their final grade for the quarter immediately after submission by a teacher. On average, phone calls related to password resets can last five minutes. Multiply the large number of password reset calls by five minutes, and not only does that add up to wasted time, resources, and money, but an overwhelmed and increasingly backlogged help desk staff. Most calls are answered. However, a small percentage of unanswered calls go to voicemail (Support Process Quarterly, 2003). Backlogged conditions and unanswered calls inevitably lead to service process delays, unneeded stressful situations, and frustrated faculty and staff.

The RIT computer network is vital to the campus community and the ITS helpdesk prides itself on a high degree of professionalism and growing client trust and confidence. Unpleasant call experiences could reduce this trend (Support Process Quarterly, 2003). Since this situation occurs quarterly, clearly, changing the process for password resets would help. Improving this process frees ITS helpdesk staff to provide better desktop support, troubleshoot computer network problems, and combat computer viruses. The ITS helpdesk staff, unfortunately, believes that the password reset process now in place will worsen since it just recently became required that passwords change once every 90 days for security purposes. Although responsiveness could be improved by hiring more ITS helpdesk staff, budget constraints prohibit this (Support Process Quarterly, 2003) and there are more productive and state-of-the-art approaches to password resets.

Further research examined if other schools used these non-value added processes. Tracking data and metrics from the Massachusetts Institute of Technology's (MIT) Quarterly Reports were obtained. The data showed similarities to the ITS helpdesk department at RIT as shown in Figure 5 (Support Process Quarterly Report 2003, p. 9).

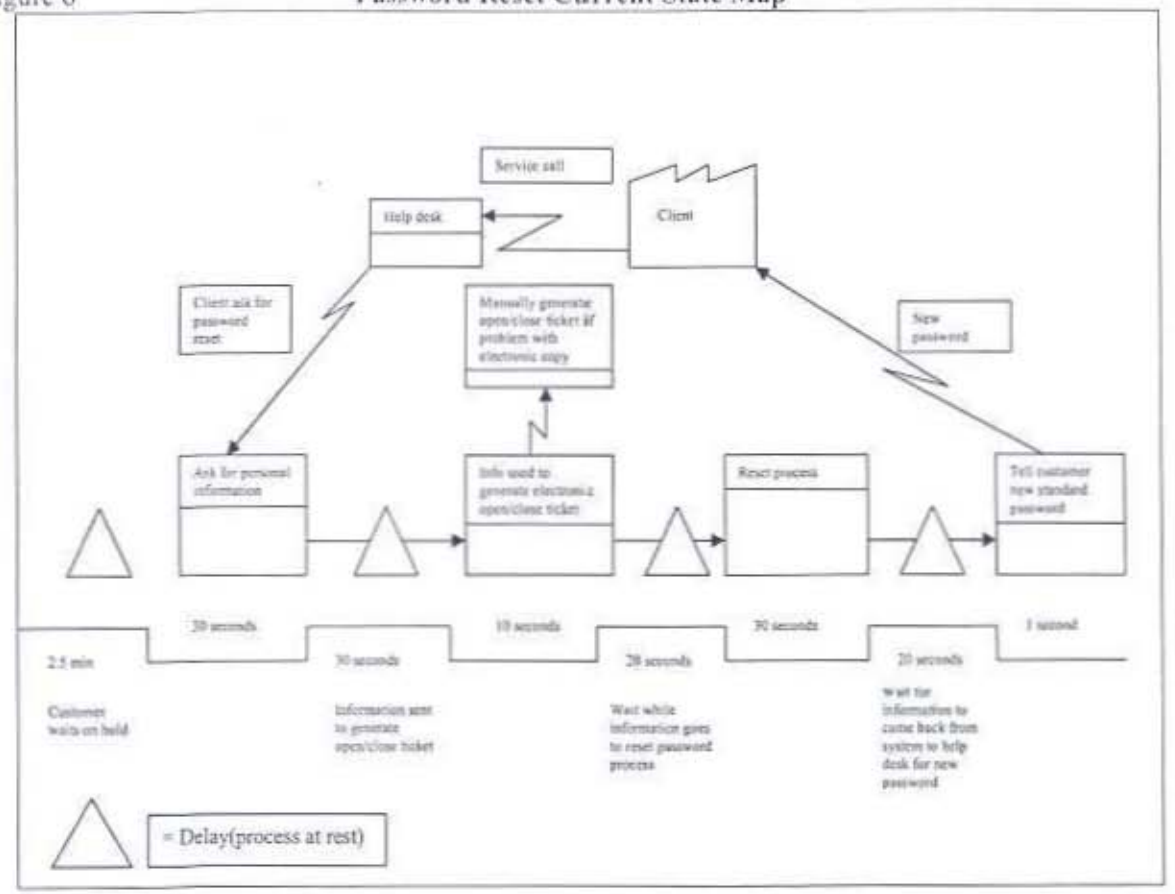
Figure 5 **Example of ITS Helpdesk Problem Cases**



Comparing the data obtained from RIT and MIT shows striking similarities concerning the number of calls requesting support for password resets. Clearly, this issue faces many colleges and universities, and they could benefit from VSM to remove the non-value added activities. In conducting the interviews with the ITS helpdesk student staff members, the following rudimentary scenario was provided to give an understanding of the steps required to reset a password when requested:

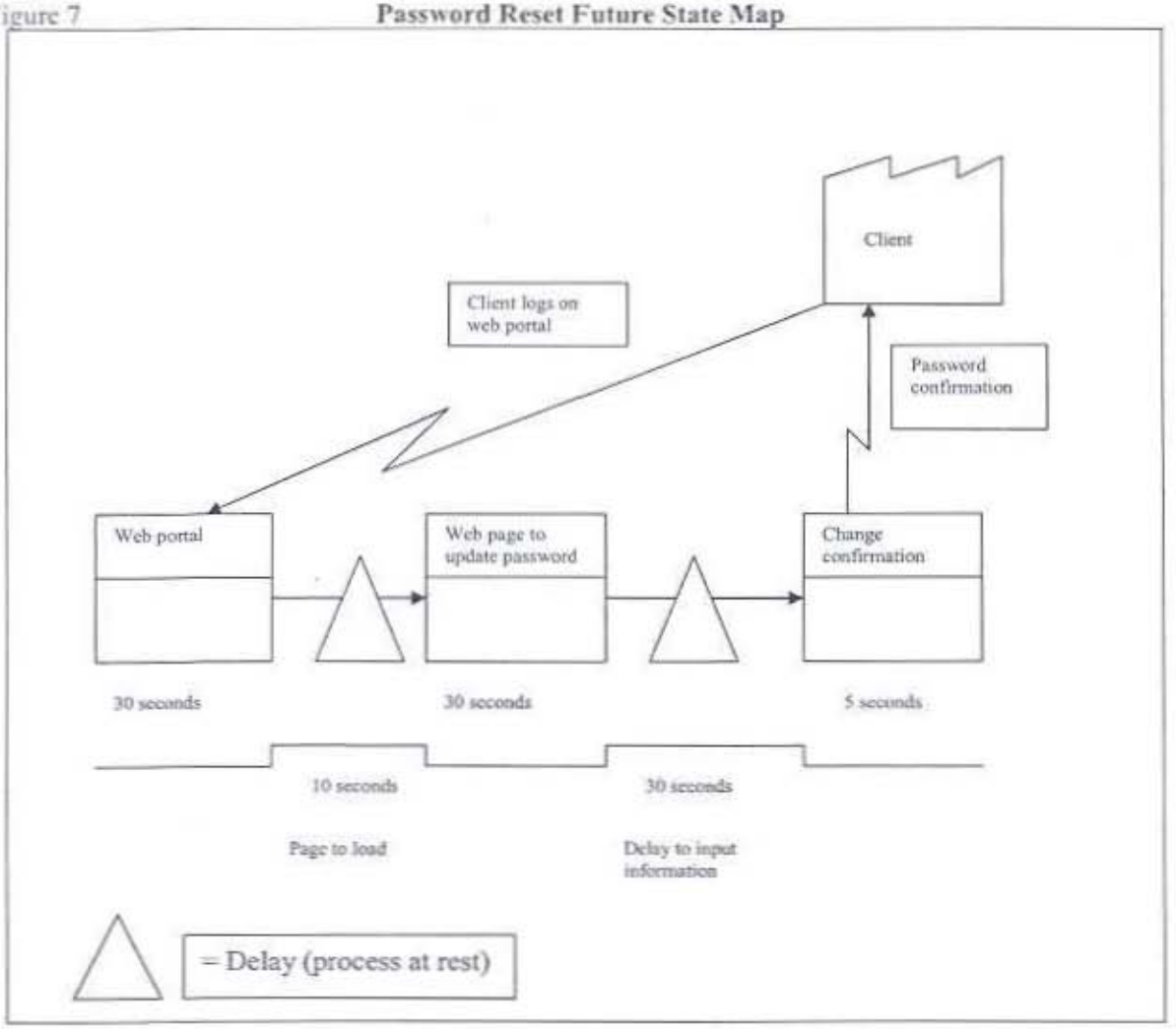
- client calls help desk;
- tells helpdesk that password has been forgotten;
- helpdesk asks for personal info and i.d.;
- client supplies information;
- helpdesk resets password;
- gives client password;
- client hangs up;
- client changes password;
- system automatically generates open and closed problem ticket; and
- in some cases, the helpdesk must manually open and close the problem ticket.

Figure 6 **Password Reset Current State Map**



The scenario's complexity increases when omitted additional steps are considered such as accidental hang ups that require the client to restart the process, when the password reset does not work properly, or miscommunication between the staff and client occur. However, for this illustration, only the most basic steps are used. Figure 6 shows the current state map for password reset. The current state map helps identify non-value added activities throughout the password reset process. Further evaluation also shows that when the computer does not generate the open/close ticket, an employee must manually generate one, another non-value added step. Clearly, non-value added activities need eliminating and a new process developed. Through evaluating the current state map, a future state map was developed, as shown in Figure 7.

Figure 7 **Password Reset Future State Map**



As shown in the future state map, a new procedure was developed utilizing web portal technology. This new procedure eliminates the non-valued added activities performed by the student staff. The reduction of these non-value added activities frees students to develop their skills in other more important IT/IS areas. Faculty benefit by reducing the non-value added time required for them to update their passwords. The IT/IS department benefits by reducing its costs and inefficiencies, and increasing its productivity.

Conclusion

Lean Thinking and VSM are beneficial tools necessary to any organization looking to become more efficient. Lean methods traditionally have been applied to manufacturing, but other non-manufacturing departments such as IT support services can benefit from its application. However, managerial backing is the most important aspect of developing and implementing a successful conversion to lean. Employee commitment to lean is also necessary to realize its full benefits. VSM is a powerful tool used to start an organization on the path to lean by visualizing all of its activities. It is the commitment made by the entire organization that dictates the level of benefits achieved.

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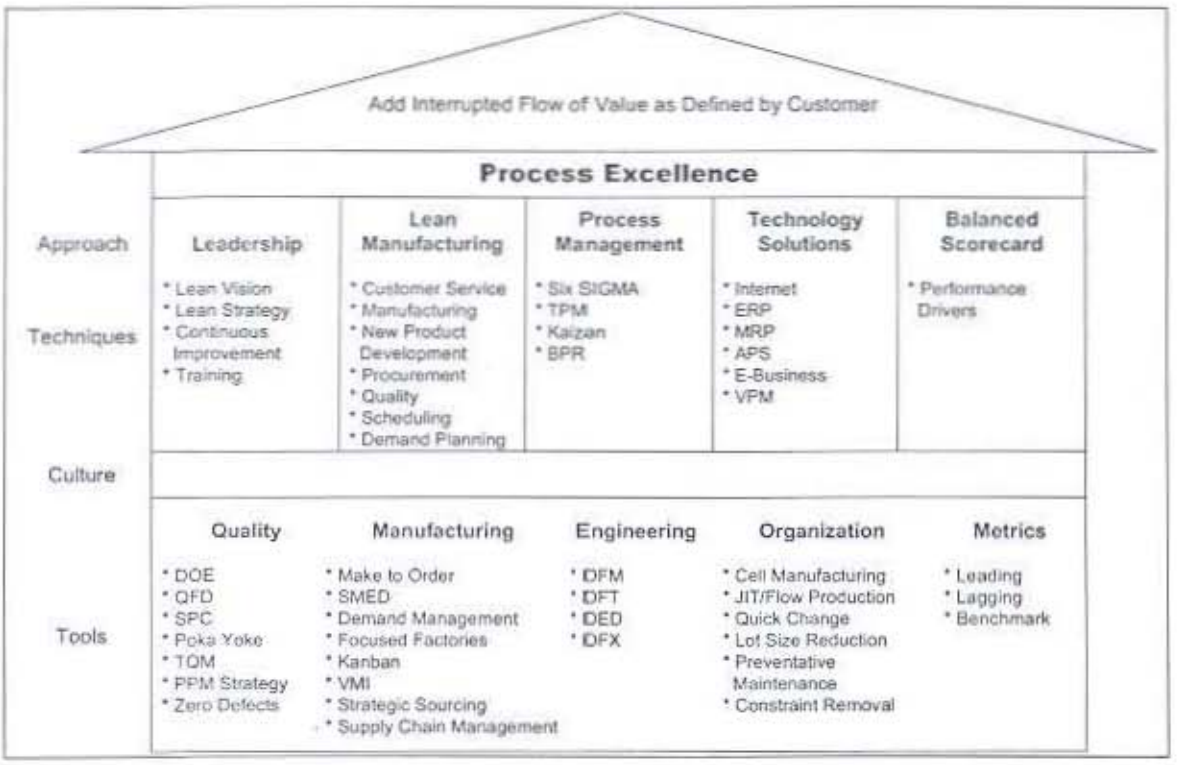
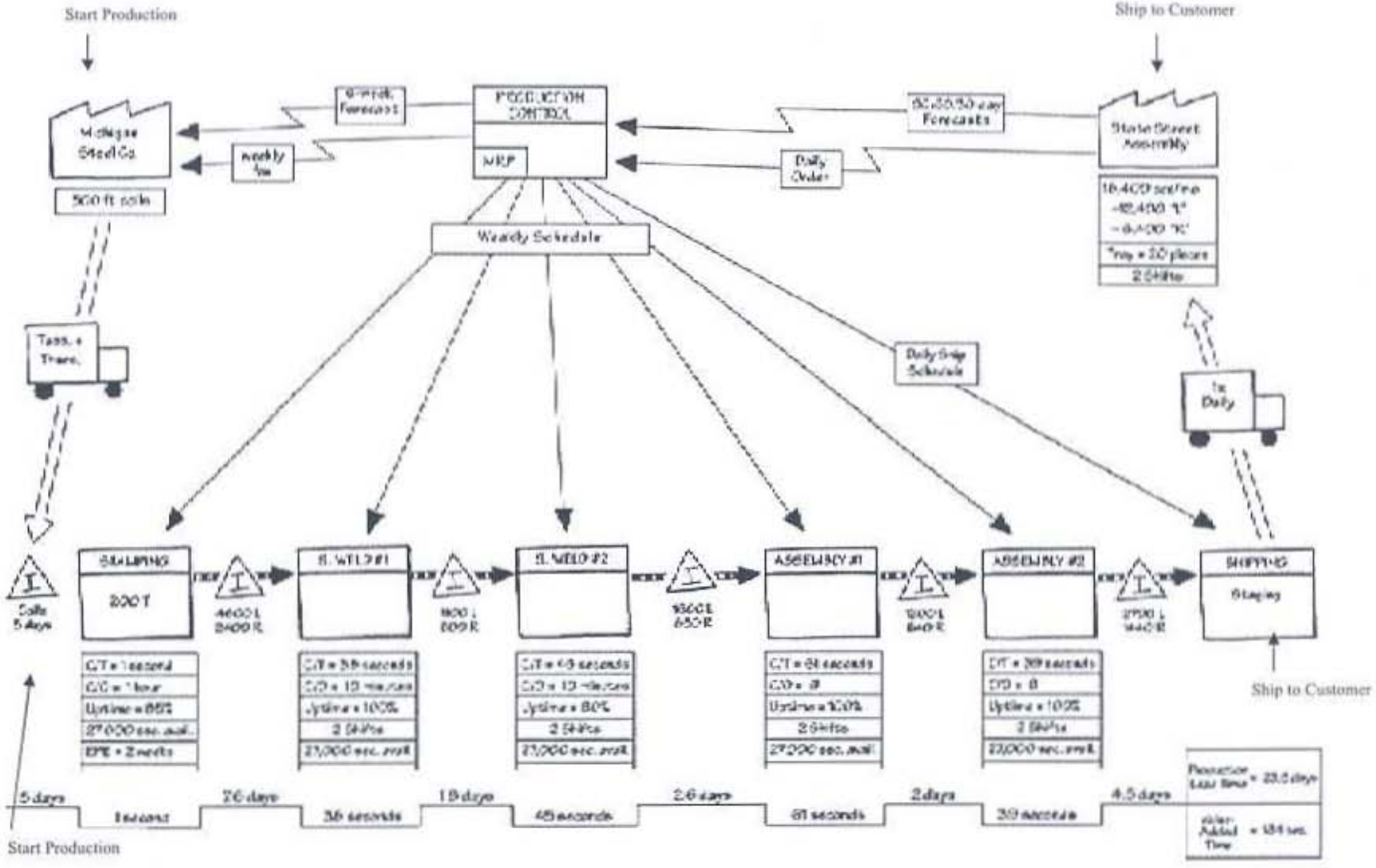
Appendix A

Lean Thinking Methodologies



Appendix B

Example of a Current Value Steam Map



Appendix C

Example of a Future Value Stream Map