VALUE STREAM MAPPING & VM

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William C. Thorsen is a Staff Project Planner in the Worldwide Facilities Group (WFG) of General Motors Corporation and has over 35 years of experience in manufacturing and construction at GM. Bill has worked in a variety of Facilities Engineering capacities at Oldsmobile Division and GM Powertrain, and he was the Facilities Engineering Manager for GM’s Electric Vehicles program. Since 1998 he has been part of the Capital Projects organization in WFG involved in pre-project planning for facilities projects. He developed and is responsible for the Value Management program for WFG Capital Projects, focusing on improvements to project delivery methods and common building systems. Bill oversees a number of internal operating processes and has developed and delivered a variety of training courses. During 2004 he became involved with Value Stream Mapping on many fronts: training his organization in the use of the tool, participating in a focused process improvement workshop, and updating the process to an improved “future state”. Bill holds a Bachelor of Industrial Engineering degree from General Motors Institute (now Kettering University), is an Associate Value Specialist, and is a LEED Accredited Professional.

ABSTRACT

Value Stream Mapping is the simple process of directly observing the flow of information and material as they occur and summarizing them visually. It is a tool being used by General Motors to analyze process flows from a systems perspective and to document the performance of the process. A Value Stream involves all of the steps, both value added and non-value added, required to bring a product or service through the process steps. Value Stream Mapping (VSM) is a visual tool used to help see the hidden waste – and sources of waste – in the value stream. A Current State Map is drawn by a cross-functional, multi-disciplined team to document how things actually operate (this is the “as-is” process vs. how it should be). Then, a Future State Map is developed to design a lean process flow through the elimination of the root causes of waste and through process improvements – all leading to an Implementation Plan that details the action steps needed to support the objectives (the what, who, and when). This paper will demonstrate the Value Stream Mapping techniques and discuss the application to the Value Methodology.
INTRODUCTION

What General Motors is currently doing with Value Stream Mapping (VSM) is to expand what started as a lean manufacturing technique into the non-manufacturing environment. As with the theories of waste identification & elimination and lean manufacturing principles, Value Stream Mapping has its roots in the Toyota Production System (TPS) with a technique known as “Material & Information Flow Mapping”. At Toyota much attention is given to establishing flow, eliminating waste, and adding value. Toyota people learn about three flows in manufacturing: material, information, and people/process. Value Stream Mapping covers the first two flows and is based on the Material & Information Flow Maps used by Toyota.

During the 1990’s the driving force behind the use of value stream mapping emerged in the form of one word – LEAN. And a major force behind this improvement revolution was one man – James Womack. Dr. Womack co-authored The Machine That Changed the World (1990) that explains lean production to the world and Lean Thinking (1996) that reveals lean improvement strategies, and he founded the Lean Enterprise Institute (LEI) that excels as a Lean center of expertise. Out of the Lean Enterprise Institute have come many of today’s new lean thinkers and excellent resource material for implementing lean principles. Chief among these resources was LEI’s Learning to See (1999), a workbook by Mike Rother and Dan Shook that explains how to use value stream mapping on the manufacturing floor to help implement key elements of a lean business system. A major follow-on to this resource is The Complete Lean Enterprise (2004) by Beau Keyte and Drew Locher that offers a step-by-step approach to applying value stream mapping to the administrative and office environment.

Just as Function Analysis is part of Value Management, Value Stream Mapping is part of a much larger activity at General Motors. That effort is the GM Global Manufacturing System (GMS) which is GM’s unique lean operating system. GM has been actively pursuing lean manufacturing methods for over two decades, starting with NUMMI, the GM-Toyota joint venture to assemble vehicles in California. NUMMI helped change the automotive industry by introducing the principles of TPS and a teamwork-based working environment to the United States. For GM, NUMMI served as a real-time example of lean production prior to its own Global Manufacturing System being developed.

In 1996, Chairman Jack Smith directed GM to develop a single integrated operating system. Prior to recent global consolidation efforts, each GM region had developed its own operating system. GMS was formed by taking the “best of the best” from GM North America, Europe, NUMMI, CAMI, and Saturn operating standards. It has its foundation in five Principles – People Involvement, Standardization, Built-In-Quality, Short Lead Time, and Continuous Improvement. As part of an integrated system, these principles are interdependent and need to be applied in balance for the entire system to function effectively. The five Principles are supported by thirty-three Elements that cover all aspects of manufacturing systems – from Vision & Values to Continuous Improvement Process. These Elements contain all of the requirements for operating a lean facility. In the end, the GM Global Manufacturing System develops lean thinking leaders to deliver lean business results and contains a set of tools that when applied help reduce waste and build value for the customer.
General Motors is, above all, a manufacturing company, and GMS is based in those roots. But GMS is also an enterprise operating system that can be applied across functions and staffs. In early 2003, James Womack was invited to visit GM’s Strategy Board to discuss his lean concepts. This visit drove the assignment of a Vice President and twelve executives—one in each functional area—to work full time on implementing GMS and lean across the entire GM enterprise, from Design to Vehicle Engineering to Manufacturing Engineering and from Purchasing to Finance to Human Relations. All of the GMS Principles and Elements apply to these administrative functions, however there is one big difference. In the factory, the process itself is very visible, making it easy to see, study, and improve. The processes in the rest of the enterprise—in these administrative areas—are not as visible. GM decided that a tool was needed to help make the administrative processes more visible…and that tool is *Value Stream Mapping*.

**VSM INGREDIENTS**

Now to the essential ingredients for Value Stream Mapping. A *Value Stream* is defined as all of the actions (both value added and non-value added) required to complete a product or service from beginning to end. And just like a stream, it’s all about flow, whether it is a process flow from raw materials to the customer (a manufacturing value stream) or a design flow from concept to product launch (an engineering value stream). The value stream often involves many processes and crosses numerous functions. It is vital to have all of the operators, users, and customers of the value stream involved in the improvement activity.

*Value Stream Mapping* is a technique that establishes a common language to document processes and provides a blueprint for improvement. It enables leadership to visualize the process, point to problems, and focus direction for future lean efforts. Mapping starts with engaging the right people, ideally a multi-disciplined cross-functional team of people responsible for implementing new ideas. VSM is all about developing the skill to clearly see customer requirements and process flow. As a visual representation of the Value Stream, the map helps reveal hidden waste in the system and problems associated with material and information flows within a process. One important note: information flow is the leading contributor to waste in administrative processes. At GM the value stream map documents the performance of the process with the metrics of process time, wait time, and first time quality to help highlight waste in the system.

The key elements of the Value Stream are documented on the map in an established sequence:

1. The Customer (and the customer’s requirements)
2. Main Process Steps (in order, including undocumented work)
4. Supplier with Material Flows (using a value stream walk-through)
5. Information & Physical Flows (how each process prioritizes work)
6. Overall Performance of the value stream (e.g. Total Lead Time)

The following chart, taken directly from GM’s VSM training material, shows these elements on a simple value stream map that illustrates the material and information flow.
THE MAPPING PROCESS

The mapping effort starts with determining the *Value Stream* to be improved and involves extensive scoping efforts to identify the practical limits of the mapping activity. The topic or process should be one that the Customer would perceive as creating value. (For GM this would be something essential to designing, engineering, manufacturing, or selling vehicles). Ideally it is an existing process that has a clear owner, has a manageable number of stakeholders, has clear start and end points, and has an indicator of performance. This last item is important because performance metrics will need to be established to gage improvements. With the Value Stream identified, the appropriate mapping participants are selected, trained, and prepped for the VSM activities to come.

Once the mapping team is in place, it draws the *Current State Map* that shows how things really work (not how the process is documented or how it should work). This is the “as-is” condition with all of the problems, inefficiencies, and flaws displayed for the entire team to see. It is crucial that the Current State Map be an honest depiction of what is really happening. In order for the greatest improvements to take place, there must be thorough documentation of all non-value added activities. It is critical at this point that the mapping team takes the next step and identifies the wastes in the system and – more importantly – the root causes of those wastes. Waste is just a symptom that points to problems within the value stream (or system). The identification of the root causes leads to the elimination of problems and the prevention of similar problems from reoccurring.
Next the mapping team draws the *Future State Map* that improves the flow and reduces waste in the value stream. This future state must meet the customer requirements and includes the necessary process improvements to achieve the Value Stream vision. The mapping team revisits the initial business objectives and reviews the current state map to capture their initial ideas for changes. Key to improving the flow of the value stream is the elimination of the root causes of the wastes identified in the Current State. One note: there is no single correct Future State. The mapping team should design a future state that directly applies to the business goals of the enterprise and that the organization can implement in a reasonable time.

The final step for the mapping team is to develop a detailed *Implementation Plan* that describes the necessary improvements to realize the Future State. The mapping effort is simply a tool; implementing the plan is the key to success. A strong Implementation Plan must be achievable, yet aggressive, and anticipate questions and concerns. It must also include a communication plan with associated documentation and established reviews to confirm the results. This detailed plan is critical to the leadership team’s efforts to track, manage, and react to the progress of the implementation activities. By tying the Value Stream design to the organization’s business objectives, the accompanying lean transformation will have a better chance of taking hold and becoming a new way of life.

**VSM WORKSHOPS**

At General Motors, the improvement activity utilizing the above VSM techniques is centered around GMS Projects which culminate in three-day workshops. Each project covers a process that directly supports the sponsoring function’s core business and project objectives are linked to a measurable business objective or performance metrics. The three-day VSM workshops include extensive pre-workshop activities to fully frame and scope the Value Stream to be improved and involve both suppliers and customers of the process. This scoping activity also establishes the performance metrics by which the improvements will be measured. Two critical elements for the success of the GMS Project are an Executive Sponsor with passion for the process and a Process Owner who is open to change and committed to implementation follow-up. The entire project initiative must be leader led in order to achieve meaningful and lasting results.

Identifying and scoping the Value Stream corresponds to the Pre-Study efforts of the VM Job Plan for determining evaluation factors and scoping the study.

Day 1 of the VSM workshop is devoted to drawing the *Current State Map* that develops an understanding of how things currently operate and to form a foundation for the future, or improved, state. It is critical that the mapping teams identify the forms of waste and the root causes of the waste contained in the Current State and consider solutions to permanently eliminate the root causes. GM teams are urged to draw their maps on large plastic sheets.
(many are 5 feet high by 20 or 30 feet long) with dry-erase markers that makes the maps both visible and editable.

Analyzing the flow of material & information for the Current State is similar to Function Analysis of features and performance.

Day 2 of the workshop involves drawing the Future State Map that designs a lean flow through the application of the GMS Principles and the elimination of the root causes of the wastes identified in Day 1. Key characteristics of the Future State are identified that will be used during the third day, and progress is reviewed with the affected leadership teams to obtain input and gain agreement on the direction of the Future State.

Generating the Future State with lean flow combines aspects of Creativity and Evaluation from the VM Job Plan.

Day 3 of the workshop is spent generating the Implementation Plan that details the actions required to accomplish the desired Future State, with specific assignments of what, who, and when. Leadership again reviews the activity and approves the plan to change the Current State to the Future State. This plan includes the objectives that address the key characteristics of the Future State, action items for each objective, and dates for follow-up reviews.

Creating an effective Implementation Plan is a universal activity for value improvement workshops.

The post-workshop activities for a GMS Project involve completing the action items identified in the Implementation Plan and verifying the results. A rigorous tracking process is used that calls for countermeasures to be written when due dates are not met to help ensure completion of the plan. And finally, performance metrics are checked to confirm that improvement targets have been met. The final Future State Map then becomes the Current State Map for the next cycle of process improvements.

Implementation of the plan and monitoring the progress of results are also universal activities for value workshops.

VSM workshops have been completed in each functional staff at GM – from Research & Development to Sales & Marketing – with significant process improvement results. But they are not limited to just the internal operating groups. GM’s Environmental Services group held a workshop in 2004 with the Michigan Department of Environmental Quality that also involved Ford and Chrysler. The goal was to improve the processing time for environmental air permits for automotive projects. The average permit processing time (total lead time) was reduced from 390 days to 180 days. And the General Motors involvement with Value Stream Mapping has not stopped at the automotive sector. After hearing about successes with the mapping tool, the Michigan State Police crime labs approached GM to help them with VSM workshops to reduce their DNA testing backlog. The results included reducing a 10-year backlog to less than a year and making nearly ten times the matches of known criminals to evidence left at crime scenes.
VSM & THE VALUE METHODOLOGY

Many obvious parallels exist between Value Stream Mapping and the Value Methodology, including the few mentioned previously. Just as VM is about building value for the customer by improving performance (or function) while reducing life-cycle cost, VSM is about building value for the customer by eliminating waste and non-value added work. There are also key similarities of purpose between VSM and VM, such as starting with – and maintaining – a focus on the customer and getting the right people involved in a creative process.

Value Stream Mapping techniques translate readily to the VM environment, as illustrated by the following brief examples:

- Drawing a Current State Map to help frame a VM study and understand how things really work.
- Using VSM at the front end of a VE workshop to establish performance metrics for the study.
- Applying mapping throughout the VM Job Plan to aid in visualizing process flows and identifying opportunities for improvement (waste) in the system.
- Combining VSM with Function Analysis of process steps to highlight material and information flows.

The Value Methodology is very much about balance – in improving performance while reducing (total) cost while satisfying the customer. And it is a systematic team approach that follows a structured Job Plan. Value Stream Mapping works to strike a balance as well and uses a similar structured approach that bears a striking resemblance to VM. The following “cross-stitch” chart shows the relationship of the phases of the VM Job Plan to the elements of VSM.

![Figure 2: Comparison of VM Job Plan & VSM Elements](image)
These common elements and similarities aside, Value Stream Mapping holds its own as an effective improvement tool that delivers meaningful results. VSM is the key tool used by GM to support the implementation of lean strategies in non-manufacturing areas. It is just as effective in production areas or the service industry and on any type of process or procedure. And VSM can be used to supplement VM efforts to increase visibility of process flow, aid in identifying opportunities for study, and provide additional focus for value improvements.

**SUMMARY**

Value Stream Mapping is a tool that helps develop lean thinking leaders and delivers lean results. And when applied it builds value for the customer and reduces waste. At General Motors VSM is an integrated tool that is used to drive improvements in administrative functions through the GM Global Manufacturing System. Mapping helps teams see and focus on flow with a vision of the ideal, or at least improved, state and delivers improvements through waste elimination strategies.

Much can be learned about processes by using VSM to understand how things really work (current state maps) and to design a lean flow to build value (future state maps). VSM helps teams see the flow and the sources of waste in a process or system, and it helps make decisions about flow apparent through the application of lean concepts and techniques. VSM has a natural synergy with VM, especially related to the focus on the customer and as a systematic team approach.

Value Stream Mapping is a tool that provides an excellent roadmap to improvement and can readily complement the Value Methodology to help the user manage value for the customer.

**REFERENCES**

M. Rother and D. Shook, *Learning to See*, Lean Enterprise Institute, 1999