The Book of Value Stream Maps I

Plant Level Maps for Discrete Parts and Assemblies

Solutions to common value stream mapping problems with example maps

By: Dilesh Patel, Herman Ranpuria, Jayesh Shah & Jonathan Fournier

Foreword by René Aernoudts
Objectives of this book

- To identify common problems in value stream mapping at the plant level, and show how you can solve them to better support a lean deployment.
- To provide mapping, calculation, and charting support that complements the workbooks “Learning to See,” “Creating Continuous Flow,” “Making Materials Flow,” and “Creating Level Pull” from the Lean Enterprise Institute.

Recommended Prerequisites

- A basic understanding of the VSM methodology through training or a book such as “Learning To See” (John Shook and Mike Rother).
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Acknowledgements

The ideas in this book are a result of the many interactions and learning opportunities we have had with the community of lean practitioners who have used our eVSM software. We have discussed solutions to practical VSM problems with them, and they have helped us to understand how to effectively leverage value stream maps.

Our group really began with the publication of the workbook “Learning To See” from the Lean Enterprise Institute, and at a subsequent meeting at their office in Boston. Our understanding has grown with each new workbook, with our work in value stream mapping at client sites, and with our interaction with Kevin Henn and the large practitioner community at the eVSM LinkedIn user group that he founded. The idea for this book germinated in discussion with the Lean Management Instituut in the Netherlands in 2011 at their annual lean management summit. We gratefully acknowledge their support throughout the process.

We thank Yelena Chuzhoy, Greg Falada, Peter Jahn, Joe Sabo, Fred Shamburg, Franck Vermet, Susan Delrow, Scott Chase, Trent Wall, Greg Hume, Dave Levine, Cindy Jimmerson, Jeff Boss, Brian Lange, Carl Hazzard, and many others in the lean community for the wonderful insights and conversations over the years. We look forward to continuing the journey with them.

Last but not least, Rajvi Desai and Jamie Todd in our group have worked with great enthusiasm to help us bring all the materials together within intense deadlines.
The launch of the book “Learning To See” by John Shook and Mike Rother back in 1998 gave the Lean movement the powerful method of Value Stream Mapping. This method has shown to be extremely useful in creating insight in processes by visualizing all the activities in the information flow, the physical flow and the timeline. Many more work books have been published by the Lean Enterprise Institute to build a strong series of useful methods based on this first book. Back in those days when I started using Value Stream Mapping I sometimes struggled, especially with difficult or complex value streams. Luckily Dilesh, Herman and their team came up with their brilliant software eVSM which made life a lot easier while mapping value streams. I still often map using paper and pencil, but many of my maps have been transferred in a digital form for ease of use and communication purposes. eVSM has evolved over time and more and more functions have been added and a useful support group on LinkedIn has been stimulating the further development.

Value Stream Mapping sometimes looks easy, but the more you practice, the better you get. Not all processes are easy to grasp and understand, so sometimes you need some support to be able to solve the questions you run into. Some years ago the LMI team discussed this with Dilesh and came up with the idea to create example maps based on questions and challenges that people might have while mapping their processes. Dilesh got enthusiastic and as a result you see this book in front of you with lots of great examples of maps for different industries in the process sector (ranging from food to chemicals) and in the discrete parts and assembly sector. You will find many examples of challenges you might run into, with the possible solutions and advice how to work on these issues. Together with the eVSM software this book will be a valuable help for all the Lean practitioners out there.

To Dilesh and the team: great job guys, keep up the good work, and thanks for the many years of doing business with you. We are happy with the work you have done all these years.

To you as a reader: you can use this book with or without the eVSM software. It will provide you with lots of insights in how to overcome many challenges while you map your processes. The team of eVSM is happy to help out.

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How to Use This Book

PART I: LEAN & VSM OVERVIEW

Part I provides a pictorial review of the major concepts of lean and value stream mapping. It links the idea of waste reduction to metrics of lead time, capacity and cost that can be visualized on a map. It also illustrates mapping activities within a continuous improvement process.

This section is for you if you're already familiar with these concepts, but would like to quickly refresh your understanding.

PART II: MAPPING Q&A

Part II looks at mapping questions organized by capacity, lead time and cost related to discrete parts & assemblies. It includes example maps built in eVSM to go along with the questions to understand them visually.

PART III: VSM EXERCISES

Part III includes exercises that test your ability to analyze maps. This section contains problem and solution maps about processes that are concerned with discrete parts & assemblies (scissors, widgets, computers, and the like).

APPENDICES

Appendix A shows pictures of the most commonly used value stream mapping icons. Appendix B describes the seven kinds of waste and the associated icons. Appendix C shows a list of the mapping questions from the book. Appendix D shows a list of figures from the book.
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- Muda, Mura, Muri
- Waste & Metrics
- Capacity
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- Cost
Introduction

“A value stream is all the actions (both value-creating and nonvalue-creating) currently required to bring a product through the main flows essential to every product...” (Rother and Shook, “Learning to See”)

Ever since we were introduced to the concept of Value Stream Mapping (VSM) within a lean deployment we have loved the simplicity and common sense behind the approach. Our introduction came through the workbook “Learning To See”, in which the authors developed a formal methodology based on the material and information flow diagrams and discussions they had seen used in Toyota, and that were described as a piece of the overall improvement methodology in the book “Lean Thinking” by Womack and Jones.

The Lean Enterprise Institute has published several subsequent workbooks that show how value stream maps play into different aspects of a lean deployment. Our goal as a group is to support both the mapping and related calculations recommended within this set of workbooks and make them easier to accomplish.

This book looks at the key metrics, formulas, and visuals for understanding and improving plant level value stream maps. It does not teach the basic concepts of value stream mapping. For that we refer you to the excellent resources in the bibliography starting with “Learning to See.”

Part I is a pictorial refresher through lean concepts, the use of maps in a lean deployment, and the metrics of capacity, lead time, and target cost used to analyze and visualize maps. Part II goes straight to questions and answers related to each of these metrics using simple maps for illustration.
Lean and Value Stream Mapping – A Pictorial Review

1. Specifying Value
Precisely specify value by specific product.

2. Identify the Value Stream
Identify the value stream for each product.

3. Flow
Make value flow without interruptions.

4. Pull
Let the customer pull value from the producer.

5. Perfection
Pursue perfection.

1. Value stream maps help visualize the waste and they can be drawn at different levels from an individual process to an enterprise map across plants or even companies. This book focuses on plant level maps.

2. The book “Lean Thinking” introduced us to the 5 Lean Principles, the concept of product value streams, flow, and pull.

3. Lean thinking removes waste from the value stream. Work components can be thought of as value added, non-value added but necessary, and as waste. Lean is a continuous improvement methodology that reduces the waste and questions why any non-value added work is truly necessary.
4. A useful analogy links inventory to the water level in a river. The rocks in the river represent the forms of waste. See the detailed chart later in this section.

5. These are three system level causes of wasteful activities. Muda, mura, and muri. See the detailed chart later in this section.

6. The Toyota Production System identifies 7 types of waste and value stream maps link these to the metrics of Lead Time, Capacity, and Cost. See the detailed chart later in this section.
Value Stream Improvement

The Value Stream Map Zones diagram shows the information and material flows on the map. The information flow shows how production is scheduled and the material flow shows the physical inventories and movements of materials. The two flows are closely related and both should be represented on the map. The timeline at the bottom is useful to understand the Lead Time components as a part goes through the value stream.

The Value Stream Improvement Process diagram shows one approach to developing and using maps in the Continuous Improvement Process. Mapping almost always begins with paper and pencil, and then maps are (optionally) captured electronically to aid in sharing, analysis, and visualization. Regardless of the format, mapping is followed by brainstorming towards a leaner future state with projects being planned out and implemented. The future state is then realized and the improvement cycle is repeated.

One of the lean practitioners in our community uses the following approach in creating wall maps. First start with a large roll of white paper attached to the wall. Add 3x3 Post-it Notes of different colors to document the various operations. Turn one of the Post-it colors to a 45º angle to indicate inventory. Use a separate color for any notes or questions, and post them in the corner of the paper.
Value Stream Map Zones

This simple map shows the information and material flows on a value stream map. The red information flows indicate the communications between production control, customer, and supplier, and also indicate direct scheduling of both Stamping and Assembly activities.
Start from a wall map developed with the group involved in the value stream.

Sustain improvements
Future State becomes Current State
Improvement cycle continues

Create Future State
Create a future state map based on the improvement projects selected and create an implementation plan.
Brainstorm and add improvement ideas using kaizen starbursts

Perform Root Cause analysis (5 Why’s)

Look at impact (on key metrics) and difficulty of implementation to prioritize improvement projects

Analyze the map to understand opportunity for waste elimination, flow implementation, and pull (not push) production
Generating Defective Products

Machine Breakdowns
Rework
Delay in Delivery
Mixed Materials
Poor Housekeeping
Long Set ups

Inventory "hiding" the waste

Water Level = Inventory Amount
Generating Defective Products

Inventory Amount
Inventory Levels and Waste

Because work items have to wait for existing inventory in the value stream to be processed before new items can be processed, excess inventory levels are a major contributor to Lead Times. However, for production managers, inventory is a valuable tool to make sure that they can meet production and shipping targets in case of disruptions and changing demand. In practice, inventory also has associated Carrying Costs.

The problem is sometimes illustrated as crossing a river with dangerous rocks below the surface of the water.

- Think of productions as crossing the river. This is reinforced by the value stream map above the river, where inventory is represented by the letter “I” in a triangle. Inventory can be unfinished parts between processing steps, and finished product (the gray triangle) waiting to ship.

- Think of the water level as the inventory represented by all the triangles in the value stream. The higher the water level the longer it takes to cross the river.

- Think of the variances and wastes as the rocks in the river. If you bring inventory levels down too low, then production will hit one or more rocks. For smooth production you have to maintain adequate inventory levels (water level). To reduce inventory levels, costs, and waste, you have to break down the rocks.
Activities that consume resources without creating value for the customer

Unevenness in operation, or uneven work pace

Overburdening of equipment or people

Mura and Muri reduction require a higher level of management participation

Muda, Mura, and Muri
Muda, Mura, Muri

Waste is termed as Muda and is impacted by Mura and Muri. In 2006, Jim Womack posted a Lean forum article on Mura, Muri and Muda. He noted that often the Mura (unevenness of operations) creates Muri (overburdening of people) that undercuts previous efforts to eliminate Muda. The subject matter of this book (value stream mapping) is closely related to reduction in Muda and involves the people undertaking the activities in the value stream. Efforts to reduce Mura and Muri often require the engagement of management in the Lean effort, and in their absence a pure Muda effort is doomed to failure. Publications such as Art Smalley's “Creating Level Pull” talk about protecting production operations from Mura through the use of well designed finished goods markets and pull systems.

**Muda**: Any activity that consumes resources without creating value for the customer. This is illustrated by the large forklift carrying a very small package.

**Mura**: Unevenness in an operation. This is illustrated in the diagram by showing forklifts transporting uneven quantities.

**Muri**: Overburdening equipment or operators by requiring them to run at a higher or harder pace with more force and effort for a longer period of time than the equipment designs and appropriate workforce management allow. This is illustrated by the overloaded fork lift.