

# Combining Value Stream Mapping and Discrete Event Simulation

Anthony J. Donatelli  
Gregory A. Harris  
University of Alabama in Huntsville  
Huntsville, AL 35899  
[donatea@uah.edu](mailto:donatea@uah.edu)

## KEYWORDS

Industrial processes, Industrial engineering, Manufacturing, Production, Documentation, Model design, Model evaluation, Discrete simulation

## ABSTRACT

This paper discusses the integration of value stream mapping (VSM) and discrete event simulation to further the continuous improvement goals of lean manufacturing.

## INTRODUCTION

Models are descriptions of systems, and model simulation is perhaps the primary tool for studying the behavior of large, complex systems. (IIE, 1992) Usable models should be easily understood, yet have enough detail to realistically reflect the important characteristics of the system. Two tools used in implementing lean manufacturing are value stream mapping (VSM) and simulation. If VSM is a snapshot, simulation is the movie. VSM and simulation complement each other, and at the end of this paper a real world

application of their combination is shown.

## LEAN MANUFACTURING

Lean manufacturing is the systematic approach to identifying and eliminating waste (non-value added activities) through continuous improvement by flowing the product at the pull of the customer in pursuit of perfection. (NIST, 2000) For example, wastes would be things like transportation, waiting, and inventory.

## VALUE STREAM MAPPING

A value stream is all the actions (both value and non-value added) required to bring a product, or group of products that use many of the same resources in much the same way, through the main flow essential to every product – from raw material to the arms of the customer. VSM is a pencil and paper visualization tool that shows the flow of material and information as a product makes its way through the value stream. (Rother and Shook, 1999) VSM serves as a starting point to help management, engineers, suppliers, and customers recognize waste and its sources. Value stream mapping is done

in two steps. The first step is to draw the current state value stream map to take a snapshot of how things are being done now, and the second step is to draw the future state map to show how things ought to be done. Value stream mapping provides both a picture of the current state of affairs as well as a vision of how we would like to see things work. Identifying the differences in the current and future states yields a roadmap for improvement activities.

The data collected in the act of value stream mapping provides the information necessary to develop a computer simulation of the current process. The simulation can be used in analyzing and evaluating the current and future states. And once a suggestion to improve a targeted problem has been made, the simulation can be modified to include the suggestions and then run to measure the potential impact. This allows the team to make changes and observe the effects without disrupting the production process or causing unnecessary downtime and costs.

## USE OF SIMULATION WITH VSM

Some obvious steps in VSM that can be helped by simulation are (1) analysis and evaluation of the current and future states, (2) documentation of areas to improve, and (3) assessment of the impact of proposed improvements.

Both VSM and simulation take a holistic look at the system, but VSM is an efficient design tool, while simulation is an efficient analysis tool. VSM creates the model and provides the vision, whereas simulation is used to evaluate the model and substantiate the vision. VSM is a pencil and paper, down to

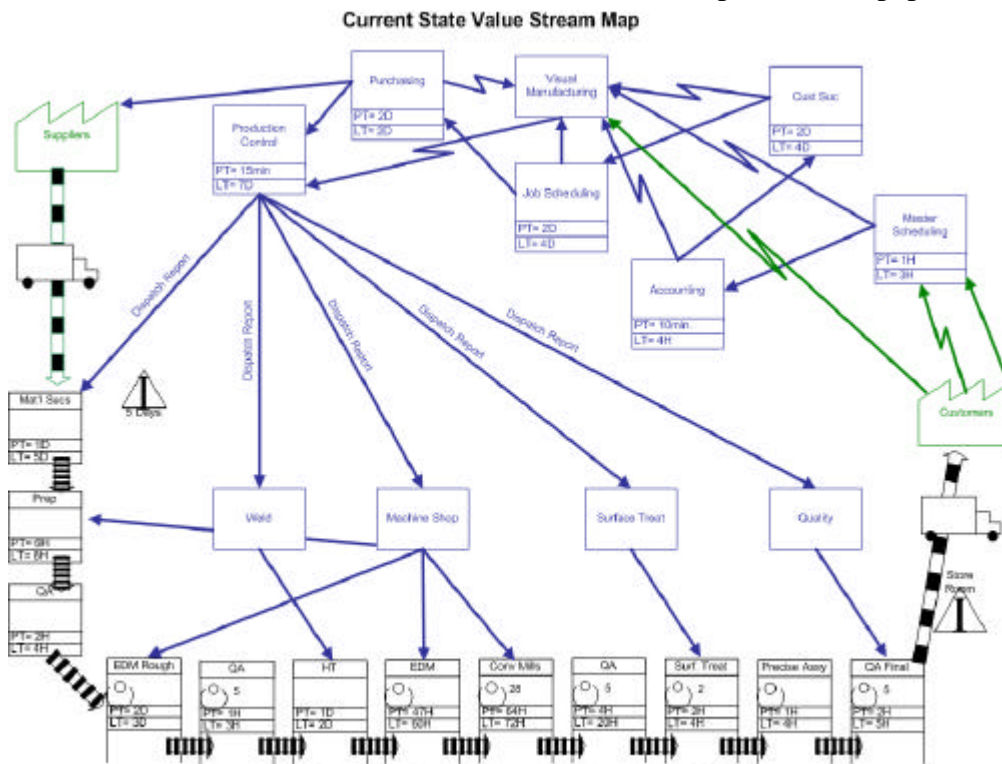
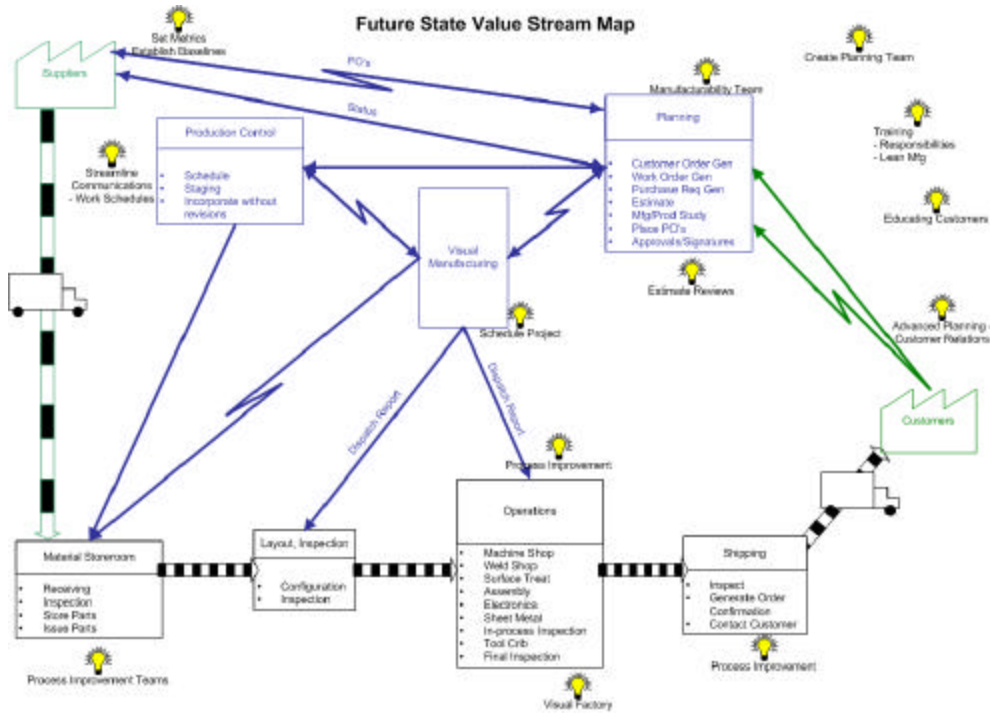


Figure 1: Current State VSM

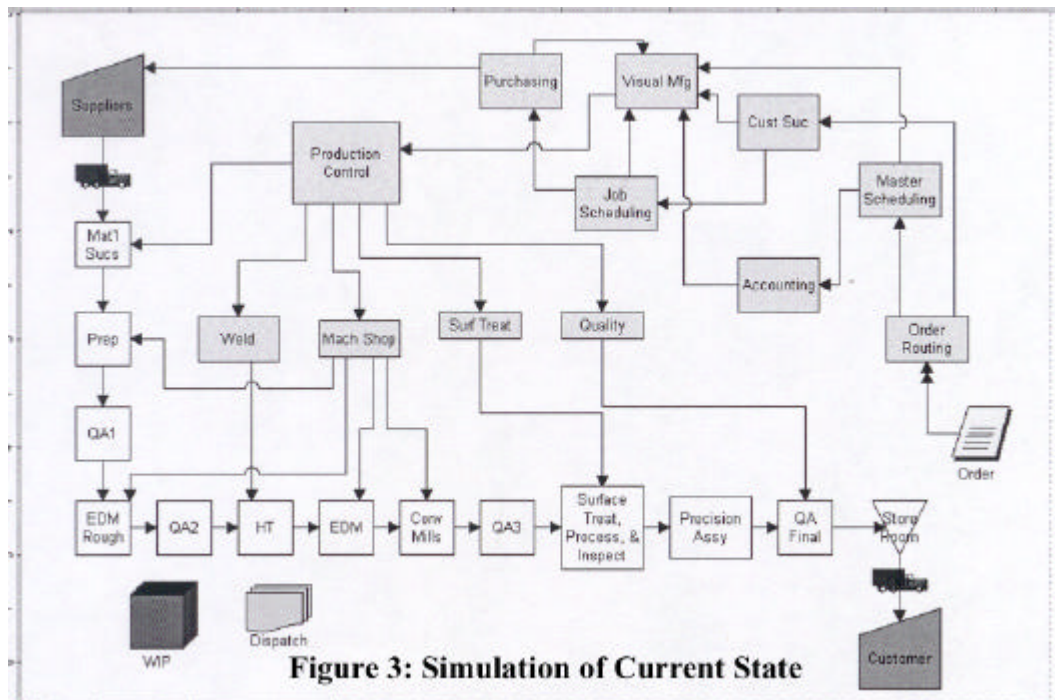


**Figure 2: Future State VSM**

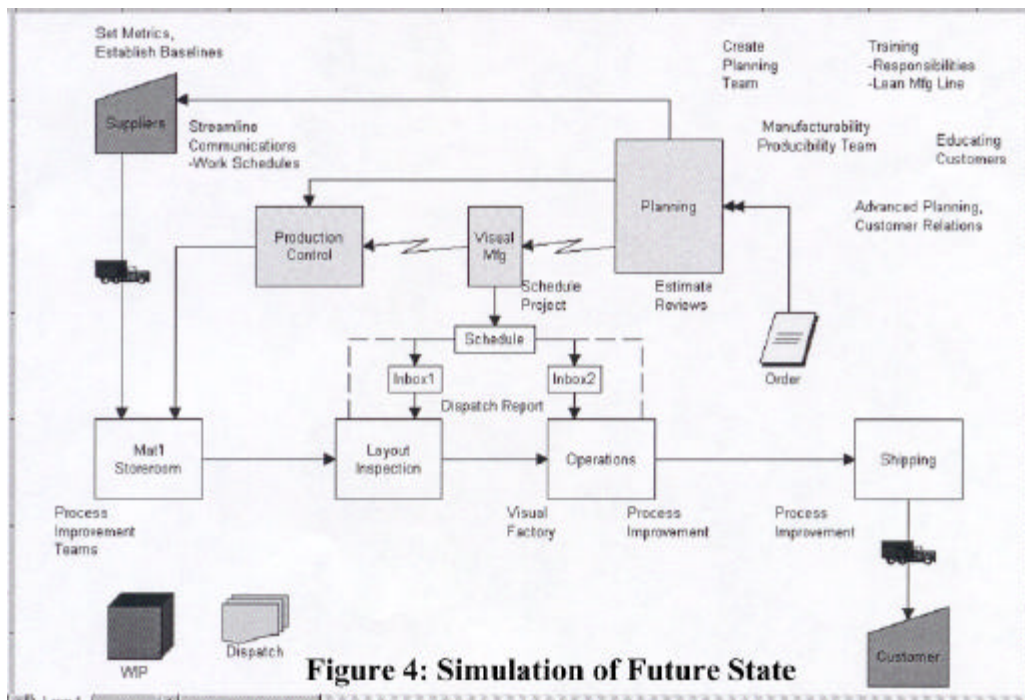
earth, and realistic representation, but simulation is a general analysis technique, and as such can only provide estimates of model performance. Again, the vision and the model come from the value stream maps, and simulation gives analysis and flexibility.

## APPLICATION OF SIMULATION WITH VSM

Notice from Figure 1 that the current process consists of 13 material



**Figure 3: Simulation of Current State**



operations and 9 information operations. Notice from Figure 2 that the future process consists of only 4 material operations and 5 information operations. Figures 3 and 4 show the obvious correlation between the value stream maps and the simulation models, as they are almost identical. The model generation and data collection phases of simulating the process were basically eliminated, due to value stream mapping first. Simulation of the VSM show problems that might have been missed with the value stream maps alone – for example, extended running of this simulation shows that the information flow, not the material flow, is the source of the process problems. Due to the lack of data in this case, the only improvements VSM and simulation can offer at this time are improvements in layout and flow.

## CONCLUSIONS

The following conclusions are made for the use of simulation with value stream mapping:

- VSM is an extremely valuable tool in lean manufacturing and the continuous improvement effort.
- Simulation adds the fourth dimension, time, to a value stream map. After being simulated, the VSM is no longer just a snapshot; it is a moving picture, which offers insights that may have been missed if VSM alone had been used.
- One tenet of lean manufacturing is to not get “paralysis by analysis,” – simulation of the VSM allows the lean team to more quickly “just do it,” and without causing interruption in the production process.

- Simulation makes not only testing ideas easier, cheaper, and quicker, but also gives immediate assessment of proposed changes to the system.
- The VSM process provides the model and the data, making simulation easier to do.
- VSM and simulation are a natural combination and each enhances the other's value in the lean manufacturing effort.

an industrial engineer, quality engineer, operations manager and plant manager. He is a certified NIST Lean Manufacturing Trainer and a registered Professional Engineer. Mr. Harris has BS in Industrial Engineering from Auburn University, a MBA from St. Edwards University and is pursuing a Ph.D. in Industrial Engineering at UAH.

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## ABOUT THE AUTHORS

Tony Donatelli is a Research Associate at the ATN Region 1 Center at UAH. He has BS in Industrial and Systems Engineering and is currently pursuing an MS in Engineering Management from UAH. He has experience in value stream mapping, simulation, production control, line balancing and standardization, facility layout, and as a lean manufacturing trainer.

Greg Harris is Director of the ATN Region 1 Center at UAH and has over 20 years of experience in manufacturing as