Using Value Stream Mapping as a Strategic Planning and Implementation Tool

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1. Introduction

Many companies begin manufacturing improvement efforts without developing an overall game plan. This results in an improvement implementation that is not integrated and that produces suboptimal results. The use of value stream mapping can provide the "30,000 ft. view" of the manufacturing operation. This view identifies the locations of waste in the current process and the opportunities for improvement. Figure 1 shows a representative value stream map. The application of lean concepts in the future state sets the stage for the development of a coordinated implementation plan. The most effective value stream maps are developed by a cross-functional team that has people from many of the activites in the value stream being evaluated. The development of a value stream map can also be part of the training used for developing understanding of the application of lean concepts.

The presentation will provide a number of real life value stream maps developed in many different industries including electronics, food, metal fabrication, plastics, and chemicals. Various methods used to develop the maps including operator teams, engineer teams, and management teams are compared and evaluated. Different techniques used to draft the maps, ranging from simple hand written documents to complex Powerpoint presentations, are shown. The effectiveness of each technique will be discussed.

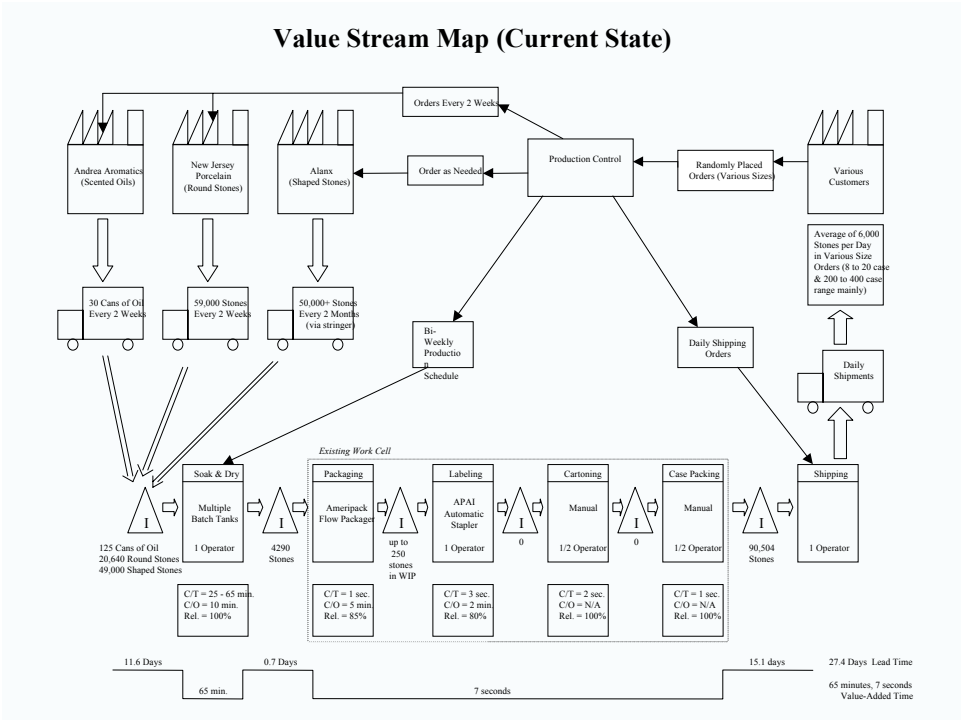

Figure 1

2. Developing Value Stream Maps

Value Stream Mapping is based on the fundamental principle of Lean Manufacturing. This principle is as follows: *any activity or action which does not add value to the product is a form of waste and must be eliminated or minimized.* Value is added any time the product is physically changed towards what the customer is planning to purchase. Value is also added when a service is provided for which the customer is willing to pay (i.e. design, engineering, etc.). If we are not adding value, we are adding cost or waste.

In order to understand where to start the implementation of lean concepts, one of the most useful tools is the *value stream map.* The value stream is the set of all specific actions, both value added and non-value added, that are needed to take a product through the information and production flows of a manufacturing operation. The value stream map follows the production path from beginning to end and shows a visual representation of every process in the material and information flows The maps show the linkage between information flow and material flow for the product family.

The process of developing the value stream map forces you to understand your product families and the interaction of the production processes. The value stream map is the road map that reveals the obstructions to continuous flow and the opportunities for reducing waste through the use of other lean techniques. Figure 2 shows a concept value stream map. (1)

The value stream map development process consists of the following two steps:

- Development of the Current State
- Development of the Future State

A brief description of the purpose and development of the two types of Maps follows.

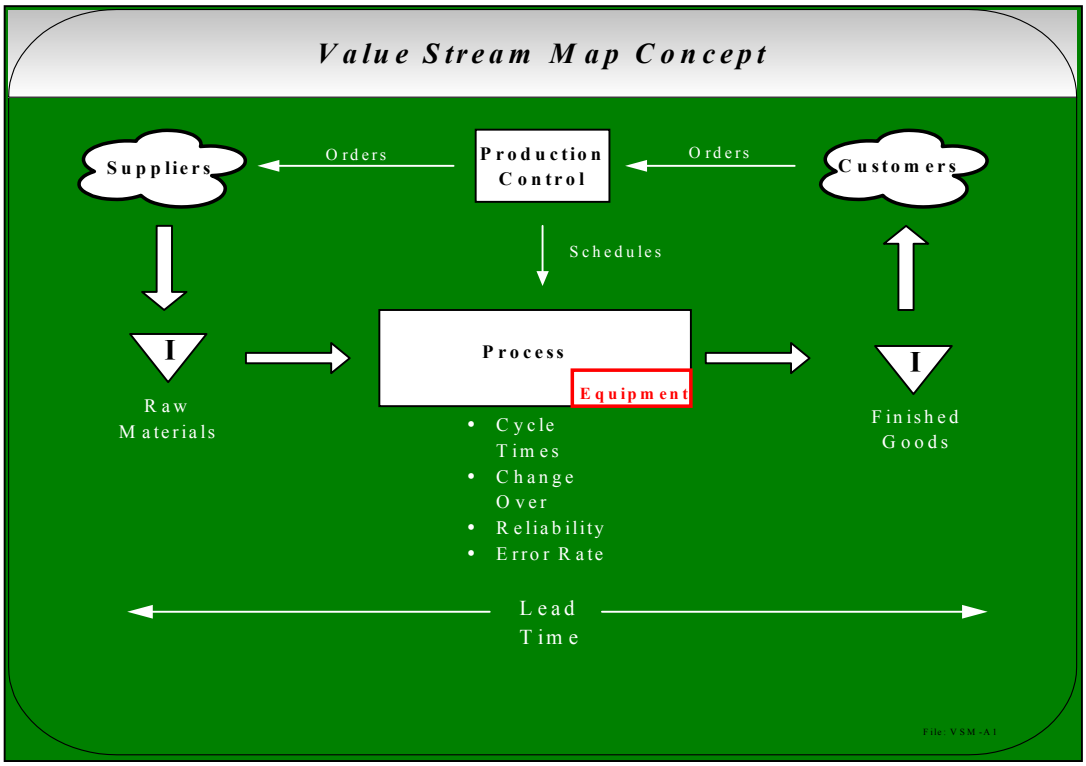

Figure 2

2.1 Current State Value Stream Map

The Current State Value Stream Map shows how the shop floor currently operates and serves as the foundation for the future state changes. The map starts with the shipping area and works back through the process to the suppliers. You need to start with one product family otherwise the map will be too complicated.

Customer demand and shipping data is a critical part of the Map since the ultimate goal is to have flow directly tied to customer demand in the Future State. In addition to flow, the Current State Value Stream Map shows key production processes and the important data for each process box. Some of the more important data that is recorded is as follows:

- Cycle time
- Changeover time
- Number of people
- Available working time
- Quality data such as reject percentage or scrap rate
- Equipment reliability data such as percentage of uptime

Raw material and finished goods inventory are shown as well as work in process between the various processes in the value stream.

The production control information flow is shown to determine how the production processes are being scheduled and controlled. At the bottom of the Map, the total process time and lead time are calculated for a typical product family unit or order. Figure 3 shows a completed Current State Map.

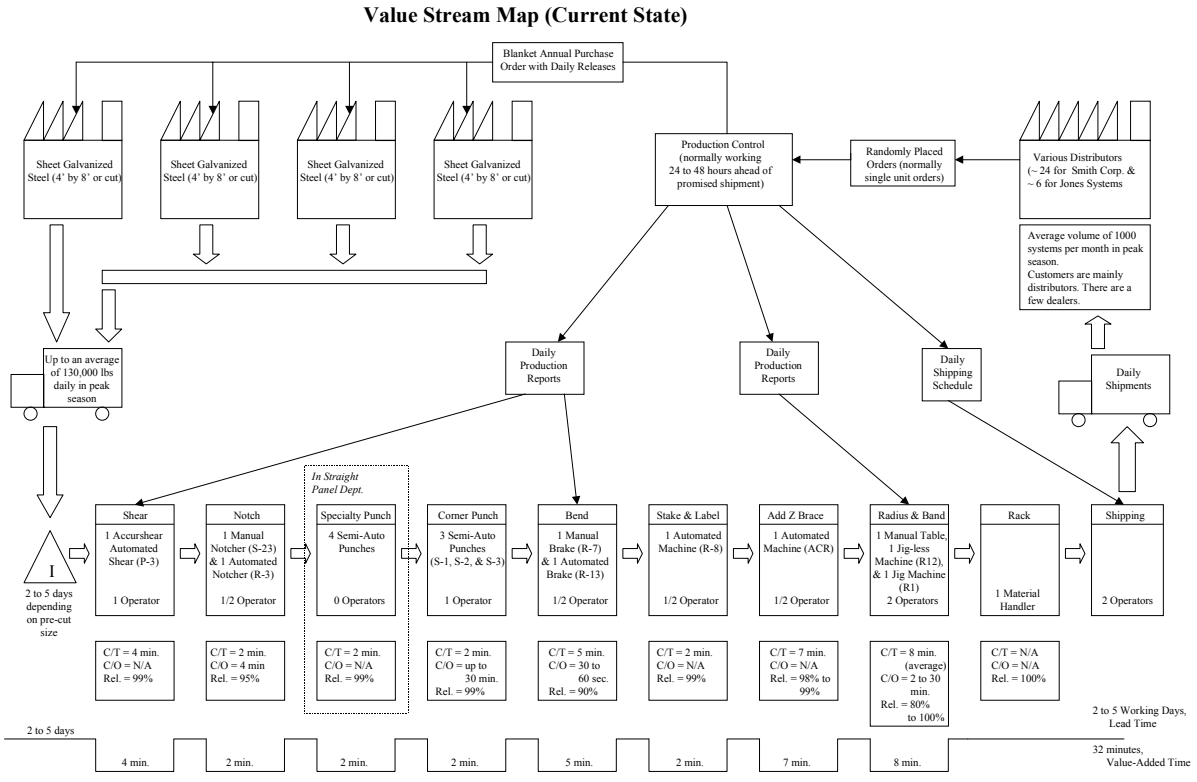

Figure 3

2.2 Future State Value Stream Map

The Future State Value Stream Map shows how the shop floor will operate after lean improvements have been implemented. The Current State Value Stream Map serves as the starting point for developing the Future State. The goal in developing the Future State Map is to make the flow continuous and to eliminate as much waste as possible. Lead time is shortened as much as possible by implementing lean techniques. The flow in the Future State Map is built around the takt time, or how frequently a unit must be completed to meet customer demand. Takt time is simply the available working time per shift divided by the rate of customer demand per shift.

The key questions that must be asked while developing the Future State Map are as follows:

- What is the takt time?
- Should you build to a finished goods supermarket or directly to shipping demand?
- Where can continuous flow processing be implemented, i.e. eliminate cycle time mismatches and WIP?
- Where will supermarket pull systems be required between processes?
- What is the pacemaker process, i.e. the process which will be used to schedule and regulate production flow?
- How will the production mix be leveled at the pacemaker process?
- What increment of work will be released?
- What process improvements need to be made to achieve continuous flow and to eliminate waste? (1)

The development of the Future State Value Stream Map is an iterative process that requires a very good understanding of lean concepts. Figure 4 shows an example of a Future State Map.

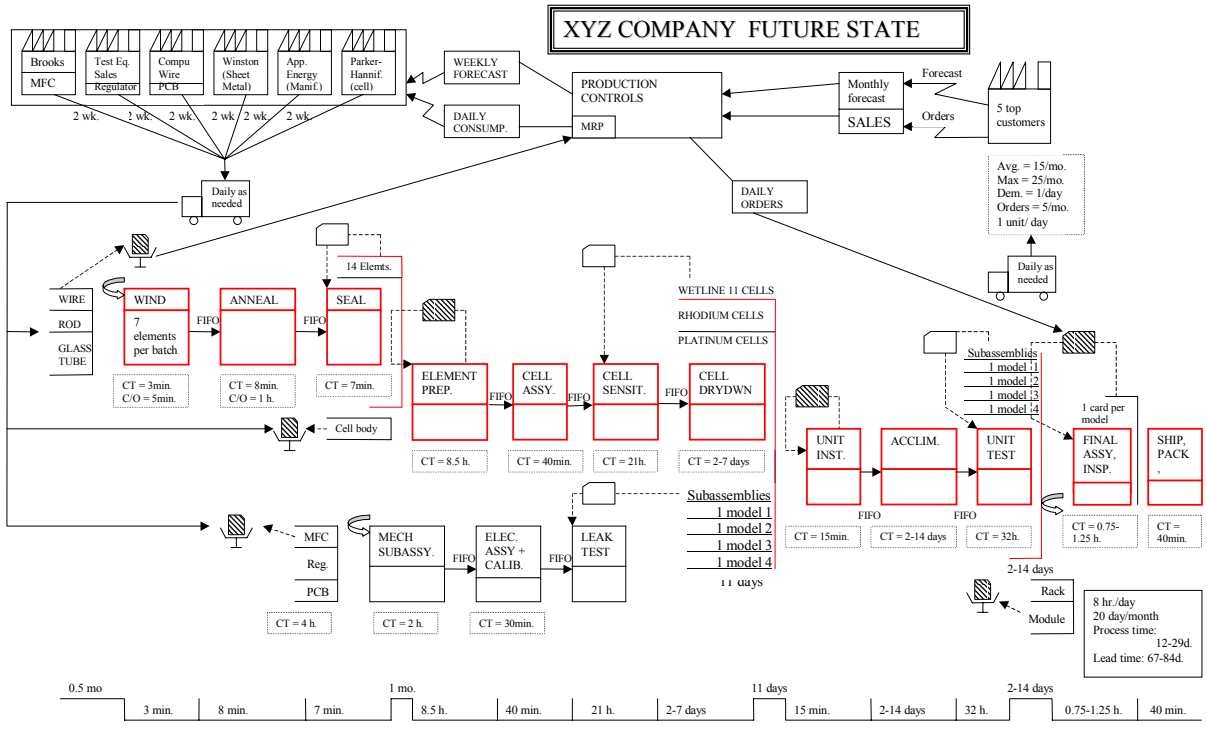

Figure 4

3. Use of Value Stream Maps for Implementation and Planning

When the Future State Value Stream Map is completed, an implementation plan must be developed to convert the Current State into the Future State. The Future State Map can be broken into different loops for ease of implementation. The Current State Map can also be used to show the key process improvements that must be completed to achieve continuous flow in the Future State. Figure 5 shows an example of how process improvements can be highlighted on the Current State Map.

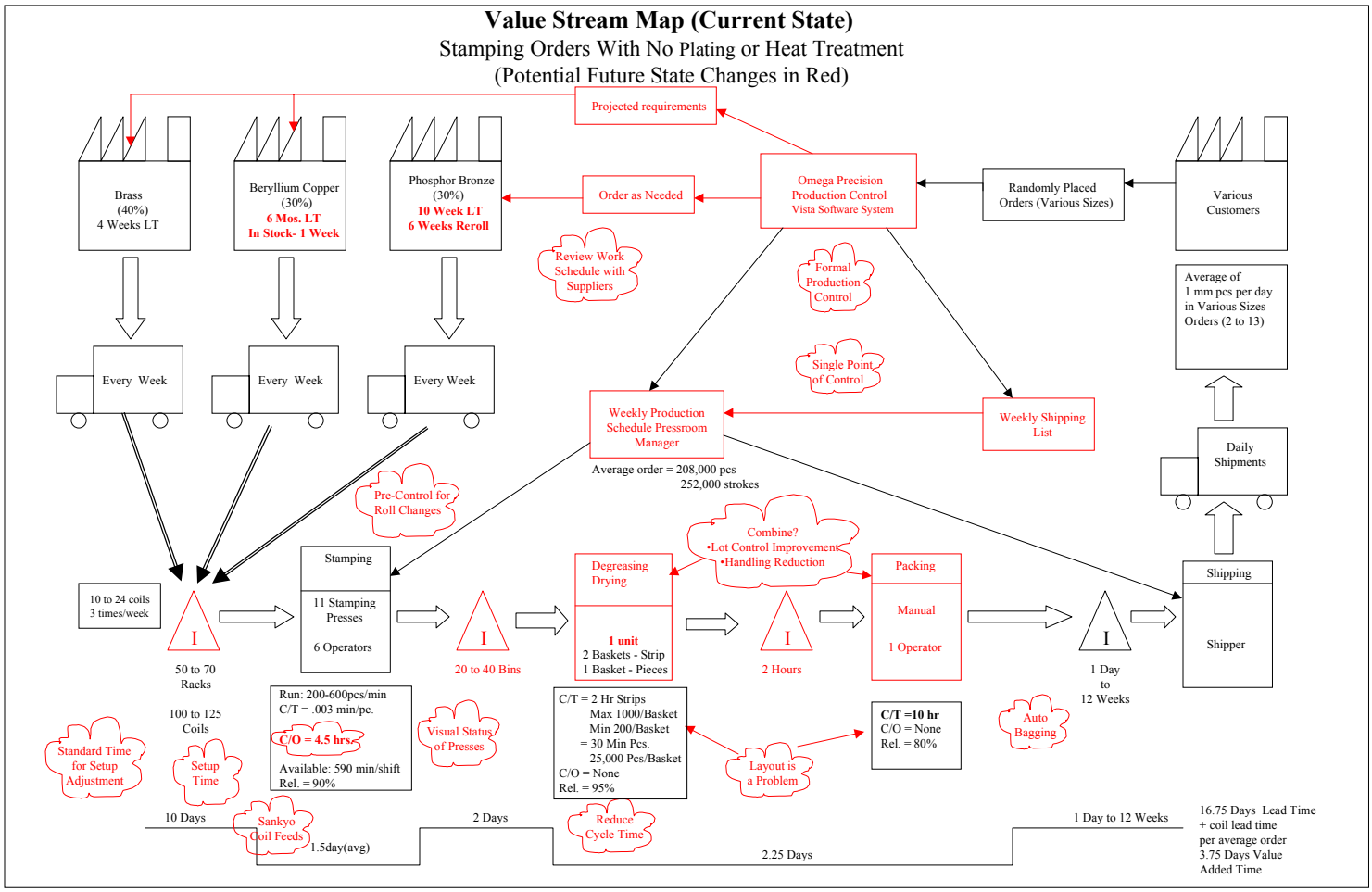

Figure 5

Highlighting the process improvements on the Current State Map makes it easier to explain to management and how the changes are related to current operations. Once the improvements are identified, a time-sequenced list of improvement projects by loop can be made. A brief goal and the expected improvement should be show for each project. The projects should be given a relative priority so that the most important projects can be scheduled first. The plan should be established to complete the majority of the projects within three to six months. Organizing the lean improvement projects in this manner can make it easier to include them in the capital planning process if new process equipment is required. Figure 6 shows an implementation plan developed for a company in the past year. The plan shows the Value Stream Map loop, objectives for the loop improvements, the specific projects, priority, and expected completion date.

FUTURE STATE IMPLEMENTATION PLAN & SCHEDULE

LOOP	OBJECTIVES	PROJECTS	SEQUENCE (PRIORITY)	COMPLETION DATE (Mon./Yr)
Supplier Loop	* Develop pull system with suppliers	1. Review Weekly/Monthly Requirements With Suppliers	1	Sep-01
	* Increase number of deliveries per week	2. Revise current blanket orders	1	Sep-01
	* Reduce raw material inventory to match demand	3. Send daily consumption data to suppliers	2	Nov-01
		4. Setup point of use raw material areas	1	Oct-01
Production Control Loop	* Implement daily shipping schedule	1. Single point to schedule(shipping). See pacemaker loop.	1	Oct-01
	* Work to schedule manufacturing based on shipping requirements	2. Daily production schedule by Operations Manager	1	Oct-01
		3. Implement kanban loops as shown on future state VSM	2	Nov-01
		4. Use MRP for materials forecasting	1	Oct-01
Element Loop	* Reduce lead time	1. Eliminate WIP between winding & annealing	1	Sep-01
	* Develop continuous flow	2. Implement supermarket for element prep and kanbans	1	Oct-01
	* Develop pull system with element prep supermarket	3. Crosstrain element assembly operations	2	Dec-01
Module Assembly Loop	* Reduce cycle time	1. Analyze process variance in environmental test	1	Oct-01
	* Reduce variation in cycle time in testing	2. Analyze process variance in module drydown	1	Oct-01
	* Reduce variation in cycle time in drydown	3. Implement supermarket and kanbans for cell installation	1	Oct-01
	* Establish pull system with supermarket from cell installation	4. Crosstrain module assembly operations	2	Dec-01
	* Reduce use of carriers	5. Analyze need for carriers vs. subassembly units	1	Sep-01
		6. Analyze material handling reductions and layout improvements for element prep operations	3	Jan-02
		7. Set up leak tested subassembly units in supermarket for final assembly	1	Oct-01
Pacemaker Loop	* Reduce cycle time	1. Improve assembly methods in final mechancial assembly	2	Dec-01
(Unit Assembly/Shipping Loop)	* Establish pull system with supermarket from shipping	2. Review design for manufacturing assembly improvements for tubing assembly	3	Feb-02
		3. Consolidate inspection with final mechanical assembly or shipping/packing	2	Nov-01
		4. Set up raw material suppermarket for final assembly	1	Oct-01
		5. Crosstrain unit assembly operations	2	Dec-01

NOTES:

1. Conduct kanban and point of use training for plant personnel in 2001.
2. Priotities as follows: #1(Complete in 2 months), #2(Complete in 4 months), #3(Complete in 6 months)
3. Consider use of teams for implementation after training.

4. Techniques and Tools used to Develop Value Stream Maps

Value Stream Maps have traditionally been hand-drawn and developed by a cross-functional team that has representatives from various company functions that are familiar with the product family being mapped. The advantage of this approach is that the team members become trained in implementing lean techniques and take ownership of the improvements required to achieve the Future State.

Another method is to have a small team working with an outside consultant who draws the Current State Value Stream Map using data and input from the team. This team can consist of management personnel or a combination of technical and production personnel. This approach works well when the company has limited lean experience and wants to get a "big picture' concept of what lean techniques can be implemented along with the potential benefits. The Map is then presented to the team for critique, and the Future State Map is developed interactively with the team.

The use of Microsoft Powerpoint and Visio has been found to facilitate the Value Stream Map development process. Maps developed with either of these two software programs offer the following advantages:

- can be easily corrected and changed,
- can be readily used to present the Maps to other company personnel,
- can be sent via e-mail for review.

5. Summary

The Value Stream Map is a valuable planning tool and can be used for a developing and implementing lean improvement projects. The process of creating a Value Stream Map helps to train the team on lean techniques and to reveal opportunities to reduce waste. A completed Value Stream Map can be used as a visual communications tool to explain how lean techniques can reduce waste in the value stream. Value Stream Maps become the first step towards achieving the following:

- shortened lead times
- fast identification of waste in the value stream
- identification of process improvement projects to eliminate the waste and achieve continuous flow.

Biographical Sketch

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Mr. Garcia, a registered professional engineer, served seven years in the U.S. Navy submarine force after graduation from the U.S. Naval Academy. After completing his military service, he obtained his Master of Engineering in Industrial Engineering from the Rochester Institute of Technology. In addition, he has 13 years of varied industrial experience in engineering, quality assurance, and operations management. He has worked for Mobil Chemical Company, Burroughs Corporation, Spectra Graphics, and the Department of Defense. His experience includes planning and implementing plant expansions in manufacturing, warehousing and materials handling systems. He has been responsible for Quality Assurance and Customer Service for multi-plant operations; engineered, justified and installed major manufacturing equipment systems; and has successfully managed manufacturing operations with staffing into the hundreds.

As a manufacturing engineering consultant for the past 12 years, Mr. Garcia has worked and managed projects involving material handling improvements, plant layouts and relocation, packaging line design and installation, and quality improvement. He has been involved with many lean manufacturing implementations involving setup reduction, cellular manufacturing, and value stream mapping. He has assisted in the development of manufacturing improvement strategies for national and international companies. His projects have been in the chemical, food, pharmaceutical, electronics, defense, and consumer products industries.

Mr. Garcia is a senior member of the Institute of Industrial Engineers (IIE) and American Society for Quality (ASQ). He is also a certified Systems Integrator (IIE), Quality Engineer (ASQ), and Quality Manager (ASQ).

References

1. Shook, J., Rother, M., 1999, *Learning to See: Value Stream Mapping to Create Value and Eliminate Muda,* The Lean Enterprise Institute, Brookline, MA.
2. Suzaki, K., 1987, *The New Manufacturing Challenge: Techniques for Continuous Improvement*, The Free Press, New York.
3. ____, 1998, *Principles of Lean Manufacturing: Instructor Guide*, The Lean Network, NIST Manufacturing Extension Partnership, Baltimore, MD.