The Strategos Guide To

Value Stream Mapping
&
Process Mapping

Genesis of Manufacturing Strategy

SAMPLE
PAGES

Quarterman Lee, P.E.

Strategos
CONSULTANTS•ENGINEERS•STRATEGISTS
www.strategosinc.com

Chapter

1

Introduction

Value Stream Mapping and Process Mapping are techniques that help to visualize work processes. By doing so, they enable improvement teams and managers to identify areas for streamlining the work, reducing defects and improving operations in many ways. Both techniques are valuable tools for Lean Manufacturing.

Process Mapping—Was pioneered by Frank Gilbreth in the early 1900's. It is effective across a wide range of situations and levels of detail. Process mapping is fundamental. It assumes no pre-conceived set of arrangements, tools or technique. Figure 1 shows a typical Process Map.

Value Stream Mapping—is a more recent technique designed specifically around the Toyota version of Lean Manufacturing. Figure 2 illustrates this technique.

These two approaches view the same work from different perspectives and on different levels. Each has a place in the improvement of work processes and the attainment of business goals. Both have a place.

A factory is enormously complex. Only visuals convey enough information to understand the pieces, relationships, hidden waste and time-domain behavior. Visualization brings a deep understanding and leads to major breakthroughs in productivity and other performance. It leads to consensus on systemic problems and remedies.

While a finished process or value stream map communicates valuable information, the most important benefit comes from its creation. During the mapping process, when properly done, insights grow, paradigms shift and consensus builds. Not only does mapping lead to better processes, it leads to a consensus that enables and enhances implementation.

Mapping of work processes is analogous to geographic mapping in many ways (hence the term). Both geographic and work maps tell us:

Figure 4 is an aviation chart for the same area. It shows features that are visible from the air and does not show features that are only identifiable from the ground. It shows the location of navigation beacons, tall obstructions, airspace boundaries and even minor airports with grass runways (useful in an emergency). An aviation map has little use for the motorist. There is no detail about streets and no way to orient the motorist with respect to street signs or ground level landmarks.

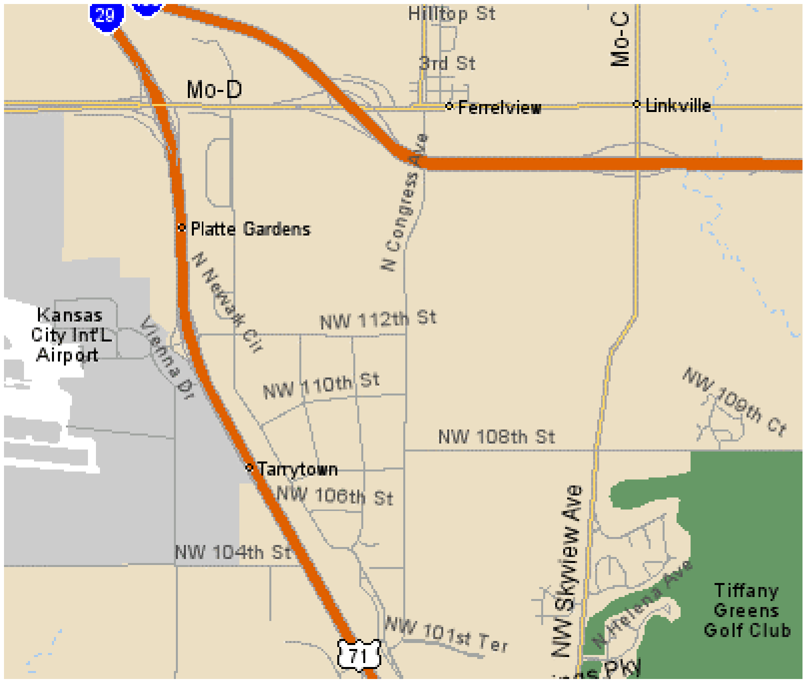


Figure 1 Kansas City, Missouri Street Map

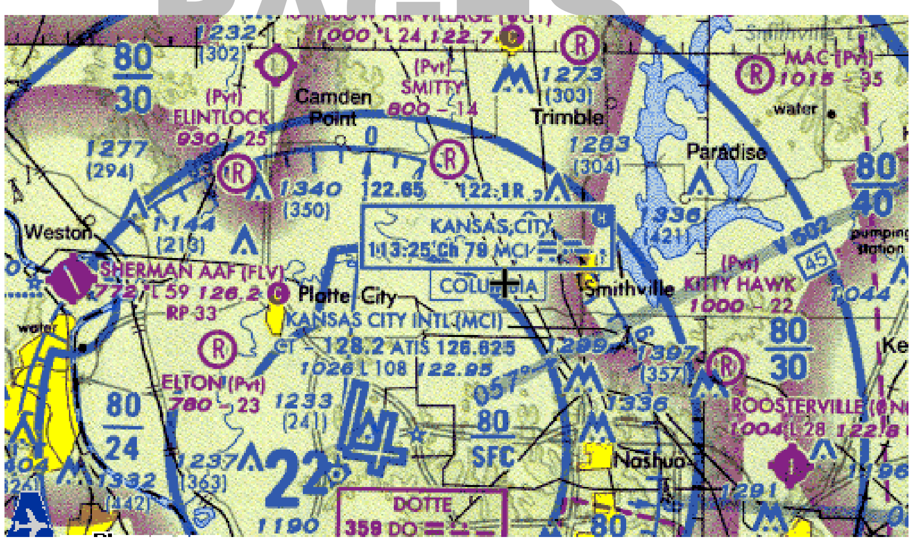


Figure 2-Aviation Chart of The Same Area

The key point is this: select a map and its level of detail that fits your specific purpose. There is no all-purpose mapping technique for analyzing work processes or for navigation.

Maps have varying degrees of accuracy. Figure 5 shows the map that Lewis and Clark used for their exploration of North America in 1803. This is hardly an accurate representation but it was they best available and undoubtedly useful. Indeed, one purpose of the expedition was to improve the accuracy of available maps.

> **"The Map Is Not The Territory"**
> *--Alfred Korzybski*
>
> This means that an abstraction derived from something, or a reaction to it, is not the thing itself, e.g., the pain from a stone falling on your foot is not the stone; one's opinion of another person is not that person**;** *a metaphorical representation of a concept is not the concept itself***.**
>
> **A specific abstraction or reaction does not capture all facets of its source** — e.g., the pain in your foot does not convey the internal structure of the stone. This may limit an individual's understanding and cognition unless the two are distinguished.

Maps do not have to be completely accurate to be useful. The important point for the users of maps is to be aware of the possible inaccuracies and work accordingly. All maps distort and filter information. This is what makes them useful but it also limits their use to the appropriate purpose.

Figure 3 Lewis & Clark's Map of North America

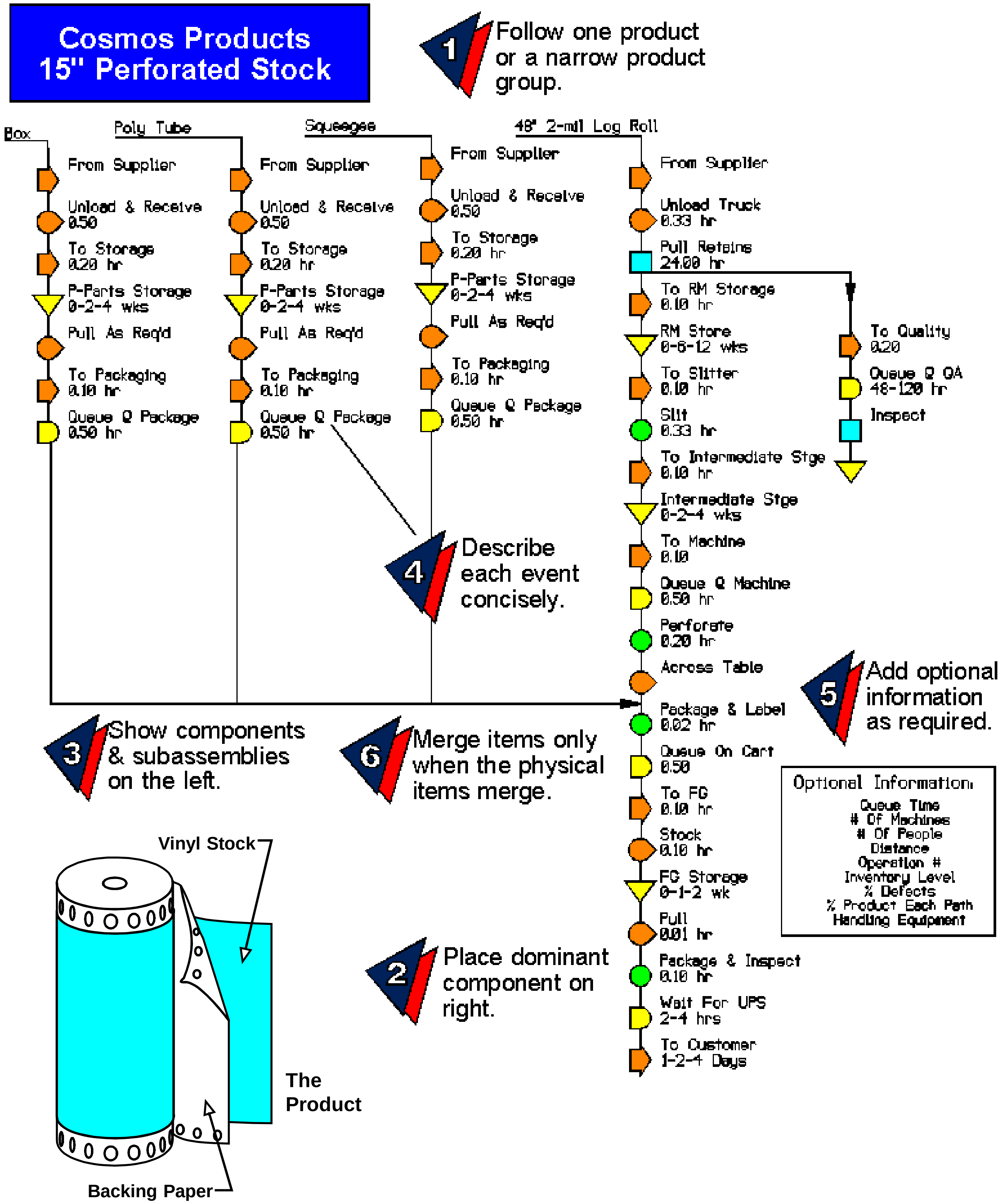


Figure 4 Process Map Example

Chapter

3

Value Stream Mapping

VSM, Introduction & Conventions

Introduction

What Is Value Stream Mapping

Value Stream Mapping (VSM) is a visualization tool oriented to the Toyota version of Lean Manufacturing (Toyota Production System). It helps people to understand and streamline work processes and then apply certain specific tools and techniques of the Toyota Production System. This chapter shows how to do it. Chapter 5 addresses the more important issue, what to do with it.

VSM addresses material process sequences and flows as well as information flows that impact this movement. It encourages data acquisition in a systematic manner that often gives additional insights. See figure 23 for a typical value stream map. The various icons and symbols have fairly specific meanings and it requires knowledge of these symbols as well as knowledge of TPS to interpret a Value Stream Map and use it well.

What Is A Value Stream?

A Value Stream is "the set of all the specific actions required to bring a specific product through the three critical management tasks of any business: …problem solving, …information management, …physical transformation".

--Womack and Jones

Value Stream Maps reflect a broad view of the process, usually from external supplier to external customer at a given facility. Extended Value Stream Maps take an even broader view and often incorporate tier two and tier three suppliers and distributors.

Like Process Mapping, VSM is most valuable in a group setting. Many of the problems it exposes reach across organizational lines of responsibility and expertise. When a mapping team has representation from all the different functions and specialties, it gains a common understanding of the process and a better position for developing and implementing good solutions.

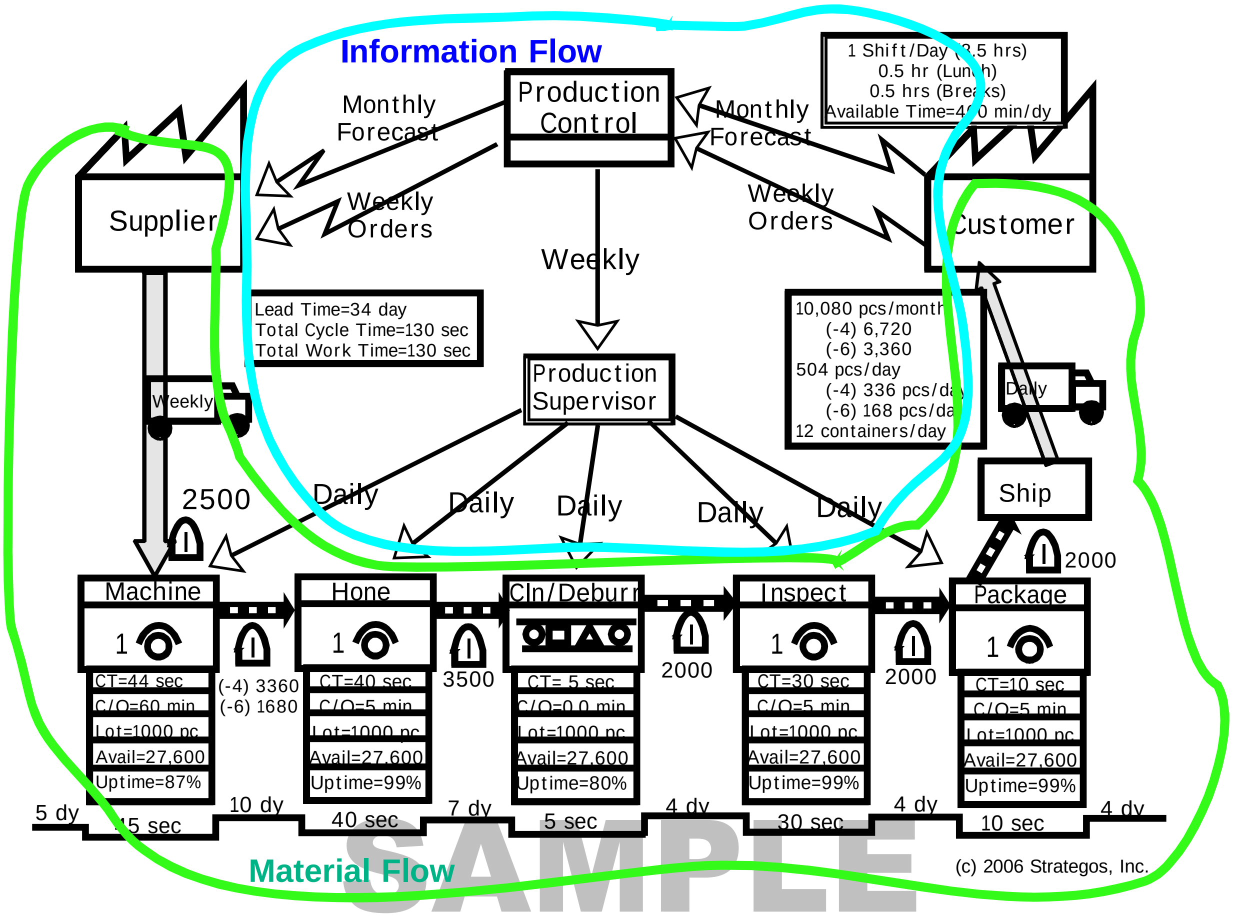


Figure 5 Typical Value Stream Map

History & Background

VSM derives from the automotive industry and was popularized by Womack and Jones in their book “Learning To See.” It is not clear whether Toyota invented VSM or even used it in a formal way. This origin in the automotive industry explains some of the limitations of Value Stream Mapping. The technique lends itself well to such high-volume, low variety production. Application in other situations can be problematic.

When To Use Value Stream Maps

As we pointed out in Chapter 1, no mapping technique fits every situation and purpose. Use Value Stream Mapping for high-production, low-variety product mixes with few components and subassemblies and dedicated equipment. In other situations, Process Mapping, often combined with a Group Technology analysis may be a better choice.

Table 3 summarizes the important factors and discusses each in more detail.

Sixteen Steps To The Present State Map

Step 1—Draw customer, supplier and production control icons. Place these as shown in figure 25.

Step 2—Enter customer requirements per month and per day. The value stream of figure 25 has two similar but distinct parts labeled as "-4" and "-6." If the customer orders in infrequent batches, note the frequency and batch size

Step 3—Calculate daily production and container requirements. Production should correspond to customer requirements. When containers hold multiple pieces, calculate the number of containers as well. (Figure 25)

Step 4—Draw outbound shipping icon and truck with delivery frequency. Note full, partial or mixed loads. Figure 26 illustrates.

Step 5—Draw inbound shipping icon, truck and delivery frequency. Note full, partial or mixed loads. Figure 26 illustrates.

Step 6—Draw boxes for each process in sequence, left to right. See figure 27.

Step 7—Add data boxes below the process boxes and Timeline for Value-Added and Non-Value Added. (Figure 27

Figure 6 Present State Steps 1,2 &3

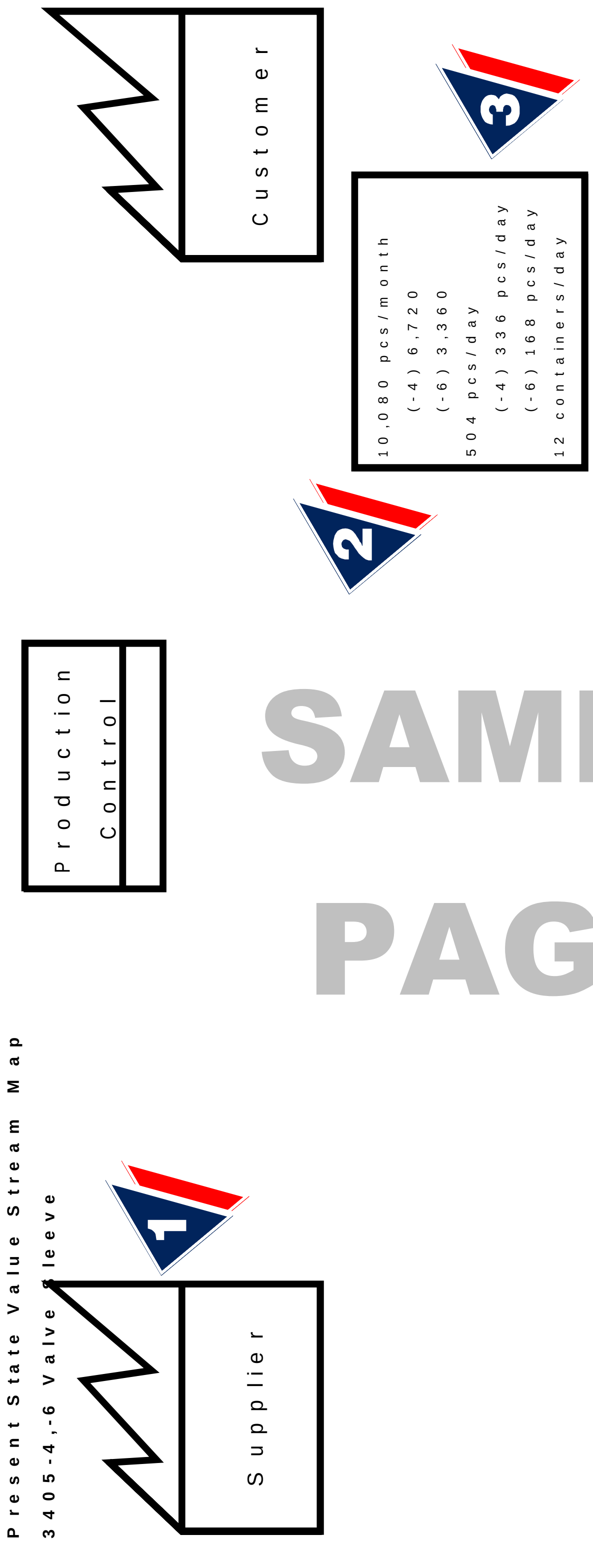
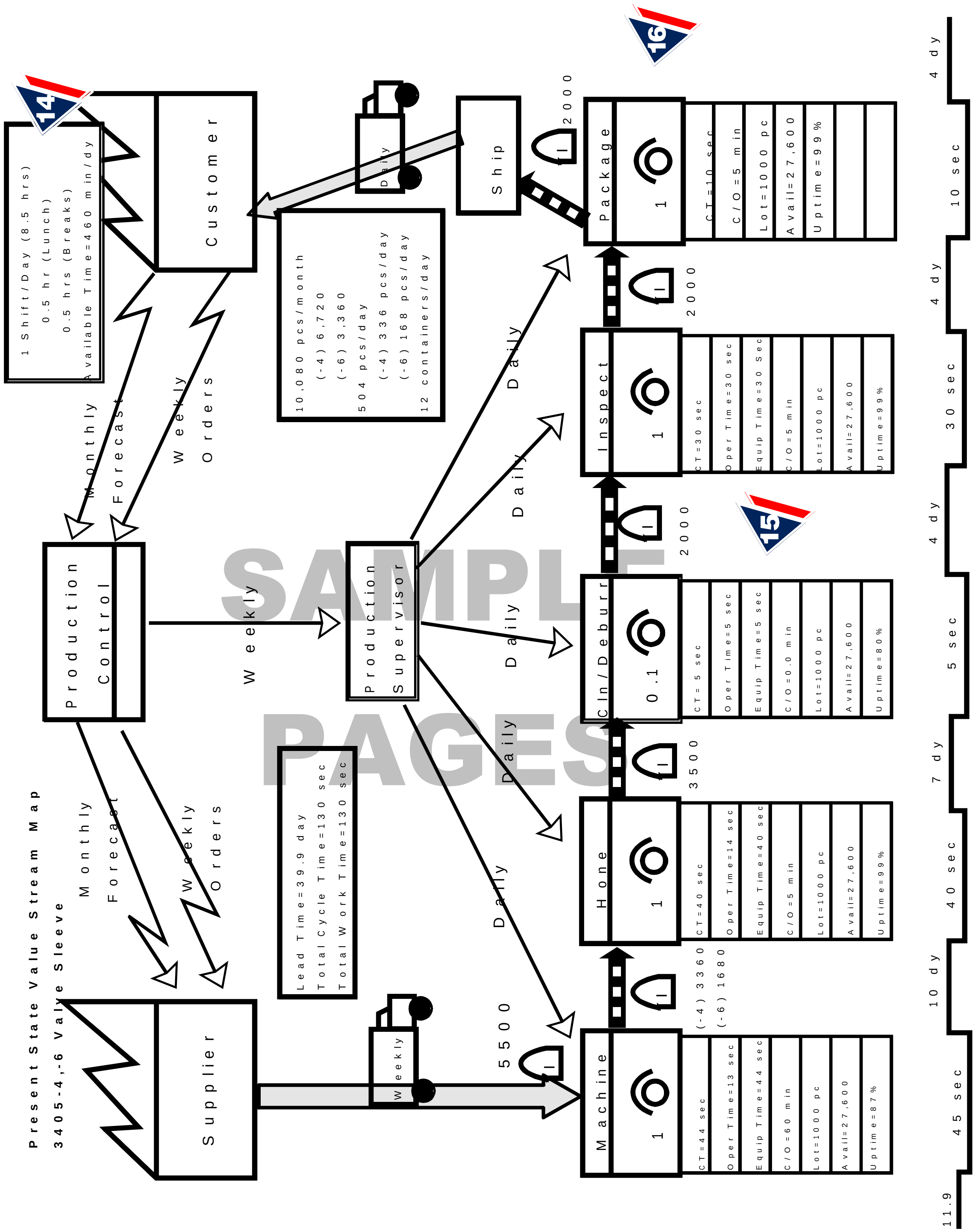


Figure 7 Present State Steps 14, 15 & 16



What Goes In A Data Box?

While some authors attempt to define exactly the information in a data box, the fact is that, in practice, the information that is useful varies greatly. In many situations there is simply too much information to fit in a data box of reasonable size and this information must be analyzed separately. You should try to put any information that might be useful in the data boxes provided that the map does not become too confused and cumbersome.

Table 8, below, offers some suggestions on the information that is commonly included in data boxes and often quite useful.

Item	Description
Cycle Time (C/T)	The time required to produce a single unit of product and start on the next unit
Person Time	The time that a person or operator is occupied to produce a single piece.
Equipment Time	The time that equipment or a machine is occupied producing a single piece.
Changeover Time (C/O)	The time from the last piece of one product to the first good piece of a subsequent product.
Availability Time	The total time per day that the workstation is available for production and/or changeover on the product family being mapped.
Uptime %	The average percentage of available time that the workstation can actually operate considering the effects of maintenance and breakdowns.
Scrap Rate	The average percentage of defective product that must be reworked or scrapped
Other	Any other useful data such as the number of other products the equipment processes.

Table 1 Data Box Suggested Information

Calculating Work Times

For the Data Blocks, we need estimates of setup, equipment, process and person times. Figure 31 illustrates the differences. Traditional time study often assumes that person, process and machine times are the same. This assumption is often invalid. In the example of figure 31, after an initial setup, the person loads the machine. The person is then idle while the machine operates. The person then unloads the machine and inspects the part. The machine is idle during part of this time.

Disparities between person and machine times can generate significant productivity increases. Where such disparity is significant, people can load a machine and then move to another process while the machine operates. The longer the process time, the more advantageous this becomes. The closer we can place machines, then the smaller are the increments of useful time that we can effectively utilize.

Equipment Time—This is the time for each cycle when the equipment is busy and unavailable for other work. You may get these times from equipment specifications, stopwatch timing, existing standards or experience.

Chapter 4

Lean Elements, Tools and Techniques

Lean Concepts

VSM and Lean Manufacturing Principles

While a mapping team can develop their present state map with only a limited knowledge of Lean Manufacturing, the Future State map is another matter. We cannot do justice to the topic in this publication, but here are a few of the principles, practices, tools and techniques that the team must be familiar with.

- The Role of Inventory
- Takt Time
- Cellular Manufacturing and Workcell Design
- Kanban
- Setup Reduction (SMED)
- Lean Lot Sizing

In this section, we briefly address these issues. The development of an effective Lean Strategy, let alone implementation of such a strategy requires far broader and deeper knowledge.

The Role of Inventory

Inventory- Asset or Plague?

Inventory is a recurring theme in Lean Manufacturing. Many authors and lecturers on Lean Manufacturing say it is "evil". Inventory is probably one of the two biggest assets on your company's balance sheet. It is an important determinant of Return On Assets (ROA) and other measures of financial performance. Carrying stock is expensive, usually 20%-40% of the average value per year. It devours capital—capital the business may need for growth. It requires large warehouses and valuable floor space. It increases material handling. Large stocks require massive computer systems for tracking and control.

Chapter
5

Mapping & Strategy

What Is Manufacturing Strategy?

Definition

Strategos, an ancient Greek word, translates literally as "the General's art". From the ancient Greek, through military to modern business usage, the word retains much of its original meaning—

- Decisions and actions with long-term and wide-ranging consequences.
- Pinpointing vulnerabilities in the opponent's position.
- Exploiting resources and deployment relative to opponents.
- Using topography, and technology for advantage.

For those of us who struggle every day with productivity, quality and schedules, these concepts are pretty vague. They seem irrelevant to the current tasks. As engineers, workers, specialists and managers most of us have too many and too much:

- Too Many Projects
- Too Many Priorities
- Too Many Priority Changes
- Too Many Policies
- Too Many Problems
- Too Many Mistakes
- Too Many Bosses
- Too Much Paperwork
- Too Much Criticism
- Too Much To Do

In most cases, the "Too Many and Too Much Syndrome" is traceable to an absence of strategic thinking—not erroneous strategic thinking but absence of strategic thinking. Strategic thinking helps the entire organization focus on a manageable set of priorities.

Manufacturing Strategy ensures a match, or congruence, between the company's markets and the existing and future abilities of the production system. Manufacturing strategy generally addresses issues including:

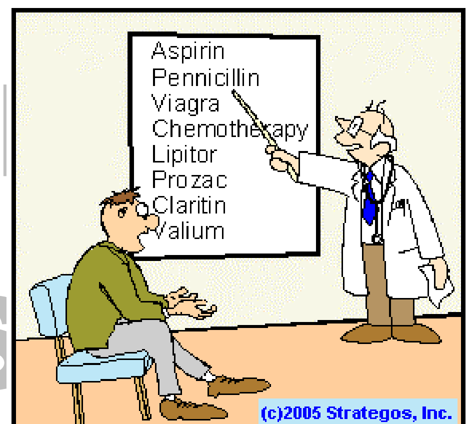
- Manufacturing capacity

Lean Manufacturing Elements, Tools and Techniques

- Cellular Manufacturing
- Total Quality
- Teams
- Rapid Setup (SMED)
- Kanban
- Metrics & Measurements
- Mixed Model Production
- Value Stream Mapping
- Process Mapping
- Work Balancing
- 5S
- Autonomation
- Pokayoke
- Jidoka
- Elimination of Waste
- Total Productive Maintenance
- Continuous Flow
- One Piece Flow
- Standard Work
- Visual Management
- In Station Process Quality
- Level Production
- Takt Time
- Point of Use Storage
- Kaizen
- Supplier Development

Table 2 elements, Tools and Techniques

Imagine a physician with a list of the top twenty drugs. He prescribes the same list to every patient, regardless of symptoms. The thought does not inspire confidence and the approach is unlikely to work on a complex system like the human body. Nor will it work for a factory.



"This combo works for all my patients!"

List thinking is especially problematic when implementing. All the elements in the Laundry List of table 12 have value in some situations. However, the list gives no guidance for priorities, precedence or impact. Indeed, it cannot because each factory and situation is unique. Examining this topic strategically and systemically raises several questions:

- Do we need the entire list of "Tools and Techniques?"
- If not, which do we employ?
- Which elements come first?
- Do we implement Lean Manufacturing company-wide or in focused areas?
- How does Kaizen fit into the picture?
- How detailed should the plans be?
- How long will it take?
- How do we know when we are really Lean?

Implementation Project Example

Figure 66 is a very simple example of a Phase I implementation that illustrates the principles. It anticipates three workcells. Each workcell will require Rapid Setup (SMED), kanban production control, Total Quality and Team development.

In addition, the plan anticipates a more general supplier development effort that eventually brings suppliers into the kanban system.

The Gantt chart shows a timeframe for each activity. The workcells are sequential. The more general supplier development and kanban is essentially separate. This schedule limits the number of tasks that a particular department must undertake at any one time.

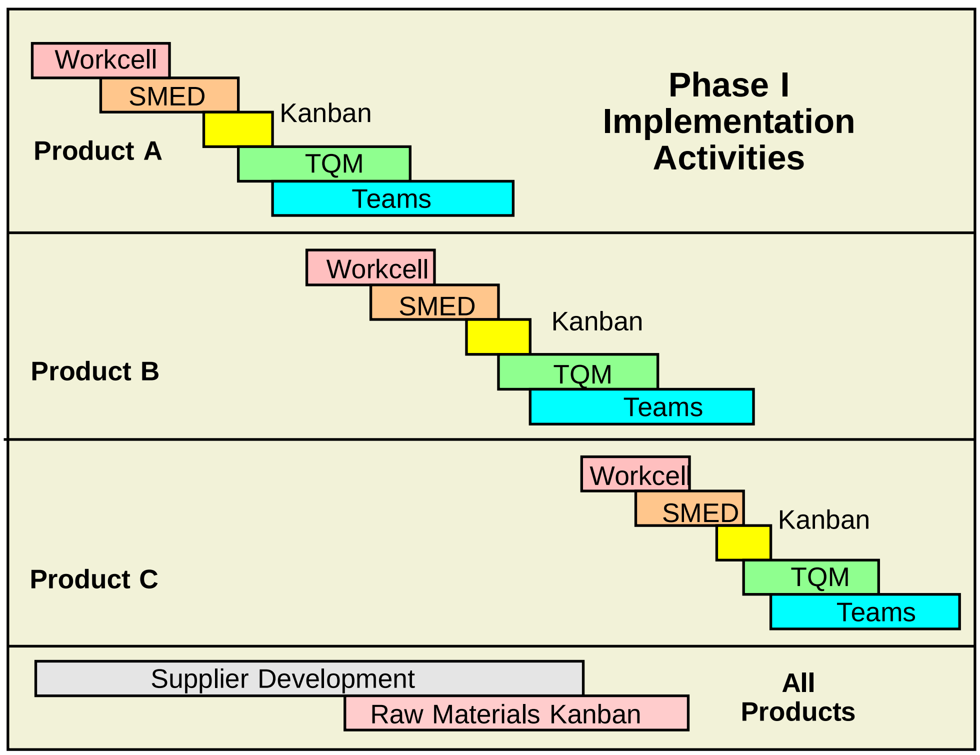
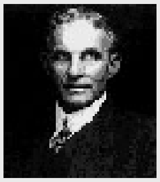


Figure 8 Implementation Plan Example

Chapter 5 Summary

This chapter has shown how to supplement Value Stream Mapping and Process Mapping with a broader assessment of the manufacturing system. It has discussed some basics of manufacturing strategy and implementation strategy. We have



Every well- thought- out process is simple.
-Henry Ford I

A Final Note

Thus, then, in Strategy everything is very simple, but not on that account very easy.
--Carl von Clauswitz

Simplicity is a recurring theme in engineering, manufacturing, Lean operations and, indeed, all strategic thinking. Yet, in any endeavor, it is one of the most difficult attributes to achieve.

One reason for an emphasis on simple processes comes from systems theory and the science of Chaos. Simple systems are usually more stable. Complexity is one of the fundamental causes of Chaos. As most manufacturing people have experienced, chaos is endemic in many factories and is not conducive to quality, delivery reliability or low cost. Not to mention the mental health of workers and managers.

Systems theory (Ashby's Law) also tells us that simple systems require only simple controls. Thus simple manufacturing processes produce simplicity in production and inventory systems and many of the other supporting systems of manufacturing.

Mapping techniques help to achieve Henry Ford's ideal of simple processes. They dramatically display complexity and point the way to simple solutions. A quick review of figures 14-19 will confirm this.

- *All maps are simplified depictions of reality.* Therefore, any mapping technique shows only certain aspects of that reality while ignoring other aspects. Know several mapping techniques, choose your type of map carefully and understand its limitations.

- *The most important value of work mapping is in the process of mapping, not the final map.* Hone your facilitation skills and use maps to build understanding, generate new solutions and build consensus.

- *Mapping is not Manufacturing Strategy.* It is only a tool to assist with certain aspects of developing a comprehensive and effective Manufacturing Strategy and build a competitive position.

