What Are We Learning Since We Started *Learning to See*?

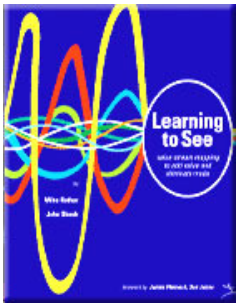
by Mike Rother

Introduction

Mike Rother

The *Learning to See* workbook, which was first made public at the Lean Enterprise Institute's June 1998 Lean Summit in Hartford, CT, has surprised us all with its ongoing success. *Learning to See* has now sold over 80,000 copies in English, been translated into nine languages (most recently Spanish), won the 1999 Shingo Prize for research in manufacturing, and continues to garner acclaim as a guide for lean transformations.

At first glance, *Learning to See* is about a method and tool for analyzing and designing value streams, but our primary intent in writing the book was to help readers widen their perspectives from a limited focus on process-level improvement to include a view of the overall flow, or "value stream." We designed the book's format with that objective in mind, and hope that it has indeed proved to be a perspective expander for you and your team.



The “flow” or “value stream” perspective represents a shift from vertical to horizontal thinking. Horizontal thinking means looking across the traditional vertical structures of functions and departments to connect activities in the stream of value flowing from suppliers, through the organization, and on to customers. In other words, concentrating on overall flow means focusing on system efficiency rather than on just the point efficiency of individual elements in your organization.

In the last few years, the flow or value stream oriented manufacturing measureable that has started climbing to the top of the heap, along with quality, is production lead time (or it's inversely-related sibling, inventory turns). One of the main goals of most production systems today is a continual reduction of lead time, which requires that processing steps in the value stream become more closely coupled to one another, allowing value to more efficiently flow across them. Toyota's original flow mapping methodology — which we

expanded into Value-stream Mapping — has provided us with an especially practical tool for thinking about flow and designing value streams with shorter lead times.

With all the interest and activity around value-stream mapping it seems a good time to review how the value stream perspective and the mapping tool are developing, and some lessons we have learned along the way. That is the purpose of this article.

Nonproduction Flows Are Getting More Attention

When we say lead time we are usually thinking about production lead time, which is the time it takes to go from raw material to shipment, or from "dock to dock." However, another type of lead time measurement is the order lead time, or the time it takes to go from a customer order to delivery.

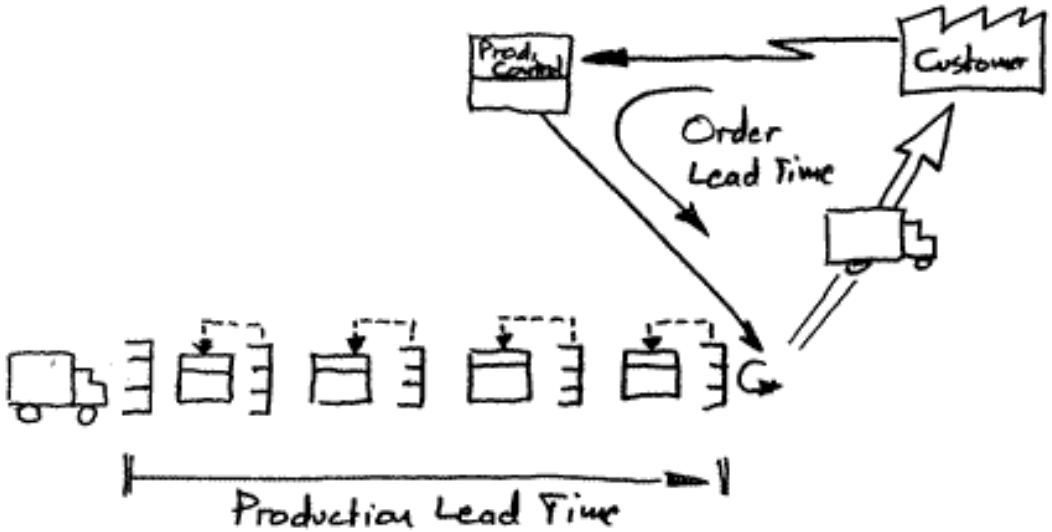


Figure 1: Production and Order Lead Times
(Note: In make-to-order value streams the schedule point will be further upstream than is shown here.)

When you take a close look at the flow of a customer order through many organizations it doesn't take long to see that a significant amount of the order lead time occurs in non-production administrative functions; before the order even reaches the shop floor. This kind of work is often being called an "administrative," "service" or "white collar" value stream. Here too, material (orders) sits in inventory (in-baskets) and doesn't flow. In addition to the order flow there are several other nonproduction activities in an organization, such as processing engineering changes, purchasing, maintenance, quality assurance, and so on.

However, one can argue that in a manufacturing company there are really only two true "value streams," flows that create physical value for customers by transforming the product in a way that the customer is willing to pay for. These are the product design/engineering value stream, and the product manufacturing value stream. I would

call the other types of work “flows,” but not “value streams.” (In the future, activities in product service and product recycling may also become known as value streams.)

In this way of thinking about the organization — or the “enterprise” — the other work flows exist primarily to make the two value streams operate as effectively and efficiently as possible. That means with nonproduction flows we need to be concerned not only with making them more efficient, but also with making them function in a way that serves the value stream most effectively. In fact, thinking about effectiveness should precede striving for efficiency. Just making every function in your company as lean as possible will definitely not create a “lean enterprise,” i.e. one that is best at providing (flowing) value to the customer. As W. Edwards Deming was fond of pointing out, if you tell every player in an orchestra to maximize their output, you are not going to get music.

The value-stream mapping tool presented in *Learning to See* is increasingly being applied to administrative flows. Of course, it often takes longer to personally trace a practically invisible administrative value stream (but that's how you have to do it, because you should not rely on statements like, This is how it normally goes), and administrative processes are usually more make-to-order in nature. But these are only small obstacles that should not prevent you from getting started. The goal is the same: To draw how something works so you can understand it and design a better flow.

Some administrative work is relatively short — such as a simple order-entry process — and can often be reduced to a single “cell” that processes the work in a one-piece flow from beginning to end at one location. Value-stream mapping is usually unnecessary here, since it is used to design flows of work across multiple processes. Process level tools that analyze the number of steps, time delay, number of handoffs, and so on — as well as cell-design concepts such as presented in *Creating Continuous Flow* — are sufficient for understanding and improving this sort of process.

Other administrative flows have steps that remain separated by time or distance, for example due to waiting for customer approval or for information from another office or organization. The processing steps cannot all be conducted in one cell from beginning to end. Such administrative flows can be similar to manufacturing value streams, and value-stream mapping can often be used to understand and redesign them.

However, whenever you seek to analyze and improve nonproduction work there are two key questions to ask in the following order:

1. Effectiveness. How can we organize and manage this work to optimize flow in the value stream that it serves? (Help achieve the shortest production, or product development, lead time.)

2. Efficiency. How can we do that with minimal waste in this non-production function?

Readers Are Starting to Include Their Supply Chains

Once you have initiated flow and lead time improvement inside the four walls of your facility, you can start expanding your view to include the supply chain. More and more users of value-stream mapping are reporting successes in this area, and LEI's new workbook, *Seeing the Whole* by Dan Jones and Jim Womack, gives you more insight and suggestions on what some are calling "macro mapping."

At one level, value stream refers to the entire production flow from raw materials coming out of the earth all the way through to the hands of the end consumer, and increasingly even beyond to include servicing and recycling the product. However, if this is to much too tackle right now then I suggest you expand your one-facility view by going from the point of use at your customer's facility back through to the receiving dock at one or two of your most important suppliers. The discoveries of waste, batched information flow and interrupted material flow that you have made inside your own facility will repeat themselves there, and issues of location and transportation between facilities will become additional factors.

Although a single-piece flow across the supply chain is usually still a dream, closer-coupling concepts like pull systems between facilities and milk-run deliveries can be applied with good results. Even at the supply-chain level the basic lean goal remains the same: How can we get ever nearer to having each process make (and, if necessary, the delivery truck pick up) only what the next process needs when it needs it?

The Pacemaker Process Needs More Attention

A question that often arises is, "What should we focus on as we analyze and redesign our value streams?" There are a host of factors that affect lead time (take a look at pages 30-36 in Richard Schonberger's new book, *Let's Fix It*), but clearly the pacemaker process — which is often a final assembly process — is one that needs more of our attention. Many manufacturers don't realize the pacemaker process' important role in attaining a short lead time through the production value stream.

Most in-plant value streams can be divided into two segments: pacemaker and fabrication.

- The upstream fabrication processes respond to requirements from internal customers, and often utilize general-purpose equipment to produce a variety of components for different downstream processes.

- In contrast, the downstream portion of a value stream is often dedicated to a particular product family and responds to external customers. This segment typically starts with the value-adding process that is the schedule and leveling point in a lean value stream (see *Learning to See* p.86), and involves processing steps that give the product its final form for the customer. This downstream segment of the value stream — which is often the final assembly process — is called the pacemaker.

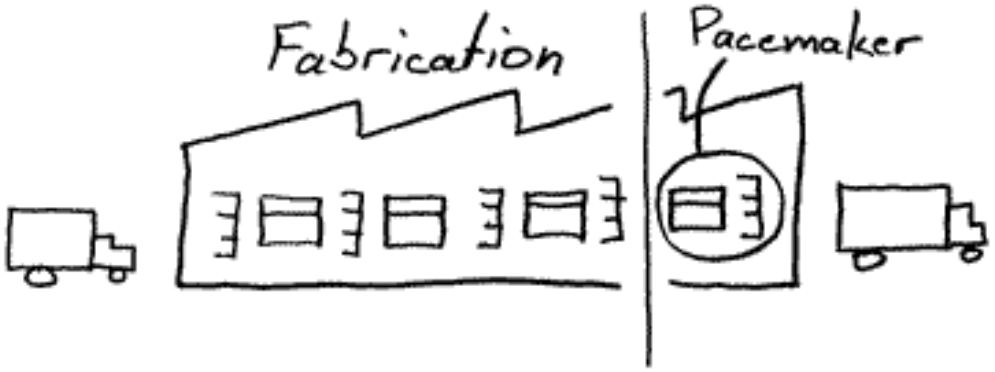


Figure 2: Fabrication and Pacemaker Segments of a Value Stream

The pacemaker process influences production lead time because it is the rhythm-setting point, or "heartbeat," for any value stream that utilizes pull systems. If the pacemaker makes large batches of one product type, or if it has significant fluctuations in production volume, then the upstream fabrication processes will have to hold more inventory in their supermarkets to be able to meet the peaks of the pacemaker's jerky component requirements.

In addition, due to the "bullwhip" effect (first described by Dr. Jay Forrester in 1958) the mix or volume surges at the pacemaker get amplified as you move up the value stream and into the supply chain. The effects of pacemaker fluctuations get worse the further upstream you go! (LEI's *Seeing the Whole* workbook includes information on assessing the effects of such demand amplification in supply chains.)

Another problem: when the pacemaker makes large batches of one product type, then your external customers who want other types have to wait, or you will have to try to hold even more inventory of finished items that you think the customer will want. But correctly guessing what customers will want is very difficult to do.

All of this means that the efficiency of your value stream depends partly on how small you can keep the batches and volume fluctuations at the pacemaker (assembly) process. Many plants are now trying to link their chain of processes by establishing supermarket pull systems between processes. However, if you run significant volume fluctuations and/or large batches in assembly, then the inventory in those supermarkets will be too high. With or without pull systems, the production lead time will still be too long. Leveled and mixed production at the pacemaker - a steady heartbeat - helps make shorter production lead time possible. Think of the pacemaker process as the conductor of the orchestra.

As you may have guessed, the final assembly point in a macro value stream (across several facilities and companies) is the rhythm-setting pacemaker process to which the

supply chain responds. The characteristics of the information flow emanating from this point will influence how lean the whole upstream supply chain can be.

To achieve lean value streams, managers, production control, maintenance, supervisors and engineers will need to pay closer attention to how you are operating your pacemakers. (Please refer to LEI's *Creating Continuous Flow* workbook for detailed guidelines on setting up and running operator-based pacemaker process.)

Leaner Value Streams Will Require Faster Response to Abnormalities

As the lead time through a value stream shrinks, the processes in that value stream become more "close coupled" (less buffer between them). This makes a value stream more sensitive to problems. When there is a machine breakdown, absenteeism, defective parts and so on in one segment of the value stream, it will take less time before these problems adversely affect other segments. This is especially true of problems at the pacemaker process.

As it more closely couples its value streams, industry will need to work more on a heretofore largely ignored aspect of Toyota-style manufacturing: The leaner a production chain gets, the greater the need for swift, local response to abnormalities. And swift response requires swift awareness of abnormalities, someone to do the responding and a structured approach for how to respond.

The diagram below shows two basic factors that influence the size of the supermarkets, or inventory buffers, down- and upstream of a process: The amount of variability in the process (downtime, batching, defects, rework, etc.) and the time it takes to respond to and resolve process problems. The greater the variability and/or response time, the bigger the buffers must be. And bigger buffers equal longer production lead time.

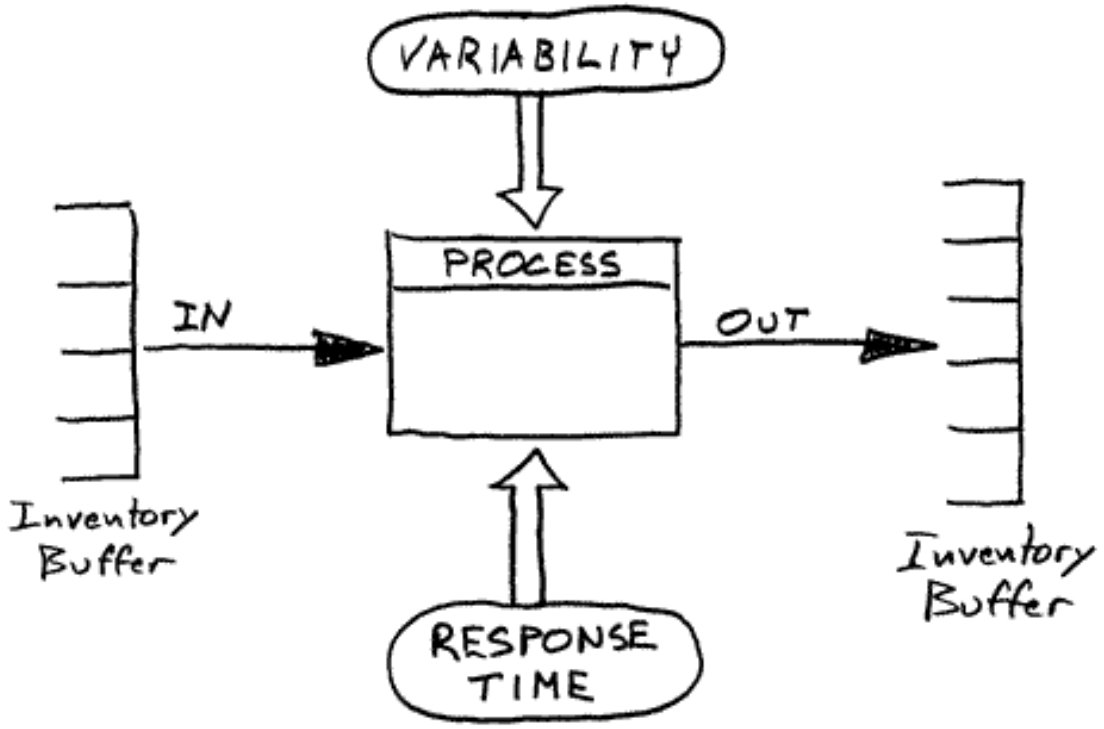


Figure 3: Factors Influencing Buffer Size

Interestingly, if you simply design your inventory buffers to cover the degree of variability in a process, you are creating a static system. Only by adding in a swift problem recognition and response system (the bottom arrow in the diagram) do you actually achieve a dynamic system that continuously improves. In fact, with a swift response system in place the goal is not really to establish a stable system, but rather an almost stable system. Here lie the roots of continuous process improvement and evolution.

A critical issue in this regard is how management thinks about production problems. If your vision is to ban problems from production (indicated by statements like, We just need more discipline.) then you will organize and manage differently than if you assume that problems are going to occur. There seems to be a tacit belief that Toyota's system means the occurrence of problems will be eliminated. Yet Toyota and its suppliers do experience quality problems, machine breakdowns, absenteeism, and so on. In fact, these types of problems are statistically guaranteed to occur. And as one problem is solved and its causes eliminated, others will develop. New product programs also bring new problems.

When management assumes that problems in production are inevitable, then the most important question becomes, How will we respond to them? This is going to become a particularly important question for any organization that is seriously trying to adopt Toyota-style production. It means that simply "leaning out" your various production support functions will not get you to a lean enterprise. A Toyota assembly plant's

production organization, for example, uses fewer people overall than Big 3 assembly plants to produce a vehicle, but has a higher percentage of indirect labor. That indirect labor is there to respond to problems as they occur, making a leaner value stream (superior flow) possible.

Notes from the Field: Lessons Learned About Value-Stream Mapping

The now widespread use of value-stream mapping means that as I visit and work with many companies I can observe how the tool is being applied. *Learning to See* has helped many people expand their perspectives, but any book is subject to various interpretations by its readers. This can lead to some pitfalls. Here are a few I have observed, and some suggestions for avoiding them.

• Some readers of *Learning to See* appear to think that value-stream mapping is in itself a goal, occasionally telling us, "We are drawing maps of all our value streams!"
That may lead to a better understanding of your flows, but not necessarily to any measureable improvement. Results come from active implementation of an improved future state. Value-stream mapping is a very useful tool, yet still only a tool – not the actual improvement itself.

Instead of mapping everything and expecting good things to happen, I suggest you, 1) select a value stream where business objectives require measurable improvement, 2) develop an understanding of the current state, 3) design and agree upon an improved future state that can be introduced within six or 12 months, 4) put together an action plan to implement that vision (who is responsible for achieving what elements of the vision with what measureable results by when?). And in 12 months, you need to create the next future state map for that value stream and again charter a team to achieve that future state.

• Having a perfectly drawn current state map is not the point.
A main intention of current state mapping is going through the *process* of trying to understand the dock-to-dock flow…the looking and sketching and trying to see and comprehend what is happening - and thinking about what should be happening - as material and information travel through your facility (or supply chain). Have you noticed that the person who best understands the material and information flows that a value-stream map represents is the person who drew the map? The map creation process - more than the map itself - helps you learn to see.

This is why we suggest that you begin sketching with just pencil and paper as you walk a flow. The looking, sketching and resketching may seem like a lot of manual work, but it is in fact a Plan-Do-Check-Act (PDCA) learning cycle that keeps you focused on the flow and deepens your understanding of the current production system. With practice you may be surprised at how quickly you can accurately sketch dock-to-dock material and information flows. In other words, how quickly you can see. Then you are in a better position to develop useful future-state value-stream designs.

• Don't confuse value-stream mapping with traditional process flow charting.
Process flow charting is typically used by industrial engineers to analyze and improve a process, while value-stream mapping (and design) cuts across process, departmental and functional boundaries, as well as across existing departmental performance-measurement systems. It involves trying to optimize dock-to-dock flow instead of an individual process.

By the way, due to this cutting across boundaries, manufacturing management should lead any value-stream improvement effort. It can't be delegated to process specialists.

• Avoid overemphasis on tallying inventory to estimate the production lead time.
Some readers have focused intently on counting and tallying inventory, and using that data to estimate the production lead time as described in *Learning to See*. Lead time is a great metric and we recommend that you focus on reducing it. (Note: Outsourcing lead time does not equal reducing it.) It is fun to count inventory accumulations and use this data to estimate a lead time from dock to dock. However, don't let this activity become more important than the fundamentals of seeing and understanding the flow (or lack of flow) through your value streams.

Inventory accumulations show you where a flow is interrupted. When you find these spots in a value stream, the next question to ask is, Why does the flow stop here? (there is always a reason), and, What can we do to improve this situation?

• Stay at a 50-foot altitude the first few times you walk through a flow and seek to understand the current state.
After years of making process-level improvements you may naturally tend to drop to a very detailed level of analysis at every process along the way, trying to record all sorts of current-state process data up front. This especially seems to happen when you walk the flow through your own, familiar facility. Unfortunately, you then tend to lose the valuable overall flow perspective that *Learning to See* is all about.

Instead, begin with the main or most important dock-to-dock branches of your value stream, and walk through them at a "50-foot altitude." Then go back and progressively drop down to add detail or additional branches on successive walk-throughs as is necessary to support your design and implementation of a future state. The first walk-through may only take an hour and result in only a rough sketch of the current flow.

I should also point out that the value-stream mapping process is not linear, although our presentation of it in *Learning to See* might lead you to believe that. You don't really finish a current state map ("done!"), then finish a future state map ("done!") and then shift to implementation. There is considerable overlap and feedback between these stages, and you should expect to have to periodically go back and gather more data as you realize you need it.

• Don't go too far out into the future with your future-state map.
Such future states are nice in theory, but difficult to implement. Introducing Toyota-style production can't be done overnight, and involves steady progress via lots of base hits. If you have drawn more than, say, six kaizen lightning bursts on a future state map, you are probably reaching too far out into the future with that map.

Instead, sketch where you would like to be in about five years - an "ideal state map" – to give a sense of direction. Then draw a more detailed "future state map" of what your team can implement within a maximum of 12 months. As you implement this future state, you'll gain insights for fine-tuning the ideal-state vision. At the end of 12 months, it is time to have another 12-month map, and implementation plan and implementation team charter.

• Pull Systems Do Work.
Many readers have been telling me, We tried to implement a pull system, but it didn't work. Causes of failure include incapable processes, supermarkets that were too small, losing kanbans, and so on.

In fact, if a pull system fails it was probably functioning as intended. One of the main purposes of a supermarket pull system is to establish a more systematic (tighter) link between processes and expose problems. The failure of the pull system to work meant that it has exposed a problem. The next step is to work on the problem and then reintroduce the pull system. That's PDCA in action, and Dr. Deming would be happy to see it.

Going Strong

Our publisher, Jim Womack and his worldwide Lean Enterprise Institute, have been open to comments and feedback from the lean community. In addition to much positive feedback we have also received ideas and suggestions for improvements and additions to the *Learning to See* book, and were able to incorporate several of them in the current edition of *Learning to See*. There are also a handful of items that we have not added, such as:

- More end-item variety to the Acme Stamping case
- Examples from different industries
- Mapping in non-production settings (administrative or white-collar mapping)
- Detailed guidelines for managing the implementation of a future state value-stream vision
- Tips for mapping across multiple facilities and organizations (extended value stream or "macro" mapping)
- How to set up and run the pacemaker process
- Dealing with changing demand
- Calculating the financial benefits of a future-state design.

These — and probably more — could all be useful additions to *Learning to See*. But then by far the most frequent feedback of all is that the book is wonderfully straightforward,

clear, and easy to understand and use. Readers are able to absorb the book and get started with positive action in their own facilities, and in many cases train others (sometimes using LEI's *Training to See* kit) in value-stream mapping.

This makes us hesitant to complicate *Learning to See* with a string of detailed appendices in an attempt to make the book completely authoritative. Like any book, *Learning to See* reflects a need and some thinking at a point in time. After years of making gains by improving individual processes it is the right time to think about tying those processes together and creating flow. The intent is to provide a springboard for seeing and thinking about your own value streams. *Learning to See* says what it says, does what it does, and we are pretty happy with that. You must be too, because demand for the book is still growing.

In fact, the amount of positive action, experimentation and dialog that is being triggered in part by *Learning to See* has been astounding. Many people are working on all manner of problems related to removing waste from their value streams. Follow-on books are being published at the Lean Enterprise Institute (such as *Creating Continuous Flow and Seeing the Whole)*, workshops are focusing on value streams, value-stream management, and value-stream thinking, and elements of the simple (but surprisingly effective) Acme Stamping case from *Learning to See* are popping up everywhere.

So *Learning to See* continues to serve as the fundamental value-stream book, while supplements to it are being created in an even better fashion than just a couple of authors might do. Many more people are working on the issues, via several channels and with interesting perspectives.

Of course, successful implementation is what really counts. So my hat goes off to all who are rolling up their sleeves and advancing the war on waste through improvement that generates shorter lead times and positive results for customers. Keep on looking and thinking — and seeing — with a value-stream perspective.

Every good wish for creating flow in your business,

Mike Rother

Mike Rother is a researcher, engineer, teacher and advisor to large and small companies. He is the co-author of *Learning to See, Training to See* (a train-the-trainer kit) and *Creating Continuous Flow*. Mike recently returned to Ann Arbor, Michigan after spending a year as guest researcher with the Fraunhofer Institute for Production Technology in Stuttgart, Germany.

Resources

Learning to See by Mike Rother and John Shook, is an easy-to-read guide that teaches you to how to see complete value streams and design an improved future state flow from dock-to-dock and beyond.

Training to See by Mike Rother and John Shook provides a company with all the tools needed to conduct its own successful Value-stream Mapping workshops, including a Trainer's Guide with step-by-step instructions, participant manuals, a CD-ROM of overheads, video remarks from Jim Womack, and much more.

Creating Continuous Flow by Mike Rother and Rick Harris provides the practical, Toyota-based thinking, and tools to design, implement and keep improving continuous flow in operator-based cells and lines. This sequel to *Learning to See* takes you to the next level in cellularization where you'll achieve even greater cost and lead time savings by focusing on your pacemaker process.

Seeing the Whole by James Womack and Daniel Jones is a breakthrough guide that introduces a new mapping methodology for extended value streams. It takes managers step-by-step through an improvement process that converts a traditional value stream into one where value flows from raw materials to customer in just 6 percent of the time previously needed, eliminating the transport links, inventories, and handoffs, that are the key drivers of hidden connectivity costs.

Let's Fix It by Richard Schonberger Overcoming the Crisis in Manufacturing based on research of 500 companies

Workshops — LEI runs monthly workshops around the country on basic and more advanced lean concepts. Get the schedule and more information here.