DESIGNING AND IMPLEMENTING

Lean in Your Supply Chain

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At the turn of the century, Toyota Motor Manufacturing set a goal to be the number one car manufacturer in the world; they reached this goal earlier than expected. Measured by number of new vehicles sold, the truth is Toyota has been number one for many years when measured by more important metrics such as market capitalization, quality, sales growth and profitability. In fact, it is not uncommon for Toyota's annual net profit to exceed that of the traditional *big three* combined. Something has clearly happened in the automotive industry. What's happened is called the *Toyota Production System.*

I recently had the distinct pleasure of speaking in Guadalajara Mexico at the Lean Summit Mexico. Flanked by Jim Womack, I was in good company. Jim Womack, along with his co-author Dan Jones, authored the premier lean books *The Machine that Changed the World, Lean Thinking and Lean Solutions.* The "*Machine*" as us leansters now call it, was the first book that warned the automotive industry (and the world) that something called the *Toyota Production System* was coming down the track. *Lean Thinking* was the book where Womack and Jones coined the phrase lean Manufacturing. Now shortened to lean, lean Manufacturing is the business system, principles, methods and tools based upon make up the Toyota Production System.

During a break in the agenda, Dr. Womack handed me an article, knowing I would find it interesting. "This is the first article ever written in English on the Toyota Production System. It was written in 1977!" he said. He stressed the 1977, and I immediately understood his point. Here we are, thirty years later, trying to understand lean, yet it was spelled out for us decades ago! The article was written by four members of the Toyota Motor Co. Production Control Department. One of the authors is F. Cho, known now as Mr. Cho, President of Toyota Motor Corporation.

The Toyota Production System – Lean - 1977 to Present Day

In the 1977 article on the Toyota Production System (TPS), the main attributes of TPS are listed as:

Note: The wording in the list below may sound awkward; I have tried to keep the essence of the language used in 1977 by the authors.

- Reduction of cost by thoroughly removing all forms of organizational waste
- Just in Time Production and elimination of waste from over producing
- Pull systems and use of Kanban techniques to replace complicated Material Requirements Planning (MRP) systems
- One piece production and conveyance of reduced lot sizes
- Leveling of production and mix model production lines
- Jidoka, or Quality at the Source, to ensure first time quality
- Full utilization of workers capabilities
- Full consideration to workers safety

- Visual management, or “self display” of workers progress and the ability for workers to “stop the line”
- Elimination of inventories in order to expose problems in the production system

What is most fascinating about this list of attributes from 1977 is that years later, lean (TPS) has not significantly changed. This teaches us that the basics need to be the focus, and completing the basics will in fact drive results. We have now had the benefit of three decades to fine tune the essence of lean manufacturing, and many organizations have relative mature lean implementations in the manufacturing function. This has lead to the next question on many peoples’ minds, which is *“What’s next after manufacturing?”* How can we drive lean into the extended enterprise? How do we drive lean in the supply chain? Whether we are talking about lean in manufacturing or the supply chain, we need to remember the essence of lean is the elimination of waste. The key wastes that lean thinking defines are:

Lean Waste	Theme
Overproduction	The king of waste, many of all the other wastes are created when we produce more than the market demands. Lean focuses on building to "takt time" which means the "beat of the Customer" in order to avoid overproduction.
Inventory	Inventory in excess of what is required to service the customer is waste. This is caused by overproduction, forecasting errors, long lead time and batch thinking based on economies of scale paradigms.
Correction	Waste that is created when we are doing things over because they were not done right the first time. This is also known as rework.
Over Processing	The waste that is created when we do more than is required to meet customer needs
Motion	All motion that does not add value to the product or process. Walking around, searching for material or tools.
Waiting	All waste that exists because we are waiting for material, people, up stream processes, customer orders and all other dynamics that result in waiting time before we can perform our work.
Transportation	Transportation in excess of what is actually required. This includes underutilized transportation equipment, inter -plant shuttles, trailer demurrage and other transportation wastes.

Figure Source: LeanCor LLC, 2014, The Seven Wastes as defined by lean principles

Logistics and Supply Chain Management

Creating the lean supply chain is a strategic undertaking that requires the same level of vision, planning and discipline as any other major business initiative. This starts with developing a vision for your supply chain. Put aside your current structure and envision your future supply chain. What does it look like? In order to do this, you need to know:

- What do your customers expect and how will you meet those expectations?
- What inventory do you need in the supply chain?
- Where do you need to keep this inventory?
- In what quantities do you need to keep inventories?
- How will you replenish inventories once they are consumed?

- How will you plan for continuous improvement in your business or in your supply chain?

At many levels, supply chain management is still in the pioneering stage. Consequently, there does not exist common understanding or definitions of what supply chain and logistics even are! For example, one organization may think of supply chain management as simply the inbound logistics process from supplier to manufacturing facility, while another company may consider supply chain management to be all logistics, demand planning, supplier management and manufacturing processes.

Similar to supply chain management, organizations will also have different definitions of logistics management. Many organizations see logistics as the transportation and warehousing functions only, while others see logistics more holistically to include inventory management, material handling and parts ordering. You may need to start with a basic discussion about these basic questions:

Relative to your organization, *what is supply chain management? What is logistics management? What is the lean supply chain?*

While standard definitions to these questions do not exist, the important thing is for the lean enterprise to develop definitions internally. All people inside the organization need to know exactly what is meant when you talk about logistics and supply chain management

For purposes of our discussion, let's propose the following definitions:

Logistics management: Processes that move material and information in support of meeting customer expectations. The logistics functions are in place specifically to achieve the eight rights: right product; right place; right time; right quantity; right quality; right service; right cost and right source. Logistics management processes include transportation, warehousing, inventory management, purchasing, supplier development, customer service, and all other functions that support the movement of material towards the customer.

Supply chain management: Processes that ensure that an organization's multiple functions are working in an optimal manner. Supply chain management recognizes the organization as a complex system with competing priorities. Supply chain management strives to deliver the highest value to the customer at the lowest total cost to the organization.

The Lean Supply Chain Defined

> Unlike manufacturing plants, which run in scheduled shifts, supply chains never stop. They are in constant motion as multiple channel members harvest and create raw materials, and move these raw materials to manufacturers — who then create products and move those products to markets — where customers buy them, consume them and dispose of them. The supply chain begins at the conception of a product and is there still at the end of the product's life.

Each supply chain is unique for all organizations, which means we end up with multiple ideas of what the lean supply chain is. All definitions of the lean supply chain should, however, reflect and include the basic concepts of lean:

Note: This is a list of current lean attributes, you will notice overlap of themes with the list noted by Toyota in their 1977 article discussed previously.

- Achieving customer satisfaction by performing only processes that create customer value;
- Respecting people by ensuring that all workers perform value-creating activities;
- Achieving vision through disciplined strategy deployment;
- Eliminating waste through continuous improvement and rigorous application the Plan, Do, Check, Act (PDCA) cycle;
- Reducing inventories in order to expose organizational weaknesses and reduce waste;
- Eliminating overproduction by producing to the pull of the customer;
- Reducing total lead time through one-piece flow and just-in-time inventory systems;
- Building a stable supply chain that is visible, predictable and responsive by using disciplined processes;
- Using first-time-quality to prevent errors from becoming defects;
- Ensuring that the supply chain acts in rhythm with customer demand (takt time);
- Applying systems thinking through an understanding that a business is a series of interdependent functions that act as a total system; and
- Fostering collaboration to ensure that everyone is working toward common goals.

This is not a complete list of lean attributes, but these and other key lean principles are very pertinent to the supply chain. Recognizing this, we can define the lean supply chain:

> *The lean supply chain is planned, stable, visible and collaborative. The lean supply chain relentlessly focuses on lead-time reduction by eliminating all non-value creating activities (waste). This is accomplished through rigorous process discipline, inventory reduction and first-time quality. The lean supply chain flows to the beat of the customer, where all supply-chain activities are triggered by the pull of the pace-setting process. The goal of the lean supply chain is to deliver the highest value to the customer at the least total systems cost.*

Having developed the definition of the lean supply chain, we need to determine how we can take our current supply chain and transform it into the lean supply chain.

Designing the Lean Supply Chain

Designing and implementing the lean supply chain can be looked upon as a series of progressive steps: The first two steps can be summarized as:

Step 1: Drawing and understanding the current state value stream
Step 2: Drawing and understanding the future state value stream

> Note: The mechanics of completing a value stream map are not specifically addressed in this article. For a comprehensive review of completing a value-stream map, please refer to *Learning to See*, by Mike Rother and John Shook, published by the Lean Enterprise Institute.

Step 1: Drawing the Current State of your Supply Chain

Relative to drawing and understanding the current state of your supply chain, you need to know:

1. How do you draw the value-stream map of the current condition of your supply chain?
2. What information is key to understanding the current condition of your supply chain?
3. How do you break down the supply chain into manageable pieces in order to paint a realistic picture of the current state?
4. Who should be part of a cross-functional team to complete an accurate value stream map of the supply chain?
5. How do you analyze the value-stream map of our supply chain to understand the current condition?

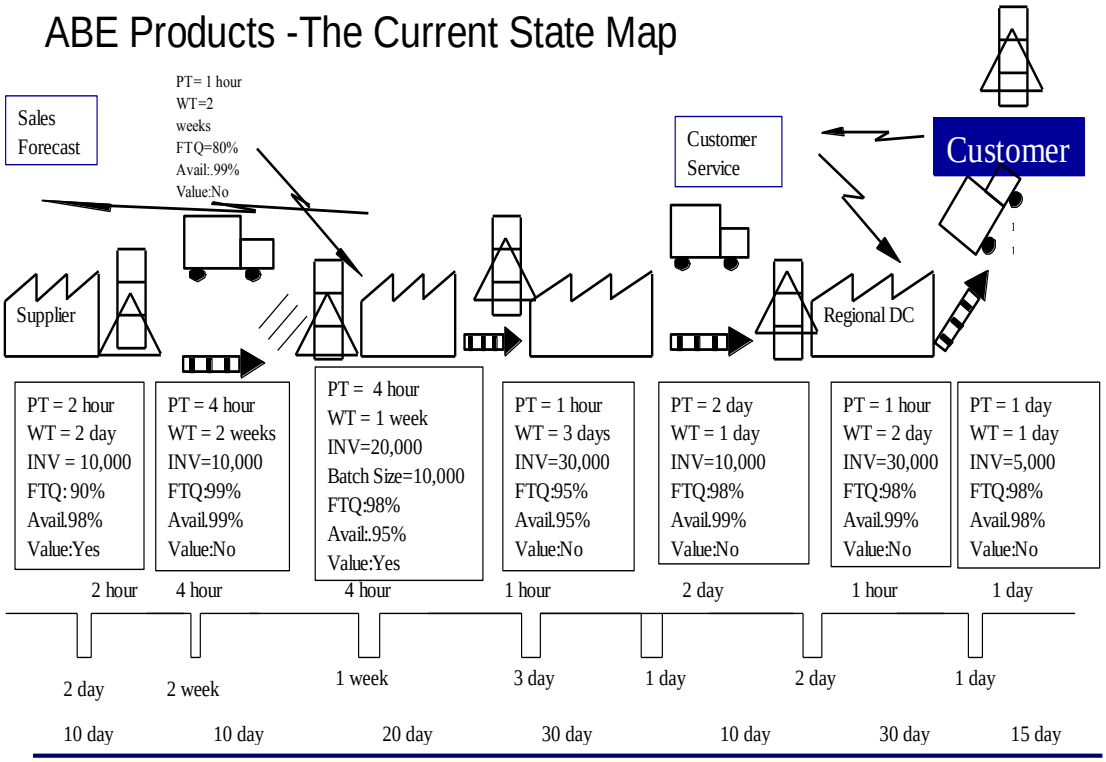
1. How do you draw the value-stream map of the current state of your supply chain?

The value-stream map is a popular tool for the lean enterprise. Most importantly, the value stream map gives you a global picture. This understanding of the current condition of your organization is critical to the lean supply chain. However, mapping the supply chain can be more challenging and complicated than mapping a manufacturing process because:

- 80% of supply-chain activities are invisible to those accountable and responsible for the processes.
- Companies have multiple suppliers, customers and service providers.
- There is high variability in consumption, transportation modes, lead time and supply-and-demand patterns.
- There is high variability in supplier performance and supplier capability.
- The extended enterprise (pipeline outside of your four walls) is not always visible

- Data is not always abundant or present.

Considering the above challenges, the most difficult part of drawing the current state is determining where to start. In order to simplify the complicated, start asking yourself: What do I want to learn by creating the value stream map of the current condition?



Summary of Current State Value Stream Map			
Total Process Time	85 Hours	First Time Quality	62%
Total Wait Time	30 Days	First Time Availability	83%
Total Inventory	125 Days	Total Value Add Time	5 hours
		Total Process / Total Lead Time	2.40%
Total Lead Time	160 Days	Total Value / Total Lead Time	0.15%

Figure 2: Example Current State value Stream Supply Chain Map: Source: *Designing and implementing* lean in your Supply Chain (2007, Lean Enterprise Institute).

Figure 2 shows the key elements of a current state value stream map.

2. *What information is key in order to understand the current condition of your supply chain?*

Although a value stream map of the supply chain may seem different from a map in a manufacturing process, you cannot lose sight of the basic principle of the value stream map. That is, the value stream allows you to see the whole by painting the overall picture of the

supply chain. To accomplish this, you need to look at basic information relative to the current condition of the supply chain:

- First-time quality (FTQ)
- Asset and resource availability
- Process time (PT)
- Wait time (WT)
- Value-creating vs. non-value-creating process determination
- Inventory levels
- Overall supply-chain lead time

The above information will be used to develop the value stream map of the current condition. However, from what perspective do you draw the map? You need to pick one customer, a small group of customers, one supplier or a group of raw material part numbers. Somehow you need to break down the supply chain into manageable pieces in order to paint a realistic picture of the current state.

3. How do you break down the supply chain into manageable pieces in order to paint a realistic picture of the current state?

Choose a product that could be considered a lean candidate for pull and flow. Look at your finished goods SKUs (stock-keeping units) relative to volume and frequency of demand. Map a finished-good product that has significant demand and relatively stable (level) demand. This will eliminate arguments that develop around variability of demand, not to mention the fact that you want to drive pull and flow in the future-state of the supply chain. High-volume, stable products should be the first to begin using pull-replenishment techniques.

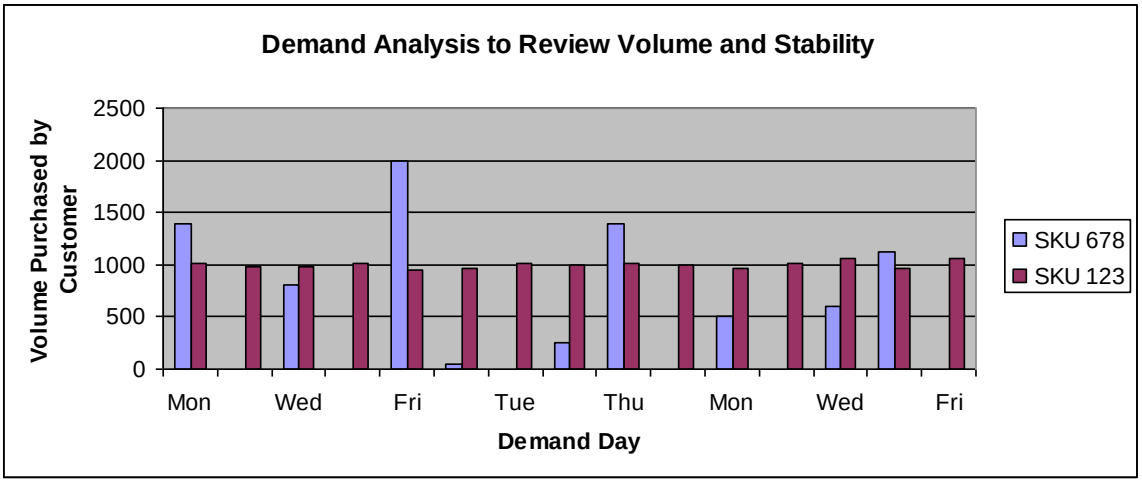


Figure 3: Example SKU Behavior Analysis: Source: *Designing and implementing* lean in your Supply Chain (2007, Lean Enterprise Institute).

Figure 3 shows that different SKU's have different behaviors. For your first value stream map, choose a SKU that is stable.

4. Who do you need as part of a cross-functional team to complete a value stream map of the supply chain?

Supply chain initiatives, of any kind, cannot be completed using silo mentality. Cross-functional participation is required to drive lean in the supply chain and logistics disciplines. Although this may seem obvious, however many organizations continue to ignore this critical point. It is never too early to begin the drive for cross-functional participation, and the creation of the current-condition value-stream map is a perfect time to bring the enterprise (all functions) into the process. Use this opportunity to invite a representative from each functional discipline to the mapping of the current state. The goal will be to develop a team of people that will in fact stay intact as a functioning team during and after the mapping exercise.

Each functional area should be represented. With that, some functional areas may resist being part of the mapping team, claiming that they have little effect on the outcome of supply-chain activities. For example, Purchasing, Finance and Marketing may take this stance in the beginning. Do not allow this to happen! While certain functional areas may believe they do not drive supply chain outcomes (or outputs), they certainly are involved with creating inputs that drive waste into the supply chain.

Mapping the current condition of the supply chain is about learning to see the whole. This means the whole enterprise needs to become aware of how their functional behaviors affect the overall performance of the organization. Once you have assembled the correct team of cross-functional representatives, you will be ready to draw and analyze the current state of your supply chain relative to a particular product.

5. How do you analyze the value stream map of your supply chain to understand the current condition?

Once the value-stream map of the current condition is completed, you need to be able to stand back and ask yourself what it all means. What does the map tell us, and more importantly, what should you do next? What action needs to happen?

As you analyze the current state map ask yourself:

- What is the takt time or rate of customer demand?
- What processes do not create value?
- Where is first-time quality an issue?
- Where is there an issue in availability of resources?
- Where are excessive inventories creating long lead times?

- Where can you implement flow and pull? Where is push being used as an inventory strategy?
- Where do you need to "go see"? Where is there clearly a problem but you have no idea what it is?

The current condition map provides a wealth of information. The next challenge is to come to a decision about what to do with it! At this point, you simply need to go back to lean basics. You want to eliminate waste. Ask: Where is the waste?

Once we understand the current state of our supply chain, we are the privilege of designing the future state.

<u>Step 2: Drawing the Future State of your Supply Chain</u>

Relative to drawing and understanding the future state of your supply chain, you need to know:

1. How do you use guiding principles to map the future state of your supply chain?
2. How do you determine what to do to get from the current state to the future state?
3. How do you prioritize and manage all the things you need to do?
4. How do you ensure continuous momentum towards the vision of the future state?
5. What challenges will you face moving from the current state to the future state, and how do you overcome these challenges?

1. How do you use guiding principles to map the future state of your supply chain?

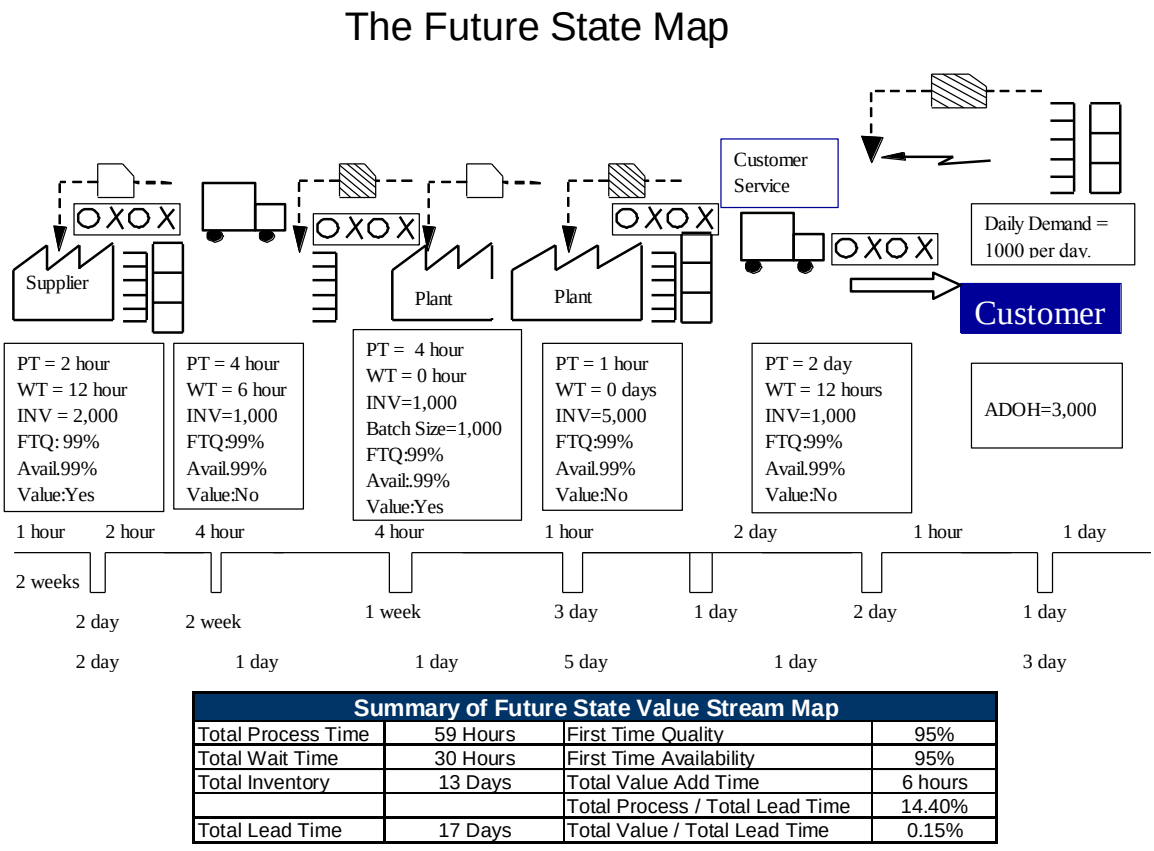
Guiding principles are those things that the organization simply believes in. They are your operational dogmas. When developing the future-state map, you need to constantly refer to your organizational guiding principles. Although the guiding principles will be different for each organization, there are common lean elements:

- Customer satisfaction — elimination of non-value creating processes
- Waste identification and elimination
- Lead-time reduction

- Inventory reduction
- Implementation of flow and pull
- Supply chain visibility
- Leveling of flow and material, both inbound and outbound
- Total Cost of Ownership

When drawing the future state, continue to ask yourself:

- How will this change improve the process from the customer's point of view?
- How will this change bring us closer to flow and pull?
- How will this change allow us to identify and eliminate waste?



Summary of Future State Value Stream Map			
Total Process Time	59 Hours	First Time Quality	95%
Total Wait Time	30 Hours	First Time Availability	95%
Total Inventory	13 Days	Total Value Add Time	6 hours
		Total Process / Total Lead Time	14.40%
Total Lead Time	17 Days	Total Value / Total Lead Time	0.15%

Figure 4: Example Future State Value Stream Supply Chain Map: Source: *Designing and Implementing Lean in your Supply Chain* (2007, Lean Enterprise Institute).

Figure 4 shows the key elements of the future state value stream map.

2. How do you determine what to do to get from the current state to the future state?

Moving from the current state to the future state is a step-by-step process that recognizes each element of the future state and requires operational changes. After the future-state map is created, you need to answer:

- What needs to be done to bridge the current and future states?
- What can be done in 30 days?
- What can be done in 60 days?
- What can be done in 90 days?
- What will require more than 90 days, and why so long?
- What executive support do we need, and how will we get it?
- Where do we need to "go see" to learn more about the operation?
- What supply-chain partners do we need to engage in the process?
- Who and how will we manage the projects?
- How do you prioritize and manage these tasks and projects?

3. How do you prioritize and manage all the things you need to do?

The list of things to be done will appear overwhelming. Where do you start? It is best to start where you will get the quickest and best results. What is in your management control to act upon? What items are easy to fix without executive-level support? Focusing on quick gains allows success and momentum to build. Nothing is more powerful than success to drive more success! After you have completed the straightforward stuff, ask yourself:

- What projects are closest to the customer?
- What projects will reduce lead time?
- What projects will drive us closer to flow and pull?
- How do you guarantee continuous momentum towards your vision of the future state?

The drive towards the future state will require discipline within project management. The fundamental elements of project management are:

- A documented and stated vision of what you need to accomplish;
- Detailed timelines (Gantt chart) outlining tasks, responsibilities and completion dates;
- Regular Plan. Do. Check. Act (PDCA) update meetings with the correct people attending each and every time;
- Countermeasure and resolution processes to keep the pace towards the goal.

4. How do you ensure continuous momentum towards the vision of the future state?

The secret to maintaining momentum is this: Make certain you know where you are going and that you are moving in the right direction. When momentum stalls, immediately go to senior support to break down the barriers. Implementing lean in the supply chain will take you to all

functional areas of the organization, including the extended enterprise of suppliers, service providers and customers. Consequently, regular communication about successes and challenges is critical.

Remember, just because something is a priority to you does not mean it is a priority to everyone! You need to sell your initiatives for the common good of the organization and supply chain partners!

5. ***What challenges will you face moving from the current state to the future state, and how will you overcome these challenges?***

There are many typical challenges that you will face while trying to implement your supply-chain vision. Perhaps:

- You require senior support, but they may not see the value in the initiative.
- You require cross-functional support, even though other departments have different priorities.
- You require extended enterprise support, yet they do not see the value or do not want to share resources.
- The organization is focused on short-term cost reduction initiatives and does not have a good long-term plan.
- Team members who must change their work style do not support disciplined process management.

Overcoming these challenges is a process in itself. It will require at least one senior sponsor is behind you 100% and can break down barriers. The secret to overcoming challenges and achieving success rests with recognizing that people do what they perceive creates value to for them. People will ask themselves, "How is moving to the future state going to help me?" Find answers for each stakeholder. Be prepared with answers to the following questions:

- How will the future state create value for the customer?
- How will the future state make your organization stronger?
- How will the future state help your supply base and service providers?

Implementing and Sustaining the Lean Supply Chain

Henry Ford once said that "no job is too big as long as you break it up into small pieces". This is true for implementation of the lean supply chain. However, when we break implementation up into focused sections, we cannot forget that the lean supply chain recognizes systems thinking and optimization of the entire supply chain. With that, implementation of the lean supply chain can start by answering the following questions.

- How do you engage with your customers to implement the lean supply chain?

- How do you design and implement a lean outbound logistics network?
- How does shipping, receiving and trailer yard management support the lean supply chain?
- How should we order parts and materials from our suppliers?
- How do you implement a lean inbound logistics network?
- How do you engage with your suppliers to implement the lean supply chain?

As we develop strategic and tactical plans to answer these six questions, we will in turn develop our plan to successfully implement the lean supply chain. However, it is critical we remember that it is a journey. Results may not happen immediately and hard work is essential. In the end though, the benefits and results will quite literally change the entire fabric of your organization.

About the Authors:

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