

# Lean Transformation of the Widget Company

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A Primer on the  
Supply Chain Logistics Model

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This is the success story of how one company was able to transform its supply chain from a traditional planning-based “Push” system to an execution-based “Pull” system and then finally to a Lean supply chain that is both responsive in meeting customer needs and cost efficient. With an enduring spirit of continuous improvement, the Widget Company goes from near extinction to becoming a powerful Lean Enterprise.

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### The Golden Years

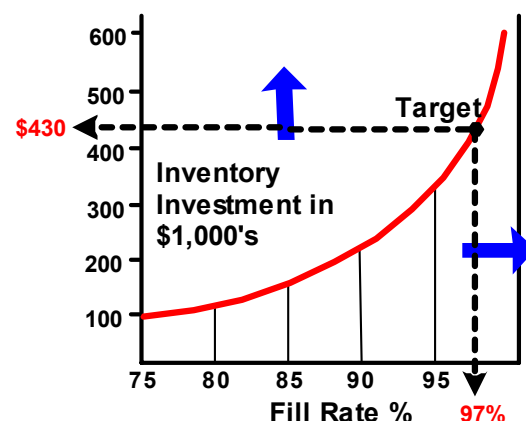
The Widget Company is a small to medium size manufacturing enterprise (SME) that produces several varieties of “widgets”. The widgets are sold to original equipment manufacturers (OEMs) as sub-assembly components used in the production of goods that are sold to end consumers. The Company has differentiated itself to the extent that it dominates the widget market segment. The market qualifiers for the Widget Company are quality and service while the market winner is low cost. The Widget Company is able to reasonably predict customer orders for its widget models, resulting in a production and distribution plan that is highly correlated with market demand most of the time. Thus, the Widget Company knows well in advance which kind of widgets need to be where at just the right time to satisfy its OEM customers. For the Widget Company, there is little unpredictable variation or “uncertainty” in customer demand. They must still, however, contend with variation in other areas such as production and transportation. There is also uncertainty associated with suppliers and their ability to reliably supply the company with raw materials.

To compensate for these uncertainties, the Widget Company plans long cycle lead-times between production and distribution points in the supply chain. Thus, if there are unexpected delays, the generous lead-time built into the company’s master plan will be able to absorb the variance without compromising on-time delivery to customers. The Widget Company leverages that fact that it has a reasonably accurate forecast to achieve economies of scale. Because it has plenty of lead-time, the Widget Company plans for large production batches, economical transportation and centralized warehouse storage. The Company also negotiates long-term volume purchasing agreements with its suppliers to get the lowest possible price on its raw materials.

### The Market Matures

Some years later, the widget market begins to change. The Internet comes along and brings with it an explosion of innovative technologies enabling new ways of doing business. The Company’s local market is now a global market. Several aggressive competitors have entered the widget market and are offering customers more varieties of widgets at a lower cost with faster delivery. Not surprisingly, the company’s loyal customers now demand the same. Some customers have even requested customized widgets bundled with value-added services.

The competitive dynamics of the widget market have also changed. The market qualifiers for the Widget Company are now quality and cost and the market winners are product variety and delivery time. This is in sharp contrast to the Widget Company’s traditional competitive strategy as a low cost provider. Now, cost has shifted to a market qualifier and the difference in actually winning the business is offering more product variety with higher service levels. To answer market demand, the Widget Company decides to double its widget product line, thus increasing the number of widget SKUs (Stock Keeping Units). To remain competitive, the Company decides to reduce the price of its widgets by 15% and to increase its service level to a 97% fill rate to match that of its most formidable competitor. (see Figure 1).



**Figure 1** - Inventory must be increased in a Push system to improve service

### Supply and Demand out of Sync

The Widget Company's supply chain is a planning-based "Push" system (see Figure 2). As they begin to execute their revised inventory and service policy, the Widget Company begins to encounter problems. The Company discovers that its forecast of customer demand is not even close to actual demand. After some analysis, the marketing manager reports that when the Company increased the number of widget SKUs, the effect was to fragment customer demand across more product varieties resulting in less volume per product. In short, the marketing manager concludes that more product variety and smaller orders means less volume turnover per product, which creates more demand variation per product. In addition the marketing manager notes that the market is global with more competitors meaning that customers have more choices when purchasing widgets. Consequently, forecasting the demand for each widget SKU is more difficult because demand uncertainty is high. As a result, the Company's forecasts are often wrong. This, in turn, results in the overproduction of some SKUs and frequent stock-outs of others. The final outcome is late deliveries to customers.

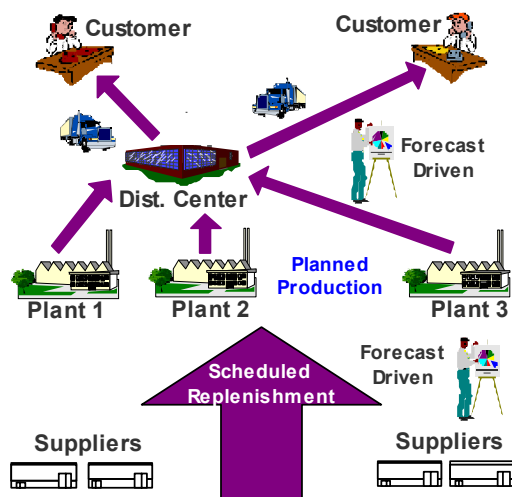


Figure 2 - Current "Push" Network

The Company's customers begin to complain. The Widget Company finds that it must increase and maintain a higher service level if they are to retain long-time customers. The Company decides that the only way for it to reliably increase its service level is to make more of each widget model and to ship the finished goods to the Company's centralized distribution warehouse. They have determined that the stocking quantity for each widget should be in proportion to the Company's demand forecast. By doing this, the Company has increased its product availability and customers have stopped complaining, for now.

### The Financial Consequences

The problem now is that the Widget Company finds that it has so much capital tied up in finished goods inventory that it has dramatically impacted the company's profitability. The Company's top line gross revenues have decreased due to the price reduction on all widget SKUs. Price reductions were not favorably offset by higher sales volume as was anticipated. Discounts given to customers because of late deliveries have accrued and now must be expensed against current income. Inventory turns have slowed significantly, resulting in escalating inventory carry costs. Transportation costs and other operational costs have also increased.

The Company's shareholders insist on knowing why the company proposes to borrow more capital to build distribution and storage facilities that cannot be financially justified. They point out that the interest expense on such fixed capital assets would significantly drag down existing revenue. Shareholders are concerned that the Widget Company is already asset heavy and cannot justify its low Return on Assets to analysts who are threatening to downgrade the Company's stock. Richard, the CEO of the Widget Company, now has a full crisis on his hands. Richard decides to assemble a team representing the heads of all functional departments to figure out how the Company can solve these problems.

### The Logistics Manager Reports

For Joe, the logistics manager, the challenge is clear – how does the Widget Company reduce its inventory and at the same time increase customer service levels? Joe decides he will assemble his own team on the Company's logistics problem, which includes the help of an outside consulting firm. What Joe learns is startling.

Joe explains to Richard that in global volatile market, the Widget Company cannot predict with any reasonable accuracy when, what, and where customer orders will be. So, what the Company has been doing is creating a production and distribution plan based on what it does know – past sales trends. Joe notes that the Company's forecasts are always wrong. It's just a matter of how wrong. When the forecast misses the mark, the result is a mismatch between supply and demand. Depending on the magnitude of error, the consequences are disastrous for the Widget Company leading to stock-outs, dissatisfied customers, and poor financial performance.

Joe tells Richard that when the Company mandated that service levels go up, he significantly increased "safety stock" as a way to hedge against uncertain demand. Joe explains that he calculated safety stock levels by averaging the peak demands for all SKUs over the last year. The resulting average peak demand is now the new stocking level for each SKU. The difference between this new stocking level and the company's demand forecast for each product is the safety stock required for that item. Joe admits that this was the only way that the Company could "stop the bleeding" and achieve higher service level consistency. However, Richard is quick to see the financial consequences of making and storing finished goods that customers do not want – it's expensive!

Joe goes on to say that the ideal goal for the Widget Company is to match supply with demand as perfectly as possible while also maximizing company profits. The planning-based approach that the

Company currently employs uses finished goods inventory as a way to synchronize with demand. Joe explains that as demand uncertainty increases, inventory levels swing from too much to not enough, both resulting in financial loss. The more demand oscillates, the greater the amplitude of inventory swings producing even greater profit loss. Joe concludes that the Widget Company is paying a terrible price for using a planning-based approach to mitigate the effects of demand uncertainty. Richard agrees, for he is all too aware of how quick the financial markets have been to punish the Company for its inefficient use of capital.

### The Guessing Game

The following four principles always apply to forecasts:

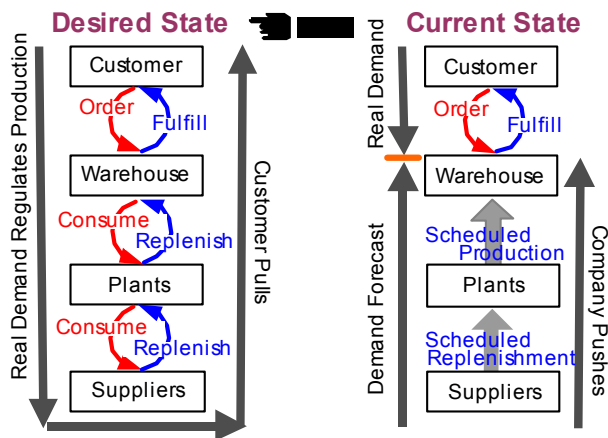
- The forecast is always wrong
- The longer the horizon, the worse the forecast
- Data updates lead to forecast updates
- Aggregate forecasts are more accurate

The first principle implies that it is difficult to match supply and demand, and the second one implies that it is even more difficult if a company needs to predict customer demand for a long period of time, e.g., the next 12 to 18 months.

### A New Concept of Operations

Joe tells Richard that he has a new concept of operations that would decrease inventory, improve customer service and increase company profits, all at the same time. Richard is stunned and says to Joe, "show me". Joe suggests that the Widget Company use production, rather than inventory, as a means of synchronizing with uncertain demand. Joe explains that execution-based models do not require planning as a means of anticipating what customer orders will be, but rather respond directly to the orders themselves. Production and distribution literally

“execute” on each customer order, creating a demand driven system where customers are able to “Pull” products out the supply chain (see Figure 3).



**Figure 3 - New Concept of Operations**

Using this approach, the Widget Company would be able to better match supply with demand while also providing highly “responsive” service levels to customers. The best part is that an execution-based system does not require excess inventory because products are either made-to-order or made-to-stock immediately after a product is shipped to a customer. In other words, the Company does not have to keep high levels of inventory sitting around waiting for customers to order. Joe tells Richard that he estimates that the Widget Company can reduce its inventory by about 70%. He also thinks that the inventory turn rate can be increased by a factor of 10. Joe concludes that this kind of Pull system is much more effective in dealing with unpredictable demand. Joe insists that the Widget Company could not only cope better with demand volatility, but may actually exploit it for strategic advantage. Richard sees the wisdom in this approach and immediately asks Joe, “How do we do it?”

### Re-Tooling for Lean Manufacturing

Joe now teams up with Sam, the production manager over all the Company’s factories, to figure out what the Company must do to convert the current Push

system to a “Just-in-Time” Pull system. To assist them with this, Joe and Sam decide to bring in John, a Lean production consultant. John explains that before a Pull system can be implemented, the factories must be able to produce widgets in smaller lot sizes. John explains that this is important because in a Pull system production is triggered directly or indirectly by actual customer orders. Average customer order quantities are significantly less than the quantities the Company is currently setup to run in its factories.

Currently, the machines in two of the Company’s three factories are configured to manufacture six widgets at a time. Sam explains that the logic behind this is to enable the Company to achieve economies of scale in production and to reduce the time and expense required to reconfigure the equipment for the next production run. By manufacturing six widgets at a time, production costs can be spread out over more products effectively reducing the production cost for each widget. Running large production lots also reduces “change over” time, which is the time it takes to clean and modify the equipment to prepare for manufacturing another type of widget. John responds by saying Lean manufacturing practices will enable the Widget Company to dramatically reduce production costs and change over time. But first, the factory machines must be modified or “right sized” to enable smaller production runs. John advises Joe and Sam to reconfigure the machines to produce widgets in lots of two.

John explains that the next big challenge is to reduce the operational lead-times in the manufacturing process itself. John advises that the factories setup for cellular manufacturing where all people, equipment, tools, and supplies necessary to manufacture each kind of widget are physically arranged in close proximity in a U-shaped layout. The purpose of this arrangement, explains John, is to enable “single piece flow” manufacturing or simply “flow” manufacturing. Now instead of large mass production runs that use batched and queued processes, the factory would be able to manufacture a single widget from start to finish in a fraction of the

time that it takes under the current production method. Not only would manufacturing lead-time be dramatically reduced, but flow manufacturing facilitates the reduction of many forms of “waste” that artificially increase production costs. John explains that this is part of what is called Lean Production and the “Just-In-Time” (JIT) philosophy waste reduction.

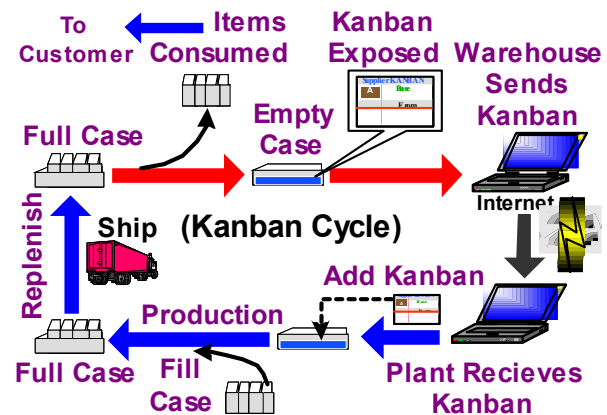
### Implementing a JIT Pull System

John explains to Joe and Sam that what is required next is a way to control the flow of raw materials from the Company’s suppliers to the point of use in the factories in such a way that replenishment is synchronized with customer demand. The way this is achieved in a Pull system is by using Kanban signals that are passed between factories and suppliers in the form of either physical cards or electronic transmissions. In this case, Kanbans are sent electronically by the Company’s information system. John explains that a Kanban signals a supplier to replenish a plant with a specific part in a specific quantity. A Plant does not release a Kanban to a supplier until some defined quantity of raw material, usually a case, has been consumed in the process of manufacturing. In this way, each plant can dramatically reduce the level of raw materials inventory that it warehouses in the plant. In a Pull system, raw materials are delivered to plants on a “just-in-time” basis, requiring suppliers to deliver on short notice after receiving a Kanban replenishment signal.

Now John explains how this same Kanban process can be used to replenish the Company’s distribution warehouse with widgets immediately after they are withdrawn from warehouse stock and shipped to customers. John advises Joe and Sam that the logistics method that makes sense for the Widget Company is a “make-to-stock” JIT Pull system. In this system, it is a withdrawal from the factory’s internal finished goods warehouse (called the “supermarket”) that actually triggers plant production. The supermarket serves as an inventory queue that is designated to hold exactly a “standard” amount of finished widgets for each factory. When the

supermarket is full, plant production stops. As widgets are withdrawn from the supermarket and shipped to the warehouse, production resumes until the supermarket is once again full. John explains that even though the Company would hold finished goods and raw material inventories, it would still be far less than the Company’s current stock levels.

Now John summarizes the Pull process from start to finish. When at least two widgets are withdrawn from the warehouse and shipped to a customer, this would immediately trigger a Kanban signal to a specific plant. The plant would then manufacture two widgets of the same type and ship them to the warehouse to replace the widgets that were shipped to the customer. As plants consume their in-house raw materials, this triggers Kanban signals to specific suppliers who in turn replenish the plants with the parts that were consumed. Plants continue to produce to the supermarket until it is full, at which point production stops (see Figure 4).



**Figure 4** Consumption-replenishment cycle using a Kanban as the trigger

With this Pull method, the level of inventory in the warehouse and plants will remain relatively constant, neither falling significantly below or above the standard inventory level. In the event of unusual demand surges or declines for any widget, the warehouse manager can “throttle” the Pull system by adding or removing the number of Kanbans that are sent to plants. This is an effective way to increase

or reduce the standard inventory level of any widget “on the fly” based on direct observation of demand. Upstream from the warehouse, the factories and suppliers respond by increasing or reducing their Kanbans as well.

### Using MRP with JIT

John points out that the Company currently uses a MRP-II system to plan and control its manufacturing processes. The issue here is that as lot sizes decrease, the volume of paper work and the number of transactions will increase dramatically in a JIT environment. The challenge is to prevent the Company’s planning control systems from becoming a constraint to achieving shorter manufacturing lead times. To prevent the cost of transactions from exponentially increasing, John recommends that the Widget Company take an approach of eliminating waste in the production side and in the transaction side of the Company simultaneously. While it may be tempting to purchase sophisticated tracking equipment to help the Company automatically handle the increased transaction volume, the focus here is on eliminating the transactions, not automating them.

The bottom line is that traditional purchase orders and work orders, as the Company knows them, cannot exist in most JIT environments. Although MRP-II systems have shop floor control modules that enable the Company to plan, track, and control individual products, the problem is that there can be a ten-fold increase in the number of transactions. In a JIT environment, things just happen too fast on the shop floor to make it practical and economical to keep an MRP-II system informed on-line, real-time, all the time. Fortunately, the Company can avoid an increase in manual transactions by using JIT and MRP-II in harmony.

### Planning and Control Changes

John explains that in a MRP-II environment, production planning both plans and controls production. In a Kanban JIT environment, planning creates a macro production plan, but production executes directly to customer orders. That is,

planning plans, but production controls. The shift from MRP detailed planning to “rate based planning” requires a different way of doing things. Imagine a garden hose connected to a faucet on one end and water running through it on the other end. All that is required to determine the rate of production in a flow environment is to watch the rate that the water is pouring out the end of the hose. The faster the water flows, the faster the rate of production; the slower the water flows, the slower the rate of production. The amount of water in the hose is controlled by the size of the hose (capacity), and in a JIT environment by the sum of the Kanbans circulating in the system.

John points out that this is why individual work orders and purchase orders issued by the Company’s MRP-II system would not function well in a JIT environment. The key here is not to simply get rid of these orders, but rather to eliminate the need for them. John recommends that instead of releasing a purchase order to suppliers for each delivery, that the Company adopt supplier schedules that show planned requirements over time. That is, a “blanket” purchase contract can be created to authorize suppliers to ship materials according to the supplier schedule. The problem, however, is that because supplier schedules are based on the MRP-II plan, it authorizes shipment to support that plan. In a JIT environment, the Company will still plan with its MRP-II system, but will authorize shipment based on actual customer orders or consumption. This is the rationale for circulating Kanbans between each supplier and the Widget Company.

### Implementing the Changes

Joe and Sam are seriously impressed. Joe notes that the big picture for the CEO, Richard, is that production and distribution would be coordinated with true customer demand rather than a forecast. No more guessing and dealing with high levels of demand uncertainty. The company can respond to customer needs without having to carry excess inventories while also maintaining consistently high service levels. Best of all, the Company would significantly decrease its operating expenses and

dramatically increase operating revenue. Too good to be true? Let's find out.

### **The First Performance Review**

After months of retooling machines, re-designing processes, educating employees, and re-defining supplier requirements, the Widget Company has achieved a working JIT-Pull system. A meeting of the original task force assembled by Richard meets to discuss the results of the transformation. In the meeting the company accountant is pleased to announce that inventory levels have decreased by 80% and the inventory turn rate is averaging 20 for the quarter. As a result, the Widget Company has dramatically improved its financial condition. Operational costs have declined 40% while net income from operations has increased by 60%. The customer service manager reports that the average fill rate has held reliably at 97%. Richard is very pleased with the results thus far.

### **The Problems**

"Any problems?" Richard asks. As logistics manager, Joe reports that transportation costs from suppliers to plants have actually increased. Joe has determined that this is because suppliers are required to ship parts as soon as they receive a Kanban replenishment signal from a plant. Hence, suppliers are shipping smaller quantities more frequently in order to get the parts to the plants on time. Joe notes that one of the biggest problems has to do with shipping lead-times. He explains that because the Company's suppliers are geographically dispersed, the distances between some suppliers and plants result in long travel times. Not surprisingly, there have been stock-out problems at plants that are replenished from remote supplier regions. Joe notes that the long replenishment lead-times are making it difficult to maintain reliable pull between certain plants and suppliers.

Joe also notes that several of the Company's customers are located in a region far from the Company's distribution warehouse, resulting in

occasional late deliveries. Joe also mentions that some of the Company's suppliers have started to complain that they have to maintain more inventories in order to ship on short notice. Other suppliers have said that shipping more frequently in smaller quantities is more labor intensive and thus more expensive for them do.

The final point that Joe makes is that by "balancing" part case quantities in the same ratios, further reductions in raw material inventory would be possible. For example, the base used in all widget models comes packaged four per case. However, discs, of which there are three varieties, all come packaged ten per case. Joe explains that it would make better sense to decrease the part count of all discs to the nearest multiple of four, which would be eight. So, Joe recommends that disc parts be packaged eight per case. This way, for every eight bases used in production, all discs would be consumed leaving no excess parts.

### **The Way Forward**

Overall, Richard is thrilled with the progress that has been made since the formation of the task group. As a seasoned executive, Richard realizes that "perfection" is always a work-in-progress. He further challenges the task group to come up with ways to improve the Company's supply chain – more immediately to solve the current logistics issues. Richard encourages the group to think out of the box and to utilize whatever resources are required. He indicates that the board of directors and the management team are prepared to do what it takes to get the Widget Company back to a position of market dominance. He concludes by congratulating the group for a job well done and asserts that this is the start of an initiative that will remake the Company into a powerful Lean Enterprise.

### **Adopting a Systems Approach**

Several people in the task group, including Joe, are advocates of "systems thinking". Joe explains that the systems approach is a holistic way of looking at

interconnected processes or “systems” in which an action taken on one process has an effect on all other interconnected processes. The key goal of systems thinking is to make decisions that are in the long-term best interests of the system as a whole and to identify “high leverage points” in order to effectuate rapid change that yields the intended results. The thing to be avoided is “policy resistance” where “interventions” are delayed, diluted, or defeated by the unforeseen reactions of other people and forces in the system. Ironically, many times our best efforts to solve a problem actually make it worse.

After some discussion, the group agrees that to find sustainable solutions to the current logistics problems, the Company must start thinking in terms of the “whole” supply chain. John, the consultant agrees with Joe that companies can sometimes make decisions based on a narrow definition of “optimization” where the focus is on improving performance within a company function without regard for its wider supply chain impact. Within a company, for example, this happens when certain logistical processes span across one or more functional departments. Each department makes decisions that optimize its objective, but inadvertently causes problems for other departments. As a result, these other departments act accordingly to “fix” the problem, only to “shift the burden” back to the previous department. The way to avoid this is to integrate logistical processes across departments and to look at the entire process across functional boundaries when making decisions.

### System Trade-Offs

John explains that optimizing a complex system such as a supply chain involves making certain “trade-offs” between seemingly conflicting objectives. In systems, trade-offs are a “best fit compromise” between two desirable objectives that are at some point inversely affected by each other. That is, two objectives are conflicting when one objective is optimized at the expense of the other. Like a seesaw, as one result goes up, the other result goes down and visa versa. The key to finding the optimal

“balance” between two conflicting objectives is to optimize each objective to the point where neither negatively impacts the other. This point is called the “balancing equilibrium point” in systems language.

John notes that the tricky thing to remember about trade-offs is that you can “have your cake and eat it too” up to a certain point. This can be conceptualized by thinking about a long rope. On each side of the rope is attached a desirable objective. Both objectives are initially pushed together so that they start side-by-side with plenty of slack rope between them. The desirable result for each objective is achieved by moving each in the diametrical or opposite direction of the other. At this point, each objective can move outward without affecting the other because there is enough slack in the rope between them.

Eventually, each objective moves out far enough to the point where there is no more slack rope and the rope is taut. At this point, moving one objective in its optimal direction will move the other objective counter to its optimal direction or backwards from the path it initially traveled. The point where the rope becomes taut is the balancing equilibrium point. It is here that both objectives have been optimized to the point where further optimization of either objective will be at the expense of the other. Thus, trade-offs at this point must be made that involve sub-optimizing one objective to optimize another in order to produce a net benefit to the system as a whole.

### Balancing Conflicting Objectives

Joe explains to the group that sometimes balancing trade-offs can be counterintuitive. Take, for example, the trade-off between transportation and inventory cost. The mode of transportation that results in the lowest transportation cost does not necessarily lower total costs for a supply chain. Cheaper modes of transportation typically have long lead times and large minimum shipment quantities, both of which result in higher levels of inventory in the supply chain. Modes that allow for shipping in small quantities lower inventory levels but tend to be more expensive.

In this case it makes sense to trade-off higher transportation costs for lower inventories. Another example is the trade-off between transportation cost and customer responsiveness. If a supplier is required to have high responsiveness and ships all orders within a day of receipt from the customer, the supplier will have small outbound shipments. This will result in high transportation costs. If the supplier decreases its response time and instead aggregates orders over a longer time horizon before shipping them out, the supplier will be able to exploit economies of scale and incur lower transportation costs. In this case the supplier must trade-off higher transportation costs for the ability to respond quickly to customer orders.

### Push-Pull Conflict

John points out that if the supplier's customer in this case happens to be the Widget Company, for instance, a "Push-Pull conflict" could occur if there is a conflict of interest between the parties. In such a case the Widget Company sends replenishment Kanbans to an upstream supplier that is required to perform fast shipment returns. The supplier, however, may be in "Push" mode and thus may be more motivated to seek cost efficiency. As a result, the Widget Company experiences slow shipment returns on Kanban orders, which effectively slows or stops production at plants that consequently stock-out of parts. In this case, the supplier optimizes its cost structure at the expense of the Widget Company and the entire supply chain.

John emphasizes that taking a systems view to solving supply chain logistics problems is important because it is the whole network that must be optimized. At the end of the day it is the supply chain network that delivers the goods, not any one participating firm. Further, supply chain networks are only as good as their weakest link. The fundamental challenge then is to redirect traditional emphasis on isolated functions within and between firms and to focus on the integration of processes across all functions within the supply chain. Balancing the cost-service trade-offs that exist between functions is the

way to optimize these extended processes. To do this, it is necessary to find the lowest process cost, not the lowest cost for each function included in the process.

### Lean Logistics

John continues to explain that this is essentially what Lean supply chain logistics is all about. Stated another way, Lean logistics is the superior ability to design and administer systems to control movement and geographical positioning of raw materials, work-in-progress, and finished goods inventories at the lowest total cost to support a target service level. As an operational strategy, Lean logistics enables a company to outperform competitors in a cost-effective manner while continuously meeting customer expectations. However, superior financial performance requires more than operational efficiency. It also requires market initiatives that leverage supply chain resources to create exceptional value for customers. Paramount is the ability to achieve sustainable competitive advantage to ensure satisfactory profits for all firms.

### Radical Improvement

John notes that when a company first initiates a Lean program, the results can sometimes be spectacular. It is possible, for example, for a company to make modest short-term improvements in their operations that result in immediate and dramatic cost reductions while simultaneously improving service level. How is this possible given that cost and service are subject to direct system trade-offs? In Lean language this is called "radical improvement" and is due primarily to the elimination of "type II waste" which are all non-value adding activities that are unnecessary and can be eliminated immediately. Connecting this to systems thinking, type II waste is basically the "slack in the rope" within a company's operations.

If a company has a production and logistics system that is significantly unbalanced (a lot of slack rope), then it becomes possible to mutually reduce cost and increase service up to a point without making trade-

offs between the two. This is possible because the company is taking the slack out of the rope and has not yet reached the balance equilibrium point that forces trade-offs between cost efficiency and service level. John points out that in many cases, the immediate cost savings gained from radical improvement can help offset the expense of making such improvements. John mentions that he knew of a company that actually financed the entire initial phase of their Lean project with immediate cost savings.

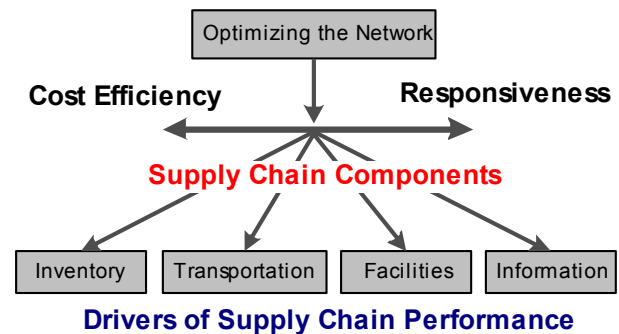
The catch is that this kind of radical improvement only happens one time. The more slack rope a company has in its operations, the more dramatic the results will be. Once the production and distribution system is “balanced”, system trade-offs regulate improvements to steady incremental improvements called “Kaizen.” Joe points out that this explains how the Widget Company was able to dramatically improve its condition in such a short time. When the Company retooled its plants for Lean and went to Pull logistics, it was using highly leveraged strategies that did indeed deliver rapid and intended results.

### Optimizing the Logistics Network

Joe asks the question, “Where do we go from here?” John explains that the next step is establishing a framework for optimizing the Widget Company’s supply chain in the context of the Company’s competitive strategy, principles of Lean logistics and systems thinking. John understands that the Company is focused on “reactively” solving the immediate logistics issues. However, John cautions the group that reaction mode must be tempered with a long-term “proactive” view of structuring a supply chain that will position the Widget Company for future growth. Sometimes, a company makes a “quick fix” decision to “put out the fire” but the decision actually ends up creating more problems down the road. It is therefore important to proceed patiently and to look at the “whole picture” when making decisions that impact the supply chain.

John explains that the four main drivers of supply chain performance are inventory, transportation,

facilities, and information. For each of these components, the Widget Company must find the optimal trade-off between cost efficiency, responsiveness, and flexibility. Once this has been done, the components are then optimally balanced with each other. The combined impact of these four components makes up the design of the entire supply chain and determines when and where the supply chain is cost efficient, customer responsive, and flexible. John points out that the Company has made progress optimizing the inventory component. The next components to consider are transportation, facilities and information flows (see Figure 5).



**Figure 5** -Balance the Trade-offs for each component to optimize the network

### Facility Network Optimization

Sam explains that the Company’s physical facilities consist of a single distribution warehouse and three manufacturing plants. All plants ship finished widgets to the distribution warehouse where they are then shipped to customers. Joe notes that on the supply side, the biggest problems are high transportation costs and travel lead-times between suppliers and the Company’s three plants. John notes that the common thread here is distance. He explains that in an execution-based system like JIT Pull, too much distance lead-time between any two points in the supply chain compromise the ability of the Pull system to function properly. Therefore, it is no surprise that the Company is experiencing problems in these areas.

### Optimizing the Supply Side

After careful analysis, John suggests that the Widget Company use a third party logistics provider (3PL) positioned between its plants and suppliers to perform a number of value-added services. First, the 3PL would act as a “supplier hub” where all suppliers would “forward deploy” part inventories closer to each plant - the point of consumption. Using a 3PL in this way would reduce travel distance from replenishment supply to the point of need. Thus, the replenishment cycle time between these points would be greatly reduced. The reduced distances would also mean that cheaper modes of transportation could be used such as short-haul panel trucks as opposed to long-haul trailers.

Second, the 3PL would perform a “kitting” function for the Company where part cases are broken down into discrete kits containing exactly enough parts to produce a certain number of widgets. Joe immediately recognizes that this what he suggested at the first performance review regarding the balancing of case quantities. Because the Company’s factories are now set up to produce two widgets at a time, John notes that the logical kit quantity would be two. This will speed things up at the plants because when the production line receives a kit, all the parts necessary to manufacture two widgets are already together in one case. The other benefit of kitting is that it would further reduce levels of raw materials inventory because there would be no excess parts due to mismatched cases.

John points out that inserting a 3PL in the supply chain in this way would mean changing the current Pull processes. All plants would now send replenishment Kanbans directly to the 3PL instead of the suppliers and the 3PL would return widget kits back to the plants. The 3PL would send its own replenishment Kanbans upstream to each supplier to which suppliers would then return the requested part cases back to the 3PL.

John also mentions that the Company may want to re-source the parts currently provided by its most

remote supplier to another supplier closer to the 3PL hub. The remote supplier is more than twice the distance away from one of the plants as the other suppliers. Doing this would further reduce travel lead-time. After performing a cost-benefit-capacity analysis of the Company’s factories, John recommends that the Company close its “plant 3” which makes only one type of specialty widget. This particular plant had been acquired by the Widget Company a few years prior. Demand for this specialty widget is much less than the other widgets and so comprises only a small fraction of the Company’s total sales. Because the other two plants are Lean, they can easily accommodate the production of the specialized widget. There is no need to keep plant 3 open. John recommends selling off the plant and using the capital windfall to pay down the Company’s debt. This would reduce interest expense drag on earnings and increase the Company’s Return on Assets.

### Optimizing the Demand Side

On the customer facing side, Joe explains that the Company’s distribution warehouse is located in “region A” which is a significant distance from “region B” where half of the Company’s customers are located. Despite the Company’s best efforts, deliveries are sometimes late to region B customers. After a thorough cost-service-location analysis, John recommends that the Company close the costly distribution facility and build a small warehouse in region B to serve the customers in this area. The Company’s “plant 2” is closest to this regional warehouse and would manufacture and supply the warehouse with all widget SKUs.

John further recommends that the Company close its “plant 1” and build a new plant closer to customers in region A. The new plant would be designed and staffed so that it could directly serve customers in this region. John notes that because this factory would be Lean and technologically enhanced, it can produce-to-stock fast enough to pace demand. The factory would be able to immediately ship most customer orders received from its expanded “supermarket”

warehouse. If customer orders exceed what is available in the supermarket, the plant could build-to-order fast enough to deliver the widgets to customers on time. Like plant 2, this new plant would also manufacture all widget SKUs.

### Dedicated JIT Truck Routes

After analyzing the Company's transportation network, John recommends that the Widget Company establish dedicated truck routes between all pick-up and delivery locations. A dedicated "JIT truck route" goes back and forth between the same two locations in a cycle – first picking up, then delivering, then backhauling if necessary, and then picking-up again. John explains that this would compress travel lead-time even more because traditional shipping methods use a third party dispatch system that queue trucks when they are called. This process creates unnecessary delays. A dedicated truck, on the other hand, is always somewhere on its dedicated route cycle and therefore never has to be dispatched. Instead, there is direct communication between the truck and the two locations it serves. Even if the truck is not called, it still proceeds with its dedicated route, thus automating this transportation function. Examples would be a JIT route between each supplier and the 3PL, a JIT route between the 3PL and each plant, a JIT route from plant 1 to region A customers, etc.

### Implementing the Plan

John submits his recommendations to Richard for consideration. Upon conferring with the task group and the executive team, Richard brings the proposal to the board of directors. After careful consideration and extensive financial assessment, the board agrees that the plan makes financial sense. They conclude that the Company would reap "immediate and long-term benefits". Richard tells the board that the new supply chain structure would strategically position the Company to capture future market opportunities that could potentially result in unprecedented growth for the Widget Company (see Figure 6).

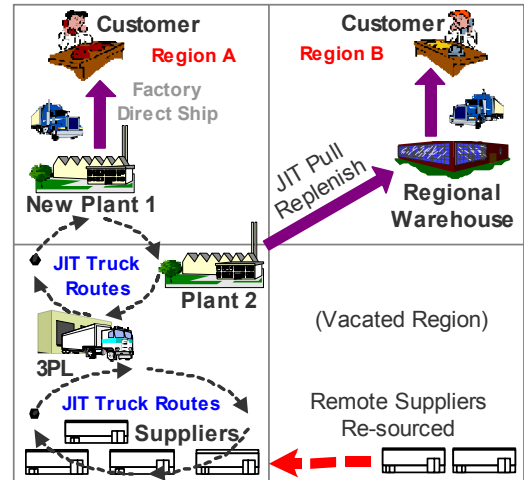


Figure 6 Optimized "Pull" Facility Network

### The Second Performance Review

Some time later, the Widget Company has fully implemented the plan outlined by John and the task group. Richard calls another meeting of the task group to review the results. The Company's chief accountant reports that inventory levels have dropped an additional 5% since the first performance review. She notes that this is a total decrease in inventory of 85% from levels before the company began the initiative. The accountant notes that the inventory turn rate has increased from 20 to 75. She explains that this is partially due to the fact that the new rate has been calculated over a longer period of time than the first inventory turn rate. The high inventory turn rate has consequently decreased inventory carry costs by a whopping 80%.

The accountant reports that the cost of operations has decreased 50% while the net income from operations has increased by 20% since the last review. The accountant explains that the cash-to-cash cycle has improved dramatically. About half the time, the Company collects on customer invoices before supplier invoices are due on the raw materials used to build the sold widgets. This "negative financing" has resulted in a positive cash flow between sales and cost of goods sold vastly improving the Company's liquidity position.

### Financial Improvement

The Company's financial position has completely turned around. The Chief Financial Officer explains that the operational improvements have created results that have rippled through all the financial performance metrics of the Company. First, the profit margin on sales has increased because there are few, if any, late customer deliveries and because it costs less to produce and distribute widgets. Because net income from operations has increased and total assets have decreased, the result is a 25% increase in the Return-on-Assets (ROA) since the last performance review.

The CFO explains that the Company has been able to finance some of its growth internally from higher retained earnings and positive cash flows on accounts payable. This, in turn, has allowed the Company to reduce its long and short-term debt, substantially improving the Company's Debt Ratio and improving profitability. Return on Equity (ROE) has significantly improved along with the Company's Price-Earnings Ratio (P/E ratio). Richard is pleased to announce that the Company's stock price is above its all time high. The Widget Company is now in a good position to make strategic acquisitions when opportunities arise and to obtain additional equity financing via a secondary public stock offering if needed.

### Service Improvement

Joe reports to Richard that shipping lead-times between the Company, its customers, and suppliers have been further reduced. As a result, there have been no late customer deliveries since the second phase of the initiative was implemented. In fact, the Company is able to consistently maintain a 98% fill rate. Reduced replenishment lead-times have virtually eliminated stock-out problems at the plants. Transportation is more reliable and less costly. The operations manager, Sam, reports that there is "excess capacity" at the plants beyond that which is required to satisfy current customer demand. Sam

suggests to Richard that the Company use this extra capacity in some strategic way.

### The Supplier Dilemma

Joe points out to Richard, however, that some suppliers are still complaining that the costs to service the Widget Company continue to erode their profitability. Joe expresses the concern that some suppliers have not adopted Lean practices and may not be as flexible or cost efficient as they could be. Joe points out that the Widget Company needs to be concerned about this for several reasons. First, if a supplier's costs are artificially high, some of these costs will eventually be passed on to the Widget Company. Second, a supplier's inefficiency impacts their profitability. This creates a dilemma for the Widget Company.

On the one hand, the Company could appease the supplier by agreeing to pay more for raw materials. However, the Company has no way of knowing whether the supplier's anemic profit is the result of "margin squeezing" by the Widget Company or is the result of the supplier's own inefficient operation. If the latter is the case, then paying the supplier more will mean taking on artificial costs and inadvertently reducing the supplier's motivation to make improvements in their operations.

On the other hand, the Widget Company could dedicate considerable resources to helping the supplier become more cost efficient. Before this could be done, however, the supplier would have to become "transparent" to the Widget Company. Traditionally, this kind of trust has been hard to achieve between Company's and their suppliers. Without knowing why the supplier's profits are inadequate, the Widget Company can take no action. However, taking no action may worsen the situation and undermine relations with a strategic supplier that would be costly and time consuming to replace – hence the dilemma.

### Organizational Change

Richard agrees that supplier relations are the “next frontier” the Widget Company must improve to continue the journey toward a Lean Enterprise. Richard explains to Joe that the Company needs a full time supply chain manager. Because of the strategic importance of this job, Richard has created a new position - the Vice President of Supply Chain Management. Richard is pleased to announce to Joe that he has been selected for this position. Joe is thrilled and immediately goes to work. To assist him in the creation of a “supplier improvement program”, Joe decides to hire a consultant, Sandy, who specializes in Lean supply chain management.

### Supplier Improvement Program

Sandy explains to Joe that lean supplier improvement programs are tricky and are often customized for each supplier. However, there are common principles that apply to all programs regardless of the suppliers involved. The first order of business is to get “visibility” into the supplier’s situation. The main obstacle to getting this is the lack of trust - more specifically, the supplier’s concern with risk exposure. The risk the supplier is worried about is that the Company will use the information it gets from the supplier to engage in “opportunistic behavior”.

Sandy explains that an example of opportunistic behavior would be when a company finds out what their supplier’s profit margin is and concludes that it is too high. The company then seeks to reduce the supplier’s margin by coercing lower prices. Another example would be when a company learns enough about a supplier’s business to by-pass them altogether. The real issue here is whether the supplier adds enough value to justify its position in the supply chain. Of course, this judgment is in the eye of the beholder.

Sandy emphasizes that trust is ultimately about power. If a supplier becomes unilaterally transparent, they lose power. On the other hand, if both supplier and company become mutually transparent in such a

way that both have roughly equal risk exposure, then neither party loses power. Sandy explains that the trick is to leverage this principle to craft an approach that will dissolve the trust barrier. Sandy repeats to Joe that companies cannot expect suppliers to extend trust when it is a one-way street. Mutual trust means that both parties must have risk exposure.

### Using Leveraged Strategies

Sandy recommends that Joe begin by making a proposition to one of the suppliers that the Widget Company is willing to share real-time demand information with them if they are willing to reciprocate with information of their own. The “leveraged strategy” is to extend trust to get trust. Sandy explains that the Company’s motivation should be clear to the supplier - to create more cost efficiency upstream in the supply chain by enabling suppliers to achieve more economies of scale in transportation, production, and long-range procurement planning. The Company also wants to increase the flexibility of suppliers in order to better prepare them for rapid changes in the market.

At the same time, the Widget Company would assist the supplier to become Lean, which would further increase the supplier’s profitability. If, with the help of the Widget Company, the supplier is able to achieve higher operational efficiency and profitability, the Company expects that the supplier would share some of the benefits with the Widget Company. Sandy notes that this supplier improvement program would be good for all parties – the Widget Company, the supplier and the supply chain as a whole.

Joe meets with a supplier and discusses the idea of a supplier improvement program with them. After several meetings, the supplier agrees to participate in the program under the Company’s terms. Sandy explains that before the Widget Company can proceed with the supplier improvement program, they will have to determine how to best use information to achieve greater upstream cost efficiency.

### Lean Logistics to Lean Supply Chain

Sandy explains that the next step is to look at the overall design of the Company's supply chain. The ultimate goal is to have a supply chain that is responsive, cost efficient, and flexible. This is often referred to as a "hybrid" supply chain network because it is structured to exploit the strengths of both execution-based systems and planning-based systems. A supply chain is said to be "adaptive" when it also makes extensive use of internet-based technologies to enhance the coordination and collaboration of firms in the network. Because the network is tightly integrated, an adaptive supply chain offers its members and customers a high degree of "visibility" which is leveraged to make faster and more informed decisions. A "Lean supply chain" is both hybrid and adaptive. What makes the Lean supply chain unique is the dedication of participating firms to Lean Enterprise principles.

### Toward the Lean Enterprise

Sandy explains that a Lean Enterprise is a "networked organization" that brings a company together with its strategic partners to form a collaborative business network that extends the company's resources and capabilities in such a way as to enhance the company's ability to channel value to its customers. All partners add value to the company's final product in some way. There is mutual trust and transparency throughout the network and all firms are dedicated to the discovery and elimination of non-value adding activities.

Sandy notes that the Lean Enterprise is similar to the concept of the "extended enterprise", but with an emphasis on Lean principles as applied to the supply chain. A core activity of the Lean Enterprise is to identify and refine the "value stream" which refers to the specific activities across the network that actually add value to the company's final product from the customer's perspective. This is achieved by "value stream mapping" all actions, both value creating and wasteful, involved in bringing the company's product from raw materials to the company's final customer.

Processes are mapped out that reflect the current state of the value stream. A future value stream state is mapped which then serves as a blueprint for the elimination of all the non-value adding activities until the future value stream state is achieved.

### Managing Uncertainty

Sandy explains that yesterday's markets were characterized by standard products that were mass-produced for reasonably predictable market demand. She points out that today's markets are in stark contrast to this. Customers now demand a greater variety of products in smaller quantities. This results in a high degree of demand uncertainty. Things that companies must deal with today include:

- Volatile markets that change rapidly and unpredictably
- Fragmented market segments instead of mass markets
- Increased technology innovation in products and processes
- Shorter and faster product life cycles
- Increased demand for made-to-order products
- Products that bundle third party value-added features

The challenge for manufacturers today is finding a way to respond to this uncertainty and still make a satisfactory profit. A key issue, therefore, is how to achieve economies of scale while also meeting different customer requirements with increasing levels of responsiveness and flexibility.

### Battle of the Systems

Sandy emphasizes that Lean production and Lean logistics by itself will not enable a manufacturer to meet the demands of today's markets. To be truly competitive requires not just the appropriate manufacturing and logistics strategy, but also an appropriate supply chain strategy. In today's business environment, individual firms no longer

compete as stand-alone entities per se, but instead compete as supply chains.

Sandy explains that we have entered the era of “network competition” where the market leaders will be those companies that can better structure, coordinate and manage the relationships with their partners in a network committed to value stream management. Indeed, the route to sustainable competitive advantage lies in being able to leverage the respective strengths and competencies of supply chain partners to achieve greater responsiveness to market needs while remaining cost efficient.

### Supply Chain Strategy

Sandy explains that at the highest level, the appropriate supply chain strategy can be determined by looking at the Widget Company’s “market qualifiers” and “market winners”. The competitive benchmarks that the Company must have just to compete in the widget market are the market qualifiers. These are product attributes that the Company’s customers expect before a product is “qualifiable” for purchase. To actually win business requires specific product attributes or “market winners”. On the front end of the supply chain, a cost efficient strategy is most appropriate when low cost is the market winner. When service and product variety are the market winners, then a responsive strategy will be the critical success factor. The great military strategist Sun Tzu, who lived in the 6<sup>th</sup> century B.C., would have advocated such an approach. For it was he who said, “when in battle use the orthodox to engage. Use the extraordinary to attain victory”.

The relative importance of the four key attributes of any product – quality, lead-time, cost, and service level – may change with time. The implication of this is that companies continually need to evaluate and, if necessary, adjust their supply chain strategy. Periodically a new market winner emerges and downgrades the previous market winner to a market qualifier. This cyclical interchange suggests that downstream cost efficient strategies are often followed by responsive supply chain strategies as

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*“When in battle use the orthodox to engage. Use the extraordinary to attain victory.”*

-Sun Tzu, from The Art of War

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markets mature. Sandy notes that in the early stage of the widget market it was a downstream cost efficient strategy that enabled the Widget Company to “win the business”. Now, the Company’s customers demand more product variety and higher service levels that require a downstream responsive supply chain strategy.

### Summary

In a meeting of all Widget Company shareholders and employees, Richard is proud to announce that the Company has come from near extinction to becoming a powerful Lean Enterprise. He notes that what made the transformation possible was a “grass roots” effort by all stakeholders in the Company – employees, shareholders, customers, and suppliers. The principles of Lean Enterprise provided a framework of continuous improvement that helped everyone to focus on a shared vision. Richard emphasizes that through mutual cooperation of suppliers and employees, the Widget Company has been able to craft a lean supply chain network that positions the Company for strong future growth. Indeed, the Company is once again the leader in the Widget market. Employee involvement and innovation at all levels will ensure that the Company will remain so for the years to come. 🌐

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### The Supply Chain Logistics Model

Is a workshop that features a physical simulation of the Widget Company’s supply chain exactly as described in this paper. Join us and [experience](#) first hand the process of optimizing your company’s supply chain logistics network.

## About the Author

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Mr. Jordan is the President of Trade Dynamics, LLC. He has conducted workshops in supply chain logistics management for Fortune 500 companies including Michelin, UPS Logistics, Alcoa, GM, Tennessee Economic

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Mr. Jordan has over 10 years of experience in the areas of supply chain management and digital business networks. He has consulted a number of companies on networked enterprise strategy including State Farm, IBM, Hewlett-Packard, General Electric and others. Mr. Jordan is a frequent speaker at industry groups on the subject of strategic supply chain management.

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## About Trade Dynamics

Based out of Atlanta, Georgia, Trade Dynamics offers educational workshops and consulting services in the areas of supply chain logistics and supplier management. Our focus is helping companies to improve both the efficiency and effectiveness of their supply chain.

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