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Learning From Supply Chains: Moving from MRP to JIT

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With the continued publicity surrounding lean manufacturing and JIT models in the automotive industry, a number of companies from various industries are turning their attention to shorter transportation lead time and batch size requirements. The cost improvements and reduction in time are certainly evident, but before immediately changing the supply chain design, we should consider how the entire model must change to meet these adjustments.

Much of the literature concerning JIT models, simply looks at the supply chain from an independent operator approach. Toyota is cited most frequently and some discussion is given to their supplier network. What is left out is how Toyota's suppliers built the system in a collaborative effort to ensure product and delivery requirements were met. As a result, numerous companies approach a shift to JIT by only looking at their own material flows. Yet the supplier adjustments are vital to ensure success and minimal disruptions to current processes. If the downstream continues to act based on an MRP model, while the upstream moves to JIT, huge material flow challenges occur, which increase costs instead of reducing them.

In order to present this situation more thoroughly, we will first consider the problems that occur when transitioning from an MRP or "push" model to a JIT or "pull" model. How does the model fundamentally change and what should companies look at when making this switch?

Secondly, we will look at a case model of Cooper Tire & Rubber Company, which underwent this change. During an expansionary period of global growth, the company not only realized the inherent challenges of changing models, but also built a new design, which remedied the costly supply chain inefficiencies they were facing.

The Challenges of Moving from MRP to JIT

The difficulties of moving from an MRP to a JIT system are based in the changes made to inventory and capacity management. The two models operate in completely different ways, and hence the procedures and policies, for purchasing, replenishment, delivery scheduling, inventory oversight, resource utilization, production planning and outbound delivery are entirely different.

Commonly what we see is the requirement for moving to a JIT system comes from the end customer. The direct supplier is influenced by the necessity for reduced lead times, more frequent deliveries, or other changes in the upstream customers ordering and planning cycle. In some cases, the supply chain redesign change stops here. With all contributors downstream impacted by these adaptations, companies must look at the whole material flow to build the system, not simply one transaction point.

When the end customer requires a new batch size requirement, the supplier must change their process to ensure this demand is fulfilled to the new operating procedures. If demand at the end customer level is for example 3,000 component parts per month with two shipments of 1,500 parts, and they change to 2 deliveries per day of 60 component parts, assuming throughput and demand will increase, the supplier must adjust. If nothing changes with the supplier's direct suppliers, they most typically will continue order fulfillment as usually. This commonly means a higher risk of either carrying excess inventory or stock-out.

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So to change, the supplier must look at their own modified demand requirements. What are the new inventory levels to carry? In most JIT models, this will be reduced. Further, the supplier must look at their own lead times for production based on their supplier's proximity to the plant. When considering inventory changes in a JIT model, each stakeholder must always remember to look at raw material, work-in-process, finished product and in-transit inventory. The balance of each is where costs are reduced and advantages gained.

Another question to add as is, how should the delivery frequency for downstream suppliers change? In JIT, this will commonly increase. Higher frequency in upstream delivery will require the supplier to increase their delivery frequency and lower the batch size demand requirements. Most companies immediately ask how much, and in reality the calculation requires a much closer look at the entire cost structure of the new supply chain model. If the goal is to completely minimize the cost factors, the equation and variables will lead to a fairly complex quantitative approach based on the numerous factors involved. The good news is this can be simplified to meet the bare requirements.

Capacity is yet another consideration. In common MRP models, capacity is looked at in a production and inventory sense. Can the capacity create the required amount of product? With JIT, however, the questions is can capacity be utilized to meet the demand requirements? This way of thinking is again very different.

Take for example, the change in batch size and delivery frequency. When the supplier receives large order sizes, they can simply run the manufacturing operations until the order is complete, package the finished product and ship. The company can take this production quantity divided into the total demand for the day, week or month and find out what capacity is required from the customer. With JIT however, the batch size is reduced. The supplier now produces much less, packages and ships the product, but maybe multiple times per day with other customer orders in between. Where the key differentiator lies turns from capacity to the idea of throughput.

Here, capacity and throughput must look at a number of factors. Of course, production capacity is one aspect, but also packaging volume and speed, inventory resource planning, and logistics scheduling, all become part of the throughput considerations for the downstream supply chain. For example, do inbound and outbound shipping preparation areas provide sufficient resources to handle varying volume sizes and frequency? Many companies do not immediately address this question, although this is a large discussion area for companies currently improving their throughput levels. If you can produce 120% of the product your customer requires, but do not have adequate space to prepare orders in a timely manner, production capacity alone may look great, but the throughput level actually reduces the service level impacting performance.

As currently, so few companies effectively use JIT models, the demand for these companies products, production time, and importantly value added service is growing each day. This also means capacity requirements are increasing in terms of expandability. In most models, JIT suppliers and downstream contributors are actually pre-allocating capacity based on resource needs, demand planning, and costing structures to build increased coordination for the model. This increases the likelihood of long-term relationship development, and expansionary planning based on helping strong suppliers grow along side the model.

What we then see more and more are regional or global manufacturing operations that build supplier networks, many who open a new production facility along side the customer. Instead of creating longer lead times, this model allows the customer to establish the

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downstream capacity needed and also continue with suppliers they are most familiar with. Here some of the risks associated with new supplier development are reduced. At the same time, rarely does the entire model move, so new local suppliers are identified and developed. In this sense, industry wide JIT expansions grows organically as new supplier understand customer requirements, adapt their process for JIT systems, and improve their own downstream supply chains to collaborate in the model. This is yet another reason we see JIT systems expanding so rapidly around the world.

Cooper Tire & Rubber Company

To better understand the transition from MRP to JIT, we will now turn our attention to a case study, where the Cooper Tire & Rubber Company actually underwent this process. Through a period of rapid expansion and changing requirements in the industry, increasing pressure was put on the company to not only improve their current operations, but also deliver product in a shorter scheduling window.

In 1998, the company had 11 production facilities in the US, and one international facility. By 2000, Cooper grew to 61 facilities worldwide. What they soon realized were a number of challenges existing in the supply chain model. The problems included overproduction, excessive lead times, movement of redeployed product between distribution centers, inappropriate processing, unnecessary safety stocks without regard for regional needs, unnecessary movements between the loading dock and storage, and a rash of procedural defects, including misshipments, misallocations and backorders. At the time, the forecasting error was 11.67 percent, with a mean monthly deviation of 52 percent. This variability greatly impacted the companies operations and ability to maintain customers. Lastly, product lifecycles in the industry had fallen to 3 years. With a current 2 year cycle, Cooper faced difficulties in delivering new products customers demanded.

The company faced these problems by asking a series of questions and looking at the design and goals of a new model from many perspectives. Here are only some of these questions: Were stocking and production locations in the right place? Did logistics processes result in the optimal movement of raw materials and finished goods? Was Cooper making the right products at the right time, and moving them to the right locations? Was data flowing in a closed-loop, real-time environment, in support of advanced supply-chain planning and execution?

By addressing these questions, Cooper began to look at multiple scenarios and alternatives to their existing system. In identifying a solution, the company closed eight facilities, consolidated two distribution centers and added two regional distribution centers. Cooper shut down production entirely at three facilities for a week to reduce excess inventory. Transportation rerouting was also used to move product directly from manufacturing to the customer, reducing both freight costs and order cycle time.

In focusing on the movement from MRP to JIT, Cooper had to address a number of procedural and policy challenges built into their current model. For example, the company measured “mold days,” which is the length of time a particular mold is used for a specific product. As a per unit measurement was not utilized, the company had to fix production schedules 2 weeks in advance. With JIT, the company would not be able to operate in the same manner. This limited flexibility greatly hindered the company's ability to adapt. To adjust, Cooper moved to a per unit measuring system of throughput, which allowed the company to look at time differently when manufacturing and assembling customer orders.

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In changing the operations and looking specifically at a per unit output measurement, the company was able to reduce the production schedule to 4 days, and allow customer orders to reserve product anytime during this period. Prior, the company could only reserve inventory once the finished product was produced. Again, this limited flexibility, but also added to the excess inventory being held.

For the increased frequency of delivery, Cooper had to move from manually operated freight billing to an automated system, which could handle the sheer volume. In 2001, for example, Cooper processed 167,000 freight bills. With the move to JIT, the volume was expected to increase by 3 times. With the automated system, the company estimates their savings were roughly 60%.

Project management software is another area of technology Cooper implemented. At the time, some of their operating systems had been used for over 30 years. With the new system, all key stakeholders could monitor process and operations changes taking place, order placements and changes, as well as transportation scheduling. With the addition of advanced software, Cooper realized a $1.6 million increase to revenue over a three year period based on productivity gains. At the same time, software was consolidate to only a select number of key operating programs, which reduced annual licensing and updating expenses by $1.3 million.

If we dig deeper into this transition, we can see the flexibility and lead time advantage created in the development of the two new distribution centers. By moving product through the distribution centers, instead of storing product as inventory, large gains were achieved by strengthening the demand scheduling requiring increased management and control of material flows. Distribution centers by their nature force a company to produce more efficiently, and act as the pull agent for the customer from the manufacturer. The results of a decrease from 14 to 4 days in the production schedule are a clear example of this. Another benefit, we should not forget, is lowering inventory holding by 10 days, means inventory is turning into cash faster as well.

Further down the supply chain, Cooper's suppliers were also realigned to better fit the new model. As inventory from the supplier was now looked at completely different, remember raw material or work-in-process inventory is critical to consider too, replenishment cycles, production forecasting, transportation scheduling and lead time development were all re-coordinated with suppliers to identify the key suppliers who would be able adapt to the new system. In most cases, Cooper first built their replenishment model and delivery schedule to satisfy demand. Following this, capacity was negotiated with suppliers to invest in the required output. Lastly, production and transportation schedules were synchronized to tie the system together.

For a company this size, the changes on such a scale were large and the process took a significant amount of time to fully implement. In doing so however, a company which hadn't made significant changes to its operating model in decades was able to adapt to the changing requirements of the industry to remain competitive. Based on the error rate alone, some theorist would suggest that the operations were far too poor to turn around. Rethinking supply chain development can however, bring about changes and success that many thought were unimaginable.

As more companies move from MRP based systems to JIT models, we must note that MRP does have an important place in manufacturing operations. In some cases, MRP is simply necessary or provides a reasonable amount of control in order scheduling, inventory

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management and order fulfillment to meet customer demands. For some companies the initiative to change too fast only creates further challenges and costs. If not looked at in terms of the entire supply chain flow, many missteps can happen.

With the change to JIT in many industries, we can clearly see the increasing customer demands for service. In most cases this is speed, but JIT also considers resource allocation as we have discussed. In this sense, resources such as capacity, transportation, and labor can be better capitalized to increase productivity. The entire material flow can develop to provide efficiencies not achieved previously and hence the advantages so many companies identify, but also increasingly require.

[1] Bowman, Robert J., "Cooper Tire: Where the Rubber Meets the Supply Chain”, *Global Logistics and Supply Chain Strategies*. July, 2003.