Improving Supply Chain Performance For Replacement Parts Distribution

by

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This article presents an overview of a research project that examined the supply chain for components and replacement parts for a Fortune 500 manufacturing company. The project first examined a portion of the supply chain which extended from the manufacturer through a central distribution center and on to independent distributors and retailers. The objective was to identify opportunities for improving supply chain performance, with an emphasis placed on reducing the cycle time required to move materials through the supply chain.

Bob was recently hired as the technology engineer for a new CART Indy car racing team. He was very excited about his dream job and wanted to make a great impression on his boss. Bob would be working with state-of-the-art race cars containing a vast amount of data-gathering computer equipment. Data is gathered during testing or a race, then downloaded to a laptop computer for analysis. Data analysis helps the race team configure everything from suspension components to gear ratios and can mean the difference between winning a race or not finishing the race at all.

After a recent testing session, Bob downloaded a weekend’s worth of data from the race car to his laptop. This data was to be analyzed and used to set up the car for the next week’s race, the most important one of the season. Bob left the laptop sitting on the tailgate of the race car transporter. As the mechanics were loading the race car onto the transporter, one of them accidentally kicked Bob’s laptop off of the tailgate. The laptop shattered when it hit the ground. Bob saw his career flash before his eyes. Bob took the remains of his laptop to his favorite computer repair shop. The shop notified Bob that his laptop was in need of several parts that were not in stock. They would have to be ordered. Bob panicked. Without the data on the laptop, he could very well lose his job. This was certainly not the way to make a great impression on his new boss.

The repair shop assured Bob that they would do everything within their power to help and placed an emergency order with the manufacturer, at added expense, for the needed part. The repair shop knew that if they placed an emergency order that they could get the parts through priority allocation of available inventory at the manufacturer’s distribution center, expedited order processing, and premium transportation services. While an expensive practice, the repair shop ordered parts on an emergency basis in order to maintain high customer satisfaction.

Unfortunately, emergency orders have become the standard practice for parts orders in many industries. Bob’s situation with his laptop was not unique. He also had to have parts emergency ordered for both his air conditioner and refrigerator during the past year.

Concerned with improving supply chain performance, a Fortune 500 manufacturing company approached the FedEx Center for Cycle Time Research (the Center) with a research
project addressing the types of problems that were experienced by Bob. Specifically, the manufacturer requested an evaluation of cycle time issues related to the distribution of parts to its distributors and retailers. The supply chain included the original equipment manufacturers, manufacturer (final assembly operations), the manufacturer’s distribution center, a third-party distribution center, a major transportation carrier, independent distributors, and retailers.

This article is divided into five sections: (1) an overview of the parts distribution process, (2) a summary of the 11 field interviews conducted with independent distributors, (3) the results of a supply chain workshop conducted to provide a forum for discussion of critical performance issues, (4) an examination of transportation issues in a portion of this supply chain, and (5) recommendations for reducing cycle time and increasing customer satisfaction based on the findings of this research.

Overview of the Process

The manufacturer was experiencing problems in its supply chain as evidenced by increasing stockouts, lengthening lead times, and increasing logistics costs. Although the independent distributors and retailers dealt directly with the consumers of the parts and components, the increasing customer dissatisfaction was being felt throughout the supply chain. The initial meetings between the manufacturer and the Center focused on developing an understanding of the current supply chain and the manufacturer’s perspective on sources of dissatisfaction with the supply chain process.

The manufacturer has two divisions directly involved in the distribution of the parts and components: the Distribution Service Division (DSD) and the Retail Customer Service Division (RCSD). The DSD is primarily responsible for determining the parts and components required to support its customer base and to manage the associated inventory. The RCSD is responsible for the maintenance of the computerized information flow between the manufacturer’s distribution centers and the independent distributors and retailers.

The manufacturer distributes products through parallel channels as shown in Figure 1. The initial channel discussed in this article consists of suppliers, a third party distribution center (DC), independent distributors, and retailers. The manufacturer’s plants and original equipment manufacturers (OEMs) ship parts and components to a third party DC. The third party DC receives orders directly from the independent distributors. After shipping the orders to the independent distributors, the third party DC sends

![Figure 1: Parallel Supply Chains](image-url)
the shipping information to the RCSD. The independent distributors also function as repair companies whose primary responsibility consists of installation of parts and components for the retailers.

The parallel channel examined in the fourth section of this paper consists of suppliers, the manufacturer, the manufacturer’s distribution center (DC), and retailers. OEMs supply the manufacturer with a wide range of parts and components which are held in the manufacturer’s DC. The manufacturer’s DC receives the retailers’ orders, ships the required items to the retailers, and then provides the RCSD with the pertinent information.

Generally, the information flow within the supply chain was considered to be adequate. However, the flow of product was often problematic. Stock-outs, long lead times, and dissatisfied customers were common within the supply chain. These problems led the manufacturer and the Center to establish two objectives for the research project: determine the critical performance functions within the supply chain and offer improvements for those functions performed poorly by any member of the supply chain. Given these objectives, the research project was designed to take advantage of the parallel channels. The independent distributors who receive parts and components from the third party DC would be interviewed concerning supply chain issues and cycle time reduction possibilities, while the retailers would be surveyed concerning transportation practices and the corresponding impact on service in the supply chain.

Most of these independent distributors carry large inventories because they believe the supply chain is unreliable in providing replenishment stock.

Independent Distributor Field Interviews

The first step of the research project was to ascertain the perceptions of the independent distributors about the performance of the supply chain. An interview guide was designed using open-ended questions to accomplish this objective. The researchers’ goal was to determine the independent distributors’ impressions of the overall supply chain, as well as their perceptions of the critical issues causing cycle time problems.

The interview guide was pre-tested on a local independent distributor which was visited by three members of the Center’s project team. The interview confirmed that the open-ended questions allowed the independent distributor to offer observations without narrowing the areas to be discussed. The pretest indicated that only minor revisions were required. Eleven interviews, consisting of eight field interviews and three telephone interviews, were then conducted. These eleven were chosen as representative of the independent distributor base of 80 firms. Included in the sample were independent distributors from seven states with firm size ranging from two of the largest independent distributors to two of the smallest.

Interview results

The initial focus of the interview was to determine the independent distributors’ perspective of the supply process (i.e., order process between independent distributors and third party DC for the period of order placement to receipt of product) cycle time. The average time for the supply process ranged from four to fourteen days with 80 percent of the responses falling in the four to eight day range. The minimum supply process cycle time ranged from two to five days with an even distribution of
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The maximum supply process cycle time ranged from seven to more than ninety days. Sixty percent of the respondents claimed individual cases requiring in excess of 90 days to receive an order, clearly indicating that cycle time issues were a major problem.

Having established the need for cycle time reduction, the problem areas of the supply process required identification. Unfortunately, most of the respondents were unable to distinguish the components of the supply process. The interviewers prompted respondents with questions about possible supply process components (e.g., transit time, order processing time, etc.). However, distributors claimed that they did not distinguish separate components. The four that did distinguish components named ordering and transit time. Transit time was estimated to take between four and six and a half days, indicating a possible area for cycle time reduction.

Despite the inability to distinguish components of the supply process, the causes of supply process cycle time variability were expounded upon at length. Most of the independent distributors blamed the variability on multiple factors, including backorder problems, product size, transportation problems, limited inventory, and a general lack of planning. The cycle time variability resulted in increased inventories held by independent distributors and decreased customer satisfaction. No general agreement was reached on whether variability was caused by the DSD, the RCSD, or the third party DC.

The hesitancy on the part of the independent distributors to place blame may lie in their lack of supporting evidence. Performance must be measured before it can be assessed. The independent distributors felt little or no need to develop objective measures of the supply process performance because as one respondent stated, “It’s the only game in town, why track it?” Four independent distributors used no measures. Measures employed by the remainder varied greatly. Fill rate was the only measure that was discussed by more than one distributor. Other measures mentioned were backorder logs, ship dates, packing list accuracy, inventory turns, time received vs. time ordered, and cycle time consistency.

Transportation problems and slow transit times continually resurfaced as barriers to cycle time performance. Several different primary carriers were mentioned; most of these are small package or less-than-truckload (LTL) carriers. Management of the in-transit portion of the supply process is believed by the independent distributors to be out of their control. Half of the independent distributors believed the third party DC was in control of this aspect, while the others were unclear about management of this component.

Ordering was the other component of the supply process discussed by many of the respondents. The majority of independent distributors were in compliance with the requirement that orders be placed through the manufacturer’s computerized ordering system controlled by the RCSD. However, only three respondents believed the system resulted in a decrease in cycle time. Independent distributors were split on the value of the system. Those who believed the system to be beneficial to the supply process cited a decrease in cycle time, ability to check order ship date, back-order status, and the inability to input erroneous information. Detractors of the computerized ordering system argued that the flow of information was inadequate. Respondents said packing lists and “big problem” notifications were common, but little other
information was received unless specifically requested. Negative comments also focused on the expense and impersonal nature of the information system, as well as the constraints placed on quantities ordered.

Overall, the interview results demonstrated that the current supply process cycle time performance has a negative influence on independent distributor-customer relationships. The majority of independent distributors claimed the supply process caused problems or directly resulted in lost customers. In addition to the impact on customer relations, one independent distributor mentioned all of the following: high frustration level with the computerized ordering system, problems due to long parts numbers, damaging reduction in billing period, and idle technicians due to stock-outs. All of the independent distributors had suggestions for improving the supply process performance. Table 1 provides improvement suggestions mentioned by at least two independent distributors.

Based on results of these independent distributor interviews, a workshop was conducted in order to gain additional insights into current supply chain performances and to collectively identify opportunities for improvement.

Supply Chain Workshop

The Center conducted a one-day workshop in order to facilitate a constructive dialogue among the members of the manufacturer’s supply chain. The focus of the dialogue was to suggest viable solutions for reducing the supply process cycle time. Representatives from the manufacturer’s DSD and RCSD, the third party DC, and ten of the independent distributors who had participated in the field interviews attended the workshop.

During this workshop, the team members from the Center explained its role in the project and presented the basic findings of the field interviews with the independent distributors. The DSD discussed the supply process initiatives currently being implemented. In addition, each of the independent distributors was asked to present the major issues that they faced in this supply chain. These issues were consolidated for the group in order to develop a concise, complete list of the problems, as well as to prevent redundancy in the discussion. With Center personnel acting as facilitators, the workshop participants reviewed the list of problems and prioritized them based on the degree of impact each issue had on the supply process cycle time performances.

Table 1: Independent Distributor's Suggestions for Supply Process Improvement

<table>
<thead>
<tr>
<th>Suggestion</th>
<th>Frequency of Mention</th>
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<tbody>
<tr>
<td>Increase inventory at third party DC</td>
<td>5</td>
</tr>
<tr>
<td>Computerize notification and status of back orders</td>
<td>5</td>
</tr>
<tr>
<td>Improve user friendliness of computerized order system</td>
<td>4</td>
</tr>
<tr>
<td>Install TQM techniques at third party DC</td>
<td>4</td>
</tr>
<tr>
<td>Stop shifting and changing parts numbers</td>
<td>3</td>
</tr>
<tr>
<td>Decrease in-transit time</td>
<td>2</td>
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Based on these discussions, the major issues raised were related to the problem of stock-outs at the third party DC. Stock-outs directly affect an independent distributor’s inventory management practices. Most of these independent distributors carry large inventories because they believe the supply chain is unreliable in providing replenishment stock. Another serious problem caused by stock-outs was their effect on the level of service that the independent distributors were able to provide their customers due to the lack of readily available inventory. Stock-outs were also considered to be the source of much of the animosity between the supply chain member organizations.

A wide variety of other issues were also discussed. In addition to issues discussed in the previous section, the independent distributors complained most about the lack of information coming from the manufacturer, particularly about new equipment configurations and shipping information. The final part of the workshop included constructive suggestions from all parties for viable options for correcting these problems.

The majority of independent distributors claimed the supply process caused problems or directly resulted in lost customers.

Premium transportation is often used to minimize poor customer service by supplying back-orders and stock-out replenishments quickly, overnight in some cases. The manufacturer also asked that a much larger group of independent distributors be surveyed. The results of this additional research are presented in this section.

The objective of this phase of the research project was to identify further opportunities for cycle time reduction in parts shipments for the manufacturer. Specifically, an examination was conducted of current transportation practices between the manufacturer owned DCs and its retailers. This phase addressed whether the level of customer service provided by the currently utilized premium air transportation carrier was commensurate with its associated cost.

Representatives from the manufacturer and the Center met to plan the strategy for this study and to develop a survey instrument to distribute to retailers nationwide. The initial version of the survey was pre-tested to ensure that all relevant issues were addressed. Field visits to Memphis area retailers were conducted by manufacturer and Center representatives to discuss the survey instrument and solicit retailer feedback. After completion of the pre-test, the survey instrument was modified and sent to 300 retailers selected by the manufacturer.

Survey Findings

Of the 300 surveys mailed, 104 were returned completed, resulting in a response rate of 34 percent. The surveys represented a total of 2,011 shipments over a three day period. The average number of shipments per respondent was 19.34 with a minimum of one shipment per retailer and a maximum of 111 shipments per retailer.

Of the 2,011 shipments tracked by the retailers, 97 percent of these shipments were overnight
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delivery. Of these overnight shipments, 83 percent were next day a.m. deliveries and 12 percent were next day p.m. deliveries. The basic shipping practice picture is completed by the fact that 90 percent of the orders placed were special orders. These factors contribute to extra costs, both in placing a special order and in requiring the fastest commercial delivery available. These extra costs are incurred to save time, and presumably, to satisfy customers. Although these costs are borne by the manufacturer and the retailer, the customer ultimately pays for the time saved.

The use of air transportation for special order situations suggests an urgent need for the product. To validate this assumption, the respondents were asked to identify the department where the parts were forwarded. Over half (52 percent) of the shipments were directed to the service department of the retailer, while another 25 percent were used to supply wholesale customers. An interesting finding was that over 35 percent of the special order service department shipments were not used for installation or repairs the same day that the parts were received. The result is that extra costs were incurred to process special orders and utilize next day express shipping, but parts were often not used on the day of receipt.

Given the expense of air transportation, each retailer was asked if they would support surface delivery of large special orders. Forty-seven percent of the respondents were not in favor of utilizing surface transportation. An interesting finding was that over 35 percent of the special order service department shipments were not used for installation or repairs the same day that the parts were received. The result is that extra costs were incurred to process special orders and utilize next day express shipping, but parts were often not used on the day of receipt.

In summary, the use of air transportation is far more common for special orders than regular orders since retailers are using air freight as a partial remedy for stock-outs. The perception that surface transportation is too slow supports the use of air transportation in providing customer service. It is difficult to measure accurately whether the increased freight costs are commensurate with the increased levels of customer service, but the retailers’ defense of air transportation strongly supports this position.

Conclusions and Recommendations

The Center was approached by the manufacturer to examine the supply chain of a product line and the associated supply process cycle time issues. After examining the parallel channels, the following problems surfaced as major obstacles to supply chain efficiencies:

- Frequent stock-outs.
- High variability in supply process cycle time.
- Lack of information on replenishment schedule for stock-outs.
- Larger inventories kept closer to the end user.
- Unreliable surface transportation.
- High reliance on air transportation for special orders.

Table 2: Reasons for Opposition to Ground Transportation

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<thead>
<tr>
<th>Reason</th>
<th>Frequency</th>
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<tbody>
<tr>
<td>Ground transportation too slow</td>
<td>16</td>
</tr>
<tr>
<td>Emergency order and ground transportation are counter-intuitive</td>
<td>4</td>
</tr>
<tr>
<td>Fast shipments are needed for customer satisfaction</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total Unfavorable Responses</strong></td>
<td><strong>22</strong></td>
</tr>
</tbody>
</table>
Given these problems, several cycle time recommendations (Wetherbe, 1995) were made to improve cycle time performance and customer satisfaction.

**Networking/Partnering/Rewarding**

Networking is communicating and collaborating within the supply chain. For the manufacturer studied, we suggest that the various parts of the supply chain become more closely coupled. Since most of the problems in this supply chain stem from stock-outs, the supply chain as a whole needs to develop a strategy that focuses on preventing stock-outs. In the undesirable event of stock-outs, the supply chain should react to minimize customer dissatisfaction at acceptable costs. The independent distributors and retailers stated that the handling of these stock-outs cause problems and negatively affect customer service. For these reasons, the following suggestions take a two-fold approach: preventive and reactive strategies.

**Preventive strategies** include better forecasting, maintaining adequate inventory levels, and air transportation. Better forecasting needs to occur throughout the supply chain in order to produce and store the correct amount of product. The manufacturer needs to share sales forecasts with the supply chain members. This information allows OEMs to produce a reasonable amount of product to prevent back-order problems further along the supply chain. Forecasting would be the basis of the second preventive strategy -- adequate supply.

Assuming the forecasting is “reasonably accurate,” adequate supply can be improved by contractual arrangements with the OEMs. Once a supply process cycle time for components and parts is established between the OEM and the DCs, the OEM performance should be evaluated based on compliance with the negotiated schedule.

Maintaining adequate inventory levels at the manufacturer’s DC and the third party DC is also required. The independent distributors and retailers are forced to hold larger inventories and use air transportation as strategies for minimizing the effects of stock-outs at these DCs. One independent distributor told Center personnel that he believed his firm had as much inventory as the third party DC. The independent distributor later validated this suspicion with a visit to the third party DC. Stock-outs are obviously a major source of customer dissatisfaction throughout the supply chain. A review of stocking policies used to determine inventory levels is required.

The final preventive strategy can also be a reactive one. The use of air transportation should be used to prevent stock-outs whenever possible. This should be used in the link between the OEM and DCs, as well as DCs to the independent distributor and retailers. The added expense of air transportation will be offset by the increase in customer service and supply chain member satisfaction. However, caution should be applied in the use of air transportation. As the case study revealed, retailers often used air a.m. delivery for parts that would not be used immediately upon receipt. The retailers interviewed during the first phase of this study used the a.m. air delivery strategy for all of their emergency orders due to the unreliable nature of deliveries provided by the surface transportation company. To help with this problem, the manufacturers should partner with a core carrier group to ensure that parts are received in a timely manner.

As a **reactive strategy**, air transportation should be used to service any independent distributor or retailer who has faced a stock-out at the DCs once that product or component has been received at the warehouse. If economically feasible, the manufacturer may want to consider having OEMs ship back-ordered components and parts directly to independent distributors and retailers. Although transportation costs will increase, minimizing the poor service is paramount.

Another reactive strategy is for the manufacturer to facilitate an exchange system among the independent distributors and retailers in order to take advantage of all the stock in the supply chain. Once a stock-out occurs, the RCS should notify all the independent distributors and
retailers of the product need. This information will allow all of the supply chain members to begin considering alternative solutions to solve the stock-out. The manufacturer should consider an incentive system that promotes this type of cooperation among the supply chain members.

**Informate**

Informating is allowing all information to flow freely so that all parties are aware. The retailers’ concern that there is a lack of communication between them and the manufacturer indicates a need for improvement in communications channels. Ideally, an information system could be used to open these channels of communication throughout the supply chain.

Resistance to new technologies is common, but the manufacturer needs to increase its support of the retailers as they learn and adapt to the new order processing system. A user friendly operating manual and an 800 number are the bare essentials of systems support. Trained personnel, available during normal business hours and dedicated to handling queries, would give the retailers the impression that their complaints have been heard and the manufacturer has reacted in a timely fashion. This is a quick, inexpensive first step in easing the strain felt by the retailers.

What does all of this mean? The information flows throughout the supply chain, ordering parts becomes easier, and parts do not have to be stockpiled but arrive when they are needed. When stock-outs occur, premium transportation can be used to maintain a high level of customer satisfaction. Changes of this type will have a significant effect on overall supply chain performance. As a result, Bob’s laptop gets repaired in a more timely manner which means that he is a much happier customer (and still has his position with the race team). As Bob is leaving the computer repair shop he can only wonder – why can’t someone make doing my taxes this easy?

**References**


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Appendix A

Independent Distributor Interview Guide

This interview guide addresses the current supply process (i.e., order process) between the independent distributor and the third party DC for the period from order placement to receipt of product. For independent distributors that carry both product groups, please identify any differences that exist between the two product groups for any of the questions listed below.

Independent Distributor Name:       Interviewer:

Contact Name:       Date:

Telephone No.
Fax No.:
Products Carried:

1. Average Supply Process Cycle Time:
2. Minimum Supply Process Cycle Time:
3. Maximum Supply Process Cycle Time:
4. What are the specific supply process components (e.g., order processing time, transit time, etc.) and associated cycle times?
5. What are the causes of supply process cycle time variability?
6. How is your order information provided to the third party DC? If entered through the information system, how has entering your orders directly into the information system affected order process cycle times?
7. What order information is received from the third party DC? When is it provided? How is it provided?
8. How is the product transported from the third party DC to your manufacturer? Which manufacturer (e.g., third party DC, your manufacturer, third party, etc.) manages this in-transit portion of the supply chain?
9. What are the performance measures that your manufacturer currently utilizes to assess supply process performance?
10. Describe the type (e.g., parts, finished goods) and amounts (e.g., dollar value, quantities) of the manufacturer’s inventory held within your manufacturer.
11. Describe your manufacturer’s inventory policies as they relate to the third party DC.
12. Describe your manufacturer’s practices as they relate to the third party DC.
13. Describe the returns process.
14. What impact does the current third party DC supply process cycle time performance have on your manufacturer?
15. How could the third party DC supply process performance be improved?