Reducing Order Fulfillment Cycle Time in an International Supply Chain

by

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Executive Summary
This study examines cycle time reduction opportunities across a firm’s international supply chain for a key product line. The supply chain extends from customer order placement at its U.S. division through the manufacturing activity at its European division. The primary focus of the project was on the firm’s customer order fulfillment process. This process extends from customer order placement to customer receipt of the firm’s products. The project objective was to identify opportunities to reduce the time required to fill customer orders in a way that reduced cost and/or improved service.

A number of cycle time reduction opportunities were identified. They included inventory policies, product distribution practices, customs clearance issues, and utilization of electronic data interchange (EDI) technology in the firm’s information systems. Project team members were assigned to “action teams” to address each of these issues.

This article presents an overview of the major project activities, discusses action team initiatives, and provides cycle time reduction insights gained from the examination of this international supply chain.

Introduction
This article reports the results of a joint research project conducted by the FedEx Center for Cycle Time Research (the Center), FedEx, and the biochemical division of a major international medical products firm. In the research project the Center’s staff played three primary roles: educators, facilitators, and team members.

The article consists of three main sections. The first section presents an overview of the major project activities. This section provides a useful model for firms that are interested in conducting a cycle time reduction project. The second section presents the results of project “action team” efforts which addressed specific cycle time reduction opportunities. A discussion of key principles of cycle time reduction associated with the action team initiatives is also provided. The final section presents the project conclusions.

Project Overview
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Major project activities included an initial meeting, a cycle time reduction workshop, action team initiatives, and a meeting in which the action teams presented their findings. In this section, a brief overview of each of these activities is presented.

Initial Meeting
The key feature of the initial project meeting was the identification of potential cycle time research problems. A “brainstorming” session yielded a number of project candidates. This list of potential projects was narrowed to two candidates through evaluation of required resources, potential for successful completion, potential benefits, and customer impact. Following the meeting, the firm’s management met independently and determined the project would address the customer order fulfillment process for a key product line within its international supply chain. A project plan was developed and project team selected. The final project team included representatives from the firm’s U.S. and European divisions, FedEx, and the Center.

Cycle Time Reduction Workshop
A two-day cycle time reduction workshop was held at an off-site location. Workshop activities included: 1) education and training regarding the principles of cycle time reduction; 2) development of a supply chain process map; 3) identification of potential opportunity areas or “points of leverage” to reduce the time required to complete the customer order fulfillment process; and 4) prioritization of these potential “points of leverage.”

Education and Training
Education and training were key elements of the cycle time reduction workshop. Participants were introduced to over 40 strategies that have been shown to be effective in reducing process cycle times. This session also drew comparisons between cycle time reduction initiatives with business process reengineering and total quality management (TQM) programs and introduced the concept of “points of leverage.”

Process Mapping
An important part of the cycle time reduction workshop was the development of the supply chain process map. The process map presents the key steps in a given process and the time required to complete each step.

Prior to the workshop, the functional groups involved in the customer order fulfillment process were asked to complete two supply chain cycle time worksheets. These worksheets provide a framework for project team members to examine current processes and cycle time performance across the supply chain. The worksheets are presented in Appendix A.

During the workshop, the project team used the information captured by the supply chain process worksheets to develop a supply chain process map. A high-level process

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map for the firm’s current order process is presented in Figure 1.

Identification of “Points of Leverage”
Upon completion of the supply chain process map, the group focused its efforts on identifying "points of leverage." The points of leverage concept for a cycle time reduction project is analogous to the flaps and rudder on an aircraft. A pilot steers an aircraft through the use of the flaps and rudder. Although these are relatively small parts of the aircraft, use of these points of leverage allows the pilot to turn the aircraft. Similarly, in examining business processes, there are often a few specific parts of the overall process (or points of leverage) that

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**Reducing Order Fulfillment Cycle Time**

![Figure 1: Current Order Process](image)

**Step 1**
Administrative and physical processes
range: 5.7 - 14.8 days
mean: 6.9 days

**Step 2**
Shipment consolidation and waiting time for flight
range: 0.0 - 5.0 days
mean: 0.3 days

**Step 3**
Transport to U.S. port of entry
range: (no variability)
mean: 1.5 days

**Step 4**
Customs clearance
range: 2.0 - 21.0 days
mean: 8.0 days

**Step 5**
Transport to U.S. DC
range: 1.0 - 3.0 days
mean: 1.2 days

**Step 6**
Pack and ship to customer
range: 1.0 - 2.0 days
mean: 1.9 days

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can provide opportunities for significant cycle time improvement.
In examining the customer order fulfillment process map, the project team developed a list of potential points of leverage to improve order cycle time performance. Specific areas identified included:

- Direct shipment of U.S. customer orders from the European division,
- Increased inventory held in the U.S. division’s distribution center (DC),
- Review of customs broker activities,
- Utilization of electronic data interchange (EDI) to link U.S. and European division information systems,
- Integrated information systems,
- Use of more frequent product shipments from the European division to the U.S. division,
- Reduction in product line through standardization of package sizes and product concentration strengths,
- Alteration of working hours, and
- Use of different U.S. port of entry.

Prioritization of “Points of Leverage”
Having identified the points of leverage and recognizing that the project team did not have the resources to address all points of leverage that were identified, the next activity was to prioritize these opportunities. To accomplish this task each member of the project team was allowed to vote for the specific area he or she thought would provide the greatest potential for cycle time reduction. When casting their votes, project team members were asked to keep two criteria in mind: (1) the “overall impact of the opportunity area on the firm’s business” and (2) “probability of implementation.” As a result of the voting process, four points of leverage were selected for further review:

- Direct shipment of U.S. customer orders from the European division,
- Increased inventory held in the U.S. division’s DC,
- Review of customs broker activities, and
- Utilization of electronic data interchange (EDI) to link U.S. and European division information systems.

Several other areas offered significant opportunities for cycle time reduction but were not considered to have high likelihood of implementation. Other opportunity areas, such as integrated information systems, were already being addressed by the firm. An “action team” was assigned to each of the selected opportunity areas. These teams worked independently in an effort to identify specific opportunities for cycle time reduction and to develop actionable recommendations for each of the four areas.

Reports from the Action Teams
Each action team worked on their specific cycle time initiative for approximately six months. At the end of this period, the entire project team met to present and discuss
action teams’ findings. An overview of each of the action team initiatives is presented in the next section.

Action Team Initiatives
The action team initiatives included modeling the customer order fulfillment process, reviewing the customs clearance process, and utilizing EDI technology to link the firm’s U.S. and European information systems. This section presents an overview of each of the action team initiatives.

Modeling the Customer Order Fulfillment Process
An action team analyzed both the direct shipment of U.S. customer orders from the European division and the impact of an increase in inventory held in the U.S. division’s DC through the use of a computer-based simulation model. The direct shipment option represented an effort to reduce the cycle time required to fill an order for products that are not currently held in inventory at the U.S. division’s DC. The inventory analysis attempted to reduce average customer order cycle time by increasing the probability that the ordered product would be in-stock. This section discusses the modeling effort and its results.

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Current Process and Alternative Approaches
The firm’s products are manufactured and inventoried at its European division. A limited product inventory is also held at the U.S. division’s DC. U.S. customer orders are received by the U.S. division sales office. If the customer order is for a product that can be filled from inventory held at the U.S. DC, then the customer receives the order in approximately two days. If the required product is not available at the U.S. DC, the customer order is relayed to the European division.

As shown in Figure 1, the current process consists of several activities. Various administrative and physical processes are performed at the European division. The product is then air freighted to the U.S., typically in a consolidated shipment that includes multiple orders and multiple products. Upon arrival in the U.S., the shipment goes through customs, which sometimes causes considerable delays, as indicated in Step 4 of Figure 1. After clearing customs, the product is shipped to the U.S. DC, and upon arrival is repacked and shipped to the customer.

This process can be lengthy, ranging from 2.2 to 9.5 (five-day) work weeks. The majority of orders are filled in 3.2 to 5.6 weeks, and the average is 4.0 weeks. Customers frequently express frustration at this lengthy lead time, but often they must wait because they have no alternative. However, when possible, many customers

Customers frequently express frustration at this lengthy lead time, but often they must wait because they have no alternative.
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will switch to suppliers that provide a shorter order fulfillment. Another sentiment expressed by customers is that they would increase their orders if they could receive their orders faster. Thus, it is critically important that customer order fulfillment cycle time be reduced.

As mentioned earlier, when a U.S. customer places an order, if inventory is available at the U.S. DC, then only the “pack and ship” part of the process (Step 6 in Figure 1) is required. In fact, order fulfillment time can be as short as one day if the product happens to be packaged in the appropriate quantity. In general, if inventory is available in the U.S., order fulfillment time is two days.

One way to reduce customer order fulfillment cycle time is to maintain a bulk stock of inventory in the U.S. From the customer’s perspective, the steps related to the manufacture of the product and shipment to the U.S. division’s DC (Steps 1 to 5 in Figure 1) are eliminated. These five steps would become the reorder process for restocking the U.S. DC’s inventory. Another alternative involves express shipment of the product from the European division directly to the U.S. customer. Each of these alternatives was considered in the simulation modeling analysis and is discussed in the following sections.

Bulk Stock, Standard Shipment of Reorders

In evaluating a U.S. bulk stock inventory, customer order fulfillment time would be one to two days if sufficient inventory was available. An important question is, how much inventory would be needed in the U.S. to maintain a high service level? The goal is to achieve a service level of 99 percent, that is, 99 percent of customer orders can be filled immediately. A specific inventory policy must be determined so the firm can achieve this service level with a minimum amount of inventory. The inventory policy consists of the reorder point, the stock up-to-level, and the frequency of inventory review. The initial proposal suggested that inventory levels be reviewed weekly, the reorder point be a four-week supply, and the stock up-to-level be an eight week supply. Six different products within the product line were

Table 1: Service Level
(percentage of orders that are filled immediately)

<table>
<thead>
<tr>
<th>Reorder Point (in weeks of supply)</th>
<th>Stock-up-to Level (in weeks of supply)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8</td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>78.3</td>
</tr>
<tr>
<td>8</td>
<td></td>
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</tbody>
</table>
included in the analysis. The results presented here are the average results for all six products. Due to the random nature of customer orders (both arrival time and order size) and random lead time for reorders, computer simulation was utilized for evaluating a number of scenarios. Simulation is useful because it allows for an accurate assessment of the impact of the specific inventory policy. Assumptions utilized in the simulation model are summarized in Appendix B.

Simulation of the reorder process (Steps 1 to 5 in Figure 1) shows the average lead time for a reorder is 3.6 weeks, ranging from 2.0 to 9.0 weeks, with the majority taking between three and five weeks. The inventory policy used in the simulation is as follows:

- Inventory levels are reviewed weekly;
- A reorder is placed if a product’s inventory has fallen below the reorder point; and

<table>
<thead>
<tr>
<th>Reorder Point (in weeks of supply)</th>
<th>Stock-up-to Level (in weeks of supply)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>6</td>
<td>11.2</td>
</tr>
<tr>
<td>8</td>
<td>9.3</td>
</tr>
</tbody>
</table>

Table 2: Average Number of Reorders Per Product

<table>
<thead>
<tr>
<th>Reorder Point (in weeks of supply)</th>
<th>Stock-up-to Level (in weeks of supply)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>2.3</td>
</tr>
<tr>
<td>6</td>
<td>2.4</td>
</tr>
<tr>
<td>8</td>
<td>5.6</td>
</tr>
<tr>
<td>10</td>
<td>7.7</td>
</tr>
</tbody>
</table>

Table 3: Average Inventory Level (in weeks of supply)
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- The size of a reorder is calculated by subtracting the current inventory level from the stock up-to-level.
- When a customer places an order, the order is filled immediately if there is sufficient inventory. If there is insufficient inventory to fill the entire order, the order must wait until a replenishment order arrives at the U.S. DC. The firm’s products are lot-specific, so partial orders are never shipped. Thus, when inventory is low, it is possible that a larger customer order may experience a stock-out, while a smaller order could be filled immediately.
- For each inventory scenario, the following information was collected for each product:
  - The service level,
  - The number of replenishment orders required, and
  - The average inventory level.

The values are collected for each product separately because these values will vary based upon the frequency of customer orders. The reorder point was varied from four weeks of supply up to ten, and the stock up-to-level was varied from eight weeks of supply up to 16. Service levels for the specific inventory policies examined are presented in Table 1. Scenarios that were clearly not feasible or unattractive were omitted.

The first inventory policy examined was the (4, 8) policy (which means the reorder point is four weeks of supply and the stock up-to-level is eight weeks of supply). The resulting service level is 73.2 percent, indicating that this policy causes stock-outs 26.8 percent of the time which is far too

<table>
<thead>
<tr>
<th>Step 1</th>
<th>Administrative and physical processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>range:</td>
<td>5.7 - 14.8 days</td>
</tr>
<tr>
<td>mean:</td>
<td>6.9 days</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 2</th>
<th>Shipment consolidation and waiting time for flight</th>
</tr>
</thead>
<tbody>
<tr>
<td>range:</td>
<td>0.0 - 1.0 days</td>
</tr>
<tr>
<td>mean:</td>
<td>0.5 days</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 3</th>
<th>Express ship to U.S. DC and customs clearance</th>
</tr>
</thead>
<tbody>
<tr>
<td>range:</td>
<td>1.0 - 3.0 days</td>
</tr>
<tr>
<td>mean:</td>
<td>2.0 days</td>
</tr>
</tbody>
</table>

Figure 2: Express Reorder Process
often. As shown in Table 1, both inventory parameters were gradually increased, causing the service level to gradually approach 100 percent. Table 2 presents the average annual number of reorders per product that resulted for each of the scenarios. This value decreases (and thus reorder cost is minimized) as one moves toward the lower right corner of the table. Table 3 correspondingly shows the average inventory level for the scenarios. This value decreases (and thus holding cost is minimized) as one moves toward the upper left corner of the table. If minimizing cost were the objective, one could use the values in Tables 2 and 3 to find the minimum cost inventory policy. However, the objective was to minimize customer order fulfillment time, so service level was the major factor in selecting the best inventory policy. It appears that the (8,14) policy is best, given the goal of achieving a 99 percent service level. These values could be further refined for each of the various products, with the more frequently-ordered products achieving the desired service level with less inventory. As may be observed in Table 3, the (8,14) policy leads to an average inventory of 7.1 weeks of supply, which is a rather high inventory level. One method for decreasing inventory while maintaining the service level is to increase the frequency of inventory reviews. If this were done daily, or continuously (with an automated process), the inventory parameters could be reduced, and less inventory would be required. However, this method would achieve a relatively small improvement. For example,

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<table>
<thead>
<tr>
<th>Step 1</th>
<th>Administrative and physical processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>6.7 - 15.8 days</td>
</tr>
<tr>
<td>Mean</td>
<td>7.9 days</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 2</th>
<th>Shipment consolidation and waiting time for flight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>0.0 - 1.0 days</td>
</tr>
<tr>
<td>Mean</td>
<td>0.5 days</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 3</th>
<th>Express ship to U.S. customer and customs clearance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>1.0 - 3.0 days</td>
</tr>
<tr>
<td>Mean</td>
<td>2.0 days</td>
</tr>
</tbody>
</table>

Figure 3: Direct Shipment Process
the (8,12) scenario with daily reviews has a service level of 98.4 percent (slightly below the goal) and has an average inventory of 6.1 weeks of supply.

**Bulk Stock, Express Shipment of Reorders**

The major contributor to the high inventory level is the lengthy lead time of reorders. If this lead time could be reduced by using express air freight, the reorder point and stock up-to-levels could be reduced significantly. In the current order process considerable time is devoted to customs clearance activities (Step 4 of Figure 1). Also, there is a self-imposed delay due to shipment consolidation and waiting (Step 2 of Figure 1). If reorders could be shipped the day they were ready, the time range for this part of the process would be reduced. The express reorder process is presented in Figure 2. If product shipments were handled by an express air freight company with express customs clearance capabilities, the product shipments would be delivered to the U.S. DC in one to three days, with an average of two days. The simulation shows this process reduces the average lead time to under two weeks.

Computer simulation of this alternative shows that a (4, 8) inventory policy using daily inventory review achieves a service level of 98.7 percent and leads to an average inventory level of 4.3 weeks of supply. This scenario would have a higher reorder cost due to the increased expense of express air freight; however, this process allows the U.S. inventory to be kept considerably lower.

### Table 4: Summary Comparison of Alternatives

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Order Fulfillment Time</th>
<th>Other Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Current process</td>
<td>2.2 - 9.5 weeks&lt;br&gt;Mean = 4.0 weeks</td>
<td>Higher worldwide inventory than #1</td>
</tr>
<tr>
<td>2. Bulk stock, standard shipment</td>
<td>1 - 2 days</td>
<td>Lower inventory than #2&lt;br&gt;Higher shipping costs than #2 for reorders</td>
</tr>
<tr>
<td>3. Bulk stock, express reorders</td>
<td>1 - 2 days</td>
<td>Customers may have to deal with customs clearance issues&lt;br&gt;Higher shipping costs than #1</td>
</tr>
<tr>
<td>4. Direct shipment to U.S. customers</td>
<td>1.5 - 4.0 weeks&lt;br&gt;Mean = 2 weeks</td>
<td></td>
</tr>
</tbody>
</table>
Direct Shipment to U.S. Customers
An alternative to maintaining bulk stock inventory at the U.S. DC is to ship orders using an express air freight carrier directly from the European division to the U.S. customer. This process is presented in Figure 3 and is essentially the same as the Express Reorder Process (Figure 2), with the difference being that delivery is being made directly to the U.S. customer (Step 3). The administrative and physical processes (Step 1 of Figure 3) would also be lengthened by one day due the need for customized packaging for the specific customer. Simulation of this alternative shows that customer order fulfillment time averages two weeks, and ranges from 1.5 to 4.0 weeks. A potential drawback of this alternative is that the addressee typically is responsible for resolving any customs problems. In the other alternatives, customers are not involved with customs issues associated with their product shipments.

Comparison of Alternatives
The four alternatives discussed here are summarized in Table 4. The two bulk stock alternatives clearly are best for customer order fulfillment, but they would increase worldwide inventory levels. Using express reorders would involve a smaller increase in inventory but would have higher shipping costs. Direct shipment would not increase inventory, however, it would not reduce customer order fulfillment time to the extent of the bulk inventory approaches. It also holds the potential problem of the customer needing to deal with customs issues that may occur.

The key principles of cycle time reduction utilized in this portion of the project include eliminating, anticipatory-scheduling, and prototyping (Wetherbe, 1995).
Eliminating is utilized with the direct shipment of U.S. customer orders from the European division of the firm. The U.S. division’s involvement in the customer order fulfillment process has been eliminated. Anticipatory-scheduling is utilized in the bulk inventory scenarios. In this situation, the objective is to identify the key factors that influence inventory availability, including reorder points, stock up-to-levels, and frequency of inventory reviews. Prototyping is the overall simulation effort utilized to analyze and compare new alternatives with the firm’s current practices. The new practices are being prototyped through the use of the simulation model to determine if they offer significant potential for cycle time reduction prior to actual implementation.

Customs Clearance
The customs clearance part of the order fulfillment process was one the longest (an average of eight days) and the most variable (a range of two to 21 days). The action team assigned to the customs clearance process conducted a detailed review of these activities in an effort to improve the cycle time performance in this area. The team conducted a field visit to the firm’s customs broker at O’Hare Airport in Chicago, Illinois to observe the processing...
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of its shipments. The objective for this visit was to observe the customs broker’s internal processes and resources in action. Key observations made included:

- The customs broker could not begin the clearance process until all packing lists and invoices had been received from the firm’s U.S. division office. The U.S. division received these documents from the European division and reviewed them prior to sending them to the customs broker. The U.S. division was unable to fax these documents to the customs broker due to problems with illegible copies. These documents were sent to the customs broker via an overnight delivery service.
- It takes customs broker personnel up to four hours to enter the firm’s documentation into their system. Therefore, if the customs broker receives the documentation at 1:00 p.m. or later, the chances of a shipment clearing that day are zero.
- Because another division of the firm is regulated by the Food and Drug Administration (FDA), the firm’s biochemical division shipments are subject to a greater level of scrutiny. During the period from January 1995 through September 1995, the firm’s biochemical division experienced 18 customs “intensive” reviews and 23 FDA “holds” which can take from three to 30 days to complete.

![Export Order Processing Diagram]

Figure 4: Export Order Processing
Chicago is a training site for FDA inspectors, and due to the rapid turnover of personnel at this location, the inspectors have limited knowledge regarding the firm’s products and their uses.

The firm’s goal is to reduce customs processing time to an average of three days as well as reduce the variability associated with this activity. To accomplish this objective, the action team developed the following recommendations:

- Shipment documentation should be sent directly from the European division to the customs broker via EDI. This approach would reduce the cycle time by at least three days.

- The firm should begin working more closely with U.S. customs and the FDA to determine which products they repeatedly question in an effort to provide these agencies with the information they need to avoid FDA holds and customs intensive reviews.

- The firm should identify products which cause a “red flag” and ship these products under a separate airbill to avoid one product delaying an entire shipment which typically contains multiple orders and multiple products.

- The firm should consider alternative clearing points that have an established record for timely customs clearance.

Each of these recommendations incorporates key cycle time reduction principles (Wetherbe, 1995). The use of EDI to transmit documentation directly from the European division to the customs broker involves eliminating and automating. The direct EDI transmission of shipment documentation from the European division eliminates the involvement of the U.S. division. The EDI approach also automates the manual entry of the firm’s documentation into the custom broker’s system.

The firm’s efforts to work closely with the governmental agencies is an example of partnering. The firm is willing to work on a cooperative basis with the FDA and customs to insure that it provides them with all the information they require to perform their duties, whenever, wherever, and however they need it. (In a perfect world, eliminating these regulatory agencies would be the preferred option. However, this option, although appealing, is not likely to occur in the near future.)

Identifying products that are likely to result in additional review and sending these products under a separate airbill apart from the main shipment is an effective means to improve the average cycle time.

The final recommendation incorporates two cycle time reduction principles, measuring and benchmarking. The firm will measure the customs processing time performance at its current point of entry and benchmark this level of performance against that of other points of entry where similar products are being cleared. If the firm identifies an
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opportunity to reduce significantly the customs clearance process through the use of another point of entry, it will do so.

Electronic Data Interchange (EDI)

This firm, like many others, must deal with the limitations of legacy information systems. Specifically, the firm’s various information systems around the world are old and incompatible. This fact has proven particularly problematic for the customer order fulfillment process within the firm. The firm’s European division receives customer orders from more than 100 sales offices around the world. The European division handles an average of 45,000 customer orders per year with a total of 380,000 line items. To complicate this issue, the firm has experienced an 11 percent decrease in its order processing staff while at the same time experiencing a 15 percent increase in the number of line items that must be processed.

Customer Order Processing

Due to the incompatibility of information systems within the firm, order processing was slow and plagued with problems. When one of the firm’s sales offices received a customer order, they would enter the customer order into their own information system. If the specific location was unable to fill the customer order from inventory held in its DC, then a printout of the customer order was faxed manually to the European division. This process often required the European order processing staff to make several phone calls to resolve questions about the order. Once the European division received the customer order, they would enter it manually into their own order processing information system, pick and pack the order, print out a delivery note/invoice, and manually fax it back to the originating sales office. This process took an average of 48 hours. In fact, the European division had two people devoted to order processing on a full-time basis. These individuals could enter a maximum of 180-200 line items per hour. As a result, no more than 20 customer orders could be handled per day. This manual order processing was also plagued with low accuracy. Another significant cycle time problem with this order processing approach was that several people merely acted as order “mailmen.”

To help streamline the order handling process, increase order entry accuracy, and reduce the cycle time of the order process, the European division decided to implement an intraorganizational EDI-based order processing system that would work in conjunction with an organization-wide implementation of an integrated information system. In addition, the firm’s management felt that only people that add value to an order should handle it.

EDI and Order Processing

EDI has been touted as a useful component of an interorganizational information system (IOIS) (e.g., Gomes-Casseres 1994, Kanter 1994, Levinson and Meter 1988, Levinson 1994, Nichols et. al., 1995). The benefits of implementing EDI interorganizationally facilitate opportunities
for business partners, even if they are a part of the same organization, to refine their relationship in a way that is beneficial to all parties involved (Riggins and Mukhopaphyay 1994). These benefits include higher levels of operational efficiency, lower costs, and improved customer service (Johnson and Vitale 1988).

The European division decided to implement EDI as a means of reducing cycle time for its global order processing. With this new intraorganizational EDI order processing system, the sales force will enter orders into their local information system. For example, the U.S. division would enter orders at their location. If the order cannot be filled from U.S. inventory, the system will transmit automatically the customer order to the European division. After a short order validation process, the European system automatically generates the required production order. The firm estimates that less than one percent of the customer orders will require additional manual intervention. In addition, each line item will now have an associated comments section. This feature will help to overcome the need for telephone conversations for explanations. Once the order has been accepted by the system, a production order is generated automatically and sent to the manufacturing facility. Invoices are created automatically and sent to the system of origin. A system generated declaration is also forwarded automatically to the firm’s customs broker (See Figure 4).

This new order-processing system reduces the total order processing cycle time to 24 hours, has a much higher accuracy rate than the old system, requires less human involvement due to line items being automatically entered without manual processing, and costs less than faxing the orders.

The key cycle time reduction principles illustrated here are once again automating and eliminating (Wetherbe, 1995). By automating the customer order transmission process through the use of EDI, the firm has eliminated the non-value-added steps of manual faxing of customer orders and multiple entry of the customer order information. The use of EDI has also improved the quality of the information utilized within the customer order processing system. This feat has been accomplished by decreasing the opportunity for input errors associated with multiple entries of a single customer order.

**Conclusions**

This article provides an overview of a successful cycle time reduction project. The project was successful in that the firm was able to identify a number of opportunity areas or “points of leverage” to reduce the time required to complete the order fulfillment process. The firm’s multi-faceted attack on order fulfillment process cycle time proved highly effective. By utilizing several action teams in a parallel manner the firm was able to address several points of leverage concurrently. Each of the action teams was
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able to develop actionable recommendations to reduce the customer order fulfillment cycle time. In the EDI case, the implementation of an intraorganizational EDI-based order processing system has already reduced order processing cycle time. Although they differ in magnitude of effect, each of the action team initiatives provide significant opportunities for cycle time reduction.

It is interesting to note that all of the action team’s recommendations relate to the key principles of cycle time reduction. These principles have proven to be a highly effective means to accomplish cycle time reduction in a relatively short period of time.

References


Appendix A
Supply Chain Cycle Time Worksheets:

Supply Process
Use this worksheet to describe the current supply process between your organization and your supplier for the period from order placement to receipt of product from the supplier.

Supplier: _______________________________
Product Supplied: __________________________
Average Supply Process Cycle Time: __________________________
Minimum Supply Process Cycle Time: ________________________
Maximum Supply Process Cycle Time: _________________________
Supply Process Cycle Time Variance: __________________________

1. What are the specific supply process components (e.g., supplier processing time, transit time, etc.) and associated cycle times?

2. What are the causes of supply process cycle time variability?

3. What information is provided to the supplier? When is it provided? How is it provided?

4. What information is received from the supplier? When is it provided? How is it provided?

5. How is the product transported from the supplier to your organization? Which organization (e.g., supplier, your organization, third party, etc.) manages this in-transit portion of the supply chain?

6. What are the performance measures that your organization currently utilizes to assess supply process performance?

7. What impact does the current supply process cycle time performance have on your organization?

8. What are potential actions that could be taken to reduce the supply process cycle time?

Customer Order Fulfillment Process
Use this worksheet to describe the customer order fulfillment process for the period from customer order receipt to customer receipt of finished goods.

Supplier: ____________________________________
Product Supplied: __________________________

Average Customer Fulfillment Cycle Time: _______________________________
Minimum Customer Order Fulfillment Cycle Time: _______________________
Maximum Customer Order Fulfillment Cycle Time: _______________________
Customer Order Fulfillment Cycle Time Variance: _________________________

1. What are the specific customer order fulfillment process components (e.g., order processing, planning, fabrication, etc.) and associated cycle times?
2. What are the causes of customer order fulfillment cycle time variability?
3. What information is received from the customer? When is it provided? How is it provided?
4. What information is provided to the customer? When is it provided? How is it provided?
5. Describe the type (e.g., raw materials, WIP, finished goods) and amounts (e.g., dollar value, quantities, and days of supply) of inventory held within your organization’s portion of the supply chain.
6. For the inventory held within your organization’s portion of the supply chain, indicate why this inventory is held.
7. How is the product transported from your organization to the customer? Which organization (e.g., your organization, the customer, third party, etc.) manages this in-transit portion of the supply chain?
8. What are the performance measures that your organization currently utilizes to assess customer order fulfillment performance?
9. What impact does the current customer order fulfillment cycle time performance have on your organization?
10. What are potential actions that could be taken to reduce the customer order fulfillment cycle time?
Appendix B
Simulation Model Assumptions

Customer Order Assumptions
- The prorated quantity shipped through July 1995 is the average annual demand.
- Customer orders arrive randomly (exponential distribution) without significant seasonal pattern.
- The prorated number of orders for 1995 is the average annual number of orders.
- The average order size is (annual demand)/(prorated number of orders for 1995).
- The order size range is ± 30 percent of the average order size.
- Order size is normally distributed, and the randomly generated values will be rounded off to the nearest 0.1 units of measure (UOM).

Inventory Assumptions
- Inventory levels are reviewed once a week.
- If an item’s inventory is below the four week supply (e.g., 1/13th of average annual demand), a reorder is placed. If inventory is greater than or equal to the four week supply, nothing happens.
- Reorder size = eight week supply minus the current inventory, this is then rounded up to the nearest whole number of normal package sizes.
- No reorder is placed if a replenishment order is pending.
- If there is insufficient stock to fill an order, the order waits until a replenishment order arrives from the European division (as opposed to placing the customer order with the European division).
- Replenishment orders placed with European division follow the current process (Figure 1) except for Step 6 (packing and shipping to customer).

Packaging Assumptions
- U.S. division inventory will be held in the normal package sizes (rather than in bulk).
- Repackaging is necessary when order size does not equal the normal package size (e.g., the exact amount the customer ordered is sent).
- The entire quantity ordered is sent together (for example, if an order is for 4.1 kilograms and the normal package size is 0.5 kilograms, then repackaging is needed for the 0.1 kilograms and the 4 standard packages wait until the entire order is ready).
- Odd amounts left over from repackaging remain in inventory to be used for other orders requiring repackaging.
- For products available in two package sizes, only the smaller package size was used in the model (for simplicity). This will not affect model results as the total inventory quantity at any given point in time is unchanged.