Rapid Replenishment at a Consumer Product Goods Manufacturer

by

Deborah Eugenia Becker

and

Roman Viktorovich Korchagin

Submitted to the Engineering Systems Division in Partial Fulfillment of the Requirements for the Degree of

Master of Engineering in Logistics

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Signature of Author .....
May 11, 2007

Signature of Author .....
May 11, 2007

Certified by .....
Edgar Blanco
Research Associate, MIT Center for Transportation and Logistics

Accepted by .....
Yosef Sheffi
Professor, Civil and Environmental Engineering and Engineering Systems
Director, MIT Center for Transportation and Logistics

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Abstract

Increasing supply chain velocity has adverse consequences for consumer product goods manufacturers, but creates value and flexibility for retail stores. This thesis outlines a case study of a rapid replenishment pilot project between the food manufacturer General Mills, Inc. and their retail customer Giant Eagle. We outline constraints that General Mills had to impose upon their customer so it could remain profitable and retain its efficient operating strategy. We offer recommendations to General Mills on how to grow and sustain their rapid replenishment business.

Thesis Supervisor: Dr. Edgar Blanco
Title: Research Associate, Center for Transportation and Logistics

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1 Introduction

This thesis was sponsored by General Mills, Inc. Kevin Fitzpatrick, Dave Jackett, Kathy Jackson, Cathy Ruehl, Amy Baker, and Stan Sherfinski made up the core team of General Mills employees who provided the inspiration, insight, and data for the analysis below.

1.1 Motivation

This thesis describes the effects of creating a "high velocity" supply chain policy for a General Mills distribution center in Ft. Wayne, Indiana. This distribution center handles thousands of General Mills SKUs and services retail customers in ten states. In the past few years, the most dynamic General Mills customers have looked at their supply chains to lower the cost of doing business and to drive profits. To respond to and sometimes preempt customer demands, General Mills has adopted new operating policies and invested in new technology to achieve efficiencies.

Giant Eagle is an innovative grocery retailer in the Northeast United States. They are a major customer for General Mills, and has grown larger and more profitable in the past few years. Aiming to become an industry leader in innovation, Giant Eagle has invested heavily in restructuring their organization, and has developed collaborative relationships between functional groups, as well as with their suppliers. In 2001 Giant Eagle requested that General Mills decrease lead time for orders in order to reduce inventory levels, create fresher product, lower operating expenses, and drive growth and profitability. In 2006, after other types of collaboration, a rapid replenishment pilot was initiated. This thesis examines this year-long pilot

project between General Mills and Giant Eagle. We will discuss the incremental steps taken, the goals achieved, and reasons for success.

1.2 Outline

This thesis will define what rapid replenishment means for a consumer product goods manufacturer, and review the relevant models and metrics that are published in supply chain and business literature. We show how velocity is meant to drive growth and profitability for General Mills' customers, and also for General Mills. In Chapter 3 we discuss General Mills' current operations and strategy. In Chapter 4 we describe a rapid replenishment pilot project with Giant Eagle. In Chapter 5 we analyze mixed results from the first six months of this pilot project. In Chapter 6, we recommend changes in operating processes and systems that would help General Mills achieve a successful rapid replenishment policy, securing growth and profitability.

2 Literature Review

2.1 Supply Chain Performance Metrics

This section describes approaches for classifying supply chain metrics that will be used in the following chapters. We discuss interactions and tradeoffs between metrics.

It is important to have the right measures in place, and so a company can react in a timely and accurate way to supply chain issues. In order to build an effective performance measurement system it is important to establish a set of evaluation criteria, and to identify the inherent tradeoffs and interactions between those criteria (Caplice and Sheffi, 1994).

Debra Hofman suggests that managers divide organizational metrics into three levels to give a more detailed view of supply chain performance. Each level serves a different purpose. The first set allows executives to assess the overall health of supply chain. The second level is more detailed, and is used for the diagnoses of supply chain issues. The lowest level uses a variety of metrics that support effective root-cause analysis and enable precise corrective action. In analyzing metrics relevant to rapid replenishment, we use this paradigm to assess metric performance (Hofman, 2004).

There are several best practices in metric portfolio design. First, a performance metrics system should be organized by process rather than by function. The metrics portfolio should be balanced against cost, quality, time, and effectiveness, and be cross-functional to avoid "siloed"

behavior. Second, how well a company measures data, as well as how well they act upon those measurements, is more important than the amount of data measured. Third, different goals require different metric portfolios. For example, people at various levels within the company need to know different information about how the supply chain is performing. Fourth, it is essential to keep each metric portfolio small, focusing on the few metrics that really matter. The more metrics are in a company's portfolio, the more difficult is to collect consistent and valid data that can be useful for decision making (Hofman, 2006).

Larry Lapide divides metrics into three groups according to the operating strategy and performance objectives that a company is pursuing: Customer Response, Efficiency, and Asset Utilization (Lapide, 2006). These metrics are outlined in **Figure 1**.

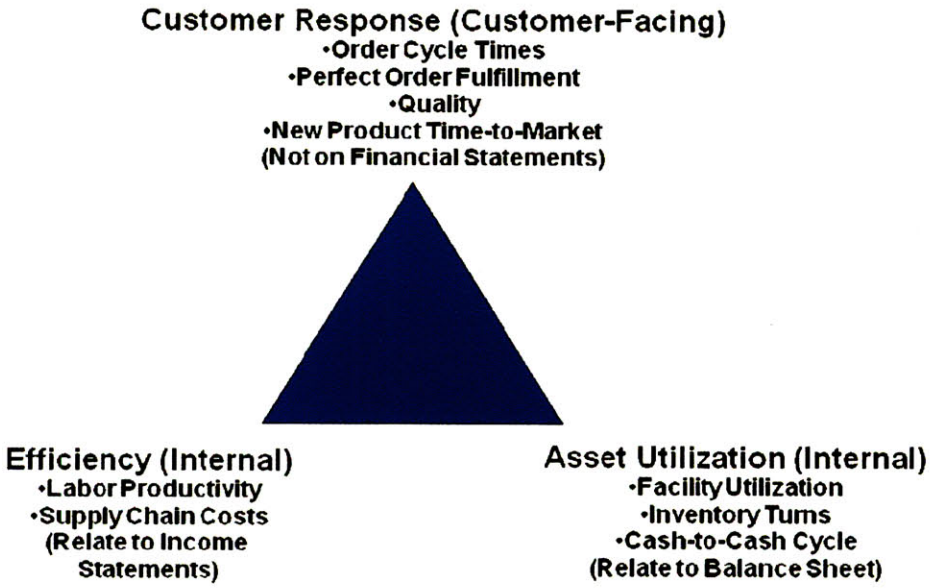

Figure 1: Aligning Operational Performance to Business Goals

Customer response metrics are used to assess the performance of operations that are directly related to customers. Emphasizing these types of objectives is important for companies working with high-margin products. Efficiency metrics measure how well a supply chain

convert inputs to outputs. Efficiency metrics are directly related to income statement. Asset utilization metrics show how effectively assets such as facilities and inventories are being used. They can be used effectively to maximize the use of production equipment. Asset utilization metrics are related directly to the balance sheet.

To achieve a competitive advantage, a successful supply chain strategy should be focused on no more than two types of performance objectives. If a company pursues all possible performance objectives, it lacks focus and competitive advantage.

2.2 Push, Pull and Push-Pull Supply Chain Management Strategies

The previous section introduced the concept of supply chain metrics. This section defines push, pull and push-pull strategies, and their strengths and weaknesses. The next sections (2.3-2.5) describe tools that companies use to implement push, pull, and push-pull demand management strategies.

Traditionally two supply chain strategies have dominated supply chain management: push and pull. In a push-based supply chain strategy all production and distribution are based on forecasts rather than on specific customer demand. Typically, the manufacturer sets production at a level in according to a long-term forecast which is based on historical ordering patterns from retailers, and uses sales force and sales promotion methods to push product through distribution channels. An example of this is PC manufacturing. Usually, a PC manufacturer builds to stock and hence makes all production and distribution decisions based on forecast. A push system has its weak point. Since "forecasts are always wrong" and "the longer the forecast horizon, the worse the forecast," it is difficult to predict customer demand and thus match supply and demand (Simchi-Levi, et al, 2003). Thus, a push system is very susceptible to bullwhip effects.

Pull production and distribution strategy are based on specific customer demand. If following a pure pull strategy, a manufacturer will only produce goods actually ordered by customers. The manufacturer holds no inventory, but instead produces to order. Toyota exemplifies this strategy, only producing cars that have been ordered by customers. In a pull-based supply chain, production and distribution are based on actual demand and fulfill actual customer orders rather than forecasted demand (Simchi-Levi, et al, 2003). On the surface, such a system is attractive because it allows the firm to eliminate inventory and the associated costs, eliminate the bullwhip effect, and increase service levels. The pull strategy, however, does not work when lead times are too long to react to demand in a way that satisfies the customer. A pure pull strategy also makes it more difficult to take advantage of economies of scale, because production and distribution are based on demand, and therefore only scheduled as needed.

These advantages and disadvantages of push and pull supply chains as well as new information technologies that emerged in the last few years have enabled the creation of a third strategy, a hybrid push-pull strategy that offers the best of both push and pull strategies. Under push/pull strategy, a production and distribution strategy is based upon a combination of forecasts and specific customer demand (Simchi-Levi, et al, 2003). For instance, a manufacturer might purchase component parts based upon sales forecast, but manufacture finished goods only upon actual customer orders. Dell Computer's supply chain is such an example. In the push part of a push-pull supply chain the focus is on cost minimization, while in the pull part of the supply chain the focus is on service levels. In the push stage of the supply chain, typically the initial stage, long-term forecast has small uncertainty and variability. It is conditioned by the fact that demand for a particular component or raw material is an aggregation of demand for all finished products that use this component or raw material. This allows a manufacturer to take advantage

of aggregate forecasts, which are more accurate and have less variability, and focus on economy of scale and cost reduction. On the other hand, in the pull stage of the supply chain, which can be the assembling of finished products, uncertainty and variability in product demand is high and the focus is on matching supply and demand.

The point at which a supply chain switches from building to forecast, to reacting to demand from its end customers, is called the push-pull boundary. The push-pull boundary is identified by the level of uncertainty in supply chain: the portion of the supply chain where uncertainty is relatively small is managed by using a push strategy (e.g. procurement). On the other hand, the portion of the supply chain where uncertainty is relatively high is managed based on realized demand, or a pull strategy (e.g. production, distribution).

2.3 Vendor Managed Inventory (VMI) and Joint Managed Inventory (JMI)

This section describes inventory management theories that enable supply chain management strategies. Vendor Managed Inventory (VMI) and Joint Managed Inventory (JMI) are defined, and examples of their implementation are outlined.

2.3.1 Vendor Managed Inventory

Vendor Managed Inventory (VMI) is a warehouse replenishment program where a supplier defines inventory levels of each of the products, and the policies to maintain those levels. Customers welcome VMI when they are too small to manage their own inventory, or when they are large and seeking new value to pass on to consumers. Suppliers welcome VMI when they can improve their understanding of demand.

Successful implementation of VMI comes with many benefits. It can be characterized by a high level of trust between the customer and the supplier. And not only do the customer and supplier trust each other, but also trust that their information systems are doing a good job of reporting on customer demand, and that their systems are accurately reporting the operations being used to meet that demand. The process to summarize demand is clear, as well as the flow of goods through the manufacturing and distribution processes. The vendor has complete control over the product, making sure the right levels of inventory exist both at the supplier and customer distribution centers, as well as the customer stores. Products' lead times are predictable and controlled. Finally, the customer trusts that their supplier only ships what can be sold, and that the supplier is interested in boosting profitability for the entire supply chain. If partners do not cooperate, it is possible for the manufacturer to take advantage of a VMI relationship and push costly inventory down the supply chain.

The supplier Baxter pioneered vendor managed inventory policies in the pharmaceutical industry. They sorted through vast amounts of data to find the A items that its customers really cared about. In focusing on the 20% of SKUs that drove 80% of stock outs, Baxter developed a streamlined process to count and replenish the most troublesome items. Baxter took full surveys of A-item stock outs, statistical surveys of other stock outs, and replenished based on cost and frequency of a stock out.

Baxter had a specific formula to identify collaborative customers. The executive staff met and agreed to share the cost of the new program pilot. Then a team of vendor sales reps met with various people in the customer's organization, to identify discrepancies between what product was needed, and what product was supplied. Getting buy-in throughout the customer's organization was key to rolling out an effective VMI process. The customer employees had to

be the ones to discover and own any problems with inventory management. The customer found a problem, and the vendor provided a solution.

Ultimately, there were four processes put in place, depending on the cost of a stock out and the volume of stock outs. The most critical items were given the most attention and inventory space, while least critical items were only counted once a quarter and stored at a customer's distribution center. Items with high turnover were given more shelf space than those with low turn.

The first iterations of VMI at Baxter failed because of a lack of buy-in and trust at all levels of the organization. But once Baxter proponents obtained executive support and trained their sales team to collaborate with hospital staff to find common solutions, they were able to achieve unprecedented levels of customer satisfaction. True VMI has to be hands-off, otherwise the vendor and customer are duplicating efforts and wasting time as well as inventory resources (Short, et. al., 1992).

The major barrier to VMI success is not technological. Electronic Data Interchange (EDI) and barcoding as well as cheap computing power and good planning software (eg. JDA, Demand Solutions, i2) are readily available. The barrier is winning the customer's trust that his inventory will be better managed by the vendor. The reason to introduce VMI is the changing nature of demand. Demand needs to be frequently monitored at the consumer-level, and communicated to the vendor's forecasters and planners.

Promotions are the largest barrier to VMI, and are usually handled on an exception basis. The customer should only move to VMI if the vendor can manage and forecast these demand shifts better than the customer can. Another con of offering VMI to customers is the difficulty of

achieving critical mass. Unless most of a vendor's volume is forecasted with VMI, it does not make sense to integrate VMI into MRP systems.

2.3.2 Joint Managed Inventory

Joint Managed Inventory (JMI) or Co-Managed Inventory (CMI) are hybrid versions of Vendor Managed Inventory (VMI). The vendor/supplier and the customer/retailer have specific roles that are defined in the sales and operating processes (Sheffi, 2002). Both vendor and retailer have input on how much material is transferred to the retailer. Such operating environments are particularly useful when managing promotional activity.

CMI is often employed when VMI fails to achieve planned goals. In 1998, Kmart went from 300 VMI to 50 CMI relationships. This addressed the lower service levels that retailers saw when going purely to VMI (Sheffi, 2002).

2.4 Collaborative Planning, Forecasting and Replenishment (CPFR)

This section describes another supply chain initiative which is aimed to enhance supply chain integration by supporting and assisting joint practices.

Collaborative Planning, Forecasting and Replenishment (CPFR) is the sharing of forecasts and related business information among business partners in the supply chain to enable automatic product replenishment. CPFR is designed to improve the flow of goods from the raw material suppliers, to manufacturer, to the retailer's shelves. It also is designed to quickly identify any discrepancies in the forecasts, inventory, and ordering data so that the problems can be corrected before they can negatively impact sales and profits.

When engaging in Collaborative Planning, Forecasting and Replenishment (CPFR), a company shares its sales history, sales projections and other important information with its business partners, and they in turn share their raw material availability, lead times and other important information with that company. Then the information is integrated, synchronized, and used in replenishment.

Yossi Sheffi points out that the main difference between CPFR and other collaborative arrangements is that under CPFR, both parties are informed of exceptions and the collaborative process to solving these exceptions is carefully laid out (Sheffi, 2002).

35% of companies in CPG industry have piloted collaborative planning, forecasting and replenishment (CPFR) initiatives to improve sales and delivery forecasting (Berger, 2003). However, they only have implemented CPFR with two customers on average, accounting for only 19% of shipped volume.

2.5 Demand/Customer Driven Supply Networks

This section describes the most recent business model of implementation of pull and push/pull strategies that appeared in Supply Chain Management and explains the difference of this model from Vendor Managed Inventory (VMI) and Collaborative Planning, Forecasting and Replenishment (CPFR).

As we mentioned earlier, there are three strategies for managing demand: push, pull, and push/pull. If a company has a push system, the organization is set up to meet production and asset utilization goals, and then sells to consumers a predetermined amount. If a company has a

pull system, the production and supply chain is more flexible, and makes only what the consumer will buy. A push method is characterized by incomplete or inaccurate demand information. A pull method is based on real-time demand signals, and requires that a supply chain respond quickly to this information. Push/pull system is a hybrid system where one part of the supply chain is managed as a push system concentrating on cost minimization and using forecasts, while the other part is managed as a pull system focusing on service level and real demand.

Some pull systems go by new names in the business literature. Consumer-Driven Supply Networks (CDSN) are also known as Demand-Driven Supply Networks (DDSN), and are such pull-based supply chain initiatives. Unlike forecast driven supply chains, consumer-driven supply networks (CDSN) start with real-time demand signals from the consumer. Consumer purchases trigger real time movement of information back through the entire supply network, from store to distribution centers to plants. This information flow is what characterizes DDSN networks, and allows a manufacturer to deliver the correct product at the right time, from the right place, and for the right price.

The product manufacturing and delivery cycle of CPG companies is usually too long to make product on order-to-stock basis, which is necessary for a purely pull-based supply strategy. In such cases of long product manufacturing cycles, DDSN shows characteristics of pull/push supply chain. On one hand, DDSN uses forecasts and demand planning for manufacturing. On the other hand, DDSN continuously refines those forecasts based on point-of-sale (POS) data, consumer traffic, and retailer needs. DDSN integrates business practices, process capabilities, information and analytics to extend visibility and reduce response time.

How does a Demand-Driven Supply Network (DDSN) differ from other business models, such as Vendor Managed Inventory or Collaborative Planning, Forecasting and Replenishment? The other replenishment models rely on forecast-based processes, while DDSN is based on immediate actions at the store shelf. Demand signals are received in real time and compared to the forecast. Then a company responds with an immediate change in replenishment planning.

To make demand-driven supply network (DDSN) a core competency, a company needs to tighten sales and operations planning process. Production and logistics use information systems that communicate in real time what consumers are actually buying. Integrated IT solutions should be implemented in order to transfer demand information through the organization from warehouse to manufacturing to finance. Finally, non-aggregate point-of-sale (POS) data should be used. CPG companies use POS today to supplement forecasts, but it should be used to provide a very clear picture of current buying patterns.

Proctor & Gamble and Cisco are two pioneers of DDSN implementation. They have reported decreases in warehouse and customer inventories, leading to lower supply chain costs. Heightened availability to demand data leads to lower forecasting error, which in turn lowers the amount of expediting and write-offs. And increased supply chain performance leads to more consumer loyalty.

2.6 Consumer Product Goods Industry Challenges

This chapter describes current state, trends and challenges of the Consumer Product Goods (CPG) industry.

The consumer packaged goods industry is experiencing an intense competition and cost restructuring. CPG firms have to respond on reduced demand, slower growth, continuous cost

pressures, and increased global competition. With the increased levels of product choice in the market, customers are becoming more demanding. This is why a CPG company's competitive edge is more and more determined by its supply chain performance and strategy.

In 2003 the Grocery Manufacturers of America (GMA) and conducted a survey among CPG companies to investigate current supply chain performance and strategies. It found that as retailers push more responsibility down the supply chain to manufacturers and the demand for shorter order-to-delivery cycles increases, logistics costs for manufacturers continue to rise. Logistics costs in CPG industry have increased 12 percent, from 6.6 percent of net sales in 1999 to 7.4 percent in 2002. The growing need for more responsive supply chain is one of the main contributors to increased logistics costs. For three years starting from 1999, the order-to-delivery cycle (OTD) has dropped by 79 hours. The order-to-delivery cycle is defined as the elapsed time from receipt of customer order to delivery of product to the customer's designated location (Berger, 2003).

A survey of CPG market conducted in 2005 by Grocery Manufacturers Association and IBM Business Consulting Services proved the tendency in increase of customer service level (GMA, 2005). According to this survey, major challenge for CPG companies is to cut costs and to provide a superior level of customer service. Most companies reduced order-to-delivery time to less than four days on average and are targeting even shorter cycle times of three days. The customers using VMI and CPFR, on the other hand, enjoyed an order-to-ship cycle time of two days. Another key customer service indicator, Case Fill Rate, has remained over 99 percent at General Mills for several years, and General Mills is still working to create even more customer-responsive operations. There is also a trend toward smaller order sizes, which is conditioned by the need to process customer orders faster to meet customer VMI and CPFR requirements.

Although many of CPG companies have order sizes decreased, they aggressively manage shipments to maintain or increase load sizes and limit the impact of smaller orders on shipments.

The primary function of the CPG supply chain is to make sure that a product is available when it is required. But it is also important that the product delivery is carried out at the least possible cost. These conflicting goals are driving CPG companies to work together to find solutions. Though collaboration companies can drive down cycle times and costs, share important information, and build joint strategies.

What are the main challenges that CPG supply chain strategies face today? They are seasonal and unpredictable demand, the influence of large clients, ballooning transportation costs, and large batch sizes. These challenges are discussed in detail below.

2.6.1 Unpredictable Demand Challenges

Sales in consumer product goods (CPG) companies are usually not order-based. The companies hence operate on build to stock (BTS) mode. The production process hence is driven by the forecast figure. Since the accuracy of forecast is modest (from 74% for CPG industry in average to ~85-90% for the best industry performers), the supply chain has to have a high degree flexibility in order to accommodate this variability (GMA, 2005).

2.6.2 Influence of Large Retail Groups

The key clients of CPG companies are usually large retail chains like Wal-Mart, Kroger, and Target. Such big clients influence the supply management strategy of CPG manufacturers from customer service side, promoting higher level of on-time deliveries, quality, and joint promotion planning.

2.6.3 Retail Sales

Many CPG companies are increasing the number of retail sales personnel in retailer locations. These sales people do everything from stock shelves to perform demonstrations in the retail outlet. The goal is to increase the visibility of retailers and the end-users. In many cases the retailer does not have the expertise or personnel to promote the CPG product to the individual end-user. Having CPG sales people in the retail location shows the retailer how dedicated the CPG firm is to the particular location and helps reduce the work load for the retailer's employees.

2.6.4 High Transportation Costs

Many CPG products are low-value and high-volume items. The contribution of transportation costs to the total product cost is often very high. CPG companies can make significant savings by maintaining low transport costs through optimization of the transportation model. This optimization should include inbound, internal, and outbound movements to deliver maximum value. This can be achieved by collaboration with suppliers, customers, and 3PL suppliers.

2.6.5 Production Cycle Times

In consumer product goods (CPG) plants, production cycle times are often short, which allows companies to set up new batches frequently. But since plants want to keep their costs low, they have an incentive to produce in large batches, and minimize manufacturing downtime. Product postponement can be a solution in some cases, to lengthen the runs of certain processes.

The goal of any CPG enterprise, as consumer-oriented enterprise is to ensure that the right product is available at the right place at the right time, in the right quality and at the lowest possible cost. Stock availability and product freshness are main sales drivers in CPG industry. A consumer buying a box of cereal won't wait if the desired brand is not available. He will just pick another brand. So, the supply chain strategy that drives the growth of CPG business should be the one that maximizes customer responsiveness while minimizing the costs.

2.7 Literature Review Conclusions

This chapter summarizes and draws conclusions from literature research.

In our literature research we explored different supply chain initiatives: VMI, JMI, CPFR and DDSN. All those business models were created with the same aims: to increase the speed of customer response, improve demand and manufacturing forecasts, and provide a superior customer service level. Those models differ by the type of demand that they designated to serve. For example, VMI is particularly good in the case of stable demand, and can be a burden when demand is subject to large fluctuations such as those caused by promotions. If a company has a variable demand signal, but needs to forecast demand because of a long manufacturing cycle, then CPFR is a particularly good model because it handles order exceptions better than VMI. If a company's production cycle is more compatible with customer delivery lead time, then the DDSN strategy can be implemented so a company produces product to order.

The presented supply chain initiatives differ in terms of cost drivers, but they all presume expenses originate on the supplier side. This tendency is reflected in supply chain surveys. Companies feel the pressure of conflicting goals, and try to find a balance between minimizing cost and maximizing service level.

The CPG industry is one of the most developed industries in terms of supply chain management. This is conditioned by levels of competition and scale of business, such that properly designed and managed supply chains become a competitive advantage. To understand which supply chain initiative is ideal for a company, it is necessary to first understand the nature of demand and then decide which demand strategy to implement: push, pull, or push/pull.

To measure the effectiveness of new supply chain initiatives, it is important to define the right metric portfolio. Such a portfolio should cover all three axes of company performance: customer service, asset utilization and efficiency. Many metrics are correlated, and companies should make note of the trade-offs between them.

3 Operating Strategy of General Mills, Inc.

This section starts with an introduction to the company General Mills, its product lines, and the customers that it serves. Then the dynamics between the company and its customers are outlined. This is done by first illustrating the distribution and planning processes used, and then describing various options the company has to achieve different supply chain goals. Finally, performance measures used to monitor logistics operations are provided.

3.1 Company Background

General Mills is a $13 billion manufacturer of packaged consumer foods. They employ 28,000 people across the globe, but the majority of their operations are in the United States. They have a logistics organization that spans multiple product lines, with executive leadership that is pioneering in its cross-functional purpose and scope.

The food industry is characterized by very stable demand. Most variability is due to demand management in the form of promotions. General Mills, like others in its field, differentiates with brand perception, by new product introductions, and by price promotions coordinated with vendors. General Mills introduces over 100 new items every year, and markets these heavily with advertising, product placement and price negotiations.

The core of General Mills' sales, suppliers, and operations are in America. General Mills demand is stable because General Mills has enjoyed being a market leader for years. It is

currently the number one seller of dessert mixes, dinner mixes, dough, flour, frozen vegetables, frozen baked goods, fruit snacks, meals, and yogurt. It is the number two seller of ready-to-eat cereals, frozen snacks, Mexican food, popcorn, and ready-serve soup.

3.2 Existing Supply Chain Network

3.2.1 Products

General Mills' manufacturing and distribution operations are divided into two groups by storage and transportation requirements. The temperature-controlled group includes products such as dough, yogurt, frozen baked goods, snacks, and vegetables. All other products are lumped into the "dry" or ambient temperature group. Compared to refrigerated items, ambient temperature products are typically lighter, bulkier, cheaper, and have longer shelf lives, longer production runs, higher inventory levels, and higher sales volumes. Some supply chain metrics for the dry side of the business vary greatly from the temperature-controlled supply chain. This discrepancy is due to the nature of the products. Temperature-controlled items can be more expensive to transport, are typically heavier, average volumes are lower, and their shelf lives require certain efficiencies in the supply chain.

3.2.2 Customers

General Mills services many retail channels including club (Costco, Sam's), drugstores (CVS, Walgreens), foodservice (Cisco, US Foodservice), grocery (Kroger, Safeway), and super centers (Wal-Mart, Target). These retailers deploy varying supply chain approaches depending on their corporate strategies. General Mills works to accommodate these diverse customer supply chain needs while maximizing its own growth and profitability. General Mills' largest customers are

pioneering new technology and business models to achieve growth in sales and in operating efficiency.

3.3 Functional Perspectives

The balanced scorecard model, created by David Norton and Robert Kaplan, is used to make sure that the operations of various functional groups are aligned with a single company strategy. The model identifies four different corporate perspectives that will be incorporated into this project, to ensure a complete picture of the supply chain. These perspectives are financial, customer, growth, and internal business processes.

The financial perspectives are provided by the Trade Finance analysts and Sales departments of General Mills. Customer perspectives are provided by the Customer Service Center, where representatives take orders from customers and troubleshoot any problems that arise in the order fulfillment process. Various growth and process perspectives are provided by all functional groups within the company. However, we found that executive management and the demand planning groups provide the most input on this front. Managers at General Mills headquarters in Minneapolis, Minnesota, are driving various methods of continuous improvement, and focus on forecasting for future operations.

3.4 Supply Chain Organization

This section describes the people that General Mills employs to produce and distribute its products. The majority of General Mills operations are planned from its headquarters in Minneapolis, Minnesota. Demand planning, customer service, sales, finance, logistics, and information systems groups are housed centrally. At the headquarters, functions are further

divided into Dry Goods, Temperature Controlled Goods, and a few smaller divisions such as International Sales, and Bakeries and Food Service. The customer service center is a matrix organization that is aligned by the top 20 customers. The smaller customers are grouped into geographic regions.

Manufacturing is executed at forty plants distributed throughout the continental United States. These manufacturing sites typically store work-in-progress and raw materials inventories for a week's worth of production. Hourly employees operate the production lines, and salaried employees plan and oversee operations.

Historically finished goods warehouses were set up close to plants to receive finished goods inventory. Only ten percent of warehouse space is owned and operated by General Mills. The rest is leased from third party logistics companies. United Facilities and Exel manage most of the warehouses for dry goods, and AmeriCold manages most refrigerated warehouses.

Figure 2 details the structure of General Mills' "Supply Chain Logistics, Strategy, and Grain Operations" organization.

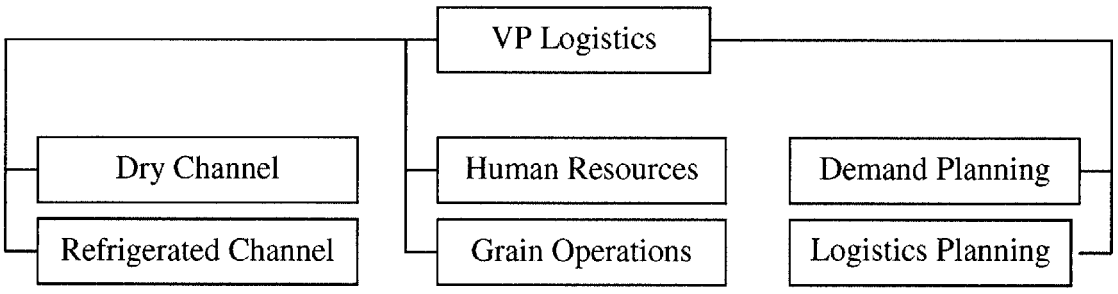

Figure 2: General Mills Logistics Organization

The Vice President of Supply Chain Logistics, Strategy, and Grain Operations oversees the following functional groups, which are headed by directors or vice presidents: Dry Channel,

Refrigerated Channel, Grain Operations, Human Resources, Information Systems, Finance, Demand Planning, Customer Strategy, and Logistics Planning.

3.5 Metrics

This section details the metrics that General Mills employees use to gauge operational performance. The most important of General Mills' metrics are shared across functional groups and product lines, and are tabulated in **Table 1**. Metrics of secondary importance, or more functional focus, are tabulated in **Table 2**.

Table 1: Metrics Common to General Mills' Supply Chain Organization

Metric	Description
Case Fill	Cases Shipped / Cases Ordered
Cost Per Case	Total Cost of Goods Sold / Total Cases Shipped
Productivity	Change in COGS from last year, adjusted for inflation
Operating Profit	EBIT

Table 2: Additional Key Metrics of General Mills' Supply Chain Organization

Sales, Marketing, Customer Service, Distribution	
Days of Supply at DC	Number of cases available at DC/An average number of cases shipped from CSF per day (can be used for a particular SKU or for the whole stock)
Turn Case Fill	% Cases of Turn (Non-Promotion) Items shipped
Promotion Case Fill	% Cases of Promotional Items shipped
Truckload Utilization	Truckload capacity used/Truckload capacity
Cash to Cash cycle	the number of days it takes to convert the expenses for raw materials into payment for the finished product
Customer Service	
Order Processing Time	Hours from when an order arrives by EDI, phone or fax to when loaded onto a truck
Orders Flagged	Number of orders that require handling exceptions
Customer Shorts	Number of cases ordered by customer and not received because they were not available at DC
Customer Inventory Turns	Number of times that a customer's inventory cycle or turns over per year

Distribution	
Out Of Stocks	Number of cases ordered by GMI from manufacturing and were not received at DC
Inventory Turns	Number of times inventory cycles or turns over per year at DC
Sales/Marketing	
Perceived Shorts	Number of cases that were ordered by a customer store from a customer DC and were not received

By studying General Mills' metrics, we were able to determine a strategic operational performance goal for the company. Larry Lapide of MIT's Center for Transportation and Logistics outlined a matrix for determining if a company mainly focused on customer response, asset utilization, or efficiency. The MIT Supply Chain 2020 Project found that leading companies were distinguished by having distinct operational goals.

General Mills has metrics for all three operational goals, but efficiency was consistently named the most critical by leaders throughout the supply chain organization. **Figure 3** is a model developed by Chris Caplice to map different operating strategies against one another. We interviewed employees from different functional groups within General Mills, and collected the metrics that they are rated on. Heads of manufacturing (black), transportation (blue), and logistics planning groups (green) were rewarded for being efficiency-focused, while customer service (red) representatives were evaluated more by customer response metrics. **Table 3** outlines different operational focuses, and the supply chain metrics that are most closely aligned with each. Since efficiency is the most prevalent focus, the following metrics get a lot of attention at General Mills: cost per case, productivity, percent of individual cases picked, and safety/environmental measures.

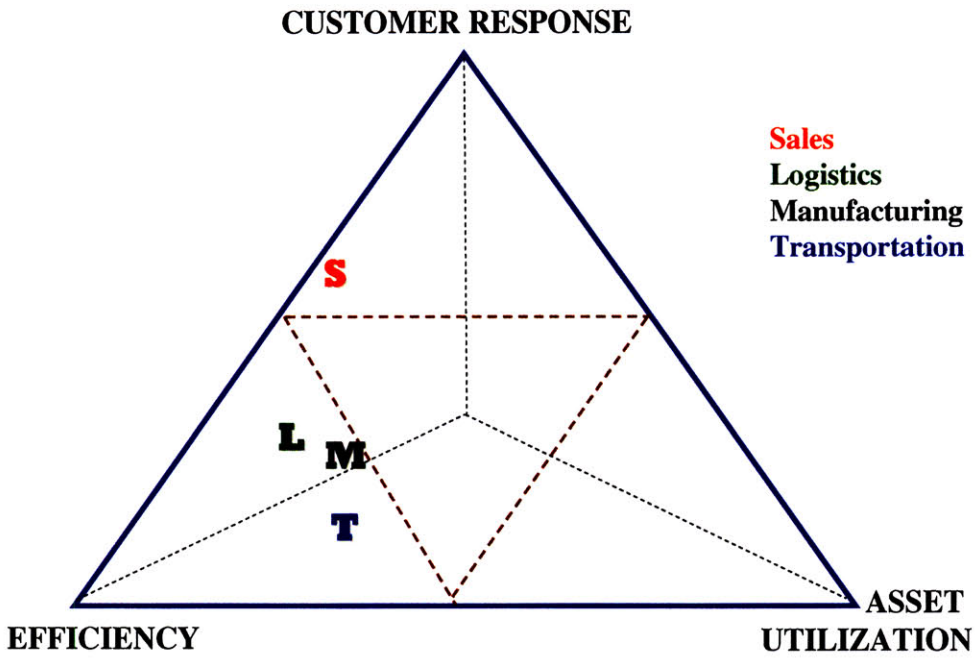

Figure 3: Operating Focuses of Manufacturing, Transportation, Demand Planning, and Sales

Table 3: Common Metrics and their Relation to Operational Focus

Focus	Metric
Assets	Corporate Operating Profits Manufacturing Uptime Safety / Environment Truckload Utilization Inventory Turns
Customer	Case Fill Retail Out of Stock Quality
Efficiency	Cost per case Productivity Individual Cases Picked Safety / Environment

3.6 Goods and Information Flow

This section describes how five million cases of dry goods flow through the General Mills' supply chain network. It follows one of two routes to customers: either through the distribution centers or directly from plants. Approximately 20% of dry goods are shipped directly from plants.

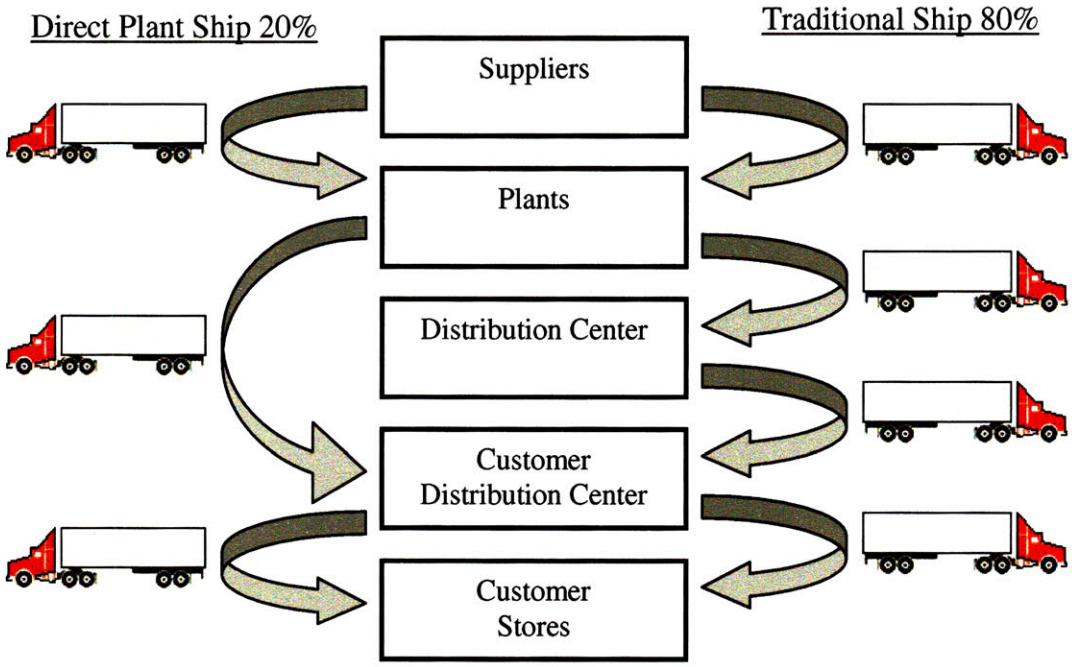

Figure 4: DPS and Traditional Flow of Goods from Supplier to Customer

Figure 4 details a flow of goods that starts at the raw material supplier, and is shipped to plants. Plants typically house a week's worth of raw materials inventory, while distribution centers normally carry 40 days of inventory. All goods produced at the plants flow to one or more distribution centers. General Mills also ships finished goods between distribution centers by truck and by rail. Though historically shipments to customers were organized by General Mills distribution centers, currently approximately 40% of General Mills shipments are customer pick up (CPU). CPU trucks are scheduled by the customer and announced to General Mills

distribution centers at least one day prior to shipment. Organizing CPU allows customers to take advantage of an allowance from General Mills to offset shipping expenses.

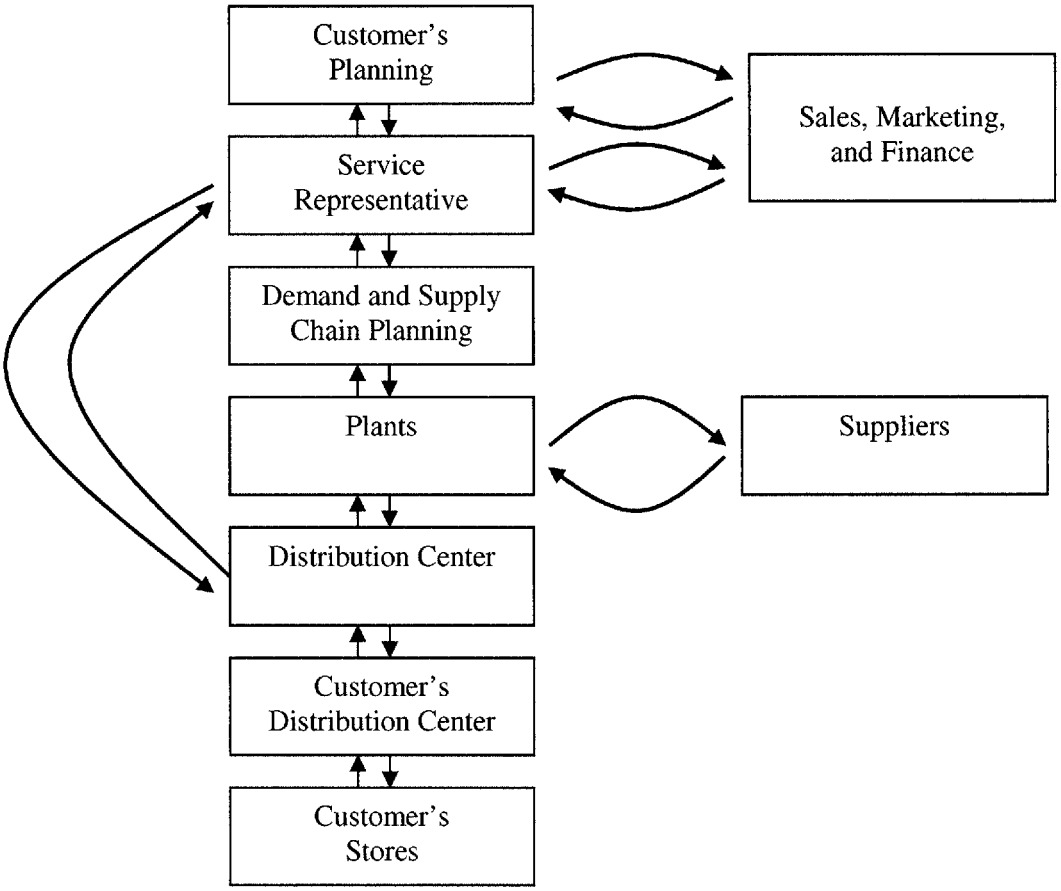

Figure 5: Flow of Purchase Order Information from Supplier to Customer

Figure 5 details the flow of communication between different parties within General Mills' supply chain. This diagram, aligned with the customer-facing objectives of General Mills, begins and ends with the customer's planning department and stores. The customer places promotional and non-promotional "turn" orders through EDI or fax to the service reps at the customer service center. Forecasts are requested at least four weeks in advance of promotional orders, which are passed onto the demand planning departments. The demand planning departments aggregate promotional forecasts with non-promotional forecasts, and set production

levels. Plants receive weekly production schedules, order raw materials from suppliers, and ship product as it is finished to distribution centers. Daily turn and promotional orders are released from the customer service representatives, and orders are filled from finished goods inventory at the distribution centers. In most shipments to and from distribution centers, except for customer pick-ups (CPU), truckloads are scheduled from the point of origin.

3.7 Demand Signal and Inventory Control

This section describes how changing the nature of the demand signal will lead to greater supply chain efficiencies. Currently, demand signals come from heterogeneous sources and the quality of data is different. Customers' distribution centers and historical shipment data are primary sources of information.

There are three problems with the current system. First, there is a lack of accuracy in the historical record of consumer demand, since everything that gets shipped to the customer is not sold. Second, there exists a bullwhip-type amplification of variability in the demand signal, because this demand data flows through several channels before it is observed and planned for by General Mills' manufacturing planners. Third, the demand data is not timely, since there are delays in transmitting the data to the planners.

Around 40% of General Mills clients have Vendor Managed Inventory (VMI) systems installed. The data that is used for VMI often comes from sales in aggregated product family units instead of particular stock keeping units, adding complexity to the planning process. Additionally orders from VMI clients are often changed manually by General Mills sales people or by request of the clients. All these distort initial demand signals.

Other retail customers place orders directly to General Mills' Customer Service Center in stock keeping units. The demand signal usually comes from customers' distribution centers. General Mills does use Point of Sale (POS) data as a demand source for a very limited set of customers but is in the process of expanding the number of customers and including it in the demand forecasting process.

3.8 Information Technology

This section describes the current state of General Mills' information systems that it uses to enable new supply chain strategies. As the consumer product goods industry shifts in focus from manufacturing to being responsive to consumer demand, systems have to adapt to new processes and to handle new volumes of information.

General Mills has been using historical data for both manufacturing planning and several Vendor Managed Inventory (VMI) systems, which causes General Mills to have lower demand forecast accuracy than its best-in-class competitors. Measuring at the most detailed level, SKU at customer location, General Mills has only 60% forecast accuracy, which is below the average 74% in the CPG industry. To protect against major errors in forecasting, General Mills keeps approximately one month of safety stock on hand at distribution centers. Temperature controlled items have shorter shelf lives and have much lower safety stock levels.

General Mills uses the following supply chain software and communication standards to collaborate with its clients and process data: SAP Advanced Planner and Optimizer (APO), Electronic Data Interchange (EDI), and Warehouse Management System (WMS). The company is going to implement the SAP modules, Transportation Planner and Vehicle Scheduler (TPVS) and Inventory Collaboration Hub (ICH), which is are internet platforms for collaboration with

clients and suppliers and can be integrated with SAP APO. The current packages are described in detail below.

General Mills uses SAP to do demand planning and promotion planning, vendor managed inventory, transportation planning and vehicle scheduling. SAP Advanced Planner and Optimizer (APO) module provides tools needed to plan, optimize and execute supply chain processes. SAP APO enables demand and manufacturing forecasts to be integrated with historical trends and current promotion plans, as well as marketing intelligence, sales objectives, and management adjustments to statistical forecast. Such intelligence include aggregated reports from customers and third-party logistics companies. SAP transportation planning and vehicle scheduling components will help optimize available fleets of third-party trucks, by scheduling vehicles and determining routes.

Electronic Data Interchange (EDI) is a technology for automated exchange of business data between dissimilar applications regardless of platform, standard or protocol. It allows General Mills to receive purchase orders, send invoices, send advanced ship notices (ASN) and other business documents with fewer errors and lower administrative costs.

General Mills' Warehouse Management System (WMS) is in-house software that runs most operations at General Mills distribution centers (DCs). WMS controls movement and storage of products within a warehouse. Data is uploaded to WMS from General Mills' SAP database every day with orders to be picked, loaded, and shipped from stock. WMS generates an advanced ship notice (ASN) when an order is shipped. Some customers receive their ASN in the form of an Electronic Data Interchange document, specifically EDI number 856, an electronic form for notification of pending deliveries.

Many capabilities of SAP have been underutilized by General Mills. In 2008, the SAP Inventory Collaboration Hub (ICH) module will be introduced to assist with collaborative planning and forecasting efforts between General Mills and their more innovative customers.

The quality of demand forecasts at General Mills is no better than the industry average since the SAP Trade Planner module is used mainly as a financial planner than as a supply chain tool. Information about turn and promotional orders are uploaded from the sales' Trade Planner system in product family units. The demand planning department has to break these aggregate numbers into how many particular stock keeping units (SKU) to ship. Demand planners make their decisions based on orders placed in previous years.

Approximately 40% of General Mills' clients have participated in Vendor Managed Inventory (VMI) programs. The orders generated by sales teams do not always have detail at the stock-keeping unit level. According to customer service representatives, this lack of information from sales teams and lack of information from the customers could be important drivers of forecast error, making the vendor managed inventory not as effective.

Promotional orders placed by General Mills for their customers are very often changed last minute, once the customer's immediate needs become apparent. There is no process in place for immediate changes in the demand signal to make their way back to manufacturing, so that safety stock levels can be adjusted. If exceptions of this sort are not kept in check, distribution centers will not have sufficient levels of safety stock.

General Mills customer service representatives have to manually edit the specific stock keeping unit mix of orders. This practice is so ubiquitous that it is not measured. All customer orders may be manually released to the distribution centers for staging. Current General Mills

systems are such that service levels are at an astounding 99%, but this due to a culture of service to the customer, and not a reflection of the efficiency of General Mills' information systems.

3.9 Transportation

Hauling inventory from plants to warehouses to customers is one of the biggest challenges to profitability at General Mills. General Mills performs delivery from its distribution centers to customers' distribution centers with the help of third party logistics (3PL) companies. Usually General Mills delivers only Full Truck Loads (TL). Major metrics used to measure performance of the transportation group are

- Truckload Utilization – percentage of trailer capacity utilized,
- Transportation Cost - a sum of Freight, Fuel, and additional charges
- Freight Cost/Truck Load.

In 2006, General Mills had approximately 12 million truckloads. To avoid having to synchronize all unloading of trailers, as well as the schedules of drivers from multiple sources, General Mills uses a "drop and hook" system for most interplant shipments and some customer shipments. Trucks drop off supply trailers next to the warehouses and pick up other trailers that are awaiting shipping to other distribution centers or customer warehouses.

3.10 Warehousing

This section describes another main cost driver in General Mills' business. General Mills owns some of its own warehouses and also leases warehouses from third party logistics companies such as Exel. The main metrics used at Warehousing Department are case picking, case fill, cost per case, and inventory holding costs. Case picking, or the number of cases that are picked not in full pallets, is usually at 20%. Case fill is a service level metric typically at 99%, which means

that 99 out of 100 cases ordered by customers were shipped from General Mills door within 48 hours of the order submission. Warehousing cost per case is rolled into manufacturing cost per case, and is higher for refrigerated goods than dry goods. Inventory holding costs are typically at 12%, although they can reach 20% for seasonal refrigerated specialty items.

Constraints on the warehouse system include the number of loading doors, the size of staging areas, the height of pallet stacks, and the number of people and forklifts available for staging and loading. There exists a tradeoff between the size of a warehouse, and the amount of complexity in distributing a vast number of SKUs. The warehouse group estimates that once warehouses exceed 700,000 square feet of space, the cost of locating and moving a pallet by forklift exceeds the gain in warehouse consolidation. Pallets typically take 2 to 3 minutes to locate and stage for a shipment, but in the largest warehouse, this time can be up to seven minutes per pallet.

The food manufacturing industry has matured to a point such that the major players compete on operating efficiency as well as customer service to gain market share. The following section shows how General Mills has taken its mature manufacturing and distribution operations, and optimized them for the benefit of an innovative customer.

4 Rapid Replenishment Project between General Mills and Giant Eagle

This section discusses why General Mills is concerned with the velocity of its supply chain. One of its more collaborative customers is introduced, and the processes and systems that link the two companies are discussed in detail.

4.1 Supply Chain Velocity

This section describes how the information and goods flows have been accelerated between General Mills and one of its larger customers, Giant Eagle. General Mills promises most of its customers a 48-hour lead time for shipments to customer distribution centers. Order-To-Delivery (OTD) time starts when a customer submits a fax or EDI order, and ends when a truck is unloaded at the customer's warehouse. In the case of Customer Pick-Up (CPU) shipments, the OTD time ends when the CPU truck has been loaded. In the case of Drop and Hook shipments, OTD time ends when the truck trailer has been dropped off next to the customer warehouse.

In a pilot project in 2006, Giant Eagle negotiated that lead time be reduced from 48 hours to 24 hours. Table 4 lists the activities that happen during lead time, and which have to be compressed. Instead of the ranges tolerated in 2005, strict deadlines have been set to create a daily routine that facilitates the order fulfillment process.

Table 4: Activities that Contribute to Order Fulfillment Lead Time

Group	Activity	48-hr "Deadline"	24-hr Deadline
Customer Promotion Planning	Place turn/promotion order – EDI	6-11am	7am
Service Representative	Check and release order for completeness	9-12pm	10am
Distribution Center	Schedule truckload	10-2pm	12pm
	Drop and Hook Trailer Staging	12am	9am-2pm
	Pick and Stage Regular Shipment	12am	11pm
	Load truck/send Shipping Notice	12am, day-before	12am
Customer Distribution Center	Receive truck	None	7am

Before the rapid replenishment pilot project, Giant Eagle sent General Mills aggregated store sales data, so the supplier could have additional visibility to consumer demand. This data helped General Mills manage Giant Eagle's non-promotional inventory. However, when the pilot started in June 2006, Giant Eagle employees started placing their own orders, and VMI was discontinued. Giant Eagle continued to send General Mills weekly sales data reports, but General Mills was no longer responsible for single-handedly managing Giant Eagle's inventory.

Because customer promotional and non-promotional "turn" orders are filled from inventory at the distribution centers, manufacturing and shipping from plants are not included in the order fulfillment lead time. Insufficient inventory, duplicate orders, and order exception handling threaten the success of increased velocity. The following sections detail what happened to General Mills to Giant Eagle service in 2006.

4.2 Rapid Replenishment Metrics

Employees at General Mills use many metrics to gauge their own and their customer's operational performance during the rapid replenishment pilot project.

General Mills uses two groups of metrics to describe the impact of rapid replenishment. One group measures performance of a customer (Giant Eagle), another group of metrics gauges effectiveness of General Mills performance. Both metrics and their description are presented in **Table 5**.

Table 5: Metrics Used for Rapid Replenishment

Metric	Description
Giant Eagle	
Case Fill to Customer DC	Cases Shipped from General Mills DC/ Cases Ordered by customer DC
Service to Stores	Cases shipped from customer DC/ Cases ordered by customer stores
Store Out of Stock	The number of SKUs that are not available on store shelves
Days Supply of Inventory at DC	Number of cases available at DC / Average number of cases shipped from DC per day
Retail Sales	Weekly sales
General Mills	
Case Picking	Number of cases picked in less than full-pallet quantities
Truckload Utilization	Truckload capacity used/Truckload capacity
Transportation Costs	Freight + Fuel + Truck Unloading + Detention Costs

4.3 Transportation Enablers of Rapid Replenishment

Section 3.9 discusses General Mills' transportation resources and metrics definitions, which did not radically change to enable rapid replenishment. Line haul rates between General Mills and Giant Eagle's distribution centers remained between $500 and $600. To maintain the service level and increase speed of replenishment to Giant Eagle, General Mills started underutilizing trailers. As a result, Freight Cost/Truckload went up $11.44 per truckload, causing $275,000 in additional transportation costs. To offset this negative effect General Mills began to combine promotional shipments with rapid replenishment shipments. The costs of transportation are compared with other operational costs in sections **4.12 and 4.13.**

To serve the 24-hour replenishment project, the transportation group dedicated between five and ten percent of their time to Giant Eagle orders. One of the benefits of rapid replenishment for the transportation group is smoother everyday volume due to more frequent deliveries, creating routines which are easier to plan. For example, instead of five trucks going out twice a week to replenish non-promotional inventory, General Mills delivers one truck to each Giant Eagle warehouse every day. Shorter delivery time makes the performance of the transportation group more dependent on upstream resources, such as inventory availability.

4.4 Warehousing Enablers of Rapid Replenishment

Section 3.10 introduces the costs of warehousing, which increase with the implementation of a rapid replenishment policy. With rapid replenishment case picking increased 19.9% since the weekly demand for each SKU did not change as rapidly as the increase in order frequency. At Fort Wayne, the General Mills warehouse that supplied the Giant Eagle warehouses in Pittsburgh and Cleveland, it took an average of three hours to pick an average order prior to rapid replenishment, and took an average of eight hours during the pilot. Main problems that would prevent a full-scale rollout of rapid replenishment include

- a limited number of forklifts
- a limited number of forklift drivers
- a lack of staging space for collecting orders prior to ship
- inventory availability
- focus on case-fill metrics rather than asset utilization metrics

The cost of warehousing is compared with other operational costs in sections **4.12 and 4.13.**

4.5 Data Collected

To identify the results of the rapid replenishment pilot project we used two sets of data from the General Mills distribution center which serves Giant Eagle and is located in Fort Wayne, Indiana. The first set of data was from June through November of 2005 prior to rapid replenishment. The second set was from a year later, June through November of 2006, when the rapid replenishment program was first adopted.

To evaluate the effectiveness of different replenishment policies, we examined logs of Giant Eagle orders from 2005 and 2006. We collected order logs for five A-listed SKUs (Cheerios, Lucky Charms, Hamburger Helper, Yellow Cake, Chicken Soup) for five months before and during the rapid replenishment pilot.

Though the data was available to demand planners, demand during November and December was not used in our order analysis. Sales during the Christmas season fluctuated unpredictably due to an increased number of promotional runs, also was also subject to fluctuations in shipping availability.

4.6 Giant Eagle Retail Sales

The fluctuations in Giant Eagle Retail Sales are shown in **Figure 6.** We have disguised the sales totals but have retained the pattern to show the effects of rapid replenishment.

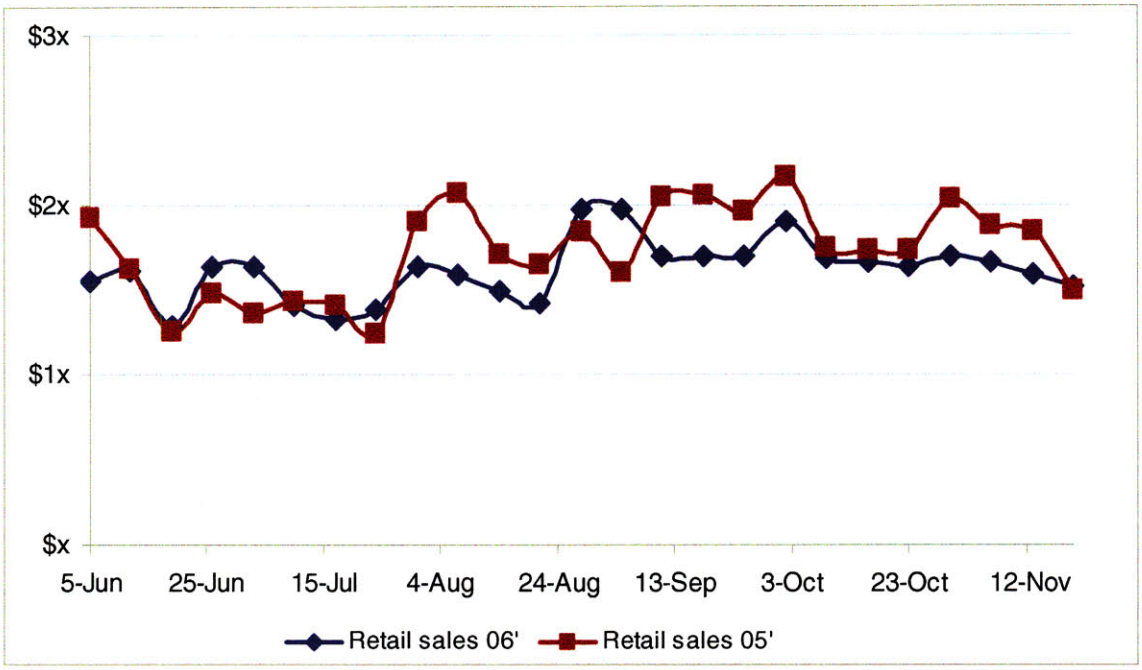

Figure 6: Giant Eagle Retail Sales Before and During Rapid Replenishment

Demand has seasonality and varies significantly from week to week. Most fluctuations in sales can be attributed to promotional campaigns and variations in day-to-day demand. However, the standard deviation in Giant Eagle's sales decreased from 12% to 8% in 2006. This is because rapid replenishment presumes more orders per week (consisting of smaller quantities) which smoothes order flow and decreases the bull-whip effect on the demand signal.

4.7 Store Order Volume

When we look more closely at a few select dry goods SKUs (Hamburger Helper, Yellow Cake Mix, Cheerios, Lucky Charms, and Progresso Noodle Soup) the total monthly order volume decreased from 52 to 44 thousand cases. This corresponds to an overall decrease in inventory by 7 days. Sales to Giant Eagle initially decreased 6% during the first five months while inventory was being used, but then sales recovered to 105% of last years in months six through eleven. **Figure 7** shows the total order volumes before and during the rapid replenishment pilot. In keeping with their goal of reducing inventory, the total volume of cases

ordered by Giant Eagle during the pilot project was 15% lower in 2006 than in 2005. The majority of SKUs surveyed, with the exception of Lucky Charms, follow this pattern.

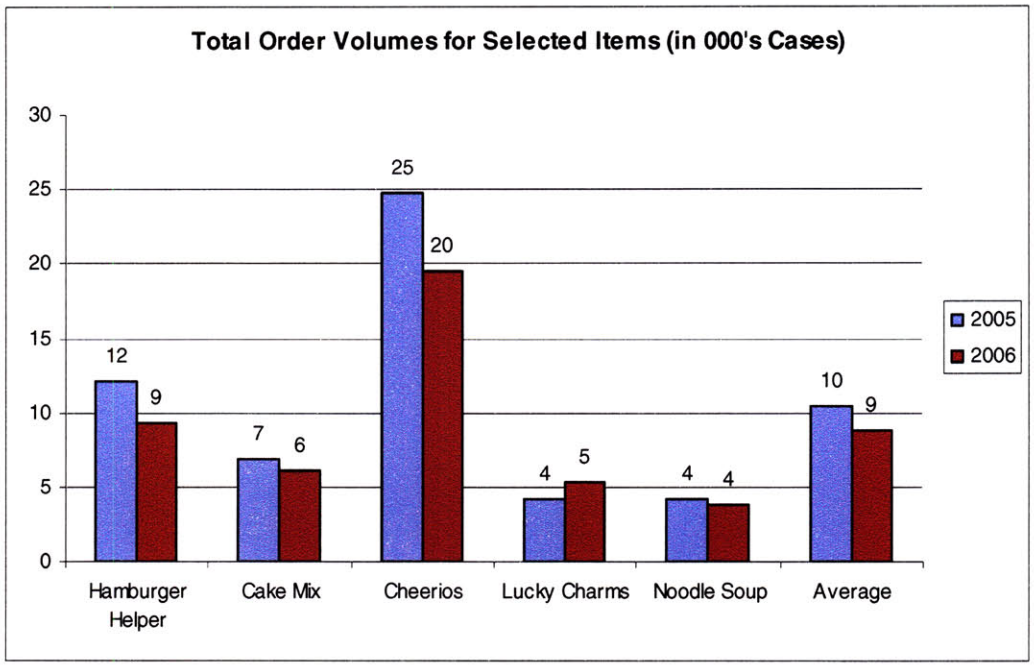

Figure 7: Total Order Volumes Before and During the Rapid Replenishment Pilot

4.8 Order Placement Frequency

During the rapid replenishment pilot in 2006, the frequency of orders went up 60% and the average size of a purchase order went down. See **Figure 8** for the average monthly demand for a subset of A-item SKUs. Hamburger Helper orders were 20% smaller, Cheerios 28% smaller, Yellow Cake Mix 54% smaller, Noodle Soup 29% smaller, and Lucky Charms 48% smaller. Overall order sizes decreased 33%.

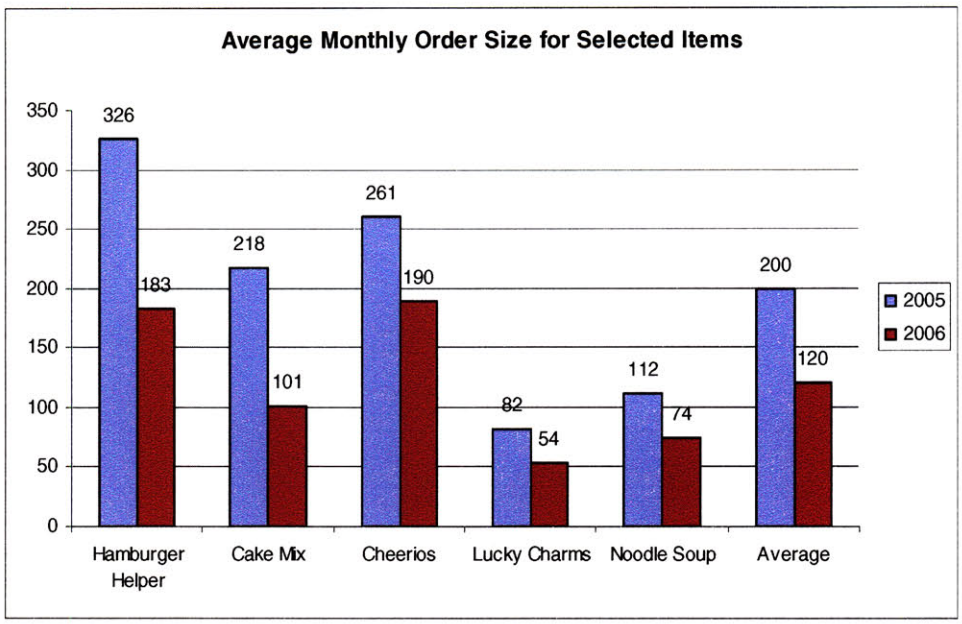

Figure 8: Average Order Size Before and During the Rapid Replenishment Pilot

By aggregating the number of purchase orders that Giant Eagle placed with General Mills, we see a trend in placement. Over the course of the year, the average number of purchase orders placed increased 60%, and the number of shipments increased 25%. The variation in order placement is greater in 2006, meaning that Giant Eagle only gradually took advantage of the shorter lead times being offered by General Mills. See **Figure 9** for a graph of order placement patterns. The number of September orders are high in both years, marking the beginning of the Thanksgiving-Christmas baking season.

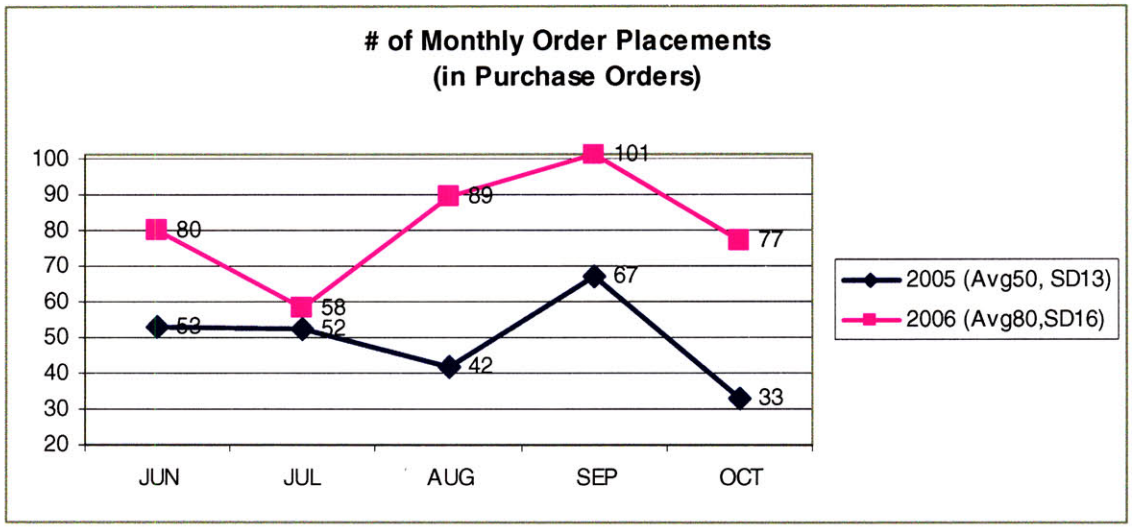

Figure 9: Total Number of Purchase Orders before and during the Rapid Replenishment Pilot

4.9 Promotional vs. Non-Promotional Orders

During the beginning of the rapid replenishment pilot, General Mills recognized that the order placement process was more involved for promotional orders than for turn orders. In June 2006, General Mills began to record the number of turn versus promotional orders that were placed, and to record the number of times an order had to be manually reviewed by a customer service representative. Because of the strategic importance of promotions in driving sales, the service levels of turn inventories suffered when compared with service levels for promotion. Also, any turn orders that could not be filled were listed as missed order, and filed again as a new order, artificially lowering the service levels. Promotional service levels were 98.59% overall in 2006, while turn service levels were 95.85%. Total service levels were 97.12%.

Figure 10 shows that turn and promotional demand was relatively steady in 2006 from month to month, except for an expected spike in September as Giant Eagle stocked up for the beginning of the Christmas season. This also shows that promotional volume was usually 40% greater than turn volume.

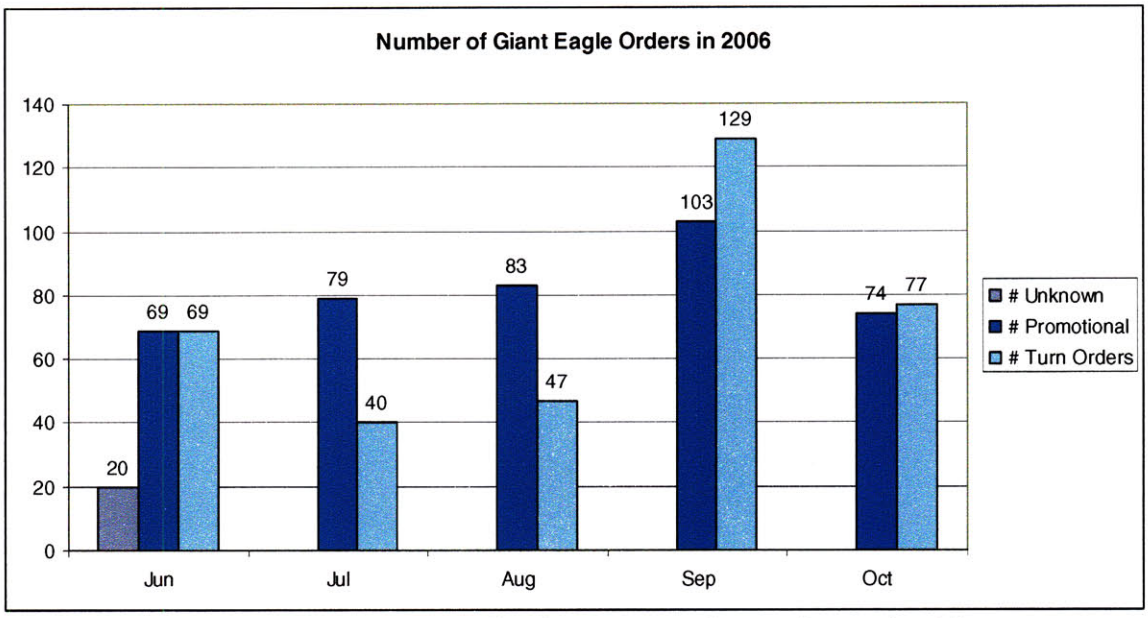

Figure 10: Giant Eagle Orders in 2006, Segmented by Turn or Promotional Inventory

4.10 Handling Order Exceptions

There exist many process exceptions that interrupt the flow of information and goods between supply chain players. At Giant Eagle, supplier representatives place daily orders for non-promotional dry goods, while promotional goods are ordered by General Mills demand planners. Though all orders are entered into the SAP database using Electronic Data Interchange (EDI), orders often need to be corrected for the following errors listed in **Table 7.**

Table 7: Data Entry Problems that Drive Order Fulfillment Delays

Order too small
Quantities not acceptable
Item out of stock
Item allocated to another order
Direct Plant Ship is available
Possible duplicate Purchase Order
Promotional price has expired

Before the 24-hour-OTD pilot started, General Mills did not have access to order change data. In June 2006, the SAP reporting system was modified to provide the number of order exceptions placed. However when the pilot started and General Mills started tracking order exceptions, over 75% of orders had issues. Tracking this problem over the course of two months led to more uniform order sizes and promotion schedules, and the number of order exceptions leveled off around 30%.

If there are none of the above exceptions, the order is considered 'perfect', and orders are released to the distribution centers for truckload scheduling, staging and loading. If there are exceptions then SAP flags the order and General Mills customer service representatives must call the customer and then fix the purchase order manually. If an exception is not cleared before 10am, then the order is not counted as placed for that day. This practice may artificially inflate General Mills' service level metric, which is currently at 99%. In this way, the exception handling process adds complexity to the order-fulfillment process and timeline.

Figure 11 shows that most of the exception handling came from the promotional purchase orders. Once General Mills became aware of the causes of exception handling, such as ordering in partial-pallet and partial-layer quantities, the number of exceptions was lowered to acceptable levels.

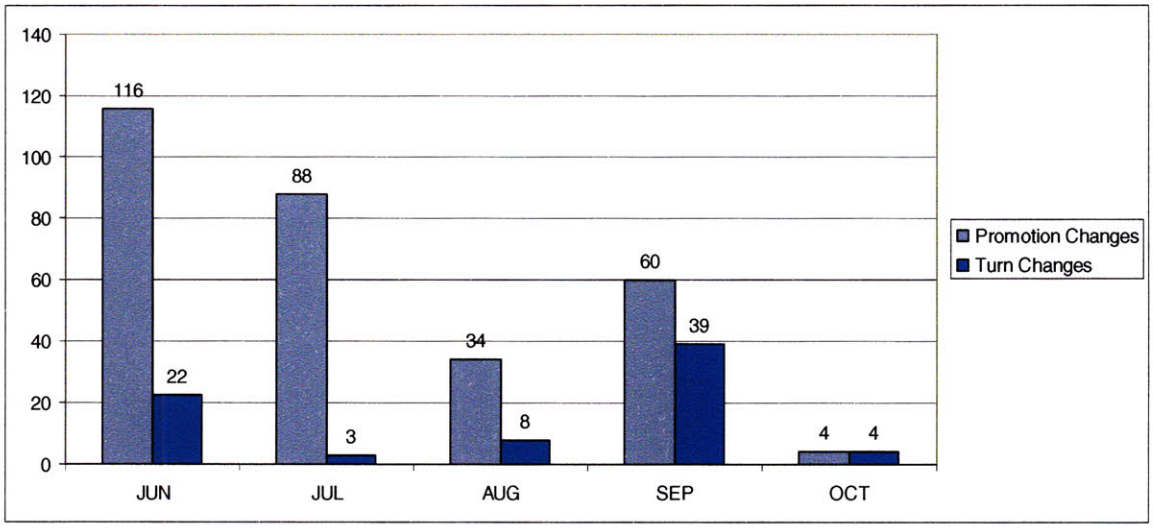

Figure 11: Promotional Order Changes More Frequent than Turn Order Changes

General Mills also compared the order changes that were initiated by different distribution centers. Most months showed little difference between the order processes initiated by Giant Eagle ship-to points Cleveland and Pittsburgh, as seen in **Figure 12.**

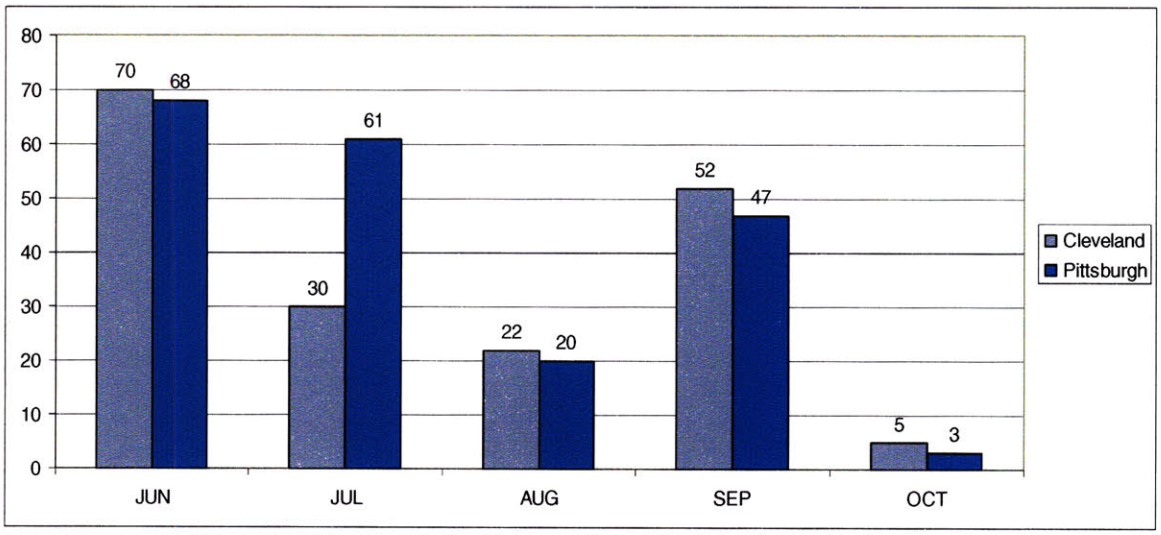

Figure 12: Similar Order Patterns from Various Customer Ship-Tos

4.11 Analysis of Rapid Replenishment Metrics

This section continues the analysis of rapid replenishment by looking at key process indicators in place at General Mills.

Besides retail sales volumes, the other four metrics for measuring Giant Eagle performance are presented in Table 8 as average weekly data. They are case fill to customer distribution center, service to stores, store out of stock, and days of supply of inventory at the customer distribution center.

Table 8: Giant Eagle Performance Metrics

Cumulative weekly average:	Year 05'	Year 06'	Change
Case Fill to Customer DC	97.7%	96.2%	(1.5%)
Service to Stores	95.5%	98.4%	2.9%
Store Out of Stock	3507 cases	1089 cases	(2418 cases)
Days Supply of Inventory at Customer DC	16.8 days	10.8 days	(6 days)

4.11.1 The Relation between Case Fill to Customer Distribution Center and Order-To-Delivery Time

The value of the "Case Fill to Customer Distribution Center" metric decreased by 1.5%. At first sight, it seems that there is a contradiction between increased service to stores, and decreased case fill rate to customer DC. This happened because in 2005 prior to rapid replenishment, orders that could not be filled from stock initially could be replenished within the 48 hour lead time. But in 2006, that same unfilled part of the order would have to be cut immediately; there would not be time to replenish stocks from other distribution centers or plants. The difference between Case Fill before the pilot project (year 2005) and after the pilot project (year 2006) shows the percentage of cases that were available immediately, versus what percentage of cases

were available the next day. So 96.2% of all ordered cases were in-stock, while presumably 1.5% could have been shipped the next day.

Let us illustrate this phenomenon using an actual order. In 2005, a large customer ordered 132 cases of Progresso Chicken Noodle Soup every day. On Monday an order for 132 arrived, and though only 100 cases were available in the customer distribution center, the other 32 would be arriving at the distribution center the next day. Because of the 48-hour lead time, there was time to wait for the additional 32 cases, and the case fill rate was 100%. However, if the customer expected deliveries within 24 hours, the additional 32 cases would have been cut from the original order (with a case fill rate of 76%) and added to a separate order for the next day (with a case fill rate of 100%). The resulting case fill rate under the rapid replenishment system is an average of 76% and 100%, or 88%. This shows that though case fill has decreased by 12%, the actual number and delivery times of shipped cases to the customer has not changed.

4.11.2 The Relation between Case Fill to Customer Distribution Center and Customer Demand

The Case Fill metric is not only affected by General Mills policies, but also by the changing nature of Giant Eagle demand. Although the supply policy of General Mills plants to General Mills distribution centers remained unchanged, Giant Eagle started ordering more frequently and in smaller quantities. Figure 13 illustrates this supply chain dynamic. We can imagine the General Mills distribution center acting as a "company", the General Mills manufacturing facility as the "supplier", and Giant Eagle as the "customer."

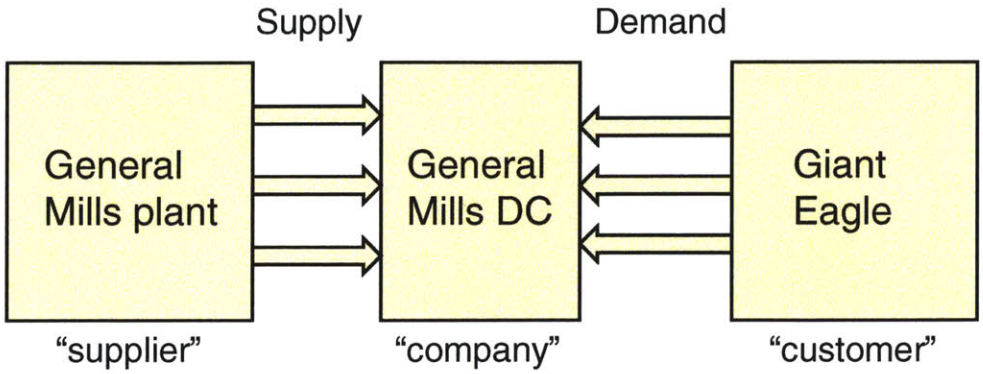

Figure 13: Supplier-Company-Customer Model

The one distribution center that serves Giant Eagle is based out of Fort Wayne, Indiana, and carries four weeks of sales in stock. We can apply the following theory to illustrate the components of this inventory:

$$s = x_L + \delta_L * k \qquad (1)$$

Where s is the inventory level, L is the replenishment lead time in weeks, x_L is the expected demand over the replenishment lead time, δ_L is the standard deviation that measures demand variability, and k is the safety factor.

When rapid replenishment is implemented, the customer demand pattern changes. The order flow becomes smoother, and the standard deviation δ_L of General Mills DC inventory stock is decreasing. Since the inventory policy of General Mills' manufacturing facilities remains the same (s and x_L remained the same), the safety factor k will increase. The increase in safety stock makes it easier for General Mills to meet higher service level goals.

Why were we unable to observe this case fill rate increase due to the Giant Eagle pilot project? The reason is simple: the share of products shipped to Giant Eagle is small, approximately 10% of Fort Wayne's volume. The change in Giant Eagle's segment of the inventory is masked by the regular fluctuations of the other 90% of customer inventory.

Let us calculate impacts of demand pattern change in this case. We know the average weekly demand for Giant Eagle (v) is 10% of all shipments from Fort Wayne. Then weekly shipments from Fort Wayne is equal to $10*v$. Inventory level s is constant and equals 4 weeks of sales, so, $s = 40*v$. In the same way, we can express expected demand over a replenishment time: $x_L = L*10*v$, where L is the replenishment lead time in weeks. We know standard deviation of Giant Eagle sales in 2005, which was 12% or $0.12*v$. For our calculations, we make the assumption that in 2005, all companies shared a similar 48-hour lead time requirement and have the same variation in sales. If the standard deviation of Giant Eagle sales is 0.12*v, then the weekly standard deviation for all Fort Wayne sales is assumed to be $0.12*v*\sqrt{10}$. Similarly, $\delta_L = 0.12*v*\sqrt{10}*\sqrt{L}$. Then the formula (1) can be expressed as (2).

$$s = x_L + \delta_L * k \tag{1}$$

$$40*v = 10*L*v + 0.12*v*\sqrt{(10*L)}\ *k \tag{2}$$

Then we can express k as:

$$k = (40\text{-}10L)/(0.3795*\sqrt{L}) \tag{3}$$

Now we need to find k. Since we know Case Fill to Customer DC is 97.7%, which is Item Fill Rate, we can use the formula (Silver, et. al., 1998):

$$\text{IFR} = 1 - \delta_L * G(k)/Q \tag{4}$$

Then we can find $G(k)$:

$$G(k) = (1 - \text{IFR})*Q/\ \delta_L \tag{5}$$

In our case $Q = x_L$. Then substituting x_L and δ_L we have:

$$G(k) = (1 - 0.977)*(10*L*v)/(0.12*v*\sqrt{10}*\sqrt{L}) = 0.6061\sqrt{L} \tag{6}$$

Now, when we have a system of 2 equations (3) and (6) and we can find L and k for 2005. L should be between 0 and 4 weeks. Inserting different values, we found values of L and k that satisfy both equations. For 2005 year (Table 9):

Table 9: Safety Values Before Rapid Replenishment

$\delta_{\text{GIANT EAGLE 2005}}$	0.12
$\delta_{\text{FORT WAYNE}}$	0.12
L	3.9145
G(k)	1.199
k_{TABLE}	1.14

Now we will calculate the item fill rate in 2006, when the Giant Eagle rapid replenishment project was implemented. We know that standard deviation for Giant Eagle sale decreased to 8%, and that Giant Eagle sales were approximately 10% of all Fort Wayne distribution center shipments. Assuming that the weekly standard deviation for the rest of the clients remained at 12%:

$$\delta_{\text{FORT WAYNE}} = \sqrt{(\delta_{\text{FORT WAYNE 2005}}{}^2 * 9/10 + \delta_{\text{GIANT EAGLE}}{}^2 * 1/10)}$$

$$= \sqrt{(0.12^2 * 9/10 + 0.08^2 * 1/10)} = 11.7\% \qquad (7)$$

Then, since the inventory policy is the same (s, L, x_L - unchanged) we can find k from (1) and IFR for 2006 from (4).

Table 10: Fill Rate for Giant Eagle During Rapid Replenishment

$\delta_{\text{GIANT EAGLE (weekly)}}$	0.080
$\delta_{\text{FORT WAYNE (weekly)}}$	0.117
L	3.915
K	1.170
G(k)	1.229
IFR_{2006}	97.71%
$\Delta\text{IFR} = \text{IFR}_{2005} - \text{IFR}_{2006}$	0.01%

As we can see, the difference between 2005 and 2006 is quite small, only 0.01%. This is why the inventory change at the Fort Wayne distribution center remains invisible. If General Mills implements the rapid replenishment initiative for 50% or 100% of its clients in Fort Wayne DC, then we obtain slightly more visible results. They are presented in **Table 11**:

Table 11: IFR for 50% and 100% Rollout of Rapid Replenishment

%Fort Wayne shipments with 24-hour lead times	50%	100%
$\delta_{\text{GIANT EAGLE (weekly)}}$	0.080	0.080
$\delta_{\text{FORT WAYNE (weekly)}}$	0.102	0.080
L	3.915	3.915
K	1.340	1.710
G(k)	1.382	1.718
IFR	97.75%	97.80%
$\Delta IFR = IFR - IFR_{2005}$	0.05%	0.10%

Taking into account the nature of current metric calculations, we can expect the following implications if General Mills were to expand its rapid replenishment services.

Since order flow will be smoother, and General Mills' inventory levels unchanged, then service level to customers will increase. Under our simplified assumptions, if rapid replenishment was rolled out to 50% of customers and inventory levels did not change, then the IFR would increase 0.3%. If it was rolled out to all customers, IFR would increase 0.8%.

Also, General Mills can choose to offset anticipated costs of rapid replenishment by decreasing the inventory level *s* to a level that corresponds to normal-replenishment service levels (which is 97.7% in this case).

4.11.3 Service to Customer Distribution Centers versus Service to Customer Stores

The "Service to Stores" metric increased by 2.9%, but this value came at the expense of a decreased "Case Fill" rate. We will walk through an extreme example to better illustrate the contradiction between the metrics "Service To Stores" and "Case Fill" (See Figures 14 to 16 below).

Imagine that a Giant Eagle store needs 2 pallets of Cheerios on Monday and 2 pallets on Tuesday. In a perfect world, there would be plenty of Cheerios at General Mills, and the correct amount would flow to Giant Eagle stores on a just-in-time basis. See Figure 14.

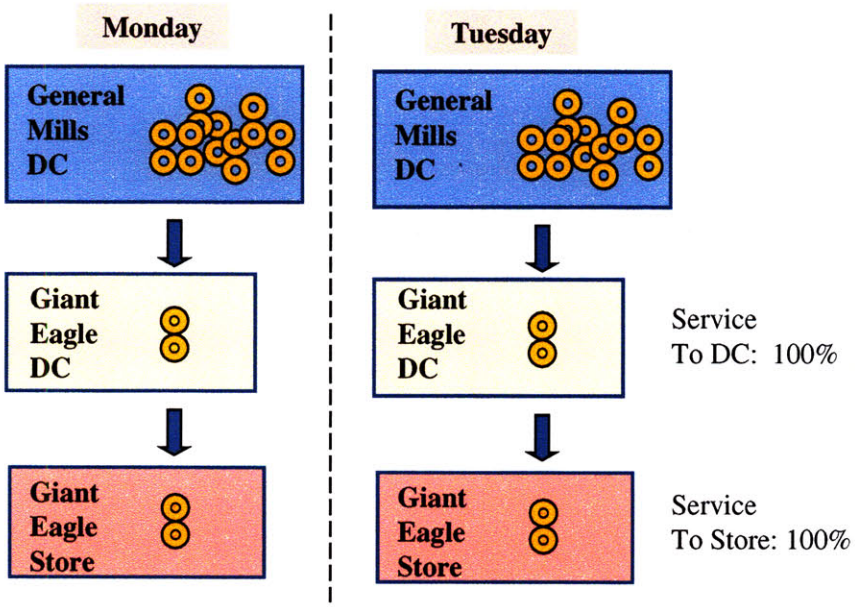

Figure 14: Ideal Order Fulfillment Process

But in reality, General Mills' inventories are not infinite. Fort Wayne might not be able to meet Giant Eagle's last-minute needs if other customer orders have priority. Before rapid replenishment, Giant Eagle's distribution center would aggregate store orders to take advantage of scale, and place an order for 4 pallets with General Mills. In our extreme example, only 3 pallets were available at General Mills on Monday, and the remaining pallet was available on

Tuesday. Before rapid replenishment, General Mills had 2 days to fulfill the order, so the order was shipped on Tuesday. General Mills Case Fill to the Customer DC equaled 4/4, or 100%. However, Service to the Stores would be only 2/(2+2) = 50% (See **Figure 15**).

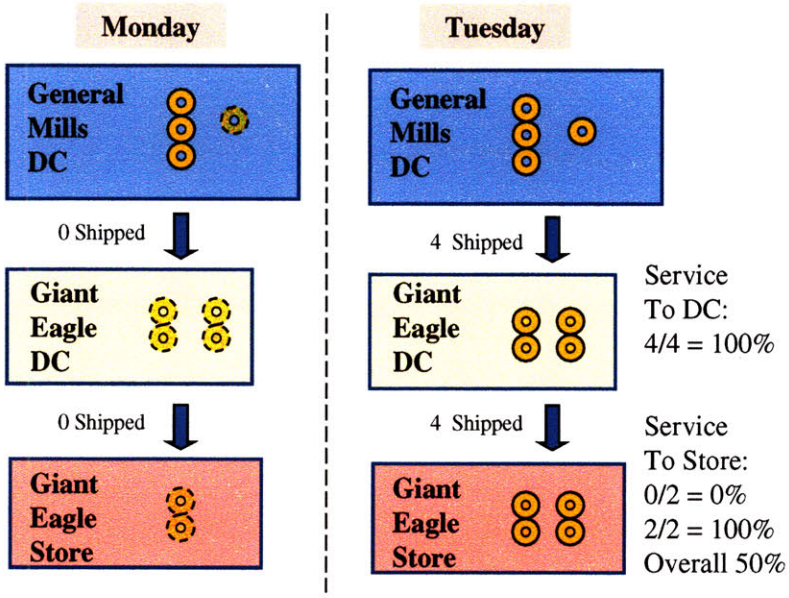

Figure 15: Order Fulfillment Process Before Rapid Replenishment

In the case of rapid replenishment, the three available pallets from order #1 would be shipped the same day, and the remaining pallet would be registered as a "case cut." The Giant Eagle distribution center would place another order on Tuesday to receive any "case cuts" from previous days. The Giant Eagle store would get the pallets when they needed them: 2 pallets on Monday, and 2 more pallets on Tuesday. So by following the rapid replenishment process, Case Fill to Customer DC has fallen to an average of (3/4) and (1/1), or 88%, while Service to Stores doubled to (2+2)/(2+2) = 100%. (See Figure 16).

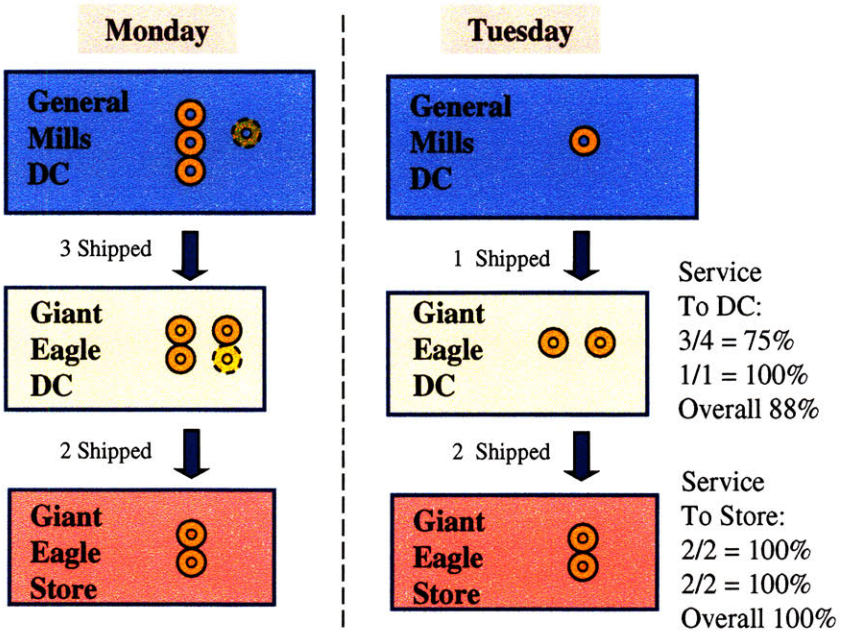

Figure 16: Order Fulfillment Process During the Rapid Replenishment Project

So under rapid replenishment, Service to Store metrics were up, but General Mills' main service level metric, Case Fill to Distribution Center, suffered significantly.

4.11.4 Impact of Rapid Replenishment on Customer Inventory

"Days of Supply of Inventory at Customer DC" is a metric which was reduced by 6 days, from 16.8 to 10.8 days. This change in inventory management, by moving from forecast-based levels to order-based levels, represents the biggest visible value for Giant Eagle. Giant Eagle inventory can be broken down into the following parts: excess, promotional, cycle, and safety stock (see **Figure 17**).

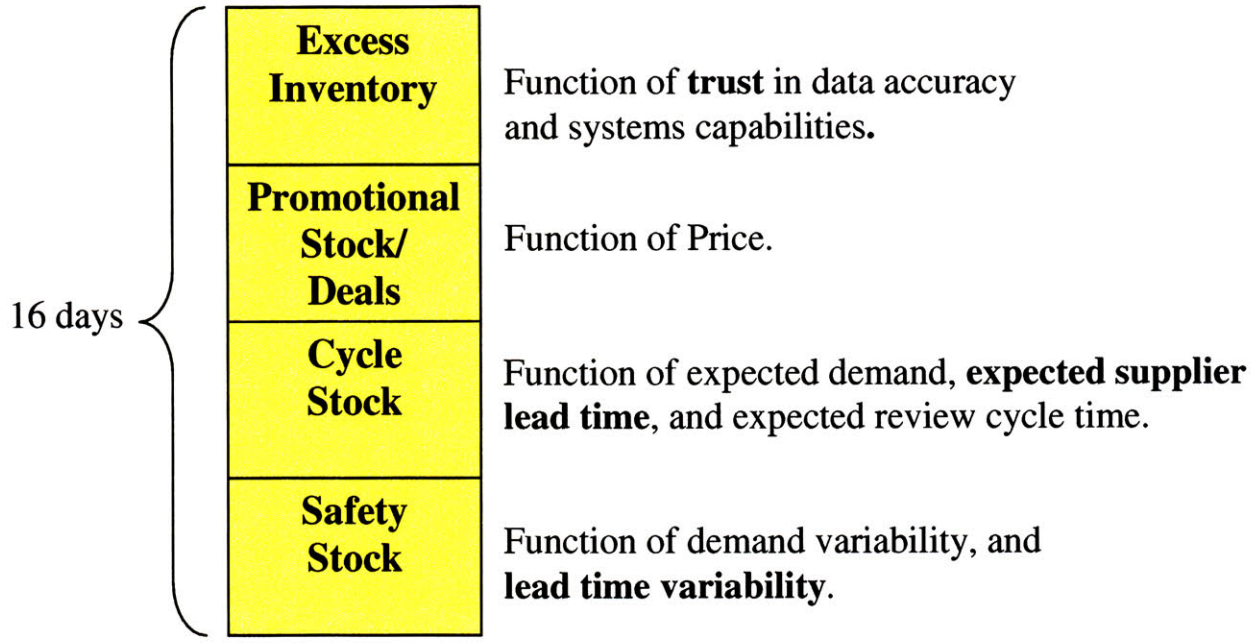

Figure 17: Breakdown of Giant Eagle Inventory

There are four reasons a customer keeps stock on hand. The first is to have stock on hand to sell. The second is to protect against surges in demand. The third is because a customer does not fully trust systems to be accurate. The fourth reason to buy stock is because a customer can sometimes get products at lower rate, and stocks up for when the prices rise.

The biggest inventory reductions have been achieved by a tremendous increase in supply chain trust between operating partners and their systems. This increase in trust was due to the close attention that Giant Eagle employees enjoy through their collaborations with General Mills. Broken down into functional uses of inventory, reductions came from:

- Reduced lead time (from 48 hours to 24 hours), hence reduced Cycle Stock
- Reduced fluctuation of orders (standard deviation reduced from 12% to 8%), hence reduced Safety Stock
- Reduced Excess Inventory as a result closer relations between Giant Eagle and General Mills

- Reduced Promotional Stock, as a result of improved forecast and increased pricing collaboration between Giant Eagle and General Mills

4.12 Summary of Rapid Replenishment Costs

The following group of metrics describes the major cost implications of rapid replenishment to General Mills: case picking, truckload utilization, and transportation costs.

Case Picking increased 19.5%, such that 38 of every 100 cases were not ordered in full pallet quantities. Since orders in 2006 were smaller, it was less likely that Giant Eagle ordered in full pallets, and instead included more individual cases or layers. As a result it takes additional labor hours at General Mills' Fort Wayne distribution center to prepare Giant Eagle orders. General Mills estimated that layer picking adds $1 to $1.50 to the cost of shipping each pallet, and case picking is $0.25 per case. Pallets have an average of 64 cases and 5 layers. The incremental picking cost is a part of the total cost of rapid replenishment policies for General Mills.

Truckload utilization decreased 16.7%, from 54.3% down to 37.6%, since orders are smaller and are placed every day. Delivery frequency has increased while sales volume remained stable. To increase truck utilization, General Mills started to ship turn and promotion orders together in January 2007. General Mills also studied how best to help proactive, collaborative, and neighborly customers to join orders to obtain full truckload shipments.

Total transportation costs increased because the number of trucks going out increased by 25%. To try and offset these costs, General Mills began to investigate backhaul opportunities from Pittsburgh and Cleveland, and also negotiated financial concessions from Giant Eagle.

4.13 Incremental Cost per Case

To judge the operational impact of rapid replenishment, we found the incremental costs for all General Mills functions that were affected by this project. We were able to collect empirical data from transportation, warehousing, customer service, and information technology representatives that were involved in serving Giant Eagle. Using the total number of cases shipped in 2006, 110,000 equivalent cases per week, we found various operational costs per case associated with rapid replenishment. We found that the rapid replenishment project cost General Mills an additional 4% of their 2006 gross margin.

Most of the cost of rapid replenishment was due to increasing transportation costs discussed in Section 4.12. Transportation costs increased approximately 25%; the number of shipments to Giant Eagle rose to 31 trucks per week. Truckload utilization also decreased from 54.3% to 37.6%, showing that rapid replenishment is 69% as efficient as regular replenishment processes. The cost of the additional truckloads came to 3.8% of General Mills' margins.

Case handling costs increased by 19.5%, from 18.6% to 38.1%. According to estimations of warehouse staff, every pallet that was "case picked" or gathered case by case, or layer by layer, adds at least $1 of expenses, but can be as expensive as $0.25 per case. The average number of cases in one pallet of dry goods is 64 cases, but can range from 24 to 210 cases per pallet. A liberal estimate of case picking costs, if we assume 19.5% of 110,000 cases were picked, comes to 1% of General Mills' margins.

General Mills saw increased customer service workload to serve Giant Eagle in the pilot project. The information technology and demand planning teams were also impacted. Though no additional personnel were added to these teams to directly support Giant Eagle efforts, we

expect that a significant number of man hours were borrowed from other General Mills businesses and projects. We estimate that the cost of increased workload was similar to that of hiring at least one customer service representative.

Cutting the order-to-delivery time in half affected all functions of General Mills supply chain organization. If General Mills were to pursue similar projects with other customers, the costs as well as the benefits would multiply. The following chapter includes specific recommendations for how General Mills can decrease the operating costs discussed above. Increasing supply chain efficiencies are necessary for successful duplication of this service initiative.

5 Recommendations

This section proposes changes in the organizational structure, performance metrics, information systems, and operating requirements that General Mills should employ to ensure successful and profitable rapid replenishment projects.

5.1 Customer Teams

Close collaboration with a customer, deep understanding of his business, timely reaction on disruptions are the keys to successful implementation of a rapid replenishment initiative. Dedicated cross-functional customer teams can be a tool of such level of collaboration. Such a team should include Sales & Marketing, Logistics, Warehousing, IT, and Manufacturing representatives. This team will be focused on implementation of rapid replenishment process and on how to create more profit from General Mills products with a customer. Such teams should obtain support from top managers and be managed by a seasoned executives, who are entrepreneurial in nature and experienced in managing business. Members of customer teams must have a mindset of continuous improvements to fine tune structure, roles and processes.

Currently General Mills has only customer teams in its sales organization to interface with customers such as Wal-Mart and Giant Eagle. In the sales organization, dedicated customer teams can be created to work with the largest and most collaborative customers. We also believe that customer teams will help to bring together competing goals of different functions. For example, manufacturing which is driven by utilization and sales which is concerned about customer service.

5.2 Customer Readiness Evaluation

In the course of our discussions with different functional groups, we identified key requirements that would help General Mills stay profitable, should it need to adopt a rapid replenishment policy with any other demanding customers. These requirements are summarized in the following table.

Table 12: Customer Readiness Evaluation

Requirement	Dimension	Reason
Scale	1% revenue	Partnership In Place
Truck Availability	Available in Peak Baking Season	3PLs Partnering with GMI
Consolidation	Full layers or pallets	Low Operating Costs
Order Placement	Create Orders Every Day	Rapid Replenishment Key Need
Advance Ship Notices	In place and useable	Necessary for Increase in Deliveries
EDI	Orders go directly into SAP	Lower Handling Costs
Drop-Shipments	Accept Drops, Mark as Delivered	Increases Warehouse Productivity
Location	Backhaul exists	Cover Cost of Additional Truckloads
Price	Pass Savings on to Consumers	Drives sales
Growth	Positive Sales Growth	Protects Overall Order Volume
Customer Pick Up	Customer Assumes Truck Cost	Low Operating Costs
Truck Scheduling	No Phones or Faxes Used	Low Scheduling Costs
Direct Plant Ships	Customer accepts and order DPS	Low Handling Costs

A customer has to be evaluated for the following characteristics before they can be considered for shorter lead times. Scale: Is the customer ordering at least 1% of General Mills revenue? The sales force believed they could only provide such service to their largest customers, and suggested this 1% metric. Collaboration: Are they willing to cover the costs of additional trucks on a real-time basis? **Consolidation:** Are customers willing to only order in full layers or pallets? **Order placement systems:** Are customers ready to forecast demand and create orders every day? **Order acceptance systems:** Can the customer's systems and people react to daily Advance Ship Notices? Can their distribution centers handle the increase in deliveries? **Electronic Data Interchange:** Can customers place orders directly into General

Mills' SAP database? **Drop-Shipments:** Can customers accept dropped trailers at their distribution centers, and mark them as delivered? **Location:** Do backhaul opportunities exist near the customer? If General Mills cannot organize backhauls, will the customer accept the costs of additional truckloads? **Price:** Will customers pass any savings in inventory holding costs on to their consumers?

General Mills would prefer customers that also meet the following criteria, in addition to the requirements mentioned above. **Growth:** Is the customer's business growing? Do they expect total order volumes to increase? **Customer Pick Up (CPU):** Can customers accept responsibility for transportation? Will they pay for orders even if they are not picked up on time? **Automated Truck Scheduling:** Can customers use an IT system instead of phones and faxes to alleviate scheduling problems during high volume (SOND) months? **Direct Plant Ships:** Can systems order Direct Plant Ships?

General Mills can offer all of its customers short lead times, but it would only remain profitable to do so if certain restrictions were placed on the supply chain operations. If General Mills wants to keep its service levels high, supply chain collaborators need to be picked carefully. General Mills needs to evaluated whether each candidate is ideal for increased collaboration.

5.3 Rapid Replenishment Metrics

This section continues the analysis of rapid replenishment by looking at key process indicators, and discusses how service levels and asset utilization goals are related. We outline procedural improvements that can help General Mills achieve consistency and accuracy of current metrics.

We propose a set metrics that display rapid replenishment costs and benefits to both General Mills and their collaborative customers.

When studying the data provided by General Mills, we noticed that the transportation cost metric is not measured consistently. In 2005, prior to rapid replenishment, this transportation metric only included the cost of freight, fuel, and unloading charges. But in 2006, during rapid replenishment, transportation costs also reflected gains from backhaul opportunities, as well as savings from financial concessions. Since such gains and savings are not articulated separately, the data gathered in 2006 conceals the true behavior of the original transportation costs, leading to incorrect perceptions of rapid replenishment impacts. To keep from drawing the wrong conclusions, we suggest arranging transportation gains into a new metric, Transportation Savings. It will help measure "apples with apples" and control transportation costs.

We also propose to track all the incremental costs relative to rapid replenishment across General Mills functional groups to control cost efficiency. These incremental costs originate from warehousing, transportation, customer service and IT expenses. Those costs can be summarized in two new metrics - Total Rapid Replenishment Cost Per Case and Total Annual Rapid Replenishment Cost as it was shown in section 4.13. These two metrics can also measure the cost effectiveness of cross functional customer teams mentioned in section 5.1.

We suggest General Mills changes their approach to measuring customer service. As it was showed in section 4.11, General Mills' current service metric, Case Fill to Customer DC, measures the performance of General Mills' supply chain rather than their direct impact on clients' businesses. To measure customer service, General Mills should use metrics that reflect

the performance that is directly visible to clients. Store Out Of Stocks and Service To Stores are the best examples.

Why are Store Service and Out Of Stocks better? Because although Case Fill to Customer DC can be easily and precisely measured, this metric does not measure the benefits of rapid replenishment to consumers. In its customer service focus, General Mills should not be scrutinizing the customer DC, but instead share its clients' focuses on stores and end-consumers. Store Out Of Stock and Service To Stores are the metrics that set the right end goal, and can measure the true benefits of collaboration.

There are some difficulties with Store Out Of Stock and Service to Store metrics. First, General Mills cannot measure or control these metrics directly, but can only receive this data aggregated from clients, or sampled from expensive third parties such as Nielsen. Currently only a few collaborative customers such as Giant Eagle provide General Mills with their internal performance metrics. Second, Store Out of Stock and Service to Stores are difficult to measure because they can be changed by clients' actions. Third, not all clients measure those metrics often or consistently. For example, Giant Eagle only measures Store Out of Stocks at a particular store only once a month. Despite all the problems mentioned above, Store Out of Stock and Service to Stores more accurately reflect General Mills' customer service effectiveness than Case Fill to Customer DC.

Store Out Of Stock can also indicate the impact of rapid replenishment on General Mills sales. The lower this metric is, the more product is available for consumer purchase. The higher the availability, the greater the chance of an item selling. The more that an item sells, the more money both General Mills and their customer makes.

We also think that Perfect Order, as detailed in **Figure 18** below, can be better metric than Case Fill in measuring General Mills' order fulfillment process. Case Fill only reflects how many cases were shipped at the end of the order fulfillment process. Whereas Perfect Order measures all stages of the order fulfillment process. Since rapid replenishment deals solely with non-promotional or "turn" orders, we suggest measuring "turn" and promotion orders separately. General Mills should set separate targets for "Perfect Order for Turn Orders" and "Perfect Order for Promotion Orders." Because promotions often drive 80% or 90% of a SKU's sales, the Perfect Order target for promotional items should be higher for that of non-promotional items.

To design an ideal metric portfolio to measure the effects of rapid replenishment implementation, we identify several criteria. First, the number of metrics should be small. The metric portfolio should describe only those variables that are expected to change due to shortening lead times. Also, the portfolio should capture all three operational performance objectives (customer responsiveness, efficiency, and asset utilization) which must be in alignment to drive success, profitability, and growth. Such metrics, or Key Performance Indicators (KPI), can be

- Total Rapid Replenishment Cost Per Case to measure cost effectiveness (see Section 4.13). A sum of incremental warehousing, transportation, customer service and IT costs, divided by the number of the cases shipped.

- Store Out Of Stock to measure the performance of clients, as well as the impact of rapid replenishment on client processes.

- Perfect Order For Nonpromotional Orders to measure the complete performance of General Mills' supply chain.

Perfect order is the order that is complete, in the right place, undamaged, and delivered to the customer distribution center on-time. Perfect order is calculated as a product of error-free rates of each stage of a purchase order. These components are illustrated in **Figure 18**.

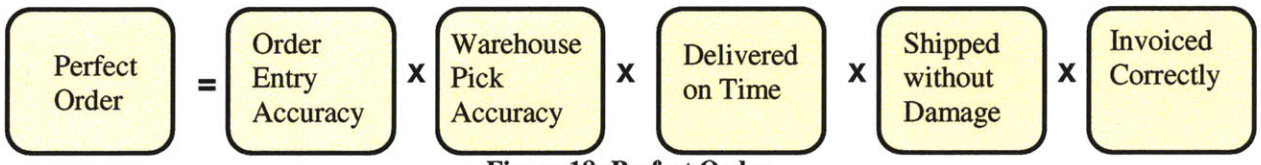

Figure 18: Perfect Order

These three KPIs, Cost Per Case, Out Of Stocks, and Perfect Order, should be used to measure rapid replenishment by managers in all functions and by cross-functional customer service groups.

The rest of the General Mills' metric portfolio are subsets of these key performance indicators. Metrics such as freshness, service to stores, and days of supply at the customer help General Mills understand store performance. Metrics that affect perfect order include order entry accuracy, warehouse case pick, delivery timeliness, damaged goods, and invoicing accuracy. Metrics such as truck utilization, the number of cases shipped, the costs of freight, customer service, and warehouse expenses all affect the overall cost per case metric. If General Mills were to increase the number of customers that it offered short lead times to, all of these metrics would be impacted.

5.4 Information Technology

General Mills' information systems were described in section 3.8 of this document. This section recommends improvements in technology that General Mills should employ to successfully pursue more rapid replenishment projects with innovative customers like Giant Eagle.

General Mills' SAP APO system is efficient for reporting current status of inventory levels and current orders, and EDI systems are in place for automating the transfer of data, but the systems have shortcomings on the customer-data integration and forecasting sides. General Mills has the capital to fund major changes to its information system. Doing so could increase the quality and speed of information processing, as well as indirectly increase the accuracy of forecasts.

We suggest the following additional features will help General Mills collaborate with its customers. A vendor managed inventory system that is compatible with current systems which also integrates customer demand forecasts. General Mills is working on a program that can integrate customer Point of Sale (POS) data into existing forecasting systems.

In addition to these systems, small modifications to existing systems can be done with minimal investments, leveraging current resources. These include automatic forms that populate with SAP database information, automatic exception handling, UCCnet data synchronization, and Automatic Truck Scheduling. These small investments are detailed below.

Currently operating costs such as truckload utilization and layer pick are not readily visible to the logistics planners that are making manufacturing decisions. If these operating costs were automatically pulled from BEx, a SAP reporting system, and integrated into Sales and Operating Process (S&OP) meetings, then decisions could be made with these costs in mind. Automatic forms would be a minimal investment for General Mills' information technology team.

Automatic exception handling would free up the time of General Mills' customer service representatives and also of customer procurement teams. For example, if a non-promotional order is smaller than a full truckload, General Mills representatives often hold that order until it

can be combined with other small orders, to increase truckload utilization. If this order was automatically delayed by SAP, then a customer service rep would be saved a phone call and a purchase order modification.

Another solution to order problems are global data synchronization processes. UCCnet is a non-profit subsidiary of the Uniform Code Council that provides global product registry and data synchronization standards. General Mills could implement UCCnet's Global Registry software to introduce data synchronization. This will help reduce inaccurate product data such as size, weight, or quantity per case. This system offers consistent format data between applications and companies.

Automated truck scheduling and planning are applications would also help General Mills' operations. These optimize the usage of available fleets of third-party trucks, as well as scheduling and optimizing truck routes. This system can be expanded so that customers can combine nearby orders to maximize truckload utilization.

These systems create visibility and alignment between customer and supplier operations, which enable the rapid replenishment process to succeed. They will also create visibility for operating costs, which may constrain the rapid replenishment process.

5.5 Promotions

This section describes recommendations of how promotion orders of the companies participating in rapid replenishment should be handled.

Around 50% of all Giant Eagle orders are promotional ones. Since such orders are placed at least four weeks in advance, they should be forecasted, planned and shipped differently than turn orders. First, promotional forecasting and planning should be arranged in collaboration with

a customer to avoid duplication of efforts, costs and differences in forecasts between General Mills and a customer.

Second, product availability on store shelves is even more important for promotion orders than for turn orders because promotions are limited in time. From this point of view, case fill metrics for promotional orders should be higher than for turn orders. Additionally, since promotion orders are placed in advance, General Mills has a much longer time to prepare such orders for shipment. In case of Giant Eagle we believe that case fill for promotional orders should be above 99%.

Promotional order planning is the most difficult and unpredictable part of demand planning. And since General Mills serves both promotional and turn orders from the same distribution centers, promotional orders influence the fulfillment of turn orders. Quite often a customer notices a promotion does better than expected, and orders an additional quantity. This additional promotion request might cause a disruption in the service of non-promotional orders. To forecast properly, General Mills demand planning groups need to be informed of the causes of spikes in demand. Customer scorecards can be used to track the frequency of short-lead-time promotional orders to create an accurate record of customer demand patterns.

In 2006, General Mills learned that increasing its operating costs in the short run led to enhanced customer performance and satisfaction in the longer term. We expect that more changes in organization, information systems, and order processes can only enhance the customer relationships it enjoys, such as the one with Giant Eagle.

6 Conclusions

Increasing the supply chain velocity between supplier General Mills and their customer Giant Eagle had both positive and negative consequences for both players. These are outlined in the following sections.

6.1 Benefits for General Mills

This section finalizes benefits of rapid replenishment for General Mills.

First, rapid replenishment facilitates customer retention. General Mills provides its customers with a superior level service, responding to and anticipating their needs. This strategy is in sync with current CPG industry trends (GMA, 2005). CPG retailers are looking and pressing for shorter order-to-delivery cycle and higher case-fill rate. Additionally, once such complicated process as rapid replenishment is developed and installed, it becomes extremely difficult and costly for customers to change suppliers.

Second, since rapid replenishment brings for clients such benefits as reduced Out of Stock and increased Case Fill from customer DC to store, increase in sales will be expected eventually. But as in the case of Giant Eagle pilot project in year 2006 such gains can be offset by negative processes. From this point of view it is important to choose growing companies for the next rapid replenishment projects, since implementing this initiative General Mills bears significant costs.

Third, rapid replenishment helps improve forecast accuracy and reduce demand uncertainty. Since Giant Eagle places orders every day, it helps to reduce bull-whip effect and smooth goods flow from General Mills to Giant Eagle. On the other hand, small everyday orders can be a very good source of real-time demand signals for General Mills manufacturing and demand planning.

Fourth, such high level of collaboration helps build better relationships with clients, promotes better and continuous communication and helps obtain insights to customers' organization and concerns, leading to enhanced decision-making.

Fifth, once having implemented more rapid replenishment projects with customers, and leveraging a trade-off between level of inventory and service levels, General Mills can choose to decrease its own inventory levels. Shortening all order-to-delivery cycles can also improve the company's cash-to-cash performance since inventory will be moving faster.

6.2 Benefits for Giant Eagle

This section summarizes benefits of rapid replenishment for Giant Eagle.

The most visible benefit that Giant Eagle already achieved with rapid replenishment is inventory reduction. In 2006, the days of inventory parameter was reduced 35%. Inventory reduction was one of the main goals of Giant Eagle in this project.

The second benefit is reduced out of stocks, which potentially helped to increase sales. Although Giant Eagle had declined sales in 2006, the result might have been much worse if Giant Eagle had not had improved the out-of-stock figure.

The third benefit is a potential sales increase. Lower out-of-stocks increase General Mills' product availability, raising the probability that a consumer will buy them.

The fourth benefit is reduced lead time, which helps Giant Eagle be more flexible in reacting to unpredicted demand.

6.3 Costs of Rapid Replenishment for General Mills and for Giant Eagle

The main incremental costs that are related to rapid replenishment for General Mills and Giant Eagle are transportation, warehousing, customer service and IT costs. These are discussed in detail below.

The cost driver for transportation expenses is the number of trucks used to deliver products to the customer. In the case of Giant Eagle's pilot project, as the number of trucks increased, the truck utilization declined. But General Mills offset these incremental costs by using backhaul opportunities and negotiating financial concessions with Giant Eagle.

The cost driver for warehousing is case picking. Since the number of Giant Eagle orders has increased and the number of each SKU has decreased, there is more case picking. Each case picked pallet represents $1 in additional warehousing costs for General Mills

The cost driver for General Mills' customer service is the number of people working in the Customer Service Center. If General Mills were to offer 24-hour order-to-delivery times to more customers, the customer service centers would have to hire additional employees to handle the increased number of orders and exception handling. Also, if General Mills created cross-functional teams to better address customer profitability, the personnel costs would skyrocket.

Similarly, a cost driver for IT is the number of working hours spent by personnel implementing changes needed for serving rapid replenishment. In the last year, the Customer Service Center has required more support in database reporting.

The main incremental costs that are related to implementation of rapid replenishment from the Giant Eagle side are financial concessions, warehousing, and supplier management costs. By sharing cost information, cost drivers that define General Mills expenses became cost drivers for Giant Eagle. The difference is that Giant Eagle's expenses are initially lower. Some concessions are directly tied to the order-to-delivery cycle, but some are not. For example, the unload fee concession depends on the number of trucks. But concessions such as unsaleable deductions are not tied to any cost drivers, and are on-off in nature. Both of these concessions were addressed during the collaboration between General Mills and Giant Eagle.

Incremental warehousing and supplier management costs include unloading and other operations that take place at Giant Eagle's warehouses. Rapid replenishment increases the number of shipments arriving from General Mills, and so additional employees and warehouse space are required to manage these. Also the increased hours of collaboration with General Mills demand planners increases the time that Giant Eagle spends on procurement.

Table 13 summarizes the costs and benefits that General Mills and Giant Eagle saw during the rapid replenishment pilot.

Table 13: Cost-Benefit Overview of Rapid Replenishment

	General Mills	**Giant Eagle**
Benefit	Customer Retention Smoother Demand Signal Improved Forecast Accuracy Shorter Cash-Cash Cycle	Shorter Lead Times Higher Supplier Service Levels Reduced Out Of Stock Lower Inventory
Cost	High Transportation Costs Initially Higher Inventory Increased Customer Service Hours More Warehouse Handling	More Warehouse Handling More Warehouse Scheduling Higher Order Placement Costs Unloading Fees Dropped

6.4 Future Research

Business literature shows that there are other supply chain initiatives that can improve company's performance, such as vendor managed inventory, collaborative planning forecasting and replenishment, and demand driven supply networks. Success or failure of these projects depends on the quality of implementation, on how strong the company is willing to commit and put effort into overcoming setbacks and adjusting particular models to company reality.

There are some related issues that can be explored and developed further in support of high velocity supply. The impact of using Point-of-Sale data on velocity needs to be quantified. Also, the needs of a refrigerated supply chain need to be outlined and explored as a baseline for rapid replenishment. A process for integrating a vendor managed inventory process within the rapid replenishment framework needs to be outlined, as well as steps for automating exception handling in General Mills' order receiving process.

General Mills' rapid replenishment initiative is in line with industrial trends. Leading consumer product manufacturers are reducing order-to-delivery times and increasing service levels for customers. The project with Giant Eagle shows how General Mills can benefit by addressing customer profitability head-on. We expect that investing in new services, such as Customer Teams, Automated Truck Scheduling, and BEx Cost Reporting, will create value for General Mills. Offering services to other innovative customers will positively impact customer loyalty. Also, creating such programs creates incentives for customers to be communicative and cooperative, increasing supply chain efficiencies that will ultimately benefit the consumer.

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