Innovative Ordering and Distribution of Grocery Products Using Advanced Telecommunications

by

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B.A., Economics
Northwestern University, 1990

Submitted to the Department of Civil and Environmental Engineering in Partial Fulfillment of the Requirements for the Degree of

Master of Science in Transportation

at the
Massachusetts Institute of Technology

May 1994

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ABSTRACT

The current distribution system for grocery products is structurally inefficient. It is not explicitly designed around distributing products in the most efficient manner throughout the entire supply channel—which extends from the point of production to the point of use, or from the factory to the household. Instead, the distribution system is built around the supermarket, whose use causes both consumers and distributors to incur unnecessary expense.

Recently, the grocery industry initiated a major, industrywide program aimed at reducing the cost to distribute grocery products. However, this program—known as Efficient Consumer Response (ECR)—may be fundamentally flawed, because it does not adopt a total channel view: it truncates the restructuring process at the supermarket.

In order to create a more efficient distribution system for grocery products, this thesis proposes a radical restructuring of the methods employed for both customer ordering and product distribution. The system proposed in this thesis incorporates the following: (1) electronic customer ordering of products from the home or office; (2) product picking into customer orders by the distributor at the distribution center; and (3) either customer pick-up of the order at a neighborhood depot, or home delivery. Essentially, the proposed system links the consumer directly into the supply channel.

This distribution system produces both a significant reduction in the cost to distribute grocery products, as well as a substantial increase in consumer value. In addition, the proposed system results in numerous other benefits that impact a wide range of functions, including production, marketing, product quality and inventory control. Overall, it is estimated that the concepts proposed in this thesis may ultimately generate gains—accruing to consumers, distributors and suppliers—measured in the billions of dollars.

The proposed distribution system is also likely to have a significant impact on the telecommunications industry. In the long run, the revenue generated by home grocery shopping could help to both fund the rollout and hasten the deployment of advanced telecommunications network infrastructure to the home.

Thesis Supervisor: Jonathan L.S. Byrnes
Title: Senior Lecturer
Acknowledgments

I want to thank my family, Mom, Dad, Nicole and Eric, for all their support throughout this process. Without their gentle reminders, this little endeavor could easily have been extended for a few more seasons.

I especially want to thank Sandra for putting up with me this past year. I don't think she realized how much she had to learn about the grocery industry.

Thank you to my advisor Jonathan for keeping me focused and helping to move the project forward. And thank you to the many people I've worked closely with over the course of this research. In particular, I want to thank Ray, for introducing me to the joys of DPC, and the people at Food Express, for cooperating so openly.

And, to the swamp rats from the basement, I have just one piece of advice: "Wherever you may go in life, watch out for those aggressive grocers!"
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Chapter One

Background

1.1. Introduction

1.1.1. Hypothesis

The current distribution system for grocery products is structurally inefficient. It is not explicitly designed around distributing products in the most efficient manner throughout the entire supply channel—which extends from the point of production to the point of use, or from the factory to the household. Instead, the distribution system is built around the supermarket, whose use causes both consumers and distributors\(^1\) to incur unnecessary expense.

Recently, the grocery industry initiated a major, industrywide program aimed at reducing the cost to distribute grocery products. However, this program—known as Efficient Consumer Response (ECR)—may be fundamentally flawed, because it does not adopt a total channel view: it truncates the restructuring process at the supermarket.

This thesis contends that by extending the restructuring process beyond the supermarket to include the consumer at the household, the entire supply channel can be made more efficient. In fact, the system proposed in this thesis produces both a significant reduction in the cost to distribute grocery products, as well as a substantial increase in consumer value. In addition, the proposed system results in numerous other benefits that impact a wide range of functions, including production, marketing, product quality and inventory control. In total, this researcher estimates that the concepts proposed in this thesis may ultimately result in gains—accruing to consumers, distributors and suppliers—measured in the billions of dollars.

1.1.2. Problem and proposed solution

\(^1\)This thesis employs terminology used by the Food Marketing Institute (FMI). According to FMI, distributors are defined to be all chains, independent operators, wholesalers, and other companies that distribute and/or retail grocery products. Suppliers are defined to be manufacturers and processors of grocery products.
Essentially, the current supply channel for grocery products is built around the *customer*, rather than the *consumer*. The customer is the supermarket operator (i.e., the distributor), while the consumer is the actual end user of grocery products. There are significant costs associated with this design, and these can be divided into two broad categories: distributor costs and consumer costs.

Distributor costs consist of the capital and operational expenses associated with running supermarkets, including building and maintaining such facilities, and stocking and merchandising products in them. Consumer costs comprise the expenses related to procuring products at supermarkets, including out-of-pocket monetary expenditures and opportunity costs.

However, because the use of supermarkets is so ingrained, there is a common perception on the part of distributors that distributor costs (i.e., those related to operating supermarkets) are a necessary condition of grocery retailing, while consumer costs (i.e., those related to consumers shopping at supermarkets) are not true "costs." As a result, the full impact of both types of cost, in the context of the total expense to distribute grocery products to the consumer, has not been sufficiently accounted for until now.

This situation contrasts with that of most industrial supply channels, in which the customer is the consumer. In recent years, many of these channels have been restructured and rationalized around a small number of suppliers. Competitive pressure from other suppliers—and from other supply channels—has forced successful suppliers to become acutely aware of the impact that they can have on the end users of their products. The most progressive suppliers work closely with their customers, forming partnerships which strive to ensure smooth and efficient product flow, at minimal cost, throughout the entire channel. A common outcome of such partnerships is that the relevant supply channels are explicitly designed around the needs of the end users of the products.

Essentially, the key lesson from these efforts is that restructuring must be undertaken on the whole supply channel in order to achieve full benefit. This thesis seeks to borrow that lesson and apply it to the grocery industry.

In order to create a more efficient distribution system for grocery products, this thesis proposes a radical restructuring of the methods employed for both customer order-
ing and product distribution. The system proposed in this thesis incorporates the following: (1) electronic customer ordering of products from the home or office, via a sophisticated interface connected to a high-capacity telecommunications network; (2) product picking into customer orders by the distributor at the distribution center; and (3) either customer pick-up of the order at a neighborhood depot, or home delivery.

By deemphasizing the role of the supermarket, the proposed distribution system results in significant gains relative to the existing system. For example, the proposed system produces a huge increase in consumer value at no added cost. In fact, under the proposed system, not only does the distribution cost not rise, it actually declines.

This knowledge results from the detailed supply channel analysis which has been conducted by this researcher. In this thesis, two channel maps are created; each tracks the activities and associated costs involved in the distribution process as products flow through the supply channel. The first map depicts the current, supermarket-based system. The second map illustrates the proposed system, incorporating the changes which take place at the distribution center and at the retail outlet, as well as incorporating new functions, such as computer-related activities and telecommunications network access. Together, these channel maps—which are developed in Chapters Five and Six—illustrate the magnitude of savings that are possible with implementation of the proposed system.

One of the most exciting aspects of the home grocery shopping concept is that it has appeal for both distributors and consumers. Distributors will be drawn to it because it allows them to lower their costs and better meet the needs of consumers, rendering to those companies that adopt the concept a competitive advantage over traditional supermarket operators. Consumers will appreciate home grocery shopping because of its convenience and possible cost savings. In the end, the fact that home grocery shopping benefits both the provider and the user is likely to be of considerable importance in helping to bring the concept to the marketplace.

1.1.3. Implications

1.1.3.1. Grocery industry

The grocery industry clearly does recognize that there are inefficiencies in the grocery products supply channel, and in fact has begun efforts to reform the supply
chain. Recently, the industry commissioned several studies addressing this issue. The culmination of these efforts is the ECR initiative, which proposes many recommendations for both distributors and suppliers. ECR is the state-of-the-art in the industry, and the plans are for the first phase of implementation to be completed by the end of 1994, with recommended full implementation by the late 1990s.

However, if the goal of the grocery industry is to remove all inefficiency from the distribution system, from the point of production to the point of use, than ECR is fundamentally flawed. As noted earlier, the program is truncated, because it ends the restructuring process at the supermarket. Yet the distribution system of the future may not even have a supermarket.

Strategically, ECR is deficient in the sense that distributors have adopted too narrow a view of their role, especially from the perspective of the consumer. Throughout the ECR literature, distributors see themselves primarily as operators of a collection of free-standing supermarkets, engaging in little or no interaction with the consumer beyond the store. In fact, ECR itself is in many ways little more than a defensive response by the traditional grocery retailing sector to competition from merchandisers outside the industry.

In contrast, this thesis has adopted an expanded view of the distributor's role: that of facilitator in the movement of grocery products to the home. Under this view, the market-savvy, proactive distributor can gain a long-lasting strategic advantage by joining with the consumer in a partnership. The overarching goal of such a partnership would be to reduce the total burden that the activity of grocery shopping places upon the consumer.

One of the basic assumptions of the ECR program is that the supermarket will continue to be the sole interface between the distributor and the consumer. But, as this thesis will show, supermarkets may not be necessary for all products or for all consumers.

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3Efficient Consumer Response, pp. 11-12

4Ibid., p. iv.
Under the system proposed in this thesis, products are marketed electronically, which pushes the distributor-customer interface out to the home. Combined with order picking at the distribution center, this type of marketing enables two of the main functions of the supermarket—display and inventory—to be more productively performed elsewhere in the supply channel: product display occurs on a viewing device in the home, and most inventory is limited to the distribution center.

Thus for the grocery industry, the implication of the proposed system is that although ECR may be effective for what it proposes, by itself it is not enough. It does not continue the restructuring process all the way through to the ultimate destination of grocery products—the home. Essentially, this means that the grocery industry may be about to follow a path that is severely limited in its capacity to remove cost from the distribution system, because the program does not incorporate any examination of the distribution process beyond the supermarket.

1.1.3.2. Telecommunications industry

For telecommunications providers\(^5\), home grocery shopping has three main implications. First, it dramatically alters the perception about the underlying value of the network to the home. Second, it opens up the possibility of funding network development in an innovative manner. Third, it can provide a new core strategic business for these companies.

The first implication concerns changing the perception about the value of the residential network. Until now, the network to the home has been viewed as a passive conduit, capable of furnishing communications links or entertainment. The consequence is that telecommunications providers—like grocery distributors—have not adopted a full channel view of their role. Whereas the grocery distributor truncates its business at the supermarket, the telecommunications provider terminates its operations at the phone or

\(^{5}\)In this thesis, a telecommunications provider is any company that currently supplies, or is capable of providing, a high-capacity telecommunications link to the home. This definition includes local and long distance telephone companies, cable television operators, and numerous other firms that are seeking to enter the residential telecommunications market. Refer to Chapter Four and Appendix B for more information.
However, the home grocery shopping concept provides a basis for the network, and by association the telecommunications provider, to migrate from today's primarily nondynamic mode of operations in the residential market to a future, more active, role. For example, rather than being viewed strictly as a passive conduit, the residential network could come to be seen as a tool that can be used by industries far removed from telecommunications—e.g., grocery retailing—to streamline their operations and take costs out of their own businesses. A shift of this nature would open up huge opportunities for telecommunications providers to revolutionize other businesses, and thus contribute a much greater value than is the case today. The implication is that telecommunications providers will be able to proactively deploy their resources in the residential market in a way that aids non-telecommunications businesses.

The second implication—creating a new funding agent for network development—is of tremendous importance to telecommunications providers, consumer ratepayers and government regulators.Essentially, home grocery shopping creates the opportunity to fund residential network development in an innovative manner.

To illustrate, at the moment, phone company revenues are generated primarily by business users and consumer ratepayers; cable company revenues derive almost entirely from consumers. However, the availability of home grocery shopping might induce distributors, manufacturers and even advertisers to finance a portion of the cost to upgrade the network. This is because an advanced network would allow these companies to restructure and/or expand their businesses.

The significance of this prospect must be stressed. At the moment, telecommunications providers and consumer advocates are engaged in heated battles regarding the installation of new telecommunications technologies. Primarily, the debates center around the source of financing for these projects, which tend to be capital-intensive. In general, consumer groups do not want rates for basic service to increase, while telecommunications providers are wary of sacrificing profitability. In the middle are government regulators, who must usually choose one side over the other.

Home grocery shopping may offer a means to move beyond this dialogue, by providing novel financing options that heretofore have not been considered. Ironically,
the value of home grocery shopping may be so great, in terms of the time and cost permanently removed from the grocery product supply channel, that the concept might help to both fund the rollout of the advanced network, and possibly allow rates for basic telephone and cable television service to be held constant or even lowered.

The third implication concerns the long term strategies of telecommunications providers. As noted above, these companies currently work chiefly in a passive capacity in the residential market, supplying networks that other businesses use to add value. However, home grocery shopping presents an opportunity for telecommunications providers to collaborate with businesses far removed from the telecommunications industry, and work to create new strategic enterprises. For example, rather than simply provide the network connection to the home, a telecommunication provider could partner with a grocery distributor and take an active role in rolling out the home grocery shopping system to the mass market. Adopting this type of strong involvement could yield to the telecommunications provider a new core strategic business.

1.2. Home grocery shopping

1.2.1. Need for a new distribution system

There are two broad classes of inefficiency in the current distribution system for grocery products. The first class consists of the explicit inefficiencies, problems which are readily apparent to knowledgeable observers. According to the ECR report, these inefficiencies are plentiful. They occur entirely in the backchannel, which is the section of the supply pipeline extending from the point of production to the supermarket. Many result from harmful trade practices between suppliers and distributors, such as forward buying and diverting. These are the inefficiencies which ECR seeks to remove.

However, there is another class of supply channel inefficiency, one which has remained hidden until now. These are the structural inefficiencies, and the reason they have remained concealed is because they are inherent in the distribution system, as currently designed. Structural inefficiencies occur primarily in the forward channel, i.e., the section

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6 Efficient Consumer Response, pp. 1-5.
7 Refer to Chapter Three for more information.
of the supply channel extending from the store out to the point of use. Essentially, these are the inefficiencies associated with actually putting grocery products in consumers' possession, and they include the construction and maintenance of supermarkets, most store labor activities, consumers' shopping costs, etc. It is these inefficiencies which this thesis seeks to examine.\(^8\)

Figure 1-1 provides an illustration of the discussion in this thesis. Figure 1-1 (a) shows how grocery products travel under the present distribution system. In general, products are transferred from the processing facility, to the distribution center, to the supermarket, and then to the home. However, as has been discussed, the supermarket may be superfluous. Figure 1-1 (b) illustrates this idea. Similar to the current system, products travel from the processing plant to the distribution center, but there the similarity ends. To move goods from the distribution center to the home, this thesis has examined a number of options, including customer pick-up and home delivery. The option that is analyzed in depth in this thesis involves a neighborhood depot. Other methods have been identified as areas for future research.

Note that in this thesis, the analysis of the distribution process is focused on the activity extending from the distribution center forward. There are two basic reasons for initiating the analysis at this stage of the supply channel. First, the various distribution costs prior to the distribution center are implicit in the cost of goods\(^9\). Second, it is only from the distribution center forward that the activities under the proposed system begin to significantly diverge from the current system.\(^10\)

---

\(^8\)There are two key points that must be mentioned. First, although this thesis deals explicitly with reducing the inefficiencies associated with the forward channel, this research also proposes numerous improvements to the ECR recommendations regarding the backchannel; see Chapters Three, Six and Seven for a more detailed discussion about this important topic. Second, there is a major project currently underway, known as Smart Store, that does address the inefficiencies in the forward channel. However, there are significant differences between the proposals in this thesis and the Smart Store effort; see Chapter Three for more information.

\(^9\)The cost of goods is the wholesale cost, i.e., the price that the distributor pays the supplier for the product.

\(^10\)Refer to Chapter Five for additional information.
Figure 1-1
Current and Proposed Distribution Systems

(a) Current Distribution System

Supplier → Distribution Center → ABC Foods → Household

(b) Proposed Distribution System

Supplier → Distribution Center → Household
Table 1-1 depicts the percentage breakdown by stage, from the distribution center to the checkout counter, of the distribution cost for a selected product under the current system. Incorporated into the values listed in this table are the costs for all activities directly performed on the product. From this table, it is clearly evident that along this section of the supply channel, the store component accounts for the largest share of the overall distribution cost. Indeed, at 84 percent of the total, the supermarket expense substantially outweighs the combined expense of the distribution center and transportation to the store. Moreover, while distribution activities prior to the distribution center are beyond the scope of this thesis, incorporating such activities still produces a supermarket cost that—at 62 percent—is the largest share of the distribution expense.

The above results are due primarily to the high costs of retail space, store labor and inventory maintenance. While the ECR program seeks to reduce distribution costs by attacking inefficiencies in the supply channel up to the store, Table 1-1 illustrates that even larger savings can be realized by revising the role of the store itself.12

It is also important to point out that there is a hidden distribution cost, one which has not been adequately measured or fully considered until now. This is the cost to consumers resulting from engaging in the grocery shopping process. As noted earlier, there are two categories of this cost. The first is the out-of-pocket monetary cost, such as the round-trip transportation expense; the second is the opportunity cost resulting from the use of time.

\[11\text{This cost breakdown was developed through field research and it represents a composite dry grocery product. Note that the actual distribution expense for a given product can vary widely based on a number of factors, including product attributes, handling characteristics, and distance between origin and destination. More detailed information on this subject is provided in Chapters Five and Six.}

\[12\text{An important issue concerns the real role of the supermarket. Traditionally, the supermarket has been viewed as a vital marketing tool that stimulates consumers to shop for grocery products. However, from a distribution context, the supermarket can be seen as a major cost center. See Chapters Six and Seven for more information.}
<table>
<thead>
<tr>
<th></th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DISTRIBUTION CENTER TO SUPERMARKET</strong></td>
<td></td>
</tr>
<tr>
<td>DISTRIBUTION CENTER</td>
<td>10.7%</td>
</tr>
<tr>
<td>TRANSPORTATION TO STORE</td>
<td>5.4%</td>
</tr>
<tr>
<td>STORE</td>
<td>83.9%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SUPPLIER TO SUPERMARKET</strong></td>
<td></td>
</tr>
<tr>
<td>TRANSPORTATION TO DISTRIBUTION CENTER</td>
<td>26.3%</td>
</tr>
<tr>
<td>DISTRIBUTION CENTER</td>
<td>7.9%</td>
</tr>
<tr>
<td>TRANSPORTATION TO STORE</td>
<td>4.0%</td>
</tr>
<tr>
<td>STORE</td>
<td>61.9%</td>
</tr>
</tbody>
</table>

Sources: Major manufacturer of grocery products
Nationwide survey of chain distributors
Together, these costs are not trivial. Therefore, any model which seeks to fully measure the total distribution expense for grocery products should incorporate them. This is especially true if the model is utilized to devise a system aimed at addressing the needs of the consumer, who is acutely aware of these costs.\textsuperscript{13}

\textbf{1.2.2. Benefits of the proposed system}

Table 1-2 illustrates the key findings of this research. As is clear from the table, the proposed system provides both a significant reduction in the distribution cost, and a substantial increase in consumer value. In fact, for some consumers, the financial equivalent of the time savings offered by home grocery shopping may outweigh the decrease in product cost. It is important to note that this table is comprehensive, i.e., it incorporates the expenses for new activities necessary under the proposed system, including order picking at the distribution center, new equipment, totes and computer-related activities.\textsuperscript{14}

Overall, the advantages to be gained from implementation of the proposed distribution system are extensive. Among the many benefits: lower distribution cost, higher return on assets, greater convenience, reduced inventory, more efficient production, enhanced product freshness and security, improved forecasting ability, wider product selection, lower information processing costs, more effective marketing, reduced shrinkage, and possible increases in sales volume. The principal question of what is obtainable in practice is dependent upon real-world implementation, and this in turn is

\textsuperscript{13}For a more detailed discussion about the subject of consumer-related distribution costs, refer to Chapters Six and Seven.

\textsuperscript{14}One item that is not included in Table 1-2 is the cost for telecommunications network access. Refer to Chapters Four and Six for more information.
### Table 1-2
CURRENT SYSTEM VERSUS PROPOSED SYSTEM

<table>
<thead>
<tr>
<th></th>
<th>BASE CASE</th>
<th>FEASIBLE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CURR.</td>
<td>PROP.</td>
</tr>
<tr>
<td>DISTRIBUTOR'S TOTAL COST</td>
<td>100.0</td>
<td>76.7</td>
</tr>
<tr>
<td>RETAIL PRICE</td>
<td>100.0</td>
<td>98.0</td>
</tr>
<tr>
<td>TIME SPENT GROCERY SHOPPING</td>
<td>100.0</td>
<td>32.1</td>
</tr>
</tbody>
</table>

Sources: Nationwide survey of chain distributors
Nationwide survey of consumers
Peapod
dependent upon such issues as marketability of the concept, cost, technology and strategy. These are all very important concerns; see Chapters Four through Seven for more information regarding these topics.\(^{15}\)

### 1.2.3. Motivating forces

There are two factors which will drive implementation of home grocery shopping: consumer demand and competition. The first factor, consumer demand, stems from the great demographic shifts in the U.S. over the past three decades. Women have entered the workforce in unprecedented numbers, and today, unlike fifty or even thirty years ago, there are relatively few households in existence with someone available full-time to do household activities. One of the outcomes of this demographic shift has been a rapid increase in the perceived value of leisure time.\(^{16}\)

Consumer shopping behavior reflects this reality. Formats designed to appeal to time-pressed consumers, such as catalogs and other forms of home shopping, have been increasing in popularity in recent years. However, the home shopping concept has yet to be thoroughly applied to the marketing and distribution of grocery products.

The second motivating factor is competition. Pressure to change the distribution system will initiate from any number of sources, including: companies within the traditional supermarket-based retailing sector; businesses outside of the industry which also merchandise grocery products—referred to as alternative formats\(^{17}\); and firms outside of the industry which are not presently merchandising grocery products, such as entrepreneurial, start-up operations.

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\(^{15}\)The marketability issue is perhaps the most important matter affecting the success of the home grocery shopping concept. The basic question concerns the willingness of consumers to purchase grocery products electronically. Impacting this acquiescence are a variety of factors, including cost and time savings, product variety and the sophistication of the display interface, but perhaps no issue is more important than product quality. In order for the consumer to delegate the responsibility of order picking to another party, he or she must have absolute assurance that the quality of the products will be no less than if he or she picked the items directly. As Chapter Seven will demonstrate, there is evidence indicating that product quality may actually improve under the proposed system. With respect to the more general topic of inducing consumers to shop electronically, there are a variety of methods that can be used to address this issue; refer to Chapters Four, Six and Seven.

\(^{16}\)Refer to Chapter Three for more information.

\(^{17}\)Alternative formats include warehouse clubs, mass merchandisers and supercenters.
The difficulty in pinpointing where change will originate stems from two factors. First, it is unclear which grocery retailing format is the most powerful at the moment. For example, supermarkets are currently the dominant mode of distribution of grocery products—accounting for $292.0 billion, or 75 percent, of the $390.0 billion in total volume in the U.S. in 1993. But, this type of operation has been losing market share to the alternative formats for the past decade. However, in the past year, at least one type of alternative format—warehouse club stores—has experienced some difficulty, and in an almost complete reversal of their position from just one year ago, many grocery industry executives no longer see this format as a major threat.

Second, with respect to start-up operations, the viability of such firms is dependent upon numerous factors, including many that are extraneous to the home grocery shopping concept. Most of these matters will not be determined until such a business has been launched and is actually operating.

In general, the alternative formats have superior cost structures relative to supermarket operators, enabling them to offer grocery products at prices far below those found at supermarkets. It is exactly this price competition which is placing a great deal of pressure on supermarket operators to reform their operations. In fact, much of the impetus behind the ECR initiative has arisen as a result of a sense of urgency on the part of the traditional grocery retailing sector to respond to this external competition.

However, the cost structure of the alternative formats does not necessarily grant them strategic advantage in the home grocery shopping business. Rather, it can be assumed that over the course of the next decade, iconoclastic operators—from a variety of


19 Efficient Consumer Response, p. iv.


21 For instance, the wholesale price that any distributor—traditional or otherwise—pays for products is based on the size of the purchase, and the quantity purchased by a start-up operation would likely be far smaller than that of a large distributor. In turn, the wholesale cost is a key factor influencing the retail price that consumers pay.

22 Efficient Consumer Response, p. iv.
backgrounds—will continue to innovate in the search for more efficient shopping formats.

1.2.4. Opportunity

Home shopping is not a new concept. Mail order catalogs date back at least to the nineteenth century, while other formats, such as phone-, personal computer-, and television-based services, have become widely available and highly popular in recent years.\(^{23}\) In fact, even home ordering of grocery products has already been implemented, with varying degrees of success.\(^{24}\)

However, there are two rapidly coalescing forces which have created the opportunity, for the first time, to fully develop the home grocery shopping concept and drive it out to the mass market. First, the institution of the supermarket may not be evolving sufficiently in order to meet recent demographic shifts. This is evident from the rising popularity of the alternative formats, and the resultant rapid erosion of market share experienced by the traditional supermarket industry. Second, the capability is now available. Recent advancements in telecommunications technology represent the key enabler; these developments which will soon make it possible to deploy a highly stimulating interface in the home, at a reasonable cost.

1.2.4.1. Grocery retailing

\(^{23}\)For example, there are now several nationwide on-line computer services that allow consumers to order a variety of products; none of these services existed fifteen years ago. Also, the two major television- and phone-based home shopping services—QVC and Home Shopping Network—were both founded in the 1980s; each now generates annual revenue exceeding one billion dollars per year.

\(^{24}\)The differences between this proposal and other home grocery shopping efforts are significant. Whether operating via the phone, fax, personal computer, or even television monitor in the case of one service currently under development, other home grocery shopping services have not achieved seamless integration between consumers, distributors and manufacturers. Essentially, under most of these services consumer orders are communicated to the distributor, or to a third party, who then sends a surrogate shopper to the supermarket to pick the order and deliver it to the home. This type of service has been available since the advent of the supermarket; the only significant change has been the method of communication. (A different type of home grocery shopping service exists in which there is no supermarket; however, these services require the consumer to purchase several hundred dollars worth of goods, in bulk quantities, with each order.) In contrast, this thesis is proposing that distributors pick standard-size consumer orders directly at the distribution center, thereby preventing products from ever reaching store shelves; indeed, under the proposed system, the supermarket itself is eliminated. See Chapter Six and Appendix A for an analysis of the many key differences between this proposal and other home grocery shopping efforts.
The first opportunity factor stems from the fact that the supermarket business is a mature industry. As an institution, the supermarket may be lagging behind other businesses in its response to recent demographic shifts, such as those mentioned in Section 1.2.2. For example, both supercenters and warehouse clubs enable consumers to reduce the total number of shopping trips, while home shopping allows consumers to eliminate certain trips altogether.

Note, however, that each of these formats has significant drawbacks. For instance, warehouse clubs merchandise grocery products only in bulk quantities and are usually erratically stocked; supercenters are often found to be overwhelming by the consumer, particularly when he or she only wants to purchase a limited number of items; and home shopping has so far been applied almost exclusively to discretionary goods, such as jewelry, clothes and collectibles, and not to consumer staples, such as food, household cleaners and health and beauty care. Nevertheless, despite such weaknesses, each of these institutions continues to grow—at varying speeds—in popularity.

On the other hand, the grocery industry—while actively pursuing numerous ideas—may not be doing enough to meet the desire of many consumers to spend less time on this routine activity. For example, when fully implemented, ECR should reduce the cost of products; however, the program will do little to improve consumers' convenience, other than to possibly reduce the number of stockouts.25

As another example, the trend in the grocery industry in recent years has been toward consolidation of retail facilities and the creation of "superstores." Clearly, this process leads to both an increase in the average size of supermarkets, and to a reduction in the total number of stores. While this movement permits more "one-stop" shopping, it results in increased round-trip transportation time for the consumer, as well as the inconvenience of having to shop in a large store when only a few items are needed.

And, as one other example, many distributors and other companies are currently investing significant sums of money in order to create "supermarkets of the future;" essentially, these are stores based around self-scanning (and possibly self-bagging) of grocery

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25In a retail environment, a stockout refers to a product that is not available at the time that the consumer wants to purchase it.
products by the consumer. However, such ventures still require that the consumer enter the supermarket and physically traverse aisles in order to do the grocery shopping, and it is not clear whether checkout time is significantly lowered or even whether it is reduced at all. The net result is that any improvement in consumer convenience offered by these projects is likely to be minimal.\textsuperscript{26}

Since the advent of the supermarket over fifty years ago, distributors may have become fixated on their role as supermarket operator, rather than as distributor of grocery products to the consumer. This fixation has opened up a large opportunity to develop the home grocery shopping concept. For example, if a practical alternative to the supermarket became available, one that saves time, does not require bulk quantity purchases, stocks extensive variety, and is easy to use, many consumers would probably demand to use it; if this alternative also offers lower prices, consumer demand would likely be huge.\textsuperscript{27}

Indeed, for many consumers, it may be the case that these shoppers are patronizing supermarkets now only because they have no other choice. In the end, many of the measures currently being pursued by distributors may simply be tactics which have the net effect of extending the institution of the supermarket beyond its useful life.

**1.2.4.2. Telecommunications**

The second opportunity factor for home grocery shopping pertains to the development of new telecommunications technology. As a result of very recent break-

\textsuperscript{26}As noted earlier, there is one major venture currently under development which seeks to improve forward channel efficiency. This effort incorporates different elements, including restructuring of activities within the supermarket as well as changes in the supply process beyond the supermarket. Nevertheless, similar to the ECR program, this project may also be insufficient. See Chapter Three for more information.

\textsuperscript{27}With respect to the viability of home grocery shopping as a business, two factors are important to note: first, the service does not have to achieve 100 percent market share in every market in which it is available; second, home grocery shopping customers do not have to do 100 percent of their grocery shopping via the service. Consumer willingness to utilize home grocery shopping is likely to vary based on household characteristics and service attributes. However, there are almost 100 million households in the U.S.; a large business can be created with limited market penetration. Furthermore, for the first company into the marketplace, home grocery shopping may prove to be extremely rewarding. This company could profitably implement the service in targeted markets as a start-up operation, providing the firm with a very cost-effective entree into those markets.
throughs, the residential network will soon experience dramatic increases in both capacity and functionality; the result will be a network that is far more advanced than that available today.\textsuperscript{28} Furthermore, as will be shown in Chapter Four, the cost to achieve this advanced capability—particularly when seen in the context of the value that the network brings to the grocery industry—is remarkably economical.

This researcher has examined a range of enabling telecommunications technologies, including integrated services digital network (ISDN), asymmetric digital subscriber line (ADSL), fiber/coax, fiber-to-the-curb (FTTC), fiber-to-the-home (FTTH), wireless cable and personal communications service (PCS). Each of these technologies is sufficient for the home grocery shopping service. For example, each permits the distributor to communicate product listings and current prices to the consumer, and each allows the consumer to indicate his or her selections electronically. Furthermore, several of the technologies are also capable of transmitting full-motion video and three-dimensional graphics, which would permit highly stimulating and creative display interfaces to be offered.\textsuperscript{29} Nevertheless, it is important to note that while the recent development of new telecommunications technology is a key enabling factor, the home grocery shopping concept is \textit{not} primarily technology-driven.\textsuperscript{30}

The technologies listed above are being developed and implemented predominately by local phone companies and cable television operators, though a variety of other firms are seeking to enter the residential telecommunications market as well. While the specific technology strategies vary by industry, the important factors to bear in mind are capacity, functionality and cost. Compared to what is currently available, the new technologies will provide the residential network with increased capacity and expanded func-

\textsuperscript{28}It should be pointed out that in actuality, there is no single "network." Currently, there are two primary wired networks: the phone system, also known as the public network, and cable television systems. Each functions separately, and at the moment, there are very few links between the two. In addition to the wired networks, there are numerous wireless systems. In this thesis, unless noted otherwise, "network" refers to any telecommunications system that is capable of providing a high-capacity link to the home.

\textsuperscript{29}Additional equipment is being developed to permit the use of a television monitor as the display and ordering device; this would broaden the market appeal for home grocery shopping.

\textsuperscript{30}Home grocery shopping can also work effectively with color still photos and/or computer-type visual menus, using personal computers operating via the existing phone network. In fact, one on-line service currently in operation employs a display that is entirely text-based, and this service has not encountered major problems related to this type of customer interface. For more information, see Chapters Four, Six and Seven, and Appendix A.
tionality, while the implementation cost should be economical.\textsuperscript{31}

A key factor which impacts positively on the home grocery shopping concept is that the cost to develop the advanced telecommunications infrastructure will not be borne entirely by this one service. Rather, the expense will be allocated among the many applications which will use the upgraded network, including movies on demand, electronic databases, interactive video games, non-grocery home shopping, work at home, video conferencing, distance learning, and many that have yet to be developed.

Nevertheless, home grocery shopping may actually spur construction of the new network. For example, grocery shopping in general is an activity that virtually all households already engage in; because home grocery shopping offers to consumers numerous benefits in this activity, it is likely that the service will experience tremendous consumer demand when it becomes available. Such demand will provide telecommunications companies with a certain amount of security, which in turn will enable these companies to deploy advanced network infrastructure without (a) waiting for new applications—and the markets for such applications—to first develop, or (b) engaging in speculative construction. Interestingly, as mentioned in Section 1.1.3.2., home grocery shopping represents an application which has not even been considered until now as a potential source of funding for network development, yet ultimately, it may become a major overall contributor of revenue.

Indeed, home grocery shopping and telecommunications network development may become linked in a virtuous cycle. New infrastructure would enable the rollout of home grocery shopping in selected markets; the revenue generated by the service in these initial markets would help to supply the telecommunications provider with the funds to pay for the continued buildout of the advanced network; additional markets for home grocery shopping would result in more revenue for the telecommunications provider. In addition, competition among telecommunications providers seeking to garner this revenue will help to speed up network deployment.

The net result is that home grocery shopping provides a powerful revenue gen-

\textsuperscript{31}In addition to the network installation costs, there are other expenses that must be accounted for, including centralized equipment, operational support and equipment in the home. Refer to Chapter Four and Appendix B for a full discussion about telecommunications costs.
erating ability that should not be discounted. While the concept can be viewed as an add-
on application to an advanced network which most likely would have been built anyway,
the analysis in this thesis indicates that the tremendous value provided by home grocery
shopping should not be ignored by telecommunications companies as they make strategic
decisions regarding the deployment of advanced network infrastructure.

1.3. Research importance

This examination of the home grocery shopping concept is very important for several reasons. First, the grocery industry is huge, with nearly $400 billion in annual sales; hence, even small percentage cost reductions result in large dollar savings. Second, consumers are becoming increasingly pressed for time, resulting in an escalating valuation of leisure time; one of the consequences, although not currently visible, may be an eventual flourishing of consumer demand for home grocery shopping. Third, the concept affects companies in many different areas, including retailing, manufacturing, advertising, transportation and information forecasting. Fourth, with respect to the telecommunications industry, this research illustrates the link between the deployment of advanced network infrastructure to the home and the restructuring of existing non-telecommunications industries. Fifth, the more generalized concept of home shopping has yet to be thoroughly applied specifically to the marketing and distribution of grocery products; these products, which are continuously replenished necessities, exhibit vastly different supply channel characteristics than occasionally replenished discretionary items. Finally, home grocery shopping has not been systematically studied until now; consequently, there is a paucity of knowledge on the subject.

1.4. Research approach

The research approach of this thesis consists of a literature review, field research, model formation, and analysis and discussion of results.

1.4.1. Literature review

As part of this research, a thorough review of a wide-ranging body of material has been conducted. Specific industries that have been investigated include the grocery, telephone and cable television industries. Also examined has been material on industrial and consumer supply chains, channel partnerships, computer networking architecture,
manufacturing operations, logistics developments, and marketing.

1.4.2. Field research

Field research plays a crucial role in this thesis. A large portion of the critically important information has been collected through interviews and personal correspondence. Interviews have been conducted with chain distributors, independent supermarket operators, a third party logistics company, product manufacturers, food delivery companies, package delivery companies, service merchandisers, a software developer, telecommunications engineers, a computer vendor, a supplier of totes, a user of a food delivery service, and the Food Marketing Institute.

1.4.3. Model formation

Much of the analysis in this thesis results from the use of the FMI Unified Direct Product Cost (DPC) model. This is a standard model which is defined by FMI, and is widely used throughout the grocery industry. The model contains a set of formulas that are used to assign costs to different activities based on two types of input data: (a) activity time rates, and (b) expenses for such elements as labor, equipment, space and transportation. For a more detailed discussion regarding the DPC model and the input data, refer to Chapters Five and Six.

Using the DPC model, this thesis has created two channel maps, each of which traces the distribution process for the same sample product, referred to as Product A. One channel map identifies the activities and associated costs involved in the current system, while the other channel map performs a similar exercise for the proposed system. Note that both channel maps commence at the time Product A arrives at the distribution center, and both end when the retail transaction process is complete.

For the proposed system, there are several additional activities which are not included in the DPC model but which are necessary in order to offer home grocery shopping. These include computer-related activities, tote-related activities, and telecommunications network access. Costs for each of these components are derived in this thesis.

This thesis also examines the consumer costs associated with the grocery shopping process, in particular the expenditure of time. By including this section of the sup-
ply channel—i.e., the forward channel—it is possible to gain a fuller understanding of the overall expense involved in distributing grocery products to the consumer.

1.4.4. Analysis

The results of the channel maps are thoroughly analyzed in this thesis. Included in the examination of each distribution system is a cost analysis and a sensitivity analysis. In particular, this researcher performs a very detailed sensitivity analysis of the proposed system, including a discussion which correlates the costs under the current system with those under the proposed system. As mentioned above, the analysis of the proposed system incorporates all of the costs for new activities.

1.5. Chapter summaries

Chapter Two provides context for the ideas proposed in this thesis. This chapter briefly traces the modern chronology of logistics from the 1920s until the present time, to show that the concepts proposed in this thesis are in keeping with historical developments. Examined in this chapter is the evolution of logistical thinking over the past several decades, from a viewpoint stressing isolated functional optimization, to an emphasis on cooperation among all members of the supply chain. Chapter Two also discusses the specific example of Quick Response, which was initiated in the 1980s by the apparel and general merchandise industries. Quick Response served as the model for much of the ECR program in the grocery industry.

Chapter Three presents a macro overview of the grocery industry, primarily from a distribution perspective. In particular, Chapter Three examines the key problems affecting the industry as identified by the ECR program, and discusses the ways in which ECK seeks to address these matters. This chapter demonstrates why it may be several years before a significant percentage of the grocery industry has adopted the ECR recommendations. Chapter Three also examines other projects currently under development in the grocery industry, and explains why both the ECR program and certain other efforts may not be sufficient if the goal is to fully remove cost from the grocery products supply channel.

Chapter Four is concerned with advancements in telecommunications technology, and the relevance of such developments to the home grocery shopping concept. For ex-
ample, this chapter discusses the type of display interface that different technologies make available. In addition to examining the technical capability of the very latest technologies, Chapter Four investigates their costs and plausible implementation scenarios.

Chapter Five presents the process and economics of the current distribution system. First, a generalized background description of product flow in the grocery industry is provided. Then, Chapter Five introduces the DPC model, which is utilized for the analysis of both the current and the proposed distribution systems. Chapter Five describes the sample product—Product A—utilized in the analysis; note that this product is a composite item which has been carefully constructed so as to be representative of a cross-section of dry grocery products. Using Product A, Chapter Five creates a channel map of the distribution process. This map provides a detailed description of the physical product flow and associated costs involved in moving Product A through the current system, from the time the item arrives at the distribution center until it reaches the supermarket checkout counter. Chapter Five also conducts a sensitivity analysis on the costs derived in the channel map.

Chapter Six presents the process and economics of the proposed distribution system. First, this chapter describes the structure of the proposed system, and examines the key differences between this concept and other home grocery shopping efforts. Then, Chapter Six analyzes the proposed system in great detail, utilizing Product A and the DPC model. However, the assumptions of the model are altered in this chapter so as to incorporate the different activities involved in the proposed system, such as customer home ordering, order picking at the distribution center, and customer pick-up at a neighborhood depot. Note that several of the activity costs calculated in Chapter Six—for example, the expenses for computer-related activities, totes and telecommunications network access—are derived based solely on field research. Chapter Six also identifies the time savings that the proposed system offers to the consumer. And, for the many values which are calculated in this chapter, detailed sensitivity analyses are conducted. Finally, Chapter Six examines the different ways in which the benefits of the proposed system can be shared among the distributor and the consumer.

Chapter Seven considers other issues and additional benefits resulting from the proposed system. Among the topics that this chapter examines are product quality, marketing, sales volume, the environment and production. Overall, Chapter Seven will demonstrate that, while reductions in the cost to distribute grocery products and savings
in the time consumers spend grocery shopping are important benefits of the proposed system, home grocery shopping offers gains which extend far beyond these benefits.

Chapter Eight presents conclusions of the work and implications for future research. Areas that have been identified for further research include: other distribution models; consumer behavior with respect to shopping electronically for grocery products; important issues involved in implementing the proposed system; and home delivery.

Appendix A examines other home grocery shopping efforts, in the form of case studies. This chapter analyzes a variety of services, including several telephone- and personal computer-based services currently in operation, as well as one venture planned for operation at the end of 1994 which will utilize a television monitor and which will have the most sophisticated interface available once it is launched. Included in the examination of each service is a description of the way in which the particular service functions, as well as its fee structure and any conditions that it imposes upon the customer.

Appendix B provides a detailed review of telecommunications technology. This chapter examines new network technologies in great depth, including an examination of each technology's advantages and disadvantages. This chapter also discusses other relevant aspects pertaining to telecommunications that are not covered in earlier chapters. Overall, Appendix B supplies an additional resource for the discussion in Chapter Four.
Chapter Two

Logistics Practice

2.1. Introduction

This chapter will examine the evolution of modern logistics practice. This discussion, which traces developments in the field of logistics over the course of the past several decades, helps to provide context for the work in this thesis.

This chapter will demonstrate that a supply chain management program must span the length of the channel—i.e., from the point of production to the point of end use—if the effort is to achieve full benefit. A restructuring program which does not incorporate the entire channel is incomplete; thus the gains from the effort are not maximized.

It is important to stress that at the moment, the end user in channels that are being restructured is perceived to be either the factory or the retail store. In general, the work to date has largely missed the link to the consumer. However, since the consumer is the actual end user of most manufactured goods, it is critical that the needs of this key member of the supply channel not be ignored. Indeed, this research extends the theory of channel restructuring to include the consumer in the conceptual framework.

This chapter is structured as follows. Section 2.2. traces the chronology of logistics developments from the 1920s until the present time. Section 2.3. provides some examples involving companies in the industrial sector that have successfully executed supply chain management programs. Section 2.4. examines the Quick Response program, which served as the model for the ECR program in the grocery industry.

2.2. Historical perspective of logistics

2.2.1. Definition and background

Logistics covers the flow of both products and information. According to the National Council of Physical Distribution Management (now known as the Council of
Logistics Management), logistics is defined as

the integration of two or more activities for the purpose of planning, implementing and controlling the efficient flow of raw materials, in process inventory and finished goods from point of origin to point of consumption. These activities may include, but are not limited to, customer service, demand forecasting, distribution communications, inventory control, material handling, order processing, parts and service support, plant and warehouse site selection, procurement, packaging, return goods handling, salvage and scrap disposal, traffic and transportation, and warehousing and storage.¹

The field of logistics is often associated with the military. In this area, logistics generally refers to positioning fighting forces and the necessary supporting equipment. Logistics superiority has been cited as a decisive factor in determining the outcome of numerous military campaigns, ranging from battles which occurred thousands of years ago in the Mediterranean Sea area, to wars which took place in this century, including World War II and the Korean War.²

Unlike military logistics, which has been practiced for hundreds or even thousands of years, the more specialized field of business logistics is relatively young. In fact, modern logistics practice has its origins in developments which occurred beginning in the 1920s, and most of the thinking which now shapes the field of business logistics has been developed since the 1950s.³

This section will trace the evolution of business logistics from the 1920s to the present time. It will be shown that over this period, the logistics function has grown in importance at many companies. Whereas logistics once symbolized nothing more than making the most efficient use of necessary facilities and equipment, such warehouses and transportation vehicles, today logistics superiority has come to be seen as a strategic weapon that can be wielded by companies and supply channels alike to gain long-lasting competitive advantage.


²Ibid., pp. 9-10.

³Ibid., p. 10.

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2.2.2. Modern development

The "scientific study" of business practices largely began in the 1920s. During this period, which lasted approximately thirty years, companies undertook projects which were aimed at optimizing the operations of functionally separate units within the firm, such as production or procurement. The belief was that if each unit minimized its own expenses, in aggregate the whole company would achieve lowest total cost.4

Beginning in the late 1950s, a number of factors converged to make traditional methods of marketing and distribution obsolete. These included a rapid increase in transportation costs, limitations on further gains in production efficiency, a shift in the responsibility for holding inventory away from retailers to manufacturers, product proliferation, and the initiation of the use of computers.5

In 1958, the U.S. economy underwent a recession after having expanded for most of the post World War II period. This decrease in demand from record postwar levels placed a great deal of pressure on companies to seek out cost controls in order to maintain profitability. It was during this period, from the late 1950s to the early 1960s, that "many firms realized that physical distribution and logistics were items whose cost had neither been carefully studied nor coordinated.6

As a result of these factors, a large number of companies set out to change their marketing and distribution practices. According to one analysis, four major developments began to take root in this period:

(1) development of total cost analysis, (2) application of the systems approach, (3) increased concern for customer service, and (4) revised attention to marketing channels.7


6Ibid., p. 6.

Over the course of the following two decades, many of these practices were implemented. Collectively, they came to be known as integrated logistics.

Initial efforts at integrated logistics were restricted solely to areas within the firm, and the projects tended to focus either on physical distribution or purchasing; few companies undertook concurrent change in both functions. The decision regarding which area to emphasize depended upon the nature of the company's business. For instance, firms that were oriented toward manufacturing and retailing lower-priced consumer products "tended to place a great deal of attention on finished-goods inventory management and support of customer orders;" on the other hand, companies that produced consumer durables, such as automobiles and appliances, "focused around the orderly flow of raw materials and component parts to support manufacturing operations."

Starting in the early 1970s, several events transpired in rapid succession which had the net effect of instituting a dramatic change in thinking about the logistics function at many companies. The most significant occurrences included: large reductions in the supply—and concurrent increases in the price—of key raw materials, particularly crude oil; greater competition from foreign countries, such as Japan; development and implementation of new technology, such as containers and more powerful computers; transportation deregulation, which eventually involved the airline, railroad and trucking industries; and the high rate of inflation, which reached double digits in the late 1970s. The confluence of these pressures "catapulted a new group of logistics professionals into prominence, and for some companies highlighted their role in assuring the firms' very survival."

The new philosophy which took hold was concerned with the entire supply channel, from raw material production to final consumer takeaway. The initial emphasis was on ensuring that disruptions in the flow of products along the supply chain were kept to a minimum. However, as the severity of this set of problems lessened over time, companies

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8 Ibid., p. 10.
9 Ibid.
11 Ibid., p. 12.
began to focus on the strategic management of the supply channel; in particular, companies sought to minimize the total channel expense. A key element in this new outlook was the shift from reactive to proactive policies regarding procurement, product development and marketing.\textsuperscript{12}

It was from these early efforts that integrated supply channels began to be formed. Such channels involve close partnerships among channel members, including component and/or raw material suppliers, original equipment manufacturers, transportation carriers and retailers. These partnerships seek to not only reduce the overall channel expense, but also to provide the greatest value for the customer of the final product, in whichever way the customer defines the term "value."\textsuperscript{13} To achieve these goals, such channels have had to be fundamentally restructured around the needs of the customer. The following section provides more information about channel restructuring.

It is important to note that the customer does \textit{not} refer to the consumer. Customers are buyers of products made by other firms, and they consist of a myriad of companies, ranging from automobile manufacturers to computer vendors to apparel retailers. Presumably, customers pass the benefits of channel restructuring efforts on to consumers, thus allowing consumers to gain from such efforts as well; in fact, the current business environment often requires that the benefits be fully passed on to the consumer. However, with respect to supply chain management, the customer and the consumer are two separate entities.

\textbf{2.2.3. Supply chain management}

Supply chain management is a strategy which seeks to integrate the entire supply channel into one smoothly functioning entity. The broad goal of this activity is to make the channel as a whole more efficient and more competitive. This method of organization differs from previous logistics practice in which the goal often was to optimize the operations of individual functions—i.e., production, transportation, warehousing—or individual companies—i.e., buyer, seller, transportation carrier.

\textsuperscript{12}Bowersox, \textit{et al.}, \textit{op. cit.}, p. 12.

\textsuperscript{13}Canivato, \textit{op. cit.}, pp. 289-90.
As the following sections will demonstrate, while different industries have implemented distinct supply chain management programs, there are many similarities across these approaches. Among the common characteristics are a relentless effort to drive out all non-value-adding activities from the production and distribution processes, a recasting of the remaining activities into the most efficient form possible, and the embrace of a strategic view by channel members. Often, one of the direct results of the channel restructuring process is the removal of traditional barriers between channel members; implemented in their place is an approach based upon cooperation and partnership.

Note that in the current business environment, competition is just as likely to stem from other supply channels as it is from other companies. This factor can lend added urgency to the channel restructuring effort. In fact, as will be discussed in Chapter Three, this is exactly the situation in the grocery industry today.

Under the most optimistic scenarios presently envisioned, channel restructuring is perceived to cover all processes in a given channel from the point of raw material production to either (a) the point of use, in the case of industrial supply channels, or (b) the point of sale, in the case of consumer products supply channels. Collectively, this section of the supply pipeline is known as the backchannel.

It is important to stress that to date, supply chain management efforts have not included the forward channel, i.e., the distribution process that extends from the retail store to the point of consumer end use, which is typically the home. Rather, channel restructuring activities have ended at the transactions which occur at the retail point-of-sale14 (POS).

In practice, the section of the backchannel that is included in supply chain management activity does not usually extend all the way to the original raw material source. For example, in the automobile industry, the relevant section of the backchannel typically extends from the factories that fabricate parts used by component suppliers, to the actual automobile assembly plants; in the apparel industry, from the mill that produces undyed cloth to the checkout counter at the retail store.15

14Refer to Chapters Three and Five for more information regarding the retail point-of-sale.

15Note that if the backchannel is extended to the point of raw material production in these industries, other processes would be included in the supply chain management effort, including iron ore extraction
In general, activities or processes subject to supply chain management can be grouped into one of two categories: local or global. Local processes are those which remain confined either to specific subcomponents of a function at a company, or to the function itself. For instance, warehousing and traffic management are subcomponents of the logistics function; these elements, as well as a company's entire logistics function, can be considered local processes.

Global processes incorporate traditionally non-related functions within a particular firm, as well as activities which occur at other firms. For example, procurement, production, logistics, finance and marketing are traditionally viewed as discrete functions; in a supply chain management perspective, these functions are interconnected. Likewise, suppliers, transportation carriers and customers are conventionally seen as distinct entities; under supply chain management, the operations of the different companies that are members of the supply channel are integrated.

Essentially, supply chain management is concerned with shifting the perspective from the local to the global, and then taking action in the context of the global view. For instance, within a company, there are numerous ways in which functions interconnect: distribution is correlated to production, finance affects the size of the firm's transportation fleet, and marketing influences decisions about where to deploy warehouses. Effective supply chain management would dictate that decisions within the company should be analyzed with respect to their impact on all affected functions.16

Taking the global perspective to the next level, decisions made by one company should also be analyzed with respect to their impact on the other members of the supply channel. For instance:

Traditionally, the focus of business logistics has been on flows within the firm or flows over which the firm has direct control. But successful logistics management requires the recognition that the firm is simply one player in the long chain that starts with suppliers and includes transporters, distributors, and customers.

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16 Shapiro and Heskett, op. cit., p. 18.
Yet, in the same way that the optimization of one set of variables within the firm's logistics system without the explicit consideration of their impact on the rest of the system may lead to a lower level of overall systems performance, so it also is that optimization of one firm's logistics system without the explicit consideration of the impact of its logistical policies on its channel partners may lead to a lower level of overall channel performance. That decreased channel performance can be expected, in the long run, to adversely affect the firm's ability to perform as its managers would like.17

Supply chain management entails building strong links to partner companies. Much has been written about the requirements of such partnerships; among the key elements are: long term perspective, mutual trust, communication at all levels of the partner companies, sharing of information, and regular assessment of the partnership.18 In fact, creating a partnership is often compared to the process of getting married. For example:

Establishing this relationship is somewhat like getting married. Everything is not continuously joyful, and channels of communication must be kept open to solve problems and prevent the development of unproductive emotion. It concentrates on linking the supplier's process to the customer's process.

The initial decision is which suppliers to work with. Some American companies hold with the same suppliers year after year, but many go with whatever suppliers appear to deliver minimum acceptable quality at the lowest price. Although this is a fallacy, the thinking associated with it is not easily dispelled. The decision on which suppliers to work with long term hinges on whether the suppliers are willing to work toward forming tighter links between supplier processes and customer processes.19

While a detailed analysis of the technicalities involved in forming partnerships is beyond the scope of this thesis, the important factors to note regarding restructured supply channels are (a) the channels are rationalized around a small number of partner companies, and (b) the links between partner companies are much stronger than traditional, arm's length, arm's length.  

17Ibid., pp. 18-19.


temporary transactions.20

It is critical to note that the ultimate goal of channel partnerships is to deliver the best value to the consumer of the finished product. Therefore, although some companies may have to sacrifice more than others in order to participate in the partnership, every company gains when the finished product is purchased:

it is regarded as much more important for people to maintain confidence in each other than to shift allegiances because of temporary and minor cost advantages versus other suppliers. In fact, the customer regards it as a duty to assist the supplier in getting costs down if this happens. The real market competition is for the buyer of the end product. The more quality at lower cost, the more everyone in the chain of supply will benefit, so the emphasis is on improving the entire production process from raw material to final product.21

2.3. Industrial supply channels

Numerous industrial supply channels have been restructured based on the philosophy of supply chain management in recent years. Among those channels which have experienced the most significant effort are automobile manufacturing and electronics supply. This section will examine channels in these industries that have become very closely integrated.

A classic example from the automobile manufacturing industry is Toyota. In recent years, the "Toyota production system" has been widely discussed and analyzed, and many companies have sought to emulate this system. Often, the Toyota production system is referred to as lean manufacturing, because it seeks to continually reduce the levels of inventory, safety stock and work-in-progress.22 For example:

20See, for example, Ibid.

21Ibid., p. 207

22In industrial supply channels, inventory has two elements: parts and finished goods. Parts inventory and safety stock are somewhat synonymous; the main differences pertain to the duration and location of storage. For example, inventory is typically held for an extended period of time and is stored at a location separate from the production line; safety stock is located next to the assembly line and may be rapidly depleted, depending on the quality of production. Work-in-progress refers to unfinished products that are still on the assembly line, and finished goods inventory refers to completed products that are ready for shipment to customers. Note that in the context of consumer product supply channels, inventory and
The primary goal of the Toyota production system is to identify and eliminate waste and reduce costs. Inventories are eliminated by addressing and overcoming the hidden conditions that cause them. Order-based production, or production to demand, rather than anticipatory or speculative production, helps control these conditions. \(^{23}\)

The term Just-In-Time (JIT) is often employed to refer to the Toyota production system and similar methods of lean manufacturing. But, according to the developer of the Toyota production system, the conventional understanding of the term JIT is not comprehensive:

The term JIT notes much more than timeliness, however, because concentrating on delivery time alone might encourage early overproduction and result in unnecessary delay. But Toyota's production system is also non-stock or stockless. This means that each process must be supplied with the required items in the required quantity and at the required time—just-on-time, with no accumulation. \(^{24}\)

One of the most significant benefits of lean production is that it ensures that errors are detected—and fixed—quickly. Because the system can not rely on the security provided by high levels of safety stock, mistakes that might otherwise be ignored must be treated rapidly, including by stopping the production line if necessary. This contrasts with traditional automobile production methods in which mistakes are corrected after the automobiles have been fully assembled, and the production line is not repaired until it has been shut down at the end of the day.

Interestingly, lean production is sometimes compared to the method of stocking a supermarket. For example:

supermarket customers (processes) buy what they need, when they need it. Since they may go to the shelf and take what they want, sales man-hours (materials management) are reduced. Finally, the shelves are refilled as products are sold (parts withdrawn), which makes it easy to see how much

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\(^{24}\)Ibid., p. 69.
has been taken and avoid overstocks.

Thus, the most important feature of a supermarket system is that stocking is triggered and maintained by actual demand. Toyota has used this concept to create a flexible production system in which later processes take from earlier ones like customers in the supermarket. This is often characterized as the "pull" system of order-based production. But push and pull are only effects of measures to be taken. Toyota adopted order-based production and used a pull system to make it work efficiently.25

Chapter Three will demonstrate that in the U.S., the grocery industry has actually moved away from lean methods of replenishment in recent years, as the distribution process has become non-coordinated with respect to actual consumer demand.

One of the major criticisms of the Toyota production system is that rather than reducing systemwide inventory, lean production simply relocations inventory and other burdens from the manufacturer's facilities to those of its suppliers. For example:

The Toyota production system was once criticized as being the "devil's system." Why? Many thought that its primary conceptual approach lay in the notion of JIT. JIT, in turn, was superficially understood as a stock minimization system in which desired items were taken at the desired time and in the desired quantities. With this conception, parts and raw materials suppliers thought they were expected to provide Toyota with the desired items at the desired time and in the desired quantities, all at Toyota's convenience. In addition, they thought they would be forced to keep large inventories on hand, since they could not possibly know what, when and how much they would be required to provide.26

However, the key is that lean manufacturing involves a production, distribution and information-sharing process that is fundamentally different from traditional mass production. While it necessitates close coordination with suppliers, and requires that suppliers raise their own levels of production quality, lean manufacturing also results in significant benefits for suppliers in addition to those realized by the manufacturer. Consider the following:

25 Ibid., pp. 90-91.

26 Ibid., p. 197.
If this were indeed the way things were supposed to work in the Toyota production system, the "devil's system" appellation would have been well deserved. In reality, Toyota's monthly production plans are announced in advance and the company draws leveled quantities of parts and material from suppliers. At the same time, extremely small lots and the demand for frequent deliveries combined with unavoidable changes mean that affiliates and materials suppliers must improve their own production systems in order to respond quickly to Toyota's needs. This explains why, after 20 years of actual implementation in its own plants, it still took Toyota nearly 10 years to create a comprehensive system that encompassed both Toyota Motors and its suppliers. Suppliers and affiliates have experienced substantially higher profits because of improvements to their own production systems.

Some people are satisfied with a superficial understanding of the Toyota production system. They suggest that Toyota's insistence on receiving what it wants when it wants it and in the quantities it wants simply passes responsibility for one company's bungling to its suppliers. If examined carefully, this view is revealed as completely lacking in a correct understanding of the Toyota production system.27

It is important to note that according to the developer of the Toyota production system, the ideal situation would be to extend the supply channel to include the consumer. This would allow production to occur based solely on orders rather than on speculation. For instance:

This [the supermarket method of replenishment] can also be called a "substitution order format." Only those items that have been sold today are replenished. Yet, is there any guarantee that things that sold today will also sell tomorrow? What we have, in my opinion, is no more than a high probability that items that were popular and sold today will also sell tomorrow.

Ultimately, it is our hope to do away with inventories of finished goods by moving toward production to order, where the only items made are those that will sell. The best method, then, would be to go around taking orders in advance and selling only what was ordered. Since this would be very expensive, the supermarket system's substitution order format has been adopted instead. The problem was seen as one of the relationship between order, distribution, and the production cycle.28

27Ibid.
Interestingly, with respect to the grocery industry, this type of ideal distribution system—i.e., centered around advance customer ordering—is now both feasible and cost effective due to the development of new telecommunications technology. Indeed, as Chapter Four will discuss, such technology is the key enabler that has now made it possible, for the first time, to implement the grocery product distribution system as proposed in this thesis.

It is worth noting that in general, aside from the specific example of Toyoda, links between supply channel members are typically much stronger in Japan than in the U.S. For example:

Because of the group orientation of the Japanese companies, supplier networks have grown almost naturally there. Some American companies have established supplier networks also, but in lesser degrees, and sometimes these relationships have been less than satisfactory to all parties. The idea of sole-source suppliers is often not very palatable to either the supplier or the customer. The reason is the custom of basing the price, delivery, and other conditions on negotiations, and negotiations emphasize adversary relationships, not network relationships.

There are adversary relationships between suppliers and customers in Japan also, and these exist to a certain extent among companies engaged in stockless production, but the adversary role is much diminished. This occurs because it is so obvious that everyone can only gain by forming a network of companies to compose an industry which precludes individual companies in the network from becoming overly destructive in exploiting their position in it. In addition, the culture of Japan works against this kind of development. The Japanese have no background derived from Adam Smith economics in which everyone should mutually benefit by seeking their maximum self-interest.29

As mentioned earlier, there are numerous industrial supply channels that have engaged in the supply chain management process. In the electronics industry, one company that is very advanced in this area is Hewlett-Packard.

According to an individual who is closely involved in the supply chain management

28Ibid., p. 178

process at Hewlett-Packard, to be effective, such a program must extend from suppliers to customers. The reason is because these are two of the three entities (manufacturer production is the third) responsible for introducing uncertainty into the production and distribution functions. By incorporating these members of the channel into the supply chain management process, it is possible to dramatically lower uncertainty and risk. The result is both a reduction in inventory levels and an increase in customer service. For example:

The value of taking a systems view of the problem cannot be overstated. Organizational barriers introduce tremendous inefficiencies in supply chains. It is critical that all players in the business of getting products to customers consider their role in the objective of satisfying the customer. Strategic decisions on supply chain design can increase customer satisfaction and save money at the same time—the classic win-win situation.

Clearly, supply chain management should not be confused with supplier management. Supply chain management covers a far broader scope. Approaching problems with a systems view and a sound supply chain methodology can lead to great savings. At Hewlett-Packard, we have little doubt that hundreds of millions of dollars lie in the balance. Judging from our discussions with suppliers and customers, the same is true for other firms.

And, echoing the discussion regarding the previous example of Toyota, it is stated that the customer is the key member of the supply channel:

Customer service begins and ends with the customer. The customer feels the full effect of the complex, interacting uncertainties in the supply chain...The forecast—based on historical customer behavior—starts things rolling. Materials are purchased and delivered by suppliers. Then the factory takes its turn, producing the finished goods. Finally, the early forecasts are realized in the form of hard orders, and products are shipped to customers. This cycle repeats itself up and down the supply chain. It also repeats over time.

2.4. Quick Response


31 Ibid., p. 45.

32 Ibid., p. 39.
Quick Response is a program designed to increase the efficiency of production and distribution in the general merchandise sector. It was initiated in the mid 1980s in the apparel industry, though since that time, the program has grown to include companies in a variety of industries, including footwear, luggage and other soft goods.

From the beginning, the Quick Response program was seen as a collaborative effort involving the key members of the apparel supply channel: textile suppliers, manufacturers and retailers. For example:

Quick Response is a strategy for tying apparel and textile retailing operations to apparel and textile manufacturing operations, in order to provide the flexibility needed to quickly respond to shifting markets. By establishing production schedules closer to the actual selling season and basing replenishment on actual sales data, manufacturers and retailers ensure that they have the right product available to the consumer in the right place and at the right time.\(^{33}\)

The Quick Response concept began out of work conducted by Milliken & Co., a textile manufacturer. The program was further developed by Crafted With Pride in the U.S.A. Council, an apparel industry trade group.

Also involved in developing Quick Response was Kurt Salmon Associates, a consulting firm. During the period from 1985 to 1986, this firm conducted a detailed analysis of the distribution process in the apparel industry. This analysis revealed that although individual parts of the system were efficient, the overall efficiency of the system was very low. In seeking to minimize costs independently of each other the fiber, textile, apparel and retail industries were inadvertently pursuing practices that added significant costs to the overall supply chain.\(^{34}\)

The analysis found that long lead times between retailer ordering and supplier production and shipment were the norm in the apparel industry. As a result, the industry experienced considerable waste:


\(^{34}\)Efficient Consumer Response, p. 17.
The apparel supply chain, from raw material to consumer purchase, was 66 weeks. Of this, 11 weeks was in-plant time (fiber, textile and apparel), 40 weeks was in warehouses or transit (fiber, textile, apparel and retail), and 15 weeks was in-store. This long supply chain was both expensive to finance and, even more significantly, resulted in major losses as either too much of too little product was produced and distributed based on inaccurate forecasts of future demand.

The overall loss to the system was projected at $25 billion. Two-thirds of this loss was due to markdown losses at the retail or manufacturer level and to sales lost from out of stocks at the retail level. Exit surveys of consumers showed that being unable to find the item they wanted in the right color or size was the major reason that consumers left a store without making a purchase and was eroding store loyalty.35

Based on this analysis, Crafted With Pride in the U.S.A. Council decided to sponsor three pilot projects. These projects involved retailers in the three basic general merchandise distribution channels (department stores, national chains and mass merchants) and suppliers. The retailers partnered with the suppliers in specific apparel categories, including women's blouses, men's slacks and men's suits. The results of the pilot projects exceeded expectations and fully validated the projected benefits of Quick Response. All three pilots showed sales increases of 20-25% and improvements in inventory turns of 30%. The sales increase resulted from improving in-stock performance from 70-75% to 95%+, and the inventory turn improvement resulted from the need to carry much lower levels of safety stock because of the greatly reduced lead-times.36

After these projects, many companies set out to implement their own Quick Response programs in the late 1980s. A problem that soon became apparent was the lack of industry standards with respect to the way in which electronic information should be shared among retailers and manufacturers, a process known as electronic data interchange (EDI). Many companies had developed proprietary systems, and it was becoming increasingly expensive to communicate between the different systems.

To address this problem, the industry established the Voluntary Interindustry

35Ibid.

36Ibid., p. 19.
Communications Standards Committee (VICS) in 1986. The role of this committee was to develop and refine the technologies necessary to implement Quick Response, which included bar coding, POS scanning, and shipping container marking. In addition to VICS, three other industry organizations were founded in the mid 1980s to assist in establishing standards: Fabric and Suppliers Linkage Council, Textile and Apparel Linkage Council, and Sundries and Apparel Findings Linkage Council.

As noted above, the primary aim of Quick Response was to reduce the long lead times and subsequent inventory buildups that were common to the apparel industry. However, as the formerly autonomous members of the supply channel began to partner and change some of their operations and practices through the Quick Response framework, they have also started to experience many additional benefits. Among these gains are higher order completion rates, more frequent inventory turns, decreases in stockouts (or increases in in-stock positions), reductions in markdowns, and increases in the amount of floor space available for merchandising. In turn, the combination of fresher merchandise, better presentation and higher in-stock positions has led to increases, often substantial, in sales. Thus, while the original—and often the primary—aim of Quick Response was to reduce costs, in many instances the program directly resulted in increased revenue.

There are numerous examples of gains from Quick Response programs. The following is a small selection of findings. From Dillard's, a general merchandise retailer:

Quick Response continues to allow us to cut out basic inventories—which does not mean we're cutting dollars. In fact, dollars that used to go toward inventory on basics are now freed up for higher gross margin items. That

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37 The shipping container is the case in which a product is housed as it moves through the supply channel. Shipping container marking refers to placing a bar code label on the case. Refer to Chapter Three for more information about bar coding and POS scanning.

38 Hammond and Kelly, op. cit., p. 7.

39 An order completion refers to product shipped exactly as ordered by the customer. Typically, this pertains to the order from the retailer to the manufacturer.

40 An inventory turn refers to cycling through the entire inventory quantity one time. For example, if a company sets its inventory level for a given product at 10 items, and sells—either to consumers or to other companies—15 items, then it has "turned" its inventory 1.5 times. In most industries, turns are measured on an annual basis, though in the apparel industry, turns are typically measured in terms of the season.
means we're not only in stock on the basics, but we're offering customers a
deeper assortment.41

From Palm Beach Company, a manufacturer of men's clothing:

In a QR program like ours, we're replenishing what was sold the previous
week. We're filling the pipeline with demand from the previous week, not
accumulating orders over a long period of time, then producing the mer-
chandise.

Men's clothing inventories turn very slowly. Typically, people in our indus-
try turn inventories about two times. But with our quick replenishment
system we are turning eight and 10 times, higher in some popular models.
Fast turning inventories and not tying up capital are benefits that somewhat
offset some of the manufacturing costs incurred with smaller cuttings. It
also increases revenue because we have product available for our
customers when they're looking for it.42

And from Strawbridge & Clothier, a department store chain:

We maintained our basic turnover with a greater proportion of fashion
goods, realizing a 25 percent increase over our current fashion turnover.
Our sales growth for this particular partner was 25 percent greater than the
total area. The most dramatic results occurred in the increase in gross
margin compared to the total.

The final indicator was that we increased our market share 2.1 percent in a
market that was not realizing increases in market share and in some in-
stances was experiencing decreases in market share. There are some other
factors that occurred to contribute to these results. Our "in stock" position
went from 93 percent to 99 percent. Also, we reduced our lead time from
four weeks to eight to ten days and due to forecasting, we were able to re-
duce the markdowns.43

Across the entire general merchandise industry, the benefits from Quick Response
have been significant. For example, according to one major study, from 1985 to 1990


42Jim Draut, as quoted in Clyde E. Witt, "Quick Response: Custom Tailored by Palm Beach," Materials

order cycle\textsuperscript{44} time throughout the industry decreased from 7.9 days to 5.8 days, and inventory replenishment\textsuperscript{45} decreased from 34.2 days to 25.1 days.\textsuperscript{46} Although other factors may have played a role, much of this gain can probably be attributed to Quick Response.

Often, the most impressive gains from Quick Response come in the early stages after implementation, as the program replaces previous inefficient practices. For instance:

In the first year on board, the benefits are more visible, because you're comparing apples to oranges. In the second year, you're comparing apples to apples, so you don't see those 200\% increases. But it stabilizes at a much more profitable level than before.\textsuperscript{47}

Note that with respect to reducing inventory levels, there are analogies between Quick Response and the method of lean manufacturing as epitomized by Toyota. Both processes seek to not simply arbitrarily cut inventory levels across-the-board, but rather to ensure that the right inventory is available when needed. For example, the following statement is from the executive director of the National Retail Federation:

The result of this collaborative effort is that sales increase because stock-outs are greatly reduced. Similarly, excess stock is greatly reduced and the combination of these benefits means that the retailer's gross margin return on investment is substantially improved. Too many retailers look at Quick Response only as a means to decrease inventory. The objective is to increase the inventory your customers want and decrease what they don't want.\textsuperscript{48}

In recent years, both the breadth and the depth of the Quick Response program have expanded rapidly. First, the number and the variety of companies that have implemented aspects of Quick Response grows yearly. Second, the scope of Quick Response

\textsuperscript{44} The order cycle is the time it takes for an order to be processed by the supplier and shipped to the retailer; the cycle is completed when the retailer takes receipt of the product.

\textsuperscript{45} In this example, inventory replenishment refers to the time it takes suppliers to replenish their inventory.


\textsuperscript{47} Bill Holder, as quoted in Gill, op. cit., p. 24.

\textsuperscript{48} Schulz, op. cit., p. 41.
partnerships has greatly increased from the program's early stages in the mid to late 1980s. For instance, suppliers now offer continuous replenishment, JIT delivery, and even instore inventory management for some retailers.

One company that has moved beyond basic Quick Response is Vanity Fair. The company has implemented a program in which it manages instore inventory for its retailer partners, and produces new goods based on data captured at the retail POS. According to a vice-president at Vanity Fair:

The evolution of manufacture and retailer relationships has come a long way in recent years. Stock is controlled and automatically replenished for the retailer by the manufacturer, consistent with mutually agreed upon model stock levels. This means that no restocking orders are placed, and no approvals are required. Instead, purchase data goes from the cash register to the production site where the manufacturer immediately begins the process of replenishing stock for the retailers—replenishing tomorrow what sold yesterday.49

The results of the Vanity Fair program are significant. With respect to the relevant categories of merchandise, the company increased its turns from once per season to 1.25 to 1.5 times per season, and raised its in-stock position from under 70 percent to between 92 and 95 percent.50 For McRae's, a retailer that partnered with Vanity Fair, the program has raised sales productivity, and resulted in an increase in gross margin return on investment of more than 2.2 percent.51

Vanity Fair's program is seen as being at the forefront of recent efforts in the apparel industry. Consider the following:

[With] VF's Flow Replenishment System, sales/stockout data are reviewed on a daily basis and replenishment is ordered as frequently as required. So, while a store may have been out of stock at the end of the day when the reading was taken, a replenishment shipment was already on a truck to bring that store back in-stock.


51Ibid., p. 61.
This type of replenishment more closely resembles just-in-time performance with its daily cycles rather than what was initially thought of as Quick Response, which in most cases settled into weekly cycles.

While weekly cycles are a quantum improvement over the monthly or bi-monthly ordering of the past, it is interesting to note that daily, just-in-time cycles are possible. Moving toward delivering 24-hour replenishment is a target on which industry leaders have fixed their sights.52

While the Vanity Fair project is probably more advanced than other Quick Response efforts, it and similar programs may be leading the evolution of Quick Response. For instance:

The VF example is illustrative of a number of the directions Quick Response is taking in the industry. It shows the potential of vendor-managed retail inventory models, the precursor of which is the daily sharing of point-of-sale data from the retailer to the vendor.

This gives the vendor the ability to track actual sales, valuable data vendors had not had before. Both retailer and vendor can look at and analyze the same data, and many agree that this has been a major leap forward for the industry.

These systems will not only enable the vendors to manage retailer inventories but also provide the retailer with sophisticated analytical tools that would not have otherwise been available.53

Another company which has also moved beyond the final Quick Response program is Warren Featherbone, a manufacturer of infants' wear. In 1991, the company implemented a project in partnership with Mercantile Stores involving the Alexis brand-name. According to the president of Warren Featherbone:

The program has been very successful because measurements were clearly communicated early on and a great sense of personal partnership existed in both companies. It also includes our raw material suppliers, Springs Industries and Milliken & Co. Approximately 50 people from all four

53Robins, op. cit., p. 22.
companies work very closely to make the program a success.54

The gains from the program are considerable:

Total net profits on Quick Response products are at least doubled. In addition, store space requirements for Alexis products decrease nearly 50 percent by virtue of doubling the inventory turns. One key benefit of carrying less inventory is better presentation and a wider assortment of merchandise, which makes it easier for consumers to shop and ultimately increases sales. This was reflected in Alexis product sales in Mercantile Stores in September, when total sales were up nearly 50 percent—with total inventory being up only 12 percent.55

Ultimately, the goal of the various supply chain management programs—whether referred to as Quick Response, JIT or another term—is to restructure the production and distribution processes around consumer demand. As mentioned in Section 2.3., if the consumer purchases the product, all members of the supply channel benefit. Consider the following statement from the president of Warren Featherbone:

Everyone tries to optimize the local—most of the time at the expense of the global. We've been trained to think in terms of local costs, not global throughput. Because of this, we lose flexibility, throughput and the ability to respond to customer needs.

It sounds fairly simple, and probably not too controversial. However, we've found in working together that it becomes complicated when we begin to act on what we know intuitively in each company's application.

Yet there is the potential for a "virtually integrated" apparel chain, which will be structured vertically as "one link." All companies will act as if they were one. In this environment, it will be entirely possible that the proceeds of retail sales will be distributed to all members within this link—but only after the item is sold.56

Echoing this sentiment is the following:


55Ibid., pp. 98-100.

56Ibid., p. 100.
One insight Palm Beach Company has gained is that Quick Response brings them closer to the ultimate consumer of their product. As manufacturers, they are closer to taking directions from the consumer, making inventory accuracy as much of a goal for them as for any retailer they serve. As [a vice president at Palm Beach] says, "We know that if our customers succeed, we succeed."\textsuperscript{57}

2.5. Summary

This chapter has examined the evolution of business logistics over the past several decades. It has been demonstrated that over this period, logistics practice has shifted from a philosophy centered around optimizing the activities of functionally separate units, to an emphasis on strategic integration of the entire supply channel. This chapter has investigated a number of supply channels that have been restructured along these lines in recent years. It has been shown that such partnerships can produce significant gains for all companies involved. The ultimate goal of these efforts is to extend the channel restructuring process as close to the consumer as feasible, in order that production and distribution can be based around the needs of the end user. However, it has also been demonstrated that supply chain management programs to date have ended either at the factory where the final product is assembled, or at the POS at the retail store.

\textsuperscript{57}Witt, "Custom Tailored," p. 45.
Chapter Three

Grocery Industry

3.1. Introduction

This chapter provides an overview of the grocery industry. Primarily, this discussion will focus on the distribution aspects of the grocery business. In particular, this chapter will examine the impact of the ECR program on the industry.

It is important to note that ECR is neither the only topic of importance in the grocery industry, nor is it the only matter currently affecting the industry that is relevant to the work in this thesis. However, since the time that the ECR report was first published—January, 1993—ECR has been the main topic of discussion for most of the industry. Therefore, in order to provide context for the distribution system proposed in this thesis, this chapter will discuss both the program itself, and the reasons why the grocery industry initiated ECR.

In addition to ECR, this chapter examines several other projects currently under development. One involves improvements to the distribution process affecting the same section of the supply channel that ECR addresses, i.e., the movement of product from the point of production to the supermarket. Others pertain to areas not addressed by ECR, including supermarket instore efficiency, as well as the distribution process from the supermarket to the consumer.

This chapter is structured as follows. Section 3.2. describes the most significant distribution-related problems affecting the grocery industry today. Section 3.3. introduces the ECR program, and examines the many ways in which the program seeks to address these problems. This section also discusses the response to date from the grocery industry with respect to the program’s proposals. Section 3.4. introduces the other concepts affecting the grocery industry which are relevant to the work in this thesis. Section 3.5. analyzes some of the reasons why both ECR, and the proposals currently under development which affect the forward channel, may not be sufficient if the goal is to fully restructure the grocery product distribution system.
It is important to note that ECR and the home grocery shopping concept proposed in this thesis are neither dependent upon each other, nor are they mutually exclusive. For example, ECR primarily affects relationships among trading partners in the backchannel (e.g., the interaction between the distributor and the supplier), while the proposed system primarily affects the forward channel (i.e., the interaction between the distributor and the consumer).\(^1\) Also, companies could institute home grocery shopping without necessarily following the ECR program. Finally, the grocery industry plans to implement ECR over the course of the next several years, while home grocery shopping may not become a widespread reality for a decade or more.

Nevertheless, despite the fact that the two concepts are distinct, ECR and the proposed system are interrelated. Indeed, home grocery shopping can clearly be perceived as a means to extend to the home the channel restructuring process initiated by ECR.

### 3.1.1. Background

The grocery industry in the U.S. is very competitive. Most distributors operate on a philosophy of high sales volume and extremely low margins. In fact, the net profit margin of U.S. distributors averaged 0.74 percent of sales in 1992.\(^2\) In other words, for every dollar of product that is sold in a supermarket, distributors net less than one cent in after tax profit. One of the outcomes of this highly competitive environment is that there is relentless pressure to continually improve distribution efficiency.

In addition to competition among distributors within the industry, in recent years a competitive challenge has arisen from companies outside of the industry. Many of these alternative formats—such as warehouse clubs, mass merchants and supercenters—are built around distribution channels that are even more efficient than the traditional grocery products supply channel.

In fact, it was primarily the competitive pressure engendered by alternative formats that spurred the grocery industry to initiate the ECR program. For example, the

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\(^1\)For more information regarding the distinction between the backchannel and the forward channel, refer to Chapters One and Two.

foreword to the ECR report states:

In recent years a growing number of grocery retailers, distributors, suppliers and brokers have become increasingly concerned that the grocery industry is losing its competitive edge. Productivity growth in food retailing over the last twenty years has fallen behind other retail channels.\(^3\)

Indeed, according to individuals with long careers in the industry, without the pressure from other distribution channels, the grocery industry would never have launched the ECR process.\(^4\)

ECR is seen by the grocery industry as a way for the industry to focus more attention on the consumer, and thus regain a competitive advantage relative to other formats. For example, the report states:

ECR is a grocery-industry strategy in which distributors and suppliers are working closely together to bring better value to the grocery consumer.\(^5\)

However, it is critical to note that the ECR effort is directed solely at the back-channel. Therefore, while the program should ultimately result in an increase in consumer value in the form of significant cost reductions and improvement in product quality, it must be stressed that ECR does not address a different type of issue which also affects consumer value—making the shopping process more convenient.\(^6\)

This chapter will also show that because the program does not incorporate the forward channel into its analysis, ECR is incomplete with respect to improving distribution system efficiency. For instance, in Chapter Two, it was demonstrated that supply channel restructuring must incorporate the entire channel, from point of production to

\(^3\text{Efficient Consumer Response, p. iv.}\)

\(^4\text{Interviews with representatives of grocery products manufacturers, August to October, 1993, and with an independent supermarket operator, April, 1994.}\)

\(^5\text{Efficient Consumer Response, p. 1.}\)

\(^6\text{Note that a basic assumption of the ECR program is that grocery products are distributed to consumers via supermarkets. Therefore, while this thesis identifies numerous distribution inefficiencies and consumer costs associated with the current supermarket-based system, such problems do not so much represent oversights on the part of the ECR program as much as they epitomize elements that are inherent to any supermarket-based distribution system.}\)
point of end use, in order to obtain full benefit. However, this chapter will show that ECR is truncated, because it ends the restructuring process at the supermarket checkout counter, and not at the point of end use—i.e., the home.

3.2. Key grocery distribution issues

There are myriad issues which impact the supply channel for grocery products. The matters which most seriously affect the distribution process pertain to the relationships between channel trading partners, particularly distributors and suppliers. These issues are collectively known as trade practices, and this heading includes trade promotion, forward buying and diverting. Overall, some of the most glaring distribution inefficiencies stem directly from these practices.

Note that trade practices are not the only concerns affecting the distribution system. However, a major problem that currently afflicts much of the grocery industry is the acrimonious state of relations between trading partners, and trade practices are a significant factor in explaining this situation. In fact, settling these issues is one of the primary goals of ECR, and a large portion of the program is devoted to their resolution. Indeed, the foreword to the report states:

This report identifies major opportunities for cost reduction within the supply chain. Fundamental to the realization of these opportunities are major changes in the relationships between trading partners, moving from win/lose adversarial relationships to win/win alliances in which all parties work together to eliminate cost from the supply chain, thereby providing greater value to the grocery consumer.7

Therefore, because of their importance to present distribution process in the grocery industry, this section will briefly discuss each of the different trade practices. In addition, this section includes a discussion about push versus pull marketing, a topic which is related to the issue of trade practices, and which is also of significance to the distribution process. Note that Section 3.2.3. will examine the inefficiencies that result directly from trade practices.

3.2.1. Trade promotion

7Efficient Consumer Response, p. iv.
Trade promotion refers to discounts, also known as deals, that grocery suppliers make available to their customers, such as distributors, warehouse clubs and mass merchants. In general, trade promotion works in the following manner.

The supplier sets the everyday list price for its product at a high level. This is the price that the distributor (or other customer) encounters most of the time. Toward the end of a specific time period, such as a sales quarter, the supplier offers distributors a deep discount from this high price, to "promote" the product; this promotional period might be in effect for one to two weeks. Because the supplier's goal is to sell a large quantity of product, distributors are generally allowed to purchase as much of the item at the discount price as they desire. Distributors usually respond to the discount price, and the result—as the supplier hoped—is an often substantial increase in the supplier's sales volume during promotional periods. This boost in supplier sales has given rise to the term "sales loading" for this practice.

Trade promotion began to be used extensively during the era of price control adopted by the Federal Government in the early 1970s. At that time, suppliers were afraid that they would be legally prohibited from raising prices, and would ultimately find themselves caught in a situation of not being able to cover their own rising costs. They were especially fearful given the high inflation rates of this period. In fact, some suppliers lost money owing at least partially to the fact that they set their price-controlled base prices too low. Therefore, by using a strategy of high "list" prices and deep discounts, suppliers could both protect their profits and compete for customers in a price control environment.

Although high inflation rates disappeared from the U.S. in the early 1980s, there are many valid reasons explaining why suppliers continue to engage in trade promotion

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8Most grocery suppliers do not sell their products directly to consumers. Refer to Chapter Two for a discussion regarding the distinction between the customer and the consumer.

9Note that deals are also offered throughout the year during the introductory phase of a new product launch.


11Efficient Consumer Response, p. 80.
and sales loading. First, a supplier may be immersed in a battle for market share with a competing manufacturer. Second, the sales volume stimulus often provides support for the company's stock price. Third, the supplier may have overestimated consumer demand for the sales period about to close, leaving the company with too much supply of a product that is quickly declining in value. Fourth, the supplier may be about to launch a new item; deals can serve to both rapidly eliminate the supply of the old product from the distribution system, and induce customers to buy the new item and stock it on their shelves.

3.2.1.1. Push versus pull marketing

Related to the topic of trade promotion is the issue of push versus pull marketing. Briefly, pull marketing is geared toward persuading the consumer to come into the store and purchase the product (i.e., the consumer "pulls" the product off of the store shelf); on the other hand, push marketing is designed to give the product wide exposure in the store, so that it gets the consumer's attention once he or she is already there, but not necessarily to encourage the consumer to enter the store in the first place (i.e., the product is "pushed" onto the consumer).

With respect to marketing in general, suppliers have three major means with which to generate demand for their products: trade promotion, direct advertising and consumer promotion (e.g., coupons). Essentially, trade promotion has two goals: (a) to encourage the distributor to place the product in the store, and (b) to pass the savings on to the consumer. The problem is that in recent years, the first goal has overshadowed the second. Thus, trade promotion—which started out mainly as a form of pull marketing—has over the years become primarily push oriented.\(^\text{12}\) Note that the other marketing mechanisms—advertising and consumer promotion—are both pull oriented.

The link between trade promotion and push/pull marketing is that trade promotion is essentially the only means available to grocery suppliers to persuade their customers—i.e., distributors—to purchase their products. In general, distributors have tremendous leverage over suppliers, because it is the distributor that controls access to the supermarket. For instance, it is the distributor, not the supplier, that decides: which products should and should not be merchandised in the supermarket; where in the store a

\(^{12}\text{See Section 3.2.2. for more information.}\)
given product should be displayed; how much shelf space should be allocated to the product; and how heavily the product should be promoted, both in the store and in weekly circulars. Thus, while a supplier can engage in extensive mass media advertising and consumer promotion, if the company does not have the cooperation of distributors, it is likely to encounter difficulty selling its products.

Distributor leverage is particularly pronounced with respect to new items, of which there were over 15,000 in 1991.\textsuperscript{13} Often, the degree to which a new product becomes a success is directly correlated to the extent of instore merchandising that the product receives. Because a new product does not have an established history of consumer demand, the distributor can play a major role in determining the success of the item. For example, the distributor could choose to display the item prominently at the end of an aisle, or it could opt to place the product at the bottom of a shelf, well below eye level. Thus to a certain extent, particularly for new products, the supplier is at the mercy of the distributor.

In fact, distributors often charge suppliers simply to gain access to the store—at least for new products—through tolls known as slotting fees. Essentially, because supermarket shelf space is a limited and valuable resource, distributors do not want to squander this resource on products that may not ultimately sell to the consumer; thus slotting fees provide the distributor with a certain amount of protection in those situations where new products are not successful. (It is estimated that new products ultimately fail over 90 percent of the time.\textsuperscript{14}) Because of the rapid increase in the number of products introduced in recent years, competition for shelf space has become fierce, and slotting fees now range into the thousands of dollars at some of the large chain distributors.

However, even for existing products, distributors still wield considerable influence. For example, the distributor could display one brand of product more prominently than a competing brand, and it could choose to merchandise an item in a less visible shelf position. This issue is a particular concern for suppliers of the less popular brands in a given category.

\textsuperscript{13}Gorman's New Product News, cited in Efficient Consumer Response, p. 87. Note that this figure represents an increase of 670 percent from the number of products introduced in 1980.

\textsuperscript{14}Efficient Consumer Response, p. 88.
Thus, in recent years, many suppliers have chosen to emphasize push marketing (i.e., trade promotion) over pull marketing (i.e., advertising and consumer promotion). In fact, from 1981 to 1991, trade promotion increased from 34% to 50% of total supplier promotion spending, while advertising declined from 43% to 25 percent, and consumer promotion remained roughly constant, rising only 2 percentage points, from 23% to 25 percent.\textsuperscript{15}

This increase has resulted in many harmful effects on the grocery industry, which are discussed in Section 3.2.3. Section 3.3. then analyzes the ways in which ECR seeks to both reduce the emphasis on trade promotion and increase the level of pull marketing in the industry. Indeed, one of the main goals of the ECR program is to create a distribution system in which replenishment\textsuperscript{16} is entirely a "pull" process, driven solely by consumer demand.\textsuperscript{17}

3.2.2. Forward buying and diverting

Essentially, forward buying is the distributor's response to deals. Forward buying occurs when the distributor takes advantage of a promotion in order to buy large quantities—much greater than that necessary to satisfy immediate consumer demand—at the discount price. Distributors buy the excess quantity because once the promotional period ends, they are free to set the price at which they sell the product. Thus a distributor can sell some of the supply to consumers at the discounted level, then mark up the price after the promotion ends and pocket the difference.\textsuperscript{18} When a distributor purchases an item

\textsuperscript{15}Ibid., p. 79.

\textsuperscript{16}Refer to Section 3.3.1.1. for a discussion about the topic of replenishment.

\textsuperscript{17}Note that the terms "push" and "pull" are sometimes used in the context of replenishment. "Pull" replenishment refers to restocking product exactly as it is demanded by consumers; if taken to the extreme, this concept would result in production occurring in lot sizes of one unit. "Push" replenishment refers to stocking a supply channel with product in anticipation of future demand, typically based upon forecasts and historical data. In general, this is a misuse of the terminology. The reason is because—as described in this section—the terms push and pull have a classical meaning in the context of marketing strategy, and this definition becomes confused when utilized in the context of replenishment. For example, a pull marketing strategy could employ either "push" or "pull" replenishment, as could a push marketing strategy. Essentially, the key factor to bear in mind is that "pull" replenishment refers to a distribution process that is coordinated with actual consumer demand, while "push" replenishment involves a process that is not coordinated in such a manner.

\textsuperscript{18}To help ensure that discounts are fully passed on to the consumer, suppliers often impose conditions on
during a promotional period, the company is said to be buying "on deal."\textsuperscript{19}

Often, a distributor will purchase one or two months' supply of the product during the promotional period. In some instances, a distributor may even purchase an entire quarter's worth of stock during the promotion. For example, many suppliers open up only one deal per quarter on particular products. A distributor might wait for this period, then make one large purchase to carry it through to the next quarter, when it will repeat the process.\textsuperscript{20}

Diverting is sort of a common corollary to forward buying. This practice occurs when a distributor resells some of the excess stock to other distributors. Diverting opportunities exist because trade promotion typically occurs on a regional, rather than national, basis. Thus a distributor can profit by taking advantage of a promotion in its region and reselling the product in areas where the promotion is not being offered.\textsuperscript{21}

In fact, diverting is so prevalent that a secondary market has been established simply to handle this activity. Operating like a stock market, companies communicate buy and sell prices electronically, over what is known as the "diverter wire." Third parties, such as brokers, have also become involved in this practice; indeed, many companies earn significant profits solely from exploiting diverting opportunities.\textsuperscript{22}

Distributors engage in forward buying and diverting because such practices can be very profitable, and because the competitive pressure in grocery retailing is so high. For instance, note that when a distributor that forward buys it incurs significant expenses, such as the opportunity cost from tying up capital, and the need to have space to store the excess supply. However, because the difference between the discount price and the deals. See Section 3.2.3. for more information.

\textsuperscript{19}The term forward buying arises because the difference between the quantity that the distributor purchases during the promotional period and what consumers purchase during the same period is quite large. Hence, the distributor is "forward buying," i.e., it is purchasing product that will not be sold for several weeks or months. Forward buying is also referred to as investment buying. Refer to Efficient Consumer Response, pp. 80-81 for additional information.

\textsuperscript{20}Efficient Consumer Response, p. 27.

\textsuperscript{21}Ibid., p. 80.

\textsuperscript{22}Ibid.
everyday list price is so great, even when balanced against these additional expenses, forward buying and diverting are generally very profitable.

In fact, on some deals, the distributor can net an annualized rate of return of 50 percent or more. Moreover, for distributors that extensively employ forward buying and diverting, a gross margin\textsuperscript{23} increase of three or more percentage points is not uncommon.\textsuperscript{24} As mentioned above, distributor net profits average less than one percent of sales across the industry. Therefore, forward buying and diverting can have a huge impact on a distributor's competitive health and bottom line profits; indeed for some distributors, these practices can spell the difference between profitability and bankruptcy.

3.2.3. Inefficiencies caused by trade practices

Sales loading and forward buying wreak havoc in many ways. First, the huge—and highly variable—quantities ordered during promotional periods must be manufactured and distributed, causing large inefficiencies in the supply channel. Second, financial capital is used in an inefficient manner. Third, products often age greatly before consumer purchase. Fourth, costly procedures have had to be implemented to handle the increasing complexity of deals.

The first consequence is the inefficiency suffered by the distribution system due to artificially inflated demand. During a promotional period, distributor demand for products becomes highly skewed, and bears little resemblance to actual consumer demand, known as offtake. For example, shipments from suppliers to distributors often increase by a factor of 10 to 20 times the non-promotional rate during promotional periods, while offtake only rises by 2 to 3 times the non-promotional rate.\textsuperscript{25}

These vastly inflated quantities of product must be manufactured, then pumped through the supply channel. They need to be transported, stored and handled. And the raw materials that go into the finished goods must also be transferred to the proper loca-

\textsuperscript{23}The gross margin is the distributor's share of the sales revenue. It is the difference between the wholesale cost of goods and the retail price. See Chapters Five and Six for more information.

\textsuperscript{24}Efficient Consumer Response, p. 80.

\textsuperscript{25}Ibid., p. 82.
This entire process leads to considerable inefficiency throughout the production and supply pipeline, including: surplus manufacturing and warehousing capacity; excess labor, often employed at overtime rates; inefficient utilization of transportation equipment; and an oversupply of raw materials. As the process is repeated time and time again, the distribution system experiences stress and repeated breakdown. Then, when the quarter or promotional period is over, companies often find themselves with an excess of employees, space, goods and equipment.

Overall, this is a very costly problem. According to the ECR report, the production and distribution inefficiencies caused by sales loading and forward buying produce added costs estimated to be between 12.5 and 25 percent of retail sales.

Second, financial resources are used inefficiently. According to one estimate, between $75 billion and $100 billion worth of grocery products can be found in the supply channel at any one time, stored in trucks, railcars, warehouses and distribution centers. Much of this inventory is excess, i.e., it can not be justified based on consumer offtake. It is estimated that the expense from having capital tied up in this inventory is approximately $20 billion per year, or 5 percent of total annual retail sales of grocery products.

Third, products can become stale or degraded by the time they are ultimately purchased by the consumer. This is because over the long term, aggregate consumer demand tends to be fairly consistent, whether or not a promotion is in effect. To illustrate, note that as mentioned above, during a promotional period offtake increases by only two to three times the non-promotional rate; furthermore, the long run consumption level of the product is likely to remain unaffected by the promotion. Therefore, without an un-

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27 Efficient Consumer Response, p. 83.
28 Sellers, op. cit., p. 88.
29 To see why, suppose a consumer uses six tubes of toothpaste a year, buying one every two months. During a promotional period, he or she might buy two or three tubes, or even four. However, for the next six to eight months, the consumer would have no need for additional tubes, and would not make any further toothpaste purchases; in other words, his or her overall demand for toothpaste has not increased.
usual change in circumstances, a three month supply purchased by the distributor is in actuality sold over a three month period, and not a two month period, for example. Empirical evidence supports this fact: according to the ECR report, by the time a typical dry grocery product is ultimately sold to the consumer, it has been in the supply channel for 104 days overall, 66 days of which it is in the possession of the distributor.30

Fourth, deals are difficult to administer. A given distributor might be involved in 7,000-8,000 deals at any one time, each with its own set of conditions. For instance, to ensure that the consumer actually receives the benefit of the promotion—i.e., that discounts are in fact passed on to the consumer—suppliers have adopted a variety of different policies, including performance requirements, off-invoice allowances and till-back arrangements.31

Overall, many deals have become very complicated, as they often involve dozens of different variables. This situation has led to confusion and misunderstanding between suppliers and distributors about deal conditions. Resolving these disagreements is time-consuming and costly. A recent study found that distributor buyers and supplier salespeople spend 10 to 15 percent of each meeting resolving disagreements, and it is estimated that buyers spend two hours per day handling these problems.32

3.3. ECR

3.3.1. Description

ECR is a grocery industrywide program that calls for substantial restructuring of the dry grocery product supply channel. The program seeks to create a streamlined, more efficient distribution system in which (a) product flow is driven solely by consumer demand as measured at the POS, and (b) information is communicated electronically, in

While this pattern of stable long run consumer demand may not be true for all products, it does hold for a significant number of items. Indeed, according to one supplier representative contacted by this researcher, "The majority of product shipments in the grocery industry today bear little if any relationship to actual consumer purchases." (Interview with an executive of a major manufacturer of grocery products, July, 1993.)


31 Ibid., p. 81.

32 Ibid.
a timely manner, to all members of the supply channel. Overall, ECR impacts the entire backchannel after the product is processed, i.e., ranging from the point of production to the checkout counter at the supermarket.

Much of the program is based on the ECR report, which was prepared by the same consulting firm that worked on the Quick Response program—Kurt Salmon Associates. Most of the concepts developed in the report stemmed from the efforts of the ECR Working Group, which includes (it continues to function) chief executives from 15 to 20 of the largest distributors and suppliers in the U.S. Five leading trade associations sponsored the report: FMI, Grocery Manufacturers of America, National Association of Food Brokers, American Meat Institute, and Uniform Code Council.33

According to FMI, the ECR program incorporates two major goals: first, "focus the industry on distributing products rather than warehousing them;" second, "better focus the industry on consumer desires by using scan data to develop and market products."34 Presently, ECR is a work-in-progress. While many of the basic elements of the program are included in the original report, ECR continues to evolve. Indeed, there is presently much confusion in the industry over exactly what ECR is, and where the boundaries of the program are drawn. For instance, some of the proposals put forward by the program have been in place at different companies for years; according to a recent editorial in Progressive Grocer:

Much of what the industry is seeking to do under the auspices of ECR is not new or radical. The idea of putting more thought and fewer obstacles into product assortment, replenishment, promotion efforts and even new item introductions has been around for years. The feeling of urgency is due mostly to the current heightened state of competition with non-traditional operators.35

The report divides ECR into two phases. The first phase, known as Best Practices Implementation, covers the more basic of the program's recommendations. This phase is supposed to produce the majority of the program's overall benefits, and it is envisioned

33Ibid., p. ii.
that the practices in this phase can be implemented relatively easily. The report states:

The Best Practices Implementation is achievable by every grocery supplier and distributor within two years. All of the elements are being done today by several suppliers or distributors. When fully implemented, this phase will produce about two-thirds of the total projected ECR cost benefit.\(^{36}\)

The second phase is known as Full ECR Implementation, or ECR Phase II. This phase is perceived to be more time-consuming and costly to execute than the first phase. It is envisioned that the practices in ECR Phase II will begin to be implemented industrywide in the 1995 to 1996 time period.\(^{37}\)

Note that there is a significant amount of disagreement in the industry about many of the basic aspects of ECR. There are questions concerning how the benefits of the program will be shared among members of the supply channel, and even whether all members will in fact benefit. There is also much debate regarding the timetable for implementation. These issues will be addressed in Section 3.3.3.

Overall, the ECR program covers four broad areas of the distribution process: replenishment, store assortment, promotion and product introduction. The following sections will briefly examine these elements.

3.3.1.1. Replenishment

Replenishment refers to restocking preexisting grocery products after they have been purchased by consumers. Of the four major areas of the ECR program, replenishment is the most critical. For example, the report states:

Efficient Replenishment is a fundamental supporting platform for the overall ECR strategy. It has one and only one objective:

\[
\text{Provide the right product, to the right place, at the right time, in the right quantity, and in the most efficient manner possible.}
\]

\(^{36}\)Efficient Consumer Response, p. 5.

\(^{37}\)Ibid, p. 6.
This is supported by a free flow of accurate and timely information, integrated with the flow of product, throughout the grocery supply chain. The driving force of Efficient Replenishment is consumer sales data as captured via POS scanners and UPC bar-codes.\footnote{Ibid, p. 45.}

As defined by ECR, the grocery product supply channel consists of three separate replenishment cycles that link three independent information and product flows. The three flows are those which occur between: (a) the consumer and the supermarket, (b) the supermarket and the distribution center, and (c) the distribution center and the supplier. ECR is limited to the replenishment cycles involving the second and third flows; the cycle involving the first flow is not included in the report and is defined to end at the supermarket checkout counter.\footnote{Ibid. See Section 3.4.1. for more information.}

With respect to the two replenishment cycles that are part of the program, the ECR report offers a set of recommendations. Among the many key elements identified by the report are POS scan data, electronic receiving, perpetual inventory, computer assisted ordering (CAO), dynamic CAO, dynamic allocation, EDI communication, purchase order management, store-SKU\footnote{A stock-keeping unit (SKU) refers to a specific product, as distinguished by several characteristics, including brand, weight and size. In other words, a different SKU would be used to identify each of the following: a 10 ounce can of vegetable soup made by Company A, a 10 ounce can of tomato soup made by Company A, a 12 ounce can of tomato soup made by Company A, and a 12 ounce can of tomato soup made by Company B.} forecasting, and electronic receiving and cross-docking.\footnote{Efficient Consumer Response, pp. 45-77.} Essentially, these components all help to support the goal of ECR, which is the creation of a "responsive, consumer-driven" distribution system that is built upon paperless information flow "between manufacturing line and check-out counter;"\footnote{Ibid., p. 1.} in other words, a distribution system that is based upon continuous replenishment.

As the statement above demonstrates, perhaps the single most important element of the replenishment process—indeed, of the entire ECR program—concerns POS scan data. This collection of data refers to the information that is captured when a product is
purchased by a consumer, and the item's bar code label\textsuperscript{43} is scanned at the point-of-sale, i.e., the supermarket checkout counter. This information tells the distributor the exact rate of product flow, down to the individual unit, thus allowing the replenishment process—both into the supermarket and into the distribution center—to be precisely controlled. Hence, because it records actual consumer offtake, POS scan data is fundamental to the entire replenishment process.

Therefore, attaining a very high level of scanning accuracy—above 98 percent, for example—is critically important. In fact, such accuracy is significant not only in terms of the replenishment process, but also crucial for the whole ECR program.\textsuperscript{44} However, achieving such a degree of precision may require a shift in operating philosophy on the part of the distributor.

To illustrate, consider the following scenario. A consumer purchases blueberry, peach and vanilla yogurt, all made by the same manufacturer. In order to speed up the checkout process, the cashier scans only the first unit, then uses a "multiple" key to enter the other two. The result is that the customer spends less time in the checkout line, but the distributor loses accurate counts of total product movement.\textsuperscript{45} Thus the distributor may find that is has to trade off an increase in customer checkout time for improvements in scanning accuracy.

The critical importance of accurate scanning is underscored by the following statement from the president of Pay Less Super Markets:

Automatic reorders, computer-assisted ordering, scan validated coupon redemption, electronic consumer promotions, item sales verification, joint testing of new products and true efficient response to the consumer, all hinge on good scan data.\textsuperscript{46}

\textsuperscript{43}The bar code label is also known as the Universal Product Code (UPC) label.

\textsuperscript{44}Accurate scanning means that a product's bar code is properly read by the checkout equipment, and the cashier does not have to enter the item's code or price manually.

\textsuperscript{45}Another situation occurs when the scanner does not read the product's bar code, and the cashier has to enter information manually. While bar code labels include numerical equivalents to the machine-readable codes, cashiers in this situation often enter just the price, rather than the longer code, again so that the checkout process does not become inordinately lengthy.

\textsuperscript{46}Larry Contos, "Don't Ignore Independents," Progressive Grocer Executive Report: ECR, January, 1994,
Another important reason to have reliable POS data comes from the former chairman of Shaw's Supermarkets, who is also a former co-chairman of the ECR executive committee:

Scan data informing upstream the demand characteristics of products, with a matching flow of product downstream for replenishment, would make a difference. It would tie buyer and seller together in a common purpose of satisfying consumer demand, without which neither prospers.47

In addition to accurate scan data, the ECR report recommends the installation of a variety of computer systems and equipment, as noted above. With these systems and equipment in place, it is envisioned that the replenishment process will become not only more efficient, but also less susceptible to error. In particular, a paperless information flow will help to substantially reduce the human error that results from manually entering and reentering data.

The cost reductions from implementing the replenishment recommendations are considerable. According to the ECR report, it is estimated that full implementation of ECR Phase II will produce savings in the replenishment process equal to 2.80 percent of sales, after subtracting the expense for the necessary equipment. The distributor will reap 56 percent of this cost reduction, while the remaining benefit will accrue to the supplier.48

3.3.1.2. Store assortment49

Store assortment refers to the way in which products are merchandised in the store. In particular, this area deals with the use of store space, which, as Section 3.2.1.1. discussed, is a limited and valuable resource. Through efficient allocation of space, distributors can boost the sales volume in existing supermarkets, in two ways: (a) by im-

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48Efficient Consumer Response, p. 77.

49The information in this section is based on Efficient Consumer Response, pp. 35-43.
proving the use of existing merchandising space, and (b) by increasing the ratio of sales area to total floorspace, such as by converting backrooms into additional merchandising space. Although most distributors currently examine consumer demand for different products and allocate space accordingly, ECR seeks to bring a more sophisticated effort to this process.

In the ECR report, store assortment incorporates three main elements: category management, space allocation based on POS scan data, and regular monitoring. The first aspect, category management, refers to far more than simply allocating space to products in the supermarket. Broadly, category management is a strategy which is used by the distributor to assess the profitability of products and manage operations—both instore and overall—accordingly. This topic covers a wide range of functions, including store space allocation, distributor buying power and organizational structure, and distributor/supplier relationships. Indeed, for the distributor, category management entails a basic operating philosophy that is geared toward the use of continuous replenishment, rather than deal-to-deal buying.

Currently, most distributors focus on the profitability of products either by SKU or by vendor. In the ECR report, it is recommended that distributors utilize category management so as to maximize the profitability of the total category. It is also recommended that this effort be driven solely by consumer demand, rather than vendor needs and/or the objectives of the distributor's buyers.

The second element is supermarket space allocation. Efforts under this heading are essentially aimed at optimizing the use of store space. Assisting this process are four subcomponents: accurate POS scan data, store sales history data, demographic information, and an item database.

The third element is to monitor the category management and space allocation efforts. Because a full-scale space reallocation of the entire supermarket is a time-consuming procedure, the ECR report states that it would be inefficient to undertake such a process on a weekly basis. However, the report does recommend that distributors make minor adjustments to instore displays at least once a week, and that these efforts should be driven by consumer offtake.

The costs and benefits pertaining to more efficient store space allocation primar-
ily affect the distributor. It is estimated that the cost to implement the report's recommendations is less than 0.15 percent of sales, while sales are projected to increase by 8 to 10 percent.

3.3.1.3. Product promotion

Product promotion is concerned with generating consumer demand for goods. As discussed in Section 3.2., there are three major promotional strategies available to suppliers: trade promotion, advertising and consumer promotion. The chief issue in the area of promotion—in fact, a concern which affects the other program areas of ECR as well—is that the use of trade promotion has become quite extensive over the past decade. This heavy use of trade promotion has resulted in a variety of production and distribution inefficiencies; refer to Section 3.2.3. for more information.

ECR seeks to create a streamlined distribution system in which variability is greatly reduced. Thus the program aims to decrease or eliminate the production and distribution surges that presently accompany trade promotion. However, ECR does not seek to abolish trade promotion itself.

The ECR report offers three recommendations for dealing with the issue of trade promotion. First, suppliers should increase the availability of alternatives to distributors. This would provide the distributor with flexibility in its purchase decisions. One suggestion is to offer "continuous deals," in which the price reflects both previous supplier promotional spending, as well as the savings realized by the supplier from smoothing out the production and distribution processes.

Second, suppliers should simplify deal conditions. As discussed earlier, suppliers want to ensure that trade promotional spending gets passed on to the consumer, and one of the consequences is that deals usually involve a multitude of performance measurement variables. ECR recommends that this number be cut substantially.

Third, the supplier must take responsibility for ensuring that the distributor has up-to-date information regarding deal conditions. It is recommended that suppliers use established EDI protocols, known as transaction sets, to regularly confirm the accuracy

50The information in this section is based on Efficient Consumer Response, pp. 79-85.
of this information.

ECR also offers recommendations regarding consumer promotion. The report notes, for example, that more than 280 billion coupons are dispersed in the U.S. each year, but only 2.6 percent are ever redeemed. In order to make the consumer promotion process more efficient, the report offers two suggestions. One is to use scan-validated coupon redemption, in which distributors are reimbursed by suppliers based solely on POS scan data, without the need to process and validate coupons.\(^{51}\) The other alternative is to eliminate paper coupons completely. With this procedure, the supermarket cash register would be programmed to automatically deduct the discount at the time of the sale.

As mentioned earlier, it is estimated in the ECR report that the added cost resulting from trade promotion and forward buying is between 12 and 25 percent. There is empirical evidence to confirm this savings estimate. Procter and Gamble, one of the leading manufacturers of grocery products in the U.S., recently initiated a program aimed at increasing the use of continuous deals and deemphasizing trade promotion. The company estimates that by allowing it to restructure production and distribution, this shift will permit the firm to reduce its product list prices by 8 to 25 percent.\(^{52}\)

3.3.1.4. Product introduction\(^{53}\)

Product introduction pertains to bringing new products to the marketplace. This is a key aspect of the grocery manufacturing and retailing business. For example, the ECR report states:

The development of new products and services is one of the most important value-creating processes in every industry. The grocery industry is no exception. New products and services create interest, excitement and new business opportunities by providing consumers with better, more conven-

\(^{51}\)Currently, most distributors forward coupons to third party clearinghouses. For a fee, these firms process coupons and recoup the funds from suppliers. However, even when distributors handle coupons in-house, the process can be expensive.

\(^{52}\)Sellers, "Dumbest," p. 90.

\(^{53}\)Unless noted otherwise, the information in this section is based on Efficient Consumer Response, pp. 87-94.
ient or lower priced ways to fulfill their needs. The success of the grocery industry in creating new products is evident in the fact that one-third of consumer sales are products that did not exist ten years ago.\textsuperscript{54}

The concern in the grocery industry is that the product introduction process is inefficient. For instance, in recent years, over 16,000 new products have been introduced annually, and less than 1 percent of these items achieve yearly sales greater than \$15 million.

In addition, introducing a new product to the marketplace is expensive: it is estimated that it costs the supplier \$15 to \$20 million to successfully launch a new grocery product in the U.S. Much of this cost results from inefficient and ineffective test marketing. For instance, consumers frequently react favorably to a new product in a test marketing situation, only to reject the item once it arrives at the supermarket. Also, as discussed in Section 3.2.1.1., it is quite common for suppliers of new products to have to pay expensive slotting fees to distributors in order to secure space on the supermarket shelf.

The report recommends initiating a five-step process for evaluating and launching new products. The first step consists of regular meetings between the distributor and the supplier; at these meetings, the companies make joint decisions regarding which products to test based on consumer trends and other data. The second phase is selection of the supermarkets used for the trial, based on demographic profiles of the various stores' shoppers. As part of this step, the supplier prepares trial items and promotional materials. Third is implementation of the test. In this step, if the distributor maintains a database of regular shoppers, it sends promotional material to these customers. The fourth stage is monitoring the POS scan data in order to gauge the effectiveness of the promotion, in particular with respect to the consumers who received promotional materials. The distributor may choose to make follow-up phone calls to consumers who have purchased the product. The last step is for the companies to evaluate the success of the trial, and decide whether the product should be dropped, ramped up to full production, or the product mix should be altered and retested.

Note that in order for this process to be effective, the distributor must maintain a

\textsuperscript{54}Efficient Consumer Response, p. 87.
database of purchasing activity that allows it to identify individual purchases by consumer. To do so, the distributor can introduce

consumer cards that identify the consumer who is making a POS transaction. Such cards range from bar-coded check-cashing cards to savings club or frequent shopper membership cards which entitle the holder to special instore offers or to other awards.\textsuperscript{55}

According to the ECR report, there are three main benefits from employing this process for product introduction. First, it should lead to a decrease in the failure rate for products that have already been launched; second, it increases the correlation between the test marketing process and the actual selling environment; third, it can help the distributor and the supplier identify new profit opportunities by establishing closer links with the consumer. Overall, the report estimates that implementing the product introduction recommendations would reduce the introduction expense by 0.9 percent of total dry grocery sales.\textsuperscript{56}

\textbf{3.3.2. Implementation of ECR}

The speed of implementation for the practices recommended by the ECR report will vary by company. Based on the outcome of the Quick Response program, the ECR report expects that companies will fall into one of three categories: early adopter, close follower or laggard. The first two groups comprise companies that will have either already put in place, or have committed to implement, ECR Phase I by the end of 1994, and ECR Phase II by the end of 1996. With respect to the third group, the report states, "Many of these companies will be acquired or will cease operation in the industry consolidation that will accelerate by the mid-1990s."\textsuperscript{57}

While the report envisions that the majority of companies in the grocery industry will have begun implementing ECR by the end of 1994, there is evidence that this is an optimistic timetable. For example, in 1993, a study was conducted of several of the largest distributors. Included in the study were 38 distributors which together accounted for

\textsuperscript{55}Ibid., p. 91.

\textsuperscript{56}Note that the ECR program deals solely with dry grocery products.

\textsuperscript{57}Efficient Consumer Response, pp. 11-12.
$114 billion in annual sales, or almost 40 percent of overall supermarket industry volume. Of these 38 companies, only 16 were involved in continuous replenishment programs at the time of the study, and only 2 had been involved in such programs for more than a year. Furthermore, 13 of the companies were using EDI solely to transmit purchase orders—there are at least 6 other transaction sets in which the distributor is the sender—while 9 firms "were not involved in any form of EDI."59

In fact, there is additional evidence which suggests that the results above are not atypical of the grocery industry. For example, the following is from a recent survey of the industry, as reported in Progressive Grocer:

There are some problems for ECR. Within the industry, many still profess apathy or ignorance about ECR, despite the flood of publicity about the initiative over the past year.

For instance, although executives see ECR having a powerful impact on product assortment and replenishment methods, the same enthusiasm was lacking on the possibility of changes in promotional practices or new item introductions. And, even among executives, our surveys found a significant group saying they really aren’t sure how ECR will impact operations or bring about efficiencies in these key areas.

However, not all problems can be solved through ECR efforts. The level of trust within the industry remains fairly low. Without improvement there, gains through ECR could be fairly difficult.60

Supporting these sentiments is the following statement from a vice president at Nabisco Foods Group:

The final education challenge is overcoming a resistance to change. This is a barrier in any well-established industry, where individuals and companies can have a death grip on the status quo. Strengthening the reluctance to change is the fact that the entire ECR concept is an exercise in experimentation and faith. We won’t know the results of our efforts until we see them in action. As one industry observer said, "It’s not that the

58 Ibid., p. 57.


jury is still out. It hasn't even been picked yet."61

And from the president of Kraft General Foods, one of the prime sponsors of ECR:

One cannot underestimate the amount of education and continuous reinforcement that is necessary. ECR represents change, and change is always scary.62

3.3.3. Obstacles blocking implementation of ECR

There are several major obstacles blocking the implementation of ECR. First, distributors profit from forward buying and diverting, and suppliers are able to boost—even if only temporarily—sales volume through trade promotion. Second, compensation of key distributor and supplier employees is often based on factors that are counter to the goals of ECR. Third, most wholesalers and independent supermarket operators feel that ECR does not treat them equitably. Fourth, there is a large amount of inventory currently in the supply channel, and this stock would have to be drawn down before new product could be produced and sold.

The first issue concerns trade practices. To illustrate the difficulty in eliminating or even decreasing the emphasis on these customs, consider the following statement from the ECR report:

Trade promotion is like a drug, effective at boosting sales at first in small amounts but gradually, as competitors match offers, the amount has to be continually increased to meet quarterly shipping goals. Like a drug, trade promotion is hard to break as the system becomes dependent upon it, even despite the bad side effects that it produces. The withdrawal is painful, requiring great strength and a strong sense of the ultimate benefits to persevere to success.63

To many in the industry, this is a very important issue. For example, the president of the Grocery Manufacturers of America stated:


62Dick Mayer, as quoted in "The ECR Road Map," p. 6.

63Efficient Consumer Response, p. 80.
In the end, the distributor's buying decision should be made on what the consumer wants, not necessarily on what in individual supplier is willing to pay. We need to enter into an alliance to serve the consumer.\textsuperscript{64}

From the chairman of the Academy of Food Marketing at St. Joseph's University:

The food industry cannot correct in several years the problems associated with the addiction to easy street monies. Eliminating the source too quickly will result in the death of many food retailers and wholesalers. Making the transition will be arduous and difficult. A long-term commitment to effective customer service will be necessary, with slow returns and benefits.\textsuperscript{65}

And from the ECR report itself:

Current trade promotion practices evolved over many years and it is unrealistic to expect that they can be completely eliminated overnight without causing extreme difficulty for many distributors. Since Efficient Consumer Response is fundamentally a strategy for suppliers, brokers and distributors to work together jointly to bring greater value to the grocery consumer, a unilaterally imposed solution is quite contrary to the guiding principles of ECR.\textsuperscript{66}

The difficulty in reducing the use of trade promotion stems from the fact that most suppliers and distributors would have to initiate major changes in their operating methods. Both would need to move away from the deal-to-deal philosophy which is common in the industry today, and adopt longer term strategies. While some companies had begun such a shift even before the ECR program added impetus, for many firms the type of change affects policies that had been built up over the course of several decades. This factor implies that instituting new policies—particularly in an area as fundamental to the operations of a company as the way product is sold or bought—is likely to be a slow and complex process.\textsuperscript{67}


\textsuperscript{66}Efficient Consumer Response, p. 83.
This leads to the second concern: employee compensation. Supplier sales representatives are typically compensated based solely on the sales volume that they generate, while distributor buyers are often compensated chiefly on the amount of deal money that they generate. In both cases, there is little or no incentive for the employee to modify the purchase/sale in order to account for the impact that the agreement would have on the employee's company.\textsuperscript{68} Often, such compensation policies extend to the employees' bosses as well, further encouraging sales loading and deal buying.

In order for ECR to be successfully implemented, the way in which buyers and sellers—and possibly their bosses—are compensated would have to change. While different procedures for assessing the actual net profitability of a purchase/sale have been devised, these policies also have significant problems associated with them. For example, the new measurements often involve complex calculations, particularly when compared to assessments based on sales volume or deal revenue. Also, certain factors used in the calculations, such as the impact that the purchase/sale has on production or warehouse operations, are generally beyond the control of the buyer/seller.\textsuperscript{69}

However, an issue which is of even greater significance to the buying/selling functions is that their power is greatly reduced under ECR. For instance, with respect to existing products, much of the activity that currently involves buyers and sellers would be handled by lower level employees or even by computer equipment under ECR. In general, the fact that a given function is likely to lose clout tends to induce resistance to change among affected employees; this is no less true in the grocery industry.

\textsuperscript{67}To illustrate the difficulty in changing operations, consider two examples. First, warehouse space: over the past two decades, many large distributors have built or leased warehouses solely for the purpose of housing goods bought on deal. (See, for example, Steve Weinstein, "The Forward Buy Factor," \textit{Progressive Grocer}, February, 1994, p. 44.) Divesting these facilities is likely to be costly, particularly if other distributors in the market are simultaneously pursuing the same course. Second, Procter and Gamble: as mentioned in Section 3.3.1.3., this company has sought to reduce the use of trade promotion. For its efforts, Procter and Gamble has been called a "dictator" by one distributor, and has seen several large distributors de-emphasize the company's products; in fact, certain distributors have stopped carrying some of the company's brands altogether. (See Steve Weinstein, "Will Procter's Gamble Work?" \textit{Progressive Grocer}, July 1992, pp. 36-40. )


The third significant obstacle blocking ECR pertains to wholesalers and independent supermarket operators. Throughout the ECR report, the distributor is assumed to be a chain distributor that operates 100 supermarkets and maintains its own distribution center. However, a significant percentage of total U.S. grocery sales takes place at independent supermarkets, which generally do not possess a distribution center and instead are supplied via wholesaler-owned facilities. In fact, according to recent data, independent supermarkets represent 40 percent of the total number of supermarkets, and they account for 27 percent of aggregate supermarket sales volume.\textsuperscript{70}

The key issue for this segment of the industry is that since ECR seeks to reduce the use of forward buying and diverting, wholesalers—which depend heavily on such practices for income—will have to find a way to respond. They can do so either by charging higher fees to the independent supermarkets that they supply or by reducing their profit margins. A related concern is that trade promotion money is already inequitably disbursed in favor of chain distributors to the detriment of wholesalers and independent operators, and the situation is becoming more and more unequal.\textsuperscript{71}

Several observers have questioned the extent to which wholesalers can recoup lost income through charging higher fees. Indeed, according to a recent study of wholesalers, these firms

\begin{quote}
are encouraged by the potential cost savings, but realize that continuous replenishment implies changes in pricing policies that could undermine the economics of the wholesale-supplied system.\textsuperscript{72}
\end{quote}

The impact of ECR on wholesalers and independent operators is a very important matter, and it has yet to be resolved.

The fourth significant matter pertaining to the implementation of ECR is that the excess of stock which is currently in the distribution pipeline would have to be drawn


\textsuperscript{72}\textit{Ibid.}, p. 24.
down, meaning that very little new product would be manufactured or sold for a period of time. Thus revenues and profits are likely to decline, which can lead to a decrease in a company's share price. Although the problem of draining off excess stock is only temporary, it can be a very significant obstacle—particularly for manufacturers—blocking implementation of a system centered around continuous replenishment. Consider the following two examples:

Bristol-Myers Squibb...unstuffed its distribution system earlier this year. When the pharmaceutical company announced disappointing profits as a result, its shares sank 9% in one day.

RJ Reynolds took a $360 million hit to earnings to trim production and let customers sell off billions of cigarettes that had piled up in their warehouses.73

3.4. Other concepts

ECR is not the only concept presently under development that seeks to improve efficiency in the grocery industry. In fact, projects are underway to improve the efficiency of both the backchannel and the forward channel. For example, with respect to the backchannel, there is a proposal to establish a third party logistics operation which would service competing distributors in each market. The plan involves several large cross-docking facilities located around the country, with each facility supplying stores directly; essentially, if fully implemented, this proposal would eliminate the need for distributor-owned distribution centers. With respect to the forward channel, there are proposals to increase the use of home ordering and home delivery, and to reshape the in-store supermarket shopping experience. These plans incorporate a variety of ideas, including home delivery of "staple" goods, self-scanning and -bagging of items by the consumer, and the creation of more "market-oriented" supermarkets.

Both types of proposals are currently receiving serious consideration within the grocery industry. This section will briefly examine each.

3.4.1. Backchannel efficiency

The first concept is the establishment of a limited number of facilities, operated by a non-distributor third party, which would function solely as cross-docking operations. This proposal is being developed by Non-Stop Logistics. As planned by the company, product would flow in full pallet quantities from the supplier to one of these facilities, be broken down into mixed pallet loads, then delivered—after spending no more than twenty-four hours at the facility—directly to individual supermarkets; thus, goods would bypass the distribution center entirely. The company estimates that this type of system would reduce supplier-to-store distribution costs by 43 percent.

Non-Stop's system is designed around the use of POS scan data and forecasting tools. The company has developed proprietary forecasting software that incorporates daily and historic product movement data from distributors, then generates 60 to 90 day forecasts of product needs based on the data. These forecasts—which are updated on a daily basis—are circulated among distributors, suppliers and transportation carriers. Thus, orders are communicated to suppliers in a timely manner, and the items are delivered to the stores exactly when needed.

Non-Stop intends to target dry grocery items initially, then expand to frozen packaged goods. According to the company, all of the distribution centers currently operated by distributors to handle dry grocery products could be replaced by forty of its cross-docking facilities. Non-Stop does not intend to actually own the cross-docking facilities itself, but instead will lease the necessary buildings (and transportation vehicles, equipment, etc.) from investor companies, which might include distributors, suppliers, transportation companies and real estate firms. Also, the company will not take title to—i.e., the company will not own—any of the product that it distributes.

Non-Stop sees its role primarily as the facilitator of this concept. With respect to ECR, the company has said that one of the shortcomings of the program is that no single company is responsible for both product flow and information flow. Therefore, by man-

74A full pallet contains only one SKU; a mixed pallet contains several SKUs. Refer to Chapter Five for additional information.


76Interview with an executive at Non-Stop Logistics, August, 1993.

77Millstein, op. cit.
aging both elements, Non-Stop will be able to maintain tight control over the entire backchannel distribution process. According to the company, without such coordination, many of the efficiencies promised by ECR will not come to fruition.\textsuperscript{78}

3.4.2. Forward channel efficiency

In the area of forward channel efficiency, there are a number of projects currently under development. These can be grouped into two broad categories. The first class consists of supermarkets that revolve around the use of self-scanning and -bagging of products by consumers. In general, these projects seek mainly to reduce labor costs, by delegating a greater share of instore activities to the consumer, as well as to possibly increase consumer convenience, by reducing checkout time. A limited number of supermarkets have already implemented such systems.

The second category concerns a more advanced project known as Smart Store, located in Chicago. This venture is being directed by Andersen Consulting, in conjunction with "an advisory board composed of 12 CEOs from innovative American and European food retailers."\textsuperscript{79} The project involves changes not only to the supermarket itself, but also to the supply of products to the home. For instance, the proposal encompasses home delivery of certain goods, as well as the creation of supermarkets that are more market-oriented than today's stores. It is critical to note that this particular project represents the "cutting edge" with respect to this section of the grocery products supply channel, and that it is based on over five years of research and development, and millions of dollars of investment.\textsuperscript{80}

3.4.2.1. Self-scanning

Several varieties of self-scanning have been developed. One version involves a hand-held, wireless scanning wand that the consumer obtains upon entry to the store. Before placing an item into the shopping cart, the consumer scans the product with the

\textsuperscript{78}Interview, \textit{op. cit.}

\textsuperscript{79}From promotional materials supplied by Andersen Consulting, May, 1994.

wand. When the shopping is completed, the consumer returns the wand to the cradle, and a receipt is printed out. The consumer then takes the receipt to a checkout counter to pay for the order, though electronic self-payment, such as via credit card or debit card, is also possible. At the moment, this type of system is in actual operation in only one store around the world, in the Netherlands.\(^{81}\)

Another version exists that is less sophisticated but more common. It involves a stationary unit located at the checkout counter. The consumer scans the items in a manner similar to the way cashiers work today, then takes the bill to the appropriate location to pay. According to the director of operations for Pathmark, this system "lets customers take control of both the scanning and the bagging, and gives them the perception that they're moving faster."\(^{82}\) This type of system is currently in place in several supermarkets in the U.S.\(^{83}\)

There are yet more versions of self-scanning under development. For instance, there are proposals to fasten scanners to shopping carts, and have the items scanned either manually by the consumer or automatically by the equipment as they are placed in the cart.\(^{84}\)

Note that while self-scanning may give the consumer greater "control," it is unclear whether checkout time is significantly reduced with these systems. For example, with the stationary units, the consumer still has to wait in line to access the equipment, and with both the stationary and the mobile units, the consumer currently has to go to a cashier to pay, although electronic payment could help to eliminate this requirement in the future.\(^{85}\)

Also, note that with any type of self-scanning system, there are serious concerns regarding customer pilferage. The system in the Netherlands relies upon spot-checking

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\(^{83}\) *Ibid.*

\(^{84}\) Nannery, *op. cit.*

\(^{85}\) In addition, with the scanning wands, the consumer may have to wait to begin shopping while the wands in use are recirculated.
and the threat of public embarrassment. Another suggestion is to have weight sensors at
the checkout lanes, so that the weight of the products in the shopping cart could be corre-
lated with the weight of the order that had been scanned. However, until the customer
pilferage issue is resolved, many distributors in the U.S. are reluctant to implement such
systems.\footnote{Nannery, \textit{op. cit.}}

\textbf{3.4.2.2. Smart Store}

As mentioned above, Smart Store represents the state-of-the-art in the grocery in-
dustry with respect to the forward channel. For instance, in addition to having an advi-
sory board composed of chief executives from innovative distributors, Andersen sponsors

a "Futurists Board," which includes representatives from many different
areas, including materials handling, advertising, technology, food process-
ing and food retail. The board is devoted to predicting and analyzing fu-
ture industry trends and possible implications.\footnote{\textit{Smart Store: Making Information Work for the Consumer} (Chicago, IL: Andersen Consulting, 1993), p. 5.}

The Smart Store project encompasses several areas, including the forward chan-
nel and backchannel. With respect to the forward channel, the project essentially seeks
to (a) completely remove certain products from the supermarket, and have them distrib-
uted to the consumer entirely via home delivery, and (b) reconfigure the supermarket by
redistributing the resultant freed-up space. This section will discuss the various elements
included in the Smart Store concept.

The first element is the creation of the "supermarket of the future." Andersen has
established a supermarket test facility that incorporates several features, including: self-
scanning of products by the consumer, using the wands described in the previous section;
"frequent shopper" consumer cards, as discussed in Section 3.3.1.4.; and video monitors
attached to shopping carts, which can be used to direct the consumer to the appropriate
aisle, and to send messages targeted to individual shoppers (provided the consumer enters
a frequent shopper card into the equipment). Also, some products are not stocked on the
shelves at Smart Store; instead, they are housed in the supermarket's backroom. With
these items, the consumer scans two-dimensional representations of the product packaging in the main merchandising section of the supermarket, and the actual items are bagged into customer orders by store employees in the backroom.\footnote{C.T. Nash, "Back to the Future," \textit{Forecast}, November/December, 1993, p. 29.}

Another major aspect of the Smart Store project is very similar to the concept proposed in this thesis: the removal of certain products from the store altogether, through the use of home ordering and item picking at a location other than the supermarket. However, there are many important differences between Andersen's proposal and the system proposed in this thesis. First, to distribute these items to the consumer, Andersen proposes the use of home delivery exclusively; this thesis proposes the use of a neighborhood drive-through pick-up depot, with home delivery made available as an option, as warranted by consumer demand. Second, Andersen's proposal calls for home ordering of "staples" only;\footnote{Glen Terbeek, "Food Industry Predictions: Extensive Home Delivery, No Checkstands, Retailers out of Logistics," \textit{International Trends in Retailing}, Andersen Consulting, Summer, 1993, p. 31. Note that the decision as to which products are considered "staples" is made by the consumer; as a result, each household is likely to have a different definition of "staple" items. Essentially, according to Andersen, staples are products for which "the quality and value are established." (\textit{Ibid.}, p. 32.)} under the system proposed in this thesis, consumers can order all products from the home if they choose to. Third, Andersen proposes that order picking and home delivery be handled "by manufacturers direct through a third-party home shopping service;"\footnote{\textit{Ibid.}} this thesis proposes that order picking—and home delivery, if offered—be handled by the distributor.\footnote{Another possible difference concerns the time required to furnish the customer with the completed order. Andersen suggests that home delivery be made within an hour of customer ordering. Under the system proposed in this thesis, some items can be prepared for customer retrieval at the depot within this time period, but other products may not be ready for customer retrieval for several hours or until the following day (see Chapter Six). However, if a distributor implements the system proposed in this thesis and chooses to offer home delivery, there is no inherent reason for the delivery times under this system and under Andersen's system to differ.}
locations to find spaghetti, sauce, bread, cheese, etc.; with Smart Store, these items are all located together. Second, Smart Store offers prepared meals, mainly by redeploying the space freed up through the removal of staple products. It is envisioned that a future supermarket might even feature a chef who could prepare the meals in front of shoppers, then provide the result to consumers who do not want to do the actual cooking.

Aside from these aspects which concern the forward channel, Andersen is also proposing concepts that affect the backchannel. For instance, Smart Store suggests the use of "market-level logistics" in which a third party company is employed to supply each supermarket in a given area. This is seen as being more efficient than the current system in which each competing distributor operates its own facilities and transportation fleet. Note that this concept is essentially what Non-Stop Logistics is currently pursuing. Indeed, Andersen may participate in the Non-Stop venture: the firm "has expressed interest in processing Non-Stop's financial transactions."

Overall, this thesis has identified significant drawbacks regarding the concepts proposed by Andersen which affect the forward channel. For an analysis of these problems, refer to Section 3.5.2.

3.5. Why ECR and Smart Store are not sufficient

3.5.1. ECR

As mentioned earlier, the stated goal of ECR is to create a more efficient distribution system that is better oriented toward meeting consumer demands. In aggregate, it is estimated that the gains from the program will reach $20-30 billion. Due to the very competitive nature of the grocery industry, it is envisioned that most, if not all, of this gain will be passed on to the consumer.
However, the ECR program has a severe limitation: it is truncated, because it ends the channel restructuring process at the supermarket. In fact, one of the most basic assumptions of the program is that the supermarket will continue to be the dominant mode by which consumers obtain grocery products.

Essentially, the fundamental shortcoming of the ECR program is that it is focused solely on the backchannel, without considering how to make the distribution process out to the home more efficient. Yet perhaps the ultimate goal of the program is to bring increased value to the consumer, and for many consumers the term "value" typically consists of many elements, not the least of which is increased convenience.

This section will demonstrate why, for two reasons, ECR by itself is not sufficient. First, the channel restructuring proposed by the program is incomplete. Second, ECR does not satisfactorily address the full range of consumer needs.

**3.5.1.1. Incomplete channel restructuring**

Clearly, ECR seeks to create stronger relationships among supply channel members in the grocery industry, particularly between distributors and suppliers.\(^{97}\) Such tight partnerships should help to generate significant gains in systemwide efficiency in a variety of areas, including production, distribution and marketing.

But the one member of the supply channel who is the key to the whole production and distribution cycle—the consumer—is not effectively integrated into the channel under the ECR program. This is a fundamental limitation of the ECR program.

For example, note that in its definition of the three replenishment cycles (refer to Section 3.3.1.1.), the ECR report does not distinguish information flow occurring between the consumer and the distributor outside of the supermarket from product flow occurring between the same. Hence, ECR excludes "replenishment of consumers' pantry, [which is] clearly outside the bounds of Efficient Replenishment."\(^{98}\)

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\(^{97}\)Refer to Section 3.2.

\(^{98}\)Efficient Consumer Response, p. 45.
In fact, the report makes no mention of the type of distribution system proposed by this researcher, a system in which information flows freely between the consumer and the distributor outside of the retail outlet, but distributor-operated replenishment—i.e., home delivery—is not required. Indeed, as Chapter Six will demonstrate, the proposed system is explicitly modeled around the use of a retail outlet.

The fact that the ECR program does not integrate the supply channel beyond the supermarket means that the benefits from channel restructuring are not maximized. There are two basic explanations. First, while the distributor may base the level of replenishment stock on past sales data, and while the data may be highly accurate, in the end the distributor does not know for sure whether the items on the shelf will actually sell.\(^99\) Second, when product is restocked at the supermarket, the minimum order quantity for most items is a full case; however, the time it takes to sell this quantity of product can range from less than a week to many months or more, depending on the item.

Note that both of these aspects are true even for an ECR Phase II distributor. Essentially, the implication is that in a supermarket-based distribution system, the entire store replenishment process is to a certain extent noncoordinated with respect to consumer off-take, thereby producing unnecessary cost.

As Chapters Six and Seven will illustrate, by integrating the consumer directly into the supply channel outside of the supermarket, the system proposed in this thesis should produce considerable gains, in a number of different areas. The key point is that the home grocery shopping concept restructures the distribution system not around the supermarket, but around the actual end user of grocery products.

3.5.1.2. Consumer value

Perhaps the ultimate goal of ECR is to increase consumer value. Indeed, irrespective of whether the program began as a defensive response to threats from alternative formats, or as a means to proactively gain competitive advantage, ECR unquestionably aims to benefit the consumer. The report states:

\(^99\)Refer to the example of the Toyota production system discussed in Chapter Two.
ECR is a grocery-industry strategy in which distributors and suppliers are working closely together to bring better value to the grocery consumer. By jointly focusing on the efficiency of the total grocery supply system, rather than the efficiency of individual components, they are reducing total system costs, inventories, and physical assets while improving the consumer's choice of high quality, fresh grocery products.

The ultimate goal of ECR is a responsive, consumer-driven system in which distributors and suppliers work together as business allies to maximize consumer satisfaction and minimize cost.

The distributors and suppliers committing to ECR believe that they allowed themselves to become complacent about the efficiency of the grocery supply chain and, in so doing, have inadvertently supported business practices that add time and cost to the supply chain without creating consumer value. These companies are working together to relentlessly strip time and cost from the total supply chain. They are questioning every activity in their organizations asking themselves whether it adds to consumer value or, if not, how it can be eliminated or made less costly. 100

However, it is possible that the term "value" has been too narrowly defined by the industry. While cost and quality are very important, perhaps just as crucial is consumer convenience—i.e., the concept of reducing the overall burden that grocery shopping places upon the consumer. This is an area which is almost entirely untouched by the ECR program.

Overall, there are several factors which indicate that today, grocery shopping in general, and supermarket shopping in particular, are activities which consumers do not have the time for and/or do not favor. First, there are now fewer households in the U.S. with someone available full-time to do household activities than was the case thirty years ago. For example, from 1963 to 1993, the percentage of the U.S. workforce that is female increased from 33 percent to 47 percent. 101 During this period, the ratio of male employment to male population remained steady, which means that a higher percentage of the total population is employed now than in 1963. The net result is that in aggregate, U.S. consumers have less non-work time available than was the case thirty years ago.

100Efficient Consumer Response, p. 1.

Second, consumers appear to have a lack of enthusiasm for grocery shopping. In a 1988 survey in which consumers were asked to rank twenty-two daily activities according to how much they enjoyed each, grocery shopping ended up twenty-first, ahead of only "cleaning the house." And, according to information gathered by FMI, over 64 percent of consumers "simply do not like to go grocery shopping."

Third, consumers seem to especially dislike supermarket shopping. In a 1993 survey, consumers were asked to rate their enjoyment level at various purveyors of food. The value that supermarkets received placed it fourth out of six establishments—behind specialty food stores, warehouse clubs and mass merchandisers, and ahead of only fast-food restaurants and convenience stores.

Clearly, many consumers do not enjoy shopping for groceries, particularly at supermarkets. But ECR does not address this key aspect, a component which, from a distribution perspective, is intertwined into the whole process of supplying grocery products to the end user. For example, the following is from the director of Smart Store:

Today ECR still tends to be an issue between the retailers' and manufacturers' views of the world. Rarely do you hear the consumer mentioned outside the title. The real question is how do we focus on the consumer.

Indeed, not only is the concept of reducing the total shopping burden for the consumer not adequately incorporated into the ECR program, but the very purpose of the program itself is already beginning to drift away from the consumer as ECR is implemented. Consider the following statement, from a recent editorial in Progressive Grocer:

More important [than considering whether chain distributors, wholesalers, independent operators or suppliers will receive the most benefit from ECR] is a more fundamental issue about ECR. The list of winners and losers under ECR makes it clear that, despite all the high minded talk, no

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102 Cheryl Russell, "How Much Do You Hate This?" American Demographics, May, 1988, p. 4.


one is really focusing on the "c"—the consumer.

Let's think about that. Because everything that succeeds or fails in this industry centers on consumers. Many of the biggest problems facing the industry stem from the lack of focus on the consumer. The greatest criticism of the tangled system of buying and selling that ECR hopes to dismantle is that it concentrates too heavily on the buy, rather than the sell. That's not a strategy for long term success.106

And supporting this general sentiment is the following account:

The availability of easy money has made it unnecessary for retailers to operate well-run, customer-oriented food stores with a variety of desired products and services. For too long, the typical chain attitude has been: "If we build it, they will come." And, as retailers have become real estate merchants, willing to sell any product if the intro price is right, the art of merchandising has been lost; you just pile it high and charge the manufacturer for it.

If the product doesn't sell, the buyers know there are plenty more items available with lots of funny money behind them. Consequently, food retailers do not see customers as the reason they are in business. They do not proactively seek to please the special consumer who will spend $5,000 in their stores over the course of a year. Instead, the customer is offered long lines at the checkout, employees with bad attitudes, incorrect prices, and product that is not fresh or even out of code.107

It may be the case that over the past several decades, many distributors—and perhaps many suppliers as well—have lost sight of the primary reason for operating. At least some companies perceive themselves to be in the business of operating supermarkets and pumping product into the supermarket, rather than being in the business of facilitating the distribution of grocery products to consumer. This ill-defined strategic focus can have long lasting negative consequences. It also closely mirrors what has occurred in many other industries.

One of the clearest examples is that of the railroad industry. At the turn of the twentieth century, this was one of the preeminent industries in the U.S. It dominated both passenger and freight transportation, and it had no equal in the field of transporta-


107 Kochersberger, "Don't Hold Your Breath!" p. 17.
tion. Thirty years later, the railroad industry was in serious trouble, and by the beginning of the 1950s, most of the major lines had gone bankrupt.\textsuperscript{108}

Over this same period—from the early 1900s to the 1950s—demand for passenger and freight transportation did not decline, but instead grew by a tremendous amount. However, the railroads did not capitalize on this growth, because they had defined their business too narrowly. Consider the following statement:

The railroads are in trouble today not because the need [for transportation] was filled by others (cars, trucks, airplanes, even telephones), but because it was not filled by the railroads themselves. They let others take customers away from them because they assumed themselves to be in the railroad business rather than in the transportation business. The reason they defined their industry incorrectly was because they were railroad-oriented instead of transportation-oriented; they were product-oriented instead of customer-oriented.\textsuperscript{109}

In the end, it may be the case that while consumers definitely desire lower prices and higher quality products—as promised by ECR—they also want that and more, such as increased convenience. For instance, according to one forecast, "within ten years, 28 percent of consumers will purchase groceries from home."\textsuperscript{110} The net result is that although ECR should ultimately produce tremendous benefits for the consumer, the program is simply not adequate to meet the full range of consumer needs.

\subsection*{3.5.2. Smart Store}

Unlike ECR, Smart Store does address the requirements of the forward channel. However, this researcher has identified several important shortcomings of the Smart Store concept. Overall, perhaps the most significant drawback of Smart Store is simply that the venture does not go far enough in its proposed restructuring of the forward channel.

\begin{flushright}
\begin{itemize}
\item \textsuperscript{109}Ibid., p. 40.
\item \textsuperscript{110}Smart Store Act II, p. 3.
\end{itemize}
\end{flushright}
The first matter concerns home delivery. Andersen proposes to have all staples delivered to the home, preferably within an hour of customer ordering.\textsuperscript{111} Andersen claims that by removing these items from store shelves, the money which is saved in reduced store labor costs can be used to finance home delivery.\textsuperscript{112}

This is not necessarily true. Essentially, home delivery is cost effective only if (a) a large number of customers in the same area use the service, and (b) service to these customers can be coordinated so as to minimize the number of delivery trips. Otherwise, home delivery can become very expensive.\textsuperscript{113}

However, a more fundamental problem for the Smart Store project is that, as the base case for its comparative analysis, Andersen employs the current supermarket-based distribution system. This analysis appears to be shortsighted because there are a variety of other distribution options available that are far less costly than home delivery, and yet are not that much less convenient.

Similar to the proposal in this thesis, Andersen proposes to have customer orders picked at a location other than the supermarket, such as at the current distribution center or even at new mini distribution centers. Without a doubt, under any home grocery shopping system, picking customer orders at non-supermarket facilities designed for the purpose is much less expensive than stocking product in the supermarket and picking orders off of store shelves. Indeed, this research is devoted to understanding the economics of changing the distribution system in exactly this manner. But, home delivery is not the only alternative for distributing the order to the consumer.

As is shown in Chapter Six, transporting orders to a neighborhood drive-through pick-up depot is a very cost effective solution. There are two main explanations. First, all of the customer orders for the surrounding area can be aggregated into one or two daily trips from the distribution center to the depot. Second, the combined labor and occupancy expense associated with operating such a facility is minimal. The net result is

\textsuperscript{111}Nash, "Back to the Future," p. 31.

\textsuperscript{112}Terbeck, "Food Industry Predictions," pp. 31-32.

\textsuperscript{113}As an example of the costs involved in home delivery, Appendix A provides information regarding the delivery fees charged by existing grocery delivery services.
that the total distribution cost per item is much lower than it is with home delivery, partic-
icularly if home delivery is guaranteed within an hour of customer ordering.

To illustrate, consider that, irrespective of whether a neighborhood pick-up depot or home delivery is employed, home ordering of grocery products requires that the items be picked into individual customer orders at the distribution center or an equivalent fa-
cility. As is demonstrated in Chapter Six, of the three stages associated with using a pick-up depot—distribution center, transportation to the depot, and the depot itself—the distribution center accounts for 80.3% of the combined expense, while transportation and the depot account for 10.1% and 9.6 percent, respectively, of the total cost. Thus the bulk of the cost is centered around a stage which is required under any home ordering system, i.e., order picking at the distribution center.

Under the system proposed by Andersen, orders are delivered directly to the home, so the costs associated with transportation to the depot and operating the depot are replaced by a single home delivery expense. But, as mentioned above, unless a large number of customers opt to use home delivery—and distribution to these individuals can be coordinated—the service tends to be costly.

Thus, relative to using a depot, home delivery is likely to result in a significant cost premium. However, when compared to the expense to distribute grocery products via a supermarket, the premium is perceived to be lower, and indeed possibly even elimi-
nated, depending on the assumptions.

Essentially, the key matters that are yet to be determined are (a) the magnitude of the premium, particularly in absolute dollar terms, and (b) the extent to which consumers are willing to pay the additional cost for the added convenience of home delivery. Note that these questions will not be effectively answered until home grocery shopping is in actual operation. But, if current evidence is indicative of future consumer behavior, the percentage of consumers who will opt to use home delivery under such a scenario may be small.

For example, only 16 percent of all supermarkets presently offer home deliv-
ery.\textsuperscript{114} At the majority of these supermarkets, it is estimated that the percentage of con-

\textsuperscript{114} "61st Annual Report," p. 33.
sumers who actually utilize the service is well under 3 percent.\textsuperscript{115} It is true that present ordering interfaces are in general fairly cumbersome to use; certainly, they are not as easy to operate as an interactive display presented on a television. However, it is plainly evident that home delivery is not popular today, even though the alternative is to engage in the whole supermarket shopping process.

Therefore, given that most consumers are unwilling to pay a premium for home delivery relative to the large burden of shopping in a supermarket, it would seem reasonable to assume that the percentage who would be willing to pay a premium relative to the much smaller burden of retrieving the order at the depot would also be minimal.\textsuperscript{116} The net result is that while the number of consumers who shop for groceries from the home in the future may be large, the number who choose to employ home delivery is likely to be relatively limited.

A second major drawback of the Smart Store concept is that Andersen proposes that only staples are to be ordered from the home, while the consumer is assumed to continue venturing to the supermarket to shop for other items. Undoubtedly, some home grocery shopping customers are likely to want to pick non-staple items for themselves. However, there may be many customers for whom this is not an issue, and who would prefer to shop for their entire order via the at-home display. In addition, as is discussed in Chapter Seven, there are a variety of ways in which a home grocery shopping distributor can address the "perishable issue," if this is what is meant by non-staple items.\textsuperscript{117}

The net effect is that the Smart Store concept only partially increases consumer convenience. Clearly, under the proposal, shoppers save time by being able to purchase certain products from the home and have these items home-delivered. However, the consumer is still required to engage in the whole grocery shopping exercise in order to ob-

\textsuperscript{115}This estimate is based on a number of sources, including interviews with distributors and providers of home delivery services, and Ravo, "High-Tech," p. 10.

\textsuperscript{116}As envisioned by this researcher, the depot is a drive-through facility located closer to where consumers actually live than today's supermarkets. Essentially, all that is required of the auto-bound customer at the depot is to wait in the car for approximately five minutes or less on average, while the order is collected and brought right to him or her. The customer never has to enter the depot; in fact, he or she never even has to leave the car, if so desired.

\textsuperscript{117}Note that it is unclear whether under the Smart Store concept perishable products can be ordered from the home, or are considered solely as non-staple goods to be purchased at the supermarket.
tain those products which are only available at the supermarket. Therefore, with respect to increasing overall consumer convenience, it would seem that the Smart Store concept is a second-best solution.

A third matter pertains to the home delivery service. Andersen proposes that this operation be handled by manufacturers themselves, via a third party delivery company in each market. There are at least two basic problems with this concept (aside from the possibility that relative to retrieval at the depot, home delivery itself may not be attractive to many consumers). First, because distributors are not involved in any aspect of the delivery service, for product which is distributed via this system, the distributor's profit is eliminated. Second, this concept requires that suppliers—including suppliers of competing products—work together. Given the fact that suppliers and distributors have historically had much difficulty cooperating, it seems highly unlikely that competing manufacturers will be able to collaborate on this type of joint venture. For instance, consider the important matter of the way in which products are presented on the display interface, including the ordering of brands, and the prominence that each receives. For competing manufacturers, resolving this key issue in an equitable and efficient manner may prove to be extremely difficult.

The fourth matter concerns the Smart Store proposal to make the supermarket itself more market-oriented. There are several flaws in this area that—it is important to stress—are evident only relative to the system proposed in this thesis, but not relative to the current supermarket-based system. For example, as is demonstrated in Chapter Seven, the system proposed in this thesis allows for much more effective marketing—including micromarketing targeted to the individual consumer—than that available under any supermarket-based system, including Smart Store. Also, in regard to offering prepared foods, particularly meals cooked on-premises, a supermarket has fairly rigid physical restrictions that limit the range of food which can be merchandised, and the distributor must deal with the expense involved in outfitting the supermarket. In contrast, under the system proposed in this thesis, the distributor could partner with existing local restaurants, and provide the highly-valued service of fully-cooked meals, but at a very low cost and at minimal risk to the distributor.118

118Note that a supermarket may also encounter zoning restrictions with respect to cooking meals on-premises.

119Refer to Chapter Seven for additional information.
There are several other significant shortcomings of the Smart Store concept. However, most of these pertain to the more general issue of utilizing a supermarket to distribute grocery products, and are addressed in Chapters Six and Seven.

It should be noted that although this section has identified certain drawbacks of the Smart Store proposal, the concept does provide definite advantages for distributors relative to traditional supermarket operators. In addition, it is important to point out that even if home grocery shopping becomes widely available, there will likely be many consumers who either choose to not shop electronically, or who do not have access to such a system. For this group of supermarket shoppers, the Smart Store concept may prove to be very attractive.\(^{120}\)

However, the overall result is that while the Smart Store concept is the state-of-the-art in the grocery industry with respect to restructuring the forward channel, it does not go far enough. Although Smart Store seeks to restructure the distribution system around new practices rather than old methods, the project may be doing exactly what it is counseling against, because—like ECR—it is centered around the continuing existence of the supermarket. For instance, the following statement is from the director of Smart Store:

We have an opportunity to eliminate the checkstand. With today's technology, stores can be designed so that customer check themselves out as they shop. Shoppers would check in at the front and receive a wand scanner...

This is an example of information technology working for the consumer. A lot of what's being done in the industry today is automating the old ways of doing business, instead of rethinking how we can make information work for the consumer. If it works for the consumer, it will work for the retailer, the manufacturer—everybody down the line. If we make it an advantage for consumers to identify themselves so they won't have to wait in a checkout line, then we can eliminate checkstands from the store.\(^{121}\)

\(^{120}\)Indeed, it is possible that the system proposed in this thesis and the Smart Store concept may ultimately end up coexisting in the marketplace. For example, some consumers may choose to do their grocery shopping via a system which allows them to purchase all products electronically, while other consumers may opt for a different type of service. Note that, as mentioned earlier, home delivery can be offered under the system proposed in this thesis.
As this thesis will demonstrate, technology now exists that makes it feasible to not simply restructure the supermarket checkout activity, but to restructure the entire process of distributing grocery products to the consumer. Therefore, it could be the case that in general, money spent to make the supermarket more efficient—when the supermarket itself may be outmoded—represents ineffective investment.

For example, Chapter Five will show that for a typical dry grocery product, over 80 percent of the current distribution cost, from distribution center to checkout counter, is accounted for solely by the supermarket. And Chapter Six will demonstrate that restructuring the distribution system around a pick-up depot can reduce a distributor's total costs—not just the expense for store labor—by a minimum of 23 percent. Furthermore, and perhaps more importantly, a system which essentially eliminates the need for a consumer to shop at a supermarket is likely to provide a much greater increase in consumer value than that offered by any project—including Smart Store—which continues to require that the consumer enter the supermarket in order to obtain grocery products.

3.6. Summary

This chapter has discussed some of the key distribution issues facing the grocery industry today. The ECR program was introduced, and this chapter examined the ways in which ECR aims to make the grocery product production and distribution processes more efficient. This chapter showed why it may be many years before ECR is adopted by a significant portion of the grocery industry. This chapter also discussed two key reasons why, if the goal is to fully restructure the grocery product supply channel from the point of production to the point of use, ECR is not sufficient. In addition, this chapter examined various efforts that are separate from the ECR program, but which also seek to increase the efficiency of the grocery industry. With respect to one project, known as Smart Store, this thesis identified and analyzed several important reasons why this concept—like ECR—may also be insufficient in terms of fundamentally restructuring the grocery product distribution process.

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^121 Terbeek, "Food Industry Predictions," p. 34.
Chapter Four

Telecommunications

4.1. Introduction

There are many developments currently occurring in the field of telecommunications which may ultimately impact the home grocery shopping concept. Important areas include technology advancements, regulatory revisions, new patterns of competition and shifting sources of investment. Overall, these factors are leading to radical change in the residential telecommunications industry. In regard to the grocery industry, the net effect of these developments is that it will soon be possible to fundamentally restructure the grocery product supply channel in such a way that *was not before possible*.

With respect to the home grocery shopping concept, the most critical telecommunications-related factor is advancement in technology. Recent breakthroughs represent the key enabler that now make it feasible, for the first time, to offer home grocery shopping as proposed in this thesis. For example, because of new technology, it will soon be possible to offer an interactive home grocery shopping display that incorporates very sophisticated features, such as a simulation of the supermarket shopping experience, complete with images of fully-stocked shelves and three-dimensional renderings of products.\(^1\) In addition, new technology will allow such a display—known as a graphical user interface (GUI)—to be presented on a television monitor if the consumer so chooses. Bringing these features to the mass market has essentially been impossible until now.\(^2\)

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\(^1\) For instance, this researcher has seen a very advanced display that allows the consumer to electronically remove a "product" from the "shelf," rotate the item around, view the packaging on all sides, and place the item in a "shopping cart."

\(^2\) It is important to point out that although the discussion in this chapter focuses on visual interfaces, many companies are currently developing voice recognition technology. This technology converts human spoken commands into a format that can be understood by computers. As voice recognition technology becomes more sophisticated and cost effective, it may be feasible to deploy such a system in the home, perhaps right in the kitchen. For the time being however, the technology is relatively expensive, and requires a significant amount of further development before it is ready for the mass market. Therefore, the emphasis in this thesis is on visual interfaces, which are available today. Nevertheless, it should be noted that such interfaces will likely not be the only means by which consumers will be able to order groceries electronically.
However, while innovative technology is the key enabler for home grocery shopping, it is also the case that the concept is ultimately dependent upon the availability of an advanced telecommunications network infrastructure. Indeed, at the most elemental level, the viability of home grocery shopping as a business is predicated on the widespread availability of an advanced telecommunications network extending all the way to the household. In turn, the success of home grocery shopping in the marketplace impacts the degree to which the concept can effect fundamental change in the grocery industry.\(^3\)

This chapter is structured as follows. Section 4.2. examines the link between the proposed distribution system and the deployment of an advanced telecommunications network. Section 4.3. reviews the most significant new technologies that have recently become available. This section analyzes the capability of each technology, and discusses exactly what that capability means in terms of home grocery shopping, i.e., the type of display interface it makes available. Section 4.4. considers the implementation cost for each technology, including the expense for other necessary equipment. Section 4.5. examines likely deployment schedules.

Note that a much more detailed and comprehensive review of new telecommunications technology is provided in Appendix B. In that chapter, the advantages and disadvantages of each technology are analyzed, the costs are examined more thoroughly, and other important technology elements pertaining to the telecommunications network in general are investigated.

4.1.1. Important background issues

Before beginning the technology and cost analysis, there are two very important matters to discuss. The first concerns the way in which the cost to deploy advanced network technology is handled, the second pertains to the chicken-and-egg phenomenon re-

\(^3\)Note that in Chapter One, it was mentioned that home grocery shopping is not primarily technology-driven. This is true in the sense that as proposed in this thesis, (a) the concept encompasses far more than just home ordering—a sophisticated GUI alone is not sufficient to offer home grocery shopping—and (b) the service could be offered today on a personal computer connected via modem to the current telephone network. However, as Section 4.2.1. will discuss, a home grocery shopping service that is limited to using only a personal computer for the display and ordering device is likely to have a smaller potential customer base than a similar service which is available via personal computer and television monitor. But, in order to offer home grocery shopping via television monitor, new telecommunications network infrastructure is necessary.
garding new applications.

First, there is much debate at the present time concerning whether the installation cost for new telecommunications technology should be treated by the local telephone companies (telcos) as an incremental expense or as a replacement cost. One view is that new technology represents an investment that provides the telco with the means to offer new services. According to this perspective, the deployment cost should be treated wholly as an incremental expense, and therefore, the cost should be covered solely by new revenues from new services. The other view is that the technologies are merely succeeding worn out infrastructure that would have to be replaced anyway. According to this perspective, the cost is purely a replacement expense, and therefore, it can be financed solely through current revenues from existing services. Between these two extremes are numerous compromise positions.

This debate is particularly heated with respect to the seven Regional Bell Operating Companies (RBOCs) and GTE. These companies are the primary providers of local telephone service in the U.S., and they are heavily regulated by Federal and State agencies. Essentially, consumer groups and other parties believe that if the telcos are granted permission to deploy advanced networks, the networks will become "white elephants" that are not self-supporting. The end result, according to these groups, is that in order to allow the telcos to recoup their expenditures and prevent them from possibly going bankrupt, telephone ratepayers will have to pay higher phone bills for basic service. On the other hand, at least one telco has stated that its advanced network will be completely self-supporting, even if it never offers new services, due to operational cost savings relative to the expense to maintain the current network. Therefore, according to this telco, higher rates for basic service will be unnecessary.

Intriguingly, home grocery shopping may offer a means to move beyond this di-

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4 The seven RBOCs are Ameritech, Bell Atlantic, BellSouth, Nynex, Pacific Telesis, Southwestern Bell and US West. These companies were split off from AT&T after divestiture in 1984. Independent telcos, of which there are hundreds, were never part of the old AT&T system. GTE is the largest independent.


6 As evidence of this debate, see, for example, Dan O'Shea, "Pacific Bell Unveils Blockbuster Plan to Deliver Fiber and Video," Telephony, November 15, 1993, p. 8, and Carol Wilson, "Pacific Bell Deal Draws Protest," Telephony, December 6, 1993, p. 12.
lemma. As the analysis in this chapter and Chapters Six and Seven will demonstrate, the total value provided by the proposed distribution system—including to the consumer, the distributor and other members of the grocery product supply channel—may be comparable to a significant fraction of the total network deployment cost. Indeed, as Chapters Six and Seven will show, even at a very conservative estimate of the network cost, the benefits provided by the proposed distribution system are so large that the home grocery shopping application may be able to generate sufficient funds to fully finance the network installation cost by itself.

Furthermore, this researcher makes the extremely conservative assumption that the expense for new telecommunications technology is entirely an incremental cost. There are two main reasons why this is a conservative assumption: first, networks have natural life cycles, hence there is a need to replace equipment as it wears out; second, there are significant operational cost savings associated with new technology relative to existing infrastructure.\(^7\)

Therefore, it should be clear that the position of this thesis with respect to the network deployment cost is very conservative. First, as will be shown in Section 4.4., the actual assumed expense is itself conservative. Second, this expense is assumed to be entirely an incremental cost, thus it is also assumed that the cost must be financed solely out of revenues from new services. Nevertheless, despite this conservative position, it will be demonstrated in Chapters Six and Seven that, by capturing the value that the proposed distribution system generates, the network deployment cost can be fully recouped.

This leads to the second major issue, the chicken-and-egg phenomenon. Essentially, the present dilemma is that if the advanced network cannot be financially justified based on cost savings alone, then new sources of revenue will be needed to support the added expense (assuming that rates for basic service will not be increased). However, until the advanced network is actually up and running, new services cannot be

\(^7\)For instance, current phone networks consist of twisted-pair copper wire, while new networks are often built with fiber optic cable. Replacing the copper wire with fiber leads to numerous operational benefits, including a reduction in splicing costs, a decline in the amount of time needed to repair breeches, and a decrease in the vulnerability of the network to breakdowns. In fact, Pacific Bell estimates that it will save $50 per household per year in operational costs relative to current expenditures by installing new network infrastructure (see Richard Karpinski, "The Video Dial Tone Firestorm," Telephony, February 21, 1994, p. 28.)
brought to the marketplace; indeed many applications that are likely to use the networks of the future do not yet exist.8

Thus, there is no clear consensus on which path is more appropriate at this time: (a) push forward with deployment of the advanced network, without waiting for the development of new applications; or (b) wait until there is proven demand for the applications before building the network. Companies which choose the first course, particularly telcos, are accused of being overly risky; on the other hand, companies which adopt a wait-and-see attitude are said to be too cautious, and are faulted for letting opportunities pass them by.9

However, home grocery shopping can provide a means to overcome the chicken-and-egg problem. For instance, it is essentially a truism that there is proven demand for grocery products. Furthermore, for most consumers, it is also a truism that there is demand for convenience.

Therefore, a well-designed, well-executed home grocery shopping service is likely to appeal to a large segment of the population. Moreover, if this very convenient service can be accessed at no extra cost to the consumer, it is likely to attract an even larger portion of the population. Finally, if the service not only provides increased convenience at no added expense, but may actually reduce the cost of grocery products, then it would seem that the potential market size is truly enormous.

As Chapter Six will demonstrate, this is exactly the situation with the distribution system proposed in this thesis. Home grocery shopping can provide all of the convenience and value that comes with ordering from the home, and it can do so at considerably less cost than the current supermarket-based system.

The result is that home grocery shopping can serve as the principal vehicle used to fund the rollout of the advanced network. For example, a telecommunications

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8An analogous situation pertains to the development of software for the personal computer. Many, if not most, of the programs that are commonplace today—such as spreadsheets, high-powered graphics applications and electronic desktop publishing, to name just a few—did not exist when the personal computer was first introduced in the 1970s.

provider could work in partnership with one or more home grocery shopping distributors, and use the revenue generated by this application as the backbone for further network deployment. This would create a virtuous cycle of network development, followed by additional home grocery shopping customers and additional revenue, followed by more network development.

Interestingly, home grocery shopping as proposed in this thesis is not currently being considered by the parties influencing decisions about network deployment, such as telecommunications providers, regulators, consumer groups and business leaders. In fact, a recent study of "top executives in 100 companies in the communications, computer, entertainment and electronics industries" found that "movies on demand are expected to be among the most popular interactive multimedia offerings...Other offerings expected to be popular include electronic shopping, video games via network, airline passenger entertainment and communications systems and video conferencing."\textsuperscript{10}

Note that in this example, as well as in numerous other instances when the application is considered, home shopping is seen mainly as an expansion of already existing services that sell primarily jewelry, clothes and electronics.\textsuperscript{11} Moreover, even in the less frequent instances when home shopping for grocery products is contemplated, invariably the perspective adopted—with the exception of the Smart Store project discussed in Chapter Three—is very narrow. Essentially, future home grocery shopping is viewed as an \textit{add-on} to the current distribution system—for example, as a delivery service that operates out of existing supermarkets—and not, as this thesis proposes, as a \textit{replacement} for the current distribution system.\textsuperscript{12}

It is also worth noting, since the movies on demand application is seen as the main driving force pushing deployment of the advanced network forward, that the com-


\textsuperscript{11}See, for example, Sims, \textit{op. cit.}, and Scott Donaton, "Home Shopping Audience Widens," \textit{Advertising Age}, November 22, 1993, p. 19.

\textsuperscript{12}See, for example, Gail Roberts, "Interactive TV Shopping Looms on Food Horizon," \textit{Supermarket News}, January 29, 1994, p. 9. Section 4.2. and Chapter Six discuss this issue in more detail.
bined market for video rentals and pay-per-view movies is currently less than $13 billion annually.\textsuperscript{13} In contrast, sales of grocery products totaled over $370 billion in 1993. Clearly, there is a significant amount of value to be created—and revenue generated—by applying the new network technology in an innovative manner in the grocery industry.

Overall, what has generally been missing from the public discussion until now is a thorough understanding of the way in which deployment of an advanced telecommunications network can effect fundamental change in non-telecommunications industries. In the case of the grocery industry, for instance, the advanced network can help to revolutionize distribution, production, marketing and other key processes. Thus the value of the advanced network extends far beyond simply providing consumers with a more convenient way to order movies, or even grocery products.

This research will demonstrate that the proposed distribution system has the capacity to change the dynamics of the whole network deployment issue. Not only does home grocery shopping provide a backbone vehicle for funding network development, but it can also dramatically compress the timetable for rollout of the advanced network, as telecommunications providers compete to be the first in the marketplace to offer this application.

Therefore, instead of the artificial dichotomy of (a) risky—i.e., build an advanced network now and wait indefinitely for appealing applications to be offered—or (b) overly cautious—i.e., do nothing—home grocery shopping provides a third alternative for telecommunications providers: partner with grocery distributors, and deploy the advanced network hand-in-hand with the rollout of the home grocery shopping service. Such a link-up would provide a low-risk, yet highly effective, means with which to bring the advanced network to the marketplace.

4.2. Link between home grocery shopping and telecommunications

4.2.1. Background

Today, it is possible to offer home grocery shopping services using the current

\textsuperscript{13}Brown, \textit{op. cit.}
telephone network and existing technology, such as phones, fax machines and personal computers. These services are not impeded by the limited capacity of the present telephone network. In effect, the existing home grocery shopping services are independent from the telephone system, since network capability does not present an obstacle to their implementation. However, while these services have had some measure of success, the long run market appeal for services which are based on today's low-capacity telephone network appears to be relatively limited.

To illustrate, there are two basic methods for communicating information about grocery products to consumers at the moment: on-line computer system, or printed catalog. To respond with the actual order, a consumer employing the on-line system presumably would use a personal computer, while a consumer shopping via catalog has three options: traditional phone, more advanced "smart phone" (e.g., a phone with a small display screen and/or an attached electronic "pen" used to read bar codes), and fax machine.

Of the two methods, the on-line system is the more sophisticated. For example, with a printed catalog, the various ordering mechanisms are somewhat cumbersome in terms of ordering dozens of different grocery products, and the catalog itself has inherent drawbacks.\textsuperscript{14} But, while the on-line system may not encounter such obstacles, it too has limitations. First, the low capacity of today's network means that an on-line system is restricted primarily to a text-based display. Second, only 25 percent of U.S. households have a personal computer, and only 25 percent of these households have the required modem needed to link the computer to the on-line system.\textsuperscript{15}

Thus, with respect to home grocery shopping, current methods of communication are inadequate. Printed catalogs clearly have significant drawbacks, while on-line systems are restricted to only those households which have a personal computer and a modem; furthermore, until the network is upgraded, on-line services can not offer very advanced GUIs. The net result is that a home grocery shopping service which is based solely on today's technology would appear to be limited in its ability to attract a wide

\textsuperscript{14}For instance, only a small fraction of the available products can be depicted, and product prices typically are not included because they change so rapidly. See Appendix A for more information.

4.2.2. Home grocery shopping and new telecommunications technology

As proposed in this thesis, home grocery shopping is inherently dependent upon the capability of the telecommunications network. There are two basic reasons why network capability exerts such a strong influence.

The first aspect concerns the ability of the distributor to market the concept to the consumer. As this section will explain, certain qualities of the GUI presented to the consumer affect the degree to which consumers find the service appealing, and hence, the ability of the service to become a viable business. These display traits are contingent upon the capability of the telecommunications network that connects to the home.16

The second reason is that most of the efficiencies of the proposed distribution system are dependent upon creating seamless electronic links between the consumer and the distributor. Indeed, this researcher assumes that under the proposed system, no consumer ordering occurs via a form that requires reentry of data by the distributor, such as voice phone calls. As Chapter Three discussed, electronic ordering—which is essentially error-free—is the foundation for an efficient replenishment process throughout the supply channel; this chapter and Chapter Six will demonstrate that the proposed system enables this process to be extended right to the consumer, who is in fact the actual end user of grocery products.

The net result is that home grocery shopping is dependent upon the capability of the telecommunications network. First, without an advanced network extending to the home, the service would be restricted to relatively unattractive displays presented on personal computers, or worse, to printed catalogs. Second, the proposed distribution system is able to achieve numerous efficiencies by capturing consumer orders in an electronic manner, correctly and automatically. Therefore, although home ordering of grocery products does exist in many areas of the country today, the deployment of new telecom-

16 Note that consumers do not necessarily have to order exclusively from the home. For example, ordering through desktop equipment at work, by wireless devices on the road, and via automated teller machines in public locations, should all be feasible. Therefore, despite the fact that the concept itself is referred to as "home grocery shopping," this researcher does not assume that all ordering will take place solely from the home.
 munications technology is essential in order for home grocery shopping—as proposed in this thesis—to (a) become a business which achieves mass market appeal, and (b) effect a fundamental restructuring of the grocery product supply channel.

4.2.2.1. Marketing home grocery shopping to the consumer

Overall, there are three important technology factors influencing the degree to which consumer interest for home grocery shopping can be generated. These are: (a) the quality of the GUI, (b) the type of equipment used for the display device, and (c) the ability of consumers to shop anytime they want. The link to the telecommunications industry arises from the fact that all three elements are contingent upon the capability of the telecommunications network.

For instance, the capacity\textsuperscript{17} of the residential network directly affects the sophistication of the GUI, which in turn likely affects the degree to which a home grocery shopping service can attract customers.\textsuperscript{18} In addition, both the capacity and the \textit{functionality} of the network affect the choice of which display device is utilized. A high capacity, intelligent network would allow the GUI to be presented on "dumb" television monitors, thereby creating an opportunity to market home grocery shopping to a much wider audience than if the service is limited to personal computers.\textsuperscript{19} Furthermore, both capacity and functionality affect the number of shoppers who can access the system si-

\textsuperscript{17}Network capacity is measured in terms of the amount of information that can be transmitted per unit of time. It is analogous to the throughput of a transportation system, such as a highway or a railroad.

\textsuperscript{18}For example, although this researcher does not have any empirical evidence, it seems reasonable to assume that given a choice between (a) a GUI which simulates shopping in a supermarket, incorporates video, and allows the consumer to rotate products around and read the actual packaging, or (b) a GUI which is limited to text descriptions and still graphics, most consumers would prefer (a). In fact, based on interviews with individuals who are currently developing GUIs, the long term goal in each case is to develop an interface which closely mirrors the actual shopping experience. Note that some consumers might prefer an "express" version which allows them to identify the needed products more quickly than the simulated shopping GUI; indeed, a home grocery shopping distributor might choose to offer both versions, which would allow the consumer to interact with whichever GUI he or she feels is most appropriate.

\textsuperscript{19}If not a television monitor, the display device should share the television's features of being commonly available, easy-to-use and able to present a wide amount of information in an attractive format. Note that even if home grocery shopping is offered via a television monitor, a shopper will still have the option of utilizing the display device of his or her choosing.
multaneously. A highly advanced network would not be as susceptible to blocking\textsuperscript{20} as a less capable system, and thus would allow many more consumers to shop than a less advanced network.

Overall, these three factors—quality of the presentation, display device, and on-demand availability—are critically important in terms of inducing consumers to shop for grocery products electronically, particularly the mass of consumers who may be somewhat hesitant to use new technology. This is true irrespective of any inherent advantages—including cost reductions and increased convenience—that the proposed distribution system offers relative to a supermarket-based system.

4.2.3. Description of consumer/distributor interaction

With the home grocery shopping system proposed in this thesis, consumer ordering is assumed to be entirely electronic. The ordering can be via personal computer, television monitor, or other electronic device, but it is assumed that barring unusual circumstances, no ordering will be in a form that requires reentry of data by the distributor, such as voice phone calls.

The communication between the consumer and the distributor incorporates three main components: (a) the transmission of a signal \textit{from} the household (known as upstream communication) to the distributor indicating that the consumer is ready to shop using the distributor's database; (b) the transmission of information, such as products and prices, from the database \textit{to} the household (known as downstream communication); and (c) the upstream transmission of the completed order. Some minor additional signaling and confirming transmissions, such as communication with banks to secure payment, may also be part of the process.

Based on several sources, the way in which the interaction between the consumer and the distributor is likely to take place is as follows.\textsuperscript{21} The first screen that the con-

\textsuperscript{20} Blocking occurs when too many users attempt to utilize the network simultaneously; capacity is fully taken up, and some users do not get through.

\textsuperscript{21} See, for example, Alexander Gelman and Lanny Smoot, \textit{An Architecture for Interactive Applications} (Morristown, NJ: Bellcore, n.d.), and Debra Aho, "Winn-Dixie, Eckerd go Interactive," \textit{Advertising Age}, April 16, 1994, p. 16.
sumer encounters is a general menu listing all of the various applications available, such as movies, non-grocery shopping, video games, video mail and grocery shopping. After selecting the grocery shopping application, the consumer then chooses the particular distributor. Suppose the consumer selects the distributor named ABC Foods. A signal is then transmitted from the equipment in the home—known as customer premises equipment (CPE)—to ABC Foods indicating that the consumer is ready to do his or her grocery shopping using ABC Foods' database.

Next, information is transmitted from the database to an on-line server maintained by the telecommunications provider. Both the CPE and the database interact with the server, at least for downstream communication and possibly for upstream transmissions as well. Note that the CPE has a significant amount of processing power, and is much more advanced than, for example, the cable set-top boxes found in homes today.

The next step is for the consumer to do the actual shopping, using the GUI. For a consumer who shops with the same distributor each time, it may be possible—depending on the capability of the CPE—to permanently store the distributor's GUI and database in the CPE; this would enable transmissions after the initial use to be limited to price changes, product additions and deletions, advertisements and announcements, thereby eliminating the need to transmit the entire GUI and database with each use. Once the order is complete, the consumer sends it to the distributor.

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22In the short term, the consumer may only have one option for home grocery shopping distributor; however, in the long run, it is likely that there will be many competing home grocery shopping distributors in each market.

23Customer premises equipment is equipment which is situated within the customer's location, in contrast to network equipment, which terminates at the phone or cable jack. There are many examples of CPE, including telephones, television monitors, cable set-top boxes, satellite dishes and personal computers. In order to handle home grocery shopping, the CPE needs some form of computing intelligence.

24The server processes information in such a way that it can be efficiently transmitted to the home. All applications, not just home grocery shopping, will interact with the server.

25This scenario is different from the process used with on-line computer systems, in which the CPE interacts directly with the database, without communicating via a server maintained by the telecommunications provider. However, based on Gelman and Smoot, op. cit., as well as interviews with engineers at Bellcore—the research and development unit operated by the RBOCs—it appears that telecommunications providers intend to employ servers.

26Note that it will likely be possible for the consumer to program a regular shopping list. See Chapter Six for more information.
After the order is received by the distributor, it is then primarily a matter of internal distributor processing and order fulfillment. For a detailed analysis about what transpires once the order is received by the distributor, refer to Chapter Six.

4.3. Technology characteristics

There are a host of innovative telecommunications technologies currently under development. These technologies—which include wireline and wireless—are supported by telephone networks, cable television (CATV) systems and other structures. Some are still being refined in the laboratory, while others have already begun to be deployed.

For each technology, this section will describe its basic capability, and illustrate how that capability relates to home grocery shopping. For a much more comprehensive and meticulously-detailed review of new telecommunications technologies, see Appendix B.

This analysis is divided into three subsections. Section 4.3.1. examines technologies that are primarily geared toward local phone networks, Section 4.3.2. investigates cable television technologies, and Section 4.3.3. considers other types of telecommunications technology.

Each of the technologies discussed in this analysis is sufficient to allow for some form of GUI that is more advanced and more robust than that which is available using current technology. However, functionality differs from one technology to another, and it is the functionality which dictates the type of GUI that can be offered.

Note that this examination is concerned solely with what is known as transactional technology, which refers to the network that extends to the home. There is another type of technology, known as the subscriptional, which is also necessary in order to offer home grocery shopping. Subscriptional technology refers to centralized equipment maintained by the telecommunications provider, and it consists of items such as on-line servers and memory banks. An analysis of this technology is beyond the scope of this

\[\text{27 This distinction between subscriptional and transactional technology is based on interviews with engineers at Bellcore.}\]
4.3.1. Local telephone

Today's residential phone networks provide for switched, narrowband communication. Switching means that signals can be transmitted from any location connected to the network to any other location similarly connected. Narrowband communication refers to the fact that phone networks do not provide a great deal of capacity, or "bandwidth" as it is commonly called.

Local phone networks encounter this capacity ceiling because they are presently built almost entirely of twisted-pair copper wire (referred to hereafter as twisted-pair). These networks were originally designed strictly to carry analog voice signals, and twisted-pair has proven to be an effective medium for this function. However, future applications—e.g., a home grocery shopping service that employs an advanced GUI—require greater capacity than twisted-pair as currently engineered can provide.

There are several options available to phone companies in order to increase the capacity of their networks. The technologies which are analyzed extensively in this thesis are: integrated services digital network (ISDN), asymmetric digital subscriber line (ADSL), fiber/coax, fiber-to-the-curb (FTTC), fiber-to-the-home (FTTH) and wireless.28

For each technology, this section will describe its significance to home grocery shopping. Note that the evaluation which follows presents the technologies in a certain sequence, from those offering the least capability to the greatest. (This sequencing is repeated in the section on CATV technology.) This sequencing design is intentional: each technology is compared and contrasted to those which have gone before, and overall functionality—with the exception of wireless—increases with each new technology put forward.

4.3.1.1. ISDN29

28Fiber/coax, FTTC and FTTH are often referred to as fiber-in-the-loop (FITL) technologies.

29Information in this section is based on Richard Karpinski, "ISDN Train Keeps A'Rollin'," Telephony, May 31, 1993, pp. 18-24, and Dan O'Shea, "Two RHCs Join IXC to Test Multirate ISDN," Telephony, January 24, 1994, pp. 8-9.
ISDN functions on the existing twisted-pair network. In residential neighborhoods, the present local phone system transmits signals at a rate of 64 kilobits per second (Kb/s). Standard ISDN, known as basic rate interface ISDN, increases the transmission rate to 144 Kb/s. Another version of ISDN, known as multirate ISDN, increases the transmission speed to up to 1.5 megabits per second (Mb/s). With both versions the capacity is fully-bidirectional, which means that information can be transmitted at this speed both upstream and downstream.

Any increase in capacity allows more information to be sent across the network per unit of time. With an ISDN telephone line, a more robust home grocery shopping GUI would be possible than with a non-upgraded line. This is true irrespective of what type of CPE is employed. For instance, on a non-upgraded line even the most advanced personal computer modem is ultimately limited to a speed of 64 Kb/s (minus a certain amount for processing); with an ISDN line, the transmission rate increases by a factor of two to over twenty.30

In terms of home grocery shopping, ISDN permits a more vibrant GUI than is currently possible. For instance, rather than being primarily text-based, as present online grocery shopping services are, a basic rate ISDN GUI could incorporate menus, icons and sound, and possibly even digitized color photos. As the consumer moves through the GUI from one product category to another, an ISDN-based interface would be refreshed and updated much more rapidly than a GUI that does not utilize the technology. At the higher multirate speed, ISDN should allow the transmission of full-motion video and three-dimensional graphics.

4.3.1.2. ADSL31

A much greater capacity increase in the existing twisted-pair phone network

30 Note that the fastest modems currently available operate at either 14.4 Kb/s or 28.8 Kb/s.

would be provided through the use of ADSL technology. According to the most recent developments, ADSL can provide, over twisted-pair, up to 7 Mb/s of capacity.

As Appendix B discusses, one potential concern with these recent advancements is that they are based on the use of a very new technology, known as discrete multitone, which is still in the process of undergoing extensive laboratory testing. However, even without this technology ADSL can still offer up to 1.5 Mb/s of capacity.

ADSL would allow the distributor to design a very attractive GUI, and present it on a television monitor. This is true even for ADSL operating at 1.5 Mb/s, which is more than sufficient capacity to support both video and three-dimensional renderings of products. Moreover, ADSL allows images to be updated very quickly, enabling the distributor to provide an GUI that very effectively simulates the experience of moving a shopping cart through a supermarket.

4.3.1.3. Fiber/coax

Unlike ISDN and ADSL, fiber/coax involves the construction of an entirely new telephone network infrastructure. As the name suggests, this network consists of fiber cable and coaxial wire. The fiber is extended from the central office to a point in the neighborhood known as the node; from there, coaxial wire is used for the final connection to the home, including in-home wiring (similar to way coax connects directly to the television monitor in a CATV system today).

A fiber/coax network would more than satisfy the capacity requirements of even the most sophisticated home grocery shopping GUI. Fiber offers essentially unlimited capacity, and over short distances, coax provides up to 1 Gb/s (gigabit per second) of ca-

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32 One way to describe the difference between ADSL and basic rate ISDN is that of wideband (ADSL) vs. narrowband (ISDN). ADSL allows more of the theoretical bandwidth available through twisted-pair to be utilized than ISDN. (FITL technologies, which utilize different transmission media altogether, can be described as broadband.)


34 The central office is the phone company's local switching hub.
pacity. Thus, any type of GUI that is possible with ADSL can be provided on a fiber/coax network.

While the capacity to offer home grocery shopping may be available on a fiber/coax system, the network would still need to be specifically configured for the service to operate. For instance, it is possible to build a fiber/coax network that does not allow on-demand, digital services to be communicated, but instead is limited to the transmission of unswitched, analog cable television channels. Because home grocery shopping is an on-demand application, a fiber/coax network would have to be engineered so as to allow this type of service to function.

4.3.1.4. FTTC

FTTC is similar in many ways to fiber/coax. It also incorporates the installation of fiber from the central office to a node, but in this case, the node is located at what is known as the pedestal.\(^{36}\) The most significant difference is that in a FTTC network, the fiber is extended much closer to the home than in a fiber/coax system. Another important difference is that the drop, which is the final connection to the home, can be either coax or twisted-pair in a FTTC system, whereas it is always coax in a fiber/coax network.

If coax is used for the drop in a FTTC system, then the network would be able to offer any kind of home grocery shopping GUI possible with fiber/coax. However, some FTTC plans call for keeping the existing twisted-pair drop in place. In such a situation, ADSL would be necessary to boost the capacity of the twisted-pair; otherwise, the limited capacity of the drop would restrict the type of GUI that the distributor can offer.

4.3.1.5. FTTH

\(^{35}\)Information in this section is based on Karpinski, "The Long Road Home," pp. 14-19; Richard Karpinski, "BBT to Deliver 1500 Channels," Telephony, March 29, 1993, pp. 10-12; and Carol Wilson, "Belcore Revisits the Residential Broadband Cost Question," Telephony, July 23, 1993, pp. 9, 16.

\(^{36}\)The pedestal is a piece of equipment located at the neighborhood level, often positioned on top of telephone poles. It is used to handle upstream and downstream signals. Each telephone line connects directly to a pedestal.

\(^{37}\)Information in this section is based on Wilson, "Belcore Revisits," pp. 9, 16.
FTTH refers to the installation of fiber cable from the central office all the way to the home. The fiber would not actually be extended to the phone jack, but would terminate outside of the home. Coax would be used for inside wiring.

FTTH would offer a tremendous amount of capacity, both downstream and upstream. A FTTH network would be more than sufficient for any type of home grocery shopping GUI.

4.3.1.6. Other phone network technologies

The above options are all wireline technologies. Also being considered for upgrading the telephone network are wireless technologies. This section focuses on two wireless technologies—personal communication services (PCS) and wireless fixed access (WFA).38

4.3.1.6.1. PCS39

PCS is very similar to a cellular telephone system, particularly to an upgraded cellular network. Indeed, for the purposes of the discussion in this thesis, PCS and upgraded cellular can be considered the same.

A PCS user would employ a mobile handset for communication. The user may even employ the wireless device not just on the road, but also to replace existing wireline equipment in the home and at work.

With respect to home grocery shopping as proposed in this thesis, PCS will only play a role if the handset allows for the communication of data, rather than just voice.40 Mobile devices which enable the transmission of data have been available for several

38Overall, there are a multitude of wireless technologies, including direct broadcast satellite (DBS), cellular cable, vertical blanking interval, and FM radio-based broadcast. However, these are all distinct from the phone network.

39The information in this section is based on Randy Oster and Gary Brush, "PCS: Hands-On Communications for All," Telephony, February 28, 1994, pp. 30-42.

40As mentioned in Section 4.2.2., this researcher assumes that ordering is entirely electronic.
years, and the capability of such equipment continues to improve.

Most likely, the role of PCS will be as a supplement to a home-based GUI. For example, a consumer might do the majority of his or her ordering through the equipment in the home, then employ a mobile device to later modify the order. It is possible that some shoppers may choose to do all of their grocery shopping via mobile devices.

4.3.1.6.2. WFA\(^{41}\)

WFA involves the replacement of the twisted-pair drop with a wireless drop. A transceiver is positioned at the pedestal, and a corresponding piece of equipment is attached to the exterior of the home. Either twisted-pair or coax is used to link the outside equipment to the CPE.

Based on work currently underway, WFA provides 320 Kb/s of capacity, shared among up to ten households. With respect to home grocery shopping, WFA would therefore probably only allow the transmission of a very basic text-based display. There is a possibility that WFA technology will be further developed to allow the transmission of broadband signals. If that happens, then a WFA system would enable the GUI to include video and other advanced displays.

4.3.2. Cable television industry

Cable television networks are configured differently than local telephone networks and consequently face a different set of constraints. The primary advantage of cable systems is that they are built of coax, and thus already have high capacity connections to the home. In fact, most CATV networks already possess sufficient capacity for home grocery shopping and other on-demand applications.

However, a major obstacle must be overcome before home grocery shopping can be offered via a CATV network. This concerns the fact that most CATV networks function solely in a one-way direction, transmitting signals downstream from the headend\(^{42}\)

\(^{41}\)The information in this section is based on Dan Margiotta, “Wireless Fixed Loop Access: The Bridge to the Information Age,” *Telephony*, August 2, 1993, pp. 20-26.
to the household. Clearly, home grocery shopping requires an upstream communication path, for example to handle the transmission of the completed order. For CATV networks that currently do not have two-way capability, establishing such a path entails a network upgrade. The discussion about technology options in the following sections addresses this matter.

Another issue which could be significant for some CATV networks is switching. Currently, almost all CATV systems are unswitched; however, a number of networks are *addressable*. The distinction is that addressability only allows targeted communication from the headend to a particular household, while switching allows communication from any household to any other.

With respect to the requirements of the home grocery shopping application, addressability is sufficient. In other words, as long as the cable operator has the ability to establish a communications channel between a particular household and the grocery distributor, home grocery shopping does not require the installation of expensive switches. Communication from one household to another is irrelevant to the home grocery shopping application.\(^{43}\)

Another issue which could be of some significance pertains to interoperability. Most CATV networks are not interoperable at the moment.\(^{44}\) They function according to proprietary standards, which makes it difficult, if not impossible, to transfer signals to another network. In contrast, the public phone network has rigorously defined standards which specify protocols in great detail, and any system that connects into the public network must meet these guidelines.

Across the U.S., there are few if any regions where the incumbent cable system is large enough to retain the communication necessary for home grocery shopping entirely

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\(^{42}\) The headend is the hub of a cable system. It is somewhat analogous to the central office in a phone network.

\(^{43}\) Note that an addressable CATV system that does not have full two-way capability would require a connection to the telephone network for upstream communication of the grocery order. See Section 4.3.3.2. for additional information regarding such a combination CATV/teleco system.

within its own system. Therefore, if a cable operator wants to offer home grocery shopping on its network, it will likely have to satisfy established communication protocols.

Finally, to process on-demand applications such as home grocery shopping, most cable companies need to gain headend technology, particularly equipment used to handle billing and other functions. In general, cable companies lack much of this equipment, while telcos already have it in place. It may be possible for a cable company to contract out the responsibility to handle these functions to another party, including the local telco.

4.3.2.1. Upgraded coax\(^{45}\)

Upgraded coax is analogous to the use of ADSL on a phone network. It consists of overhauling and modernizing the network, but continuing to utilize the existing coaxial wire. A small amount of fiber may be installed, but this amount is far less than the quantity used in a fiber/coax network. The result is a network capable of the type of two-way communication necessary for home grocery shopping. The network would be capable of handling still photos, menus and sound, and may be able to also handle on-demand video.

4.3.2.2. CATV fiber/coax\(^{46}\)

CATV fiber/coax is very similar to telco fiber/coax. The biggest difference between the two designs is the extent of the fiber deployment. With a CATV design, fiber is not extended as far into the neighborhood as it is with a telco layout. For example, telco fiber/coax plans typically call for one fiber node per 64-128 households; cable companies plan to use nodes servicing anywhere from 500-7000 homes, at least initially. At a later date, cable companies may deploy additional fiber, which would reduce the number of homes per node. Once that happens, there would be few if any differences in terms of system architecture between a CATV and a telco fiber/coax network, though there may be significant differences with respect to switching and other important ele-

\(^{45}\)The information in this section is based on Chris Nolan, "Look, Ma! No Fiber!" Cablevision, September 21, 1992, p. 39.

\(^{46}\)The information in this section is based on Karpinski, "Magic Kingdom," pp. 48-53; Paula Bernier, "CoAccess Fiber/Coax System to Get Test," Telephony, November 29, 1993, pp. 12-14; and Carol Wilson, "Will the Broadband Network Ring Your Phone?" Telephony, December 6, 1993, pp. 34-40.
ments.

Home grocery shopping could function effectively on a CATV fiber/coax network. Upstream capacity would be more than sufficient. Any type of GUI that is available on a telco fiber/coax network, including video, should be available on a CATV fiber/coax network.

4.3.2.3. Other cable industry technologies

There are other technologies that cable companies can implement aside from upgraded coax and fiber/coax. For instance, they can deploy FTTC or FTTH. Cable operators are also considering wireless technologies, especially PCS. However, only fiber cable currently offers an increase in capacity and functionality relative to coax. Thus, as with the telcos, cable companies will likely deploy wireless technologies as a supplement to wireline networks. With respect to home grocery shopping, these technologies would make available essentially the same types of interfaces available on comparable telco networks.

4.3.3. Other technologies

The list of residential telecommunications technologies is quite extensive. Some of the many distinct technologies which have not already been examined include DBS, cellular cable, FM radio-based broadcast, vertical blanking interval and a combination CATV/phone system.

With the exceptions of cellular cable and the combination CATV/telco system, none of these technologies is capable of handling the home grocery shopping service. They each lack one or more of the necessary characteristics, such as capacity, switching and two-way functionality. As a result, they are not examined in this thesis.

4.3.3.1. Cellular cable

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Cellular cable refers to a cellular wireless network. The system incorporates a network of transmitters located throughout a given region. At each subscribing household, a small receiver is mounted onto a windowsill. Coaxial cable is used to connect the receiver to the television monitor.

This technology is still in the very early stages of development. At the moment, there is much disagreement about the level of capacity that cellular cable can provide, and even whether it is capable of two-way, switched communication. As a result, it is difficult to gauge at this time what type of interface cellular cable might make available for home grocery shopping.

4.3.3.2. CATV/phone system

The combination CATV/phone system does not actually represent new network technology. Rather, it is based on the use of a set-top box—more advanced than current models—that connects to both the existing CATV and local telephone networks. Downstream communication is transmitted over the CATV network, and upstream communication is handled by the phone network. A limited upgrade of the CATV network may be necessary in order for the system to operate, but for the most part, a combination CATV/telco system can utilize the cable and local telephone networks as is.

As presently configured, the combination CATV/phone system is capable of delivering color photos, menus and sound on-demand. At the moment, the technology is not set up to handle full-motion video, though it may be possible to later evolve the system in order to gain greater capability.

4.4. Analysis of installation costs

4.4.1. Background

This section provides an analysis of the installation costs for the technologies discussed in the previous section. The estimates in this analysis are based on best available information. Note that this examination is purposely limited; please refer to Appendix B

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48The information in this section is based on field research of a combination CATV/telco system currently in operation.
for greater detail.

The installation costs provided below represent good order of magnitude estimates; they are not intended to be definitive assessments. For instance, there are numerous factors which impact the cost to deploy new telecommunications technology. Among the more significant are: the sophistication of the technology, the nature of the infrastructure already in place, the type of neighborhood and its population density, the number of households over which to spread fixed costs, and the CPE expense. Some of these factors are peculiar to a particular technology, while others are common to most or all of the different technologies.

To the extent possible, this thesis has endeavored to incorporate such factors, but some are clearly beyond the scope of this research. As an example, several technologies call for new network infrastructure. This type of construction is very expensive, due to the labor-intensive nature of the work. In the cost analysis in Section 4.4.2., this distinction—i.e., that certain technologies require new infrastructure and others do not—is incorporated.

However, any time construction is undertaken, there are numerous important cost influences which must be thoroughly examined in order to refine deployment estimates to a micro level. These include such factors as: whether the neighborhood consists primarily of single-family homes or multifamily apartment buildings; whether the infrastructure must be installed above or below ground; and if below ground, whether the soil is predominantly rocky or sandy. For the purposes of this thesis, such factors can be ignored. Therefore, the technology cost analysis in Section 4.4.2. is purposely macro in scale.

One technology issue which is of significance to home grocery shopping pertains to CPE. As mentioned earlier, some form of sophisticated CPE is necessary in order to handle the home grocery shopping service. However, for a variety of reasons, the expense for CPE has been factored out of the analysis in the following section. It is rea-

49 In fact, for those technologies which require new wireline infrastructure, it is often the case that the labor expense is greater than the network equipment cost.

50 Several fundamental issues concerning CPE have yet to be resolved, such as the type of equipment to be utilized and the level of sophistication required to operate advanced applications. See Appendix B for
reasonable to state that at the moment, the general consensus is that in order to generate mass market appeal for home grocery shopping and other on-demand applications, the cost of advanced CPE should be no more than $300 per unit.\textsuperscript{51} Note that the expense for CPE is incorporated in the discussion in Section 4.4.3., which is an analysis of overall telecommunications-related costs in terms of home grocery shopping.

It is important to note that the estimates below are for installation expenditures only, i.e., the figures do not include operational costs. However, two factors provide support for concentrating solely on the installation expense: first, existing telecommunications providers are already spending money on operations anyway, so the deployment of new technology will not induce spending in an entirely new functional area; second, as mentioned in Section 4.1.1., the operational costs associated with some technologies may actually be lower than today's expenses.

4.4.2. Cost assessment\textsuperscript{52}

4.4.2.1. Local telephone

As mentioned above, the issue of whether a technology requires new infrastructure or not impacts the deployment cost in a significant manner. Thus in the local telephone industry, the two wireline technologies which utilize the existing twisted-pair network—ISDN and ADSL—have the lowest installation cost. The cost for ADSL is currently estimated to be around $600-$750 per household, while the expense for ISDN is somewhat less. The other wireline technologies—fiber/coax, FTTC and FTTH—all require construction of new infrastructure, and the costs for these technologies are therefore higher. Fiber/coax is currently estimated at $1000 per household, FTTC at $1000-$1300 and FTTH at $1500-$1800.

With respect to the wireless technologies, new infrastructure is necessary, but the


\textsuperscript{52}The information in this section is based on the references in Section 4.3. Refer to that section as well as to Appendix B for more information.
requirement is not as great as with new wireline networks. WFA is estimated to cost about 12 percent less than a FTTC network, or around $900-$1150 per household. The expense for PCS is contingent upon the number of subscribers; at the moment, the estimated cost ranges from several hundred to several thousand dollars per user, depending on the number of subscribers.

4.4.2.2. Cable television

Deployment costs in the cable industry are low relative to telco expenses, primarily because cable operators already possess coax networks extending to the home. For example, upgraded coax has been deployed at a cost of $200 per household, and fiber/coax is estimated to cost $300-$500 per household. For the other technologies—FTTC, FTTH and PCS—all of which require new infrastructure, the costs are comparable to those in the local telephone industry.

4.4.2.3. Other technologies

Cellular cable costs around $600 per subscriber. It is estimated that the cost for a combination CATV/telephone system is less than that for upgraded coax, i.e., under $200 per household.

4.4.3. Cost analysis in terms of home grocery shopping

Table 4-1 provides a mechanism to relate the deployment cost for new technology to home grocery shopping. Using three essential variables—capital cost, interest rate and payback period—Table 4-1 depicts breakeven revenue figures per subscriber per month. The amounts entered for the variables cover a wide range of plausible values, and are based on both the information developed in this chapter as well as current financial market conditions. The resulting entries thus represent the nominal amount of revenue that the telecommunications provider must generate per subscriber in order to pay in full the principal plus interest.53 Monthly payments were chosen because residential telecommunications charges are typically billed on a monthly basis.

53 The calculations in Table 4-3 are based on the standard time value of money formula.
<table>
<thead>
<tr>
<th>PAYBACK PERIOD (YRS)</th>
<th>INTEREST RATE</th>
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<tbody>
<tr>
<td></td>
<td>7%</td>
</tr>
<tr>
<td><strong>$500 CAPITAL COST</strong></td>
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<tr>
<td>10</td>
<td>$5.81</td>
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<tr>
<td>15</td>
<td>4.49</td>
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<tr>
<td>20</td>
<td>3.88</td>
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<tr>
<td><strong>$750 CAPITAL COST</strong></td>
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<tr>
<td>10</td>
<td>$8.71</td>
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<tr>
<td>15</td>
<td>6.74</td>
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<tr>
<td>20</td>
<td>5.82</td>
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<tr>
<td><strong>$1000 CAPITAL COST</strong></td>
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<td>10</td>
<td>$11.61</td>
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<td>15</td>
<td>8.99</td>
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<tr>
<td>20</td>
<td>7.75</td>
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<tr>
<td><strong>$1500 CAPITAL COST</strong></td>
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<td>10</td>
<td>$17.42</td>
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<tr>
<td>20</td>
<td>11.63</td>
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<tr>
<td><strong>$2000 CAPITAL COST</strong></td>
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<tr>
<td>10</td>
<td>$23.22</td>
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<tr>
<td>15</td>
<td>17.98</td>
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<tr>
<td>20</td>
<td>15.51</td>
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</table>
Note that the actual capital cost to deploy an advanced telecommunications network includes more than just the expense to install subscriptional infrastructure. It also includes the expense for high-capacity switches, transactional technology and CPE. The expense for the first two factors can be spread over a wide base of users, including businesses, but the cost for CPE must be assigned on a per user basis. Thus when considering the expense for a given technology, at least $300 should be added to the estimates from the previous section to give a more realistic assessment of the true cost.\textsuperscript{54}

As Table 4-1 shows, there is great variation in the cost to deploy advanced telecommunications network infrastructure, with breakeven monthly revenue per subscriber ranging from a low of $3.88 to a high of $26.43.\textsuperscript{55} Clearly, when estimating the total expense for new infrastructure on a per subscriber per month basis, not only are technology and implementation characteristics important factors, but so too are the interest rate and the length of the period over which the cost is amortized.

In terms of home grocery shopping, this thesis has made two very conservative assumptions. First, the cost (i.e., the breakeven revenue point) to install an advanced network is assumed to be $18 per subscriber per month. Second, this cost is assumed to be solely an incremental expense, and therefore must be financed exclusively out of revenue from new services.

First, it is evident from Table 4-1 that $18 per subscriber per month is more than sufficient revenue to finance the deployment cost of several highly advanced technologies (including the expense for CPE and other equipment), each of which is capable of offering appealing GUIs. Moreover, this level of income also provides the telecommunications company with a comfortable profit margin that, depending on assumptions about the installation expense, the interest rate and the length of the payback period, can range up to 15 percent or more.

\textsuperscript{54}The figure of $300 refers to the cost for an advanced set-top box that can handle interactive applications and allow the display to be presented on a television monitor. The expense for other pieces of CPE may be higher or lower. For instance, the receiver necessary to operate cellular cable is more expensive, while a high-capacity modem and a smart phone each cost around $200 or less.

\textsuperscript{55}For perspective, current local telephone and cable television bills each average around $30-40 per month.
In fact, based on empirical evidence, the assumed cost is very conservative. Consider the following: (a) payback period—local telcos typically assume a time span of 15 years when assessing the deployment expense for new network infrastructure;\textsuperscript{56} (b) interest rate—the analysis in Chapters Five and Six utilizes a 1993 nationwide average rate of 8.4 percent.\textsuperscript{57} Combining these assumptions with the assumed expense of $18 per month produces a capital cost that has a present value of $1839. Based on the discussion in Section 4.3., this level of spending is sufficient to fully finance every network technology examined in this thesis—including the cost for CPE—with the sole exception of FTTH, and even with FTTH, $1839 in spending can finance over 85 percent of the total deployment plus CPE cost.

The second assumption—that the installation cost is entirely incremental—is clearly conservative, as was discussed in Section 4.1.1. In fact, if this assumption is relaxed, and the installation cost is treated either wholly or partially as a replacement expense, then the economics in favor of home grocery shopping become even more compelling.

4.5. Deployment schedule

This section is devoted to an analysis of the implementation scenarios for the various telecommunications technologies. It is important to note that deployment schedules for new technology are impacted by a variety of factors, including government regulation, competition from other providers and assessment of the market demand for broadband services. Therefore, implementation of the technologies will not be uniform. Indeed, across the vast multitude of companies, technologies and geographic regions, there is no single strategy that will be adopted everywhere. Even within a given industry, the technology approaches over the next one to two decades will differ markedly from company to company and from region to region.

Interestingly, the vision for the long term is clearer than it is for the near term. Over the long run—on the order of two decades or more—the push will be to extend fi-

\textsuperscript{56}Interview with a consultant who has extensive experience advising local telephone companies, April, 1994.

\textsuperscript{57}Refer to Chapter Five for more information.
ber cable, or a comparable broadband technology, to most homes and businesses in the U.S. There is much supporting evidence for this assertion, including government proclamations, declarations by telecommunications providers, and statements issued by a multitude of interested parties.\(^{58}\)

It is during the interim period that there is much uncertainty regarding the timetable for new infrastructure. Decisions about network technology will not be made in a vacuum; they will be affected by the threats, both real and imagined, posed by the competition. Furthermore, the changing nature of the competition itself adds to the complexity: tomorrow’s opponent may be considerably different from today’s adversary. In addition to competition, telecommunications providers also have to consider changing government regulations, shifts in consumer demand, and a host of other factors. The net result is that while every household in the U.S. may one day be linked into a broadband network, the short to medium term upgrade of the nation’s telecommunications infrastructure is likely to be a sluggish and chaotic process.

In terms of home grocery shopping, some markets have the capability, even now, to offer a television-based service. For instance, home grocery shopping could be offered as one of the services presented on GTE Main Street, which is a combination CATV/telco system. In order for GTE Main Street to work, the cable operator must upgrade its network slightly (the telco network can be used as is), while GTE provides the set-top boxes and the necessary transactional equipment. The system is already available on several cable networks, and GTE has indicated that it plans to continue system expansion.\(^{59}\)

Another possibility is to offer home grocery shopping on a CATV network which has received the more extensive upgraded coax treatment. There are several systems which have been upgraded in this manner. However, until these networks become bidirectional, they must be linked to the local telephone network—similar to the CATV/telco system—in order to allow home grocery shopping to operate.

\(^{58}\)See, for example, "Gore's Law," The Economist, January 15, 1994, p. 72, and Carol Wilson, "Will the Broadband Network Ring Your Phone?" Telephony, December 6, 1993, p. 40.

\(^{59}\)See Appendix B for additional information about GTE Main Street.
Over a longer time frame—roughly two to three years—technology more advanced than both upgraded coax and the combination CATV/telco system should become available. For example, numerous plans have been announced to begin deployment of ADSL, fiber/coax and FTTC in 1994 or 1995; some projects have already begun. By 1998, these technologies should be widely available, even if projects are delayed by a year or more.

In the telephone industry, most of the large companies have announced plans to begin deploying advanced networks in the near future. For instance, starting in 1994, Nynex will install up to one million video-capable telephone lines per year, using FTTC technology; Bell Atlantic will use both ADSL and fiber/coax to deploy approximately 1.5 million video lines per year, starting in 1995; Ameritech is currently installing large quantities of fiber, and intends to begin offering video applications in late 1994; U S West will initiate testing of fiber/coax in mid 1994, and may begin wide deployment of the technology in 1995 or 1996; and Pacific Telesis plans to build a fiber/coax network throughout California over the next seven years.

In the cable industry, several of the major cable companies have announced plans for advanced networks. For example, Time Warner is building a fully interactive system in Orlando, Florida, and plans to build similar networks wherever it operates, beginning in early 1996; Viacom is deploying a network with comparable capability near San Francisco; and Tele-Communications intends to deploy fiber/coax in 90 percent of its network by 1998.

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64O'Shea, "Blockbuster Plan," p. 8,


Overall, enough markets should have advanced telecommunications technology by 1998 to allow home grocery shopping to be widely offered. Moreover, in the markets where the advanced networks will be deployed, the technology will be sophisticated enough by that time to permit the transmission of very attractive GUIs, including three-dimensional renderings of products and full-motion video.

4.6. Summary

This chapter has shown that home grocery shopping as proposed in this thesis is intimately linked to developments in the telecommunications industry. Essentially, the formation of mass market appeal for the service is contingent upon the availability of advanced telecommunications technologies. Thus the rollout of home grocery shopping is likely to follow behind, rather than lead, the deployment of new telecommunications networks.

This chapter has examined numerous advanced telecommunications technologies, and has analyzed the capability of each, in particular with respect to the home grocery shopping application. This chapter has also analyzed both the cost and the likely implementation scenarios for the technologies. Overall, it has been shown that the new telecommunications technologies which are now coming available provide the opportunity to implement home grocery shopping, as proposed in this thesis, for the first time.

Finally, this chapter introduced the concept of linking the cost to install advanced networks with the distribution savings offered by home grocery shopping. It has been stated that the revenue generated by home grocery shopping may help to fund additional network deployment, which can lead to a virtuous cycle of more revenue and additional deployment. The discussion in this chapter will be supported by the analysis in Chapters Six and Seven. As those chapters will demonstrate, full implementation of home grocery shopping as proposed in this thesis results in substantial reductions in the cost to distribute grocery products and the time consumers spend shopping, as well as numerous additional benefits.
Chapter Five

Current Distribution System

5.1. Introduction

This chapter analyzes the current distribution system for grocery products. There are two sections in this chapter. Section 5.1. provides a background description of product flow in the grocery industry. This overview highlights the major components of the distribution system, extending from the point of production to the point of sale.

Section 5.2. focuses on one sample product. A channel map is created for this specific product, which is in reality a composite of several different items. Using the FMI Unified Direct Product Cost (DPC) model, the channel map identifies the individual activities, and associated costs, involved in the distribution of the product under the current system. This analysis covers the entire distribution process from the time the product arrives at the distribution center until it is paid for by the consumer at the retail checkout counter. In Chapter Six, a similarly structured channel map is developed to illustrate the organization and economics of the alternative distribution system proposed in this thesis.

Together, these cost models form the core of this research. By employing the same methodology to analyze both the current and the proposed systems, this thesis is able to show (a) how the proposed system creates new value and (b) the likely magnitude of the benefits.

5.2. Generalized description of product flow

From the point of production to the point of sale, a grocery product typically passes through several resting points. The primary stops along the supply channel include distribution centers, consolidation points and warehouses.

Figure 5-1 depicts a generalized illustration of the distribution process. Included in the figure are the most frequently utilized facilities that a grocery product may pause at
Figure 5-1
Generalized Supplier to Supermarket Distribution Process
during the distribution process, presented in standard chronological order. Note that the actual pattern of distribution varies from item to item. This section will briefly describe each facility portrayed in Figure 5-1, and explain its role in the distribution process.

First, it is important to point out that there is a large subset of products which bypass these stops altogether. These are goods which move directly from the supplier to the retail outlet in a procedure known as either "store/door" delivery or direct store delivery (DSD). DSD items typically include baked goods, soft drinks, perishables and snack foods with special handling requirements. While the percentage of items distributed via DSD varies from supermarket to supermarket, one independent operator contacted by this researcher estimated that approximately 40 percent of the products in his supermarket arrive by means of DSD.¹

For a non-DSD grocery product, the first stop after manufacture, as shown in Figure 5-1, is often a warehouse controlled by the supplier. Some of the many reasons a supplier may utilize a warehouse at this point include: overproduction or ill-timed production; a desire to deploy products closer to final markets; and a need to store products that have highly seasonal demand patterns.

Next, a grocery product might be routed through a consolidation point. This facility is used to group items with other products destined for the same regional area. Such clustering is carried out primarily to economize on long distance transportation costs.² Products that move through consolidation points include small cubic size and/or low sales volume items.³

The next stage in the distribution process is often another stop at a warehouse. This

¹Interview with the owner of a full-size independent supermarket, March, 1994. The seemingly high percentage figure is accounted for by the fact that at this supermarket, the bulk of the perishable items arrive via DSD.

²Per unit of distance, it is less expensive to ship an item in a full truckload (TL) or rail carload (CL) than as part of a less-than-truckload (LTL) or less-than-carload (LCL) shipment.

³Some grocery products may be shipped directly to a regional distribution center after manufacture, bypassing the supplier warehouse and the consolidation facility. The regional distribution center is controlled by the supplier, and it is not be confused with the more conventional distribution center controlled by the distributor. The regional distribution center combines some of the functions of the supplier warehouse with those of the consolidation facility. For instance, the regional distribution center allows products to be stored for extended periods of time, and it also enables goods to be picked and grouped with other items for transportation in the same vehicle.
time controlled by the distributor. Some of the reasons why a distributor might use a
warehouse include: a need to store forward bought products; buildup of supply before a
holiday or promotional event; and general overspill of product from the distribution cen-
ter.

After the distributor-controlled warehouse, the next stage is the distribution center.
This facility might be owned by a chain operator, a wholesaler, or a collection of in-
dependent supermarkets organized into a cooperative. The distribution center functions as
the hub of a distribution network that often extends to several dozen or more super-
markets. Essentially, all non-DSD grocery products pass through a distribution center
during the supply process (note that a distributor may operate separate facilities for dry
grocery and perishable items).

Distribution centers provide many services; the primary functions are consoli-
dation, break bulk and short term storage. First, supermarkets house thousands of products,
supplied by hundreds of manufacturers and arriving from a multitude of different locations.
Consolidating these items at a distribution center allows both suppliers and distributors to
achieve transportation efficiencies: suppliers can transport large quantities—such as TLs
or CLs—to a single location, while distributors can efficiently supply individual stores.\(^4\)

The second function is break bulk. Products are usually moved through the supply
channel in palletized form.\(^5\) Such a large quantity of a single item is normally too great for

\(^4\)At the store level, because of space and labor constraints, it is impossible to receive hundreds (or even
dozens) of separate deliveries each day, as would be necessary if a large number of suppliers were to
switch to DSD.

\(^5\)There are three primary methods for distributing products from the supplier to the distribution center:
pallets, slip sheets and dead piles. Pallets are wooden or plastic platforms, approximately six inches high,
upon which cases are stacked in interlacing layers; they can be either disposable or reusable. Slip sheets
are similar in concept to pallets, but instead of a durable platform, a disposable cardboard sheed less than
one inch thick is utilized. Products shipped in either of these methods are considered to be "palletized."
Dead piles are cases floor-loaded in a transportation vehicle without a supporting platform. The advan-
tages of using pallets and slip sheets is that they can be quickly unloaded from the vehicle and conveyed
around the distribution center with the help of mechanized equipment, such as fork lifts, hand jacks, etc.
In contrast, except in very highly automated facilities, dead piles must first be palletized before movement
around the distribution center can begin; this process can be costly. The drawbacks of platforms include
purchase and disposal costs, and the fact that they occupy space in and add weight to the transportation
vehicle; pallets face the additional problem of requiring that a replacement be circulated back to the
original user. The issue of transportation platforms, which affects supply channel efficiency, is a signifi-
cant concern in the grocery industry, as the industry spends around $2 billion a year in this area. For a
more detailed discussion of pallet-related issues, see Richard Kochersperger, \textit{Food Warehousing and

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an individual store to accommodate at one time. At the distribution center, pallets are opened up and individual shipping containers (cases) are removed, in order to better match store needs.

The third function is short term storage. Supply channels are subject to all manner of disruption and delay; by maintaining a safety stock at the distribution center, the distributor can safeguard against mishaps. Also, Chapter Three pointed out that distributors regularly forward buy large quantities of goods; space permitting, the excess product is often stored at the distribution center.\(^6\)

As noted, the ownership of the distribution center varies. Typically, chain operators possess their own distribution centers, while independent operators are supplied through wholesaler-owned facilities. In some areas, groups of independent operators organize themselves into cooperatives and manage their own distribution centers; such an arrangement enables the independent operators to both gain more control over the operation of the distribution center, and reduce the fees paid to wholesalers.

The last stage in the distribution process before consumer purchase is the retail store. There are a wide variety of stores that retail grocery products; these have been noted above and in Chapter Three. In the analysis of the current distribution system, this researcher assumes that the retail store is a supermarket.\(^7\)

Transportation also plays an essential role in the distribution process. Movement

\(^6\)Note that a distribution center is distinct from a warehouse. At a distribution center, most items cycle through in one month or less, while at a warehouse, products may be stockpiled for several months or more. In fact, over the past two decades, many large distributors have built or leased warehouses solely to house products bought on deal, because distribution center space is limited. (See, for example, Weinstein, "The Forward Buy Factor," p. 44.)

\(^7\)Note that warehouse clubs combine operational aspects of retail stores and distribution centers into one facility. For example, a typical club store resembles a distribution center in appearance: the building is quite large, aisles are wide enough to accommodate forklifts, and products are stored in palletized form on racks; also, almost all of the products arrive directly from the supplier. On the other hand, consumers personally shop at warehouse clubs. Chapter One pointed out that the vast majority of consumer purchases of grocery products occur at supermarkets, and that the growth of warehouse clubs may have plateaued; in addition, very few consumers shop exclusively at warehouse clubs. Because of these reasons, this researcher has chosen the supermarket-based supply channel as the model for the current distribution system.
of products up to the distribution center is known as inbound transportation, and can occur via any of the major modes—road, rail, air and water. (If more than one mode is utilized, the operation is referred to as multimodal transportation.) The vast majority of inbound shipments utilize truck trailers or rail cars, and in recent years the modal share of trucks has increased significantly.\(^8\) Inbound transportation is typically carried out either by the supplier's fleet or by a contract carrier.

Outbound transportation, or shipment of products from the distribution center to the store, is almost entirely by truck. Most chain operators and large wholesalers manage their own fleets, either via outright ownership or through leasing arrangements; relatively few outbound shipments are handled by contract carriers.\(^9\)

5.3. Channel map

5.3.1. Background

The previous section provided a generalized illustration of the distribution process for grocery products. The remainder of this chapter is devoted to an in-depth analysis of the supply channel for a specific sample product, known as Product A (a description of which is provided in Section 5.3.3.).

This analysis, which consists of a rigorous examination of distribution activities

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\(^8\)The main advantages for trucks are speed, ease in unloading and flexibility—facilities do not have to be located next to rail lines; the primary advantage for rail is a lower cost per ton-mile (a ton of freight carried one mile). In general, trucks are more efficient for shorter trips and for smaller shipments, while rail is more efficient for long trips—such as shipments from West Coast food processors to the East—and for CL deliveries. Even for shipments where rail appears to have a natural advantage however, the recent trend in the grocery industry—as epitomized by the ECR program—is to reduce overall inventory levels. Therefore, except for items bought on deal or products with consistently high volume, most distributors do not want to accept a CL quantity of a single product at once. In response, suppliers have increased their use of mixed loads, which should allow rail to remain a viable option for distribution of grocery products. (See Kochersperger, Warehousing, pp. 249-258 for additional information.)

\(^9\)One important aspect of the transportation function pertains to the backhaul (the backhaul is the return trip from the destination to the origin). Under the right conditions, a transportation vehicle that might otherwise make a return trip empty can be employed to pick up a shipment of product, thereby resulting in a second source of income for the transportation carrier. While almost all carriers seek out backhaul opportunities, distributors in particular are well-situated: since most grocery products have to flow through the distribution center anyway, a truck returning to the distribution center can readily pick up shipments from local suppliers.
and associated costs, commences at the distribution center. As noted in Chapter One, there are two basic reasons for initiating the study at this stage of the distribution process. First, the costs of transportation, consolidation and other activities prior to the distribution center are implicit in the cost of goods; for modeling purposes, the cost of goods can therefore be treated as a given. Second, it is only from the distribution center forward that the activities under the proposed system begin to significantly diverge from the current system.\textsuperscript{10}

5.3.1.1. General assumptions

The following assumptions are utilized primarily in Chapter Six, but are important to establish prior to beginning the channel analysis. First, the total weekly household expenditure on groceries is $68. This figure represents the middle point between (a) the nationwide average per-household weekly expenditure solely in supermarkets ($58), and (b) average household weekly spending on grocery products overall, including money spent in convenience stores, superettes, warehouse clubs, supercenters and mass merchandisers ($77).\textsuperscript{11} Second, annual revenue per supermarket is $9.53 million.\textsuperscript{12} Third, the ratio of supermarkets to distribution centers is one hundred to one.\textsuperscript{13}

Based on the first two factors above, this researcher has made a further assumption that each supermarket handles the needs of 2,700 households each week.\textsuperscript{14} At a ratio of

\begin{small}
\textsuperscript{10}This researcher has striven throughout to consistently adopt conservative assessments. Thus, this thesis does not claim any unique benefit in the supply process up to the distribution center, nor for some aspects of distribution center operations. For instance, it is undoubtedly true that implementation of the proposed system—with its increased coordination of consumer demand, distributor ordering and manufacturer production—should lead to substantial improvements in activities along the entire supply channel, such as smoother production functions, more appropriate shipment quantities and decreased inventory levels. However, as Chapter Three discussed, most of these important backchannel efficiencies can be obtained solely by implementing ECR, without establishing home grocery shopping. Therefore, although it would be impossible in practice to implement the proposed system and not experience gains in these areas, to maintain conservative consistency, this thesis does not assume any quantifiable benefits prior to the distribution center. Refer to Chapter Seven for more information.

\textsuperscript{11}"61st Annual Report," pp. 11, 63.

\textsuperscript{12}"Supermarket Facts," n.p.

\textsuperscript{13}This is the ratio assumed in \textit{Efficient Consumer Response}.

\textsuperscript{14}This is different from the number of customer transactions per week per supermarket, which according to FMI is around 10,200 ("Supermarket Facts," n.p.). The disparity is accounted for by the fact that the
\end{small}
one distribution center per one hundred supermarkets, the distribution center employed in the model in this thesis is thus assumed to supply 270,000 households every week.\(^\text{15}\)

5.3.2. Direct Product Cost model

The methodology used to analyze the distribution process is that of the FMI DPC\(^\text{16}\) model.\(^\text{17}\) This model is a standard which is widely employed throughout the grocery industry. In fact, it was recently used in the Marsh Super Study, which was a comprehensive effort aimed at gaining a better understanding of industry productivity.\(^\text{18}\) Progressive Grocer states:

One of the more complex measures of productivity is direct product cost, which incorporates all the costs involved with a product including handling, stocking buying and transporting...DPC is a critical number to study and act on, especially given the tough competitive environment and the emphasis on reducing operational costs.\(^\text{19}\)

The DPC model allocates costs to specific activities based on a set of formulas and various inputs, such as labor rates, rental fees, expenditure of time and use of space. The formulas in the model are standards which have been defined by FMI. Due to proprietary restrictions, detailed derivations of the DPC formulas are not included in this thesis. However, it is essential to note that the standard DPC model—the same one utilized average customer transaction tends to be modest—$17.90 according to the same data (\textit{Ibid}).

\(^\text{15}\)Note that the analysis in this thesis is based on a model distributor similar to that employed in the ECR report, i.e., a large chain distributor that operates 100 supermarkets and its own distribution center. However, as Chapter Three discussed, over 40 percent of the supermarkets in the U.S. are independent operations. While implementation of the proposed system raises very important strategic issues for any distributor, the concerns are particularly pronounced with respect to independent operators and wholesalers. For example, there are issues surrounding how the activities under the proposed system would be divided up, and which party would control the customer. In general, these matters are beyond the scope of this thesis; they are identified in Chapter Eight as an area for future research. For the purposes of the analysis in this chapter and Chapter Six, these concerns can be ignored.

\(^\text{16}\)Also referred to as Direct Product Profit (DPP).

\(^\text{17}\)For reference, see \textit{Dry Grocery Version 1993: DPP Operating Cost & Productivity Factor Composite for use with the FMI Unified DPP Model}. (Barrington, IL: Willard Bishop Consulting, 1993).


\(^\text{19}\)\textit{Ibid.}, p. 50.
throughout the industry—is employed in the analysis of both the existing distribution system and the proposed system. By maintaining this consistency, this thesis is able to conduct an unbiased comparison of the costs of the two systems relative to each other.\textsuperscript{20}

In regard to the input data, these values can be modified to reflect different assumptions about the factors listed above. The input data actually consists of two parts. The first component pertains to the rates at which activities are carried out, such as the time needed to load trucks and to stock store shelves. The assumptions about these inputs are included in Section 5.3.3.1., which lists all of the distribution activities. The second component concerns the cost for elements directly involved in the distribution process, such as the occupancy expense and hourly labor rate at the distribution center and at the supermarket. This data is described in Section 5.3.2.1.

It is critical to note that both the cost and the activity data represent national averages. This information is developed through continually-updated surveys of major distributors across the country, as conducted by a consulting company well-known in the grocery industry. This data was last revised in 1993. The analysis in Chapter Six employs the same source for input data.

Also note that to carry out this analysis, this researcher has worked closely with a nationally-recognized supplier of grocery products, utilizing the DPC model and the input data under the guidance of the company. This firm is a Fortune 100 corporation that manufactures many of the leading brands found on supermarket shelves today. With one exception, the input data utilized in this chapter is precisely the same data that the company employs to analyze its own operations on a regular basis.

\textsuperscript{20}One important factor to note regarding the DPC model is that it does not include all of a distributor's activities and costs. For example, some of functions that are not included in the DPC model are general and administrative, merchandising, human resources, advertising, and other overhead functions that are listed in the general ledger. Because these items are not incorporated in the DPC model, some companies prefer to employ the Activity Based Costing (ABC) methodology, which does include general ledger functions when assigning costs. In this thesis, ABC is not employed, for two important reasons. First, this thesis seeks to understand how the specific activities and costs involved in the distribution process change under the proposed system; therefore, for the purposes of this research, the DPC model produces much greater clarity than ABC. Second, to be conservative, this researcher assumes that the expenses for general ledger functions remain constant under the proposed system; the implication of this assumption is that—also for the purposes of this research—ABC is unnecessary. Note that general ledger functions are incorporated into the analysis of the proposed system in Chapter Six; that analysis will illustrate why the constant cost assumption for these functions is very conservative.
The lone exception concerns the number of days that Product A is assumed to spend in inventory at the distribution center and at the supermarket. In this thesis, the storage time was purposely chosen to reflect the goals of the ECR program. In other words, as the base point for the current system, this thesis assumes that ECR has been fully implemented. Such is not the case when the supplier runs the DPC model.

5.3.2.1. Cost assumptions

The cost inputs are as follows. At the distribution center, the total direct labor expense\textsuperscript{21} is $17.91 an hour, and the annual occupancy cost is $1.97 per cubic foot of product.\textsuperscript{22} At the store, the labor rate is $12.00 per hour,\textsuperscript{23} while the yearly occupancy cost consists of two parts: (a) display space, which is $29.07 per square foot of facing (see previous footnote), and (b) backroom space, which is $3.05 per cubic foot of product.\textsuperscript{24} The total transportation cost from the distribution center to the store is $1.74 per mile. The interest charge is 8.4 percent per year.

5.3.3. Product A

In conjunction with the supplier, this thesis has developed a channel map for a typical dry grocery product—referred to as Product A. This chart identifies the distribution activities performed on Product A, and determines the cost for each activity.

Product A does not exist in reality. Rather, it is a composite of many different dry products. The DPC model makes a distinction in store labor rates, based on three different classes of supermarket employees: stocking clerks, cashiers and baggers. For simplicity, this thesis assumes a single store labor rate.

\textsuperscript{21}The total direct labor expense is an average of the wage, overtime, benefits and worker's compensation for employees directly involved in the handling of products, including immediate supervisors (e.g., floor supervisors at the distribution center and head cashiers at the supermarket). The labor expense excludes the compensation for all other personnel (e.g., invoice clerks, managers, etc.).

\textsuperscript{22}Distribution centers and supermarkets are usually measured in terms of floor square footage. The DPC model utilizes ratios that translate floor-space measurements into: (a) cubic storage space in the distribution center and in the backroom of the supermarket, and (b) display facing in the merchandising section of the supermarket. (Facing is the vertical square footage of store shelving, i.e., the view that a consumer perceives when looking directly at a shelf.)

\textsuperscript{23}The DPC model makes a distinction in store labor rates, based on three different classes of supermarket employees: stocking clerks, cashiers and baggers. For simplicity, this thesis assumes a single store labor rate.

\textsuperscript{24}The source of the cost for the backroom space is the supplier, not the survey; as with the expenses in the survey, this cost represents a national average.
grocery product characteristics. These characteristics were purposely chosen so as to make Product A as representative as possible.

Product A is a non-edible dry grocery product that does not require refrigeration or special handling. It weighs 8.6 ounces and is packed 15 units to a case; the case measures exactly 1.0 cubic feet. Product A is shipped in unitized form\textsuperscript{25} from the supplier, and each pallet consists of 55 cases. Product A spends 12 days in inventory at the distribution center prior to shipment to the store, and 22 days at the supermarket before consumer purchase.\textsuperscript{26} The wholesale cost of Product A (ignoring volume discounts) is $1.24 per unit.

5.3.3.1 Description of activities

The physical product flow of Product A, from arrival at the distribution center to movement to the supermarket checkout counter, is illustrated in Table 5-1. The activities depicted in Table 5-1 are industry standards, developed by FMI for the DPC model. This section will describe each activity,\textsuperscript{27} and note the rates used for the DPC calculations in this thesis.

Receive—"The time it takes warehouse labor to check in and unload the incoming product from a supplier truck. In general, unloading a truck involves either (1) palletizing deadpile deliveries onto warehouse pallets, (2) repalletizing unitized deliveries onto warehouse pallets (if the warehouse requires this), or (3) unloading unitized deliveries onto the receiving dock." Note: Product A is assumed to be in palletized form upon arrival at the distribution center.

rate: 24.04 pallets per hour

\textsuperscript{25}For palletized products, the standard unit for shipment up to the distribution center is a unitized pallet. Because of differences across individual products, there is no model size or weight for a unitized pallet, i.e., the characteristics of unitized pallets vary from product to product.

\textsuperscript{26}Note that these are the goals of the ECR program.

\textsuperscript{27}The source of these descriptions is \textit{DPP Operating Cost & Productivity Factor Composite}, n.p.
<table>
<thead>
<tr>
<th>STAGE</th>
<th>ACTIVITY</th>
<th>RATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>DISTRIBUTION CENTER</td>
<td>RECIPE</td>
<td>24.40</td>
</tr>
<tr>
<td></td>
<td>PUTAWAY</td>
<td>16.41</td>
</tr>
<tr>
<td></td>
<td>REPLENISH SLOT</td>
<td>20.04</td>
</tr>
<tr>
<td></td>
<td>SELECT CASE</td>
<td>182.00</td>
</tr>
<tr>
<td></td>
<td>LOAD TRUCK</td>
<td>23.93</td>
</tr>
<tr>
<td></td>
<td>OCCUPANCY</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>EQUIPMENT</td>
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</tr>
<tr>
<td></td>
<td>INVENTORY</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<tr>
<td>TRANSPORTATION</td>
<td></td>
<td>$0.160</td>
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<tr>
<td>STORE</td>
<td>PLACE ORDER</td>
<td>9.29</td>
</tr>
<tr>
<td></td>
<td>RECEIVE</td>
<td>16.80</td>
</tr>
<tr>
<td></td>
<td>SORT &amp; LOAD</td>
<td>9.23</td>
</tr>
<tr>
<td></td>
<td>MOVE TO AISLE</td>
<td>4.93</td>
</tr>
<tr>
<td></td>
<td>POSITION CASE</td>
<td>5.10</td>
</tr>
<tr>
<td></td>
<td>OPEN CASE</td>
<td>5.20</td>
</tr>
<tr>
<td></td>
<td>PRICE SETUP</td>
<td>5.02</td>
</tr>
<tr>
<td></td>
<td>PRICE</td>
<td>0.46</td>
</tr>
<tr>
<td></td>
<td>SET UP SHELF</td>
<td>12.77</td>
</tr>
<tr>
<td></td>
<td>STOCK ITEM</td>
<td>1.80</td>
</tr>
<tr>
<td></td>
<td>CLEANUP</td>
<td>10.20</td>
</tr>
<tr>
<td></td>
<td>CONDITION SHELF</td>
<td>0.26</td>
</tr>
<tr>
<td></td>
<td>RING TIME</td>
<td>2.44</td>
</tr>
<tr>
<td></td>
<td>SET UP BAG</td>
<td>5.50</td>
</tr>
<tr>
<td></td>
<td>PUT IN BAG</td>
<td>2.05</td>
</tr>
<tr>
<td></td>
<td>BAG COST</td>
<td>$0.024</td>
</tr>
<tr>
<td></td>
<td>OCCUPANCY</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>INVENTORY</td>
<td>22</td>
</tr>
</tbody>
</table>

KEY TO ABBREVIATIONS

<table>
<thead>
<tr>
<th>CA</th>
<th>CASE</th>
</tr>
</thead>
<tbody>
<tr>
<td>CF</td>
<td>CUBIC FOOT</td>
</tr>
<tr>
<td>DEL</td>
<td>DELIVERY</td>
</tr>
<tr>
<td>PAL</td>
<td>PALLET</td>
</tr>
</tbody>
</table>
Putaway—"The time it takes to (1) move pallets (supplier or warehouse) from the receiving area to the storage area and (2) put the pallets on the floor or on racks in storage."  

rate: 16.41 pallets per hour

Replenish Slot—"The time it takes to (1) take the empty pallet out of the picking slot and (2) move a full pallet from the storage area to the picking slot."

rate: 20.04 pallets loads per hour

Select Case—"The time it takes to (1) get the picking order papers, (2) drive the tow motor (fork lift) to the picking slot, (3) pick the required number of cases from the first slot and put them on the pallet, (4) drive the tow motor to the next slot and repeat the picking process until the pallet is full, and (5) drive the tow motor to the loading area and unload the full pallets for delivery to the retail stores."  

---

28 In the supermarket industry, most distribution centers are very large, one-story facilities. Pallets are housed in a system of racks, typically four to five levels high. To increase efficiency, high volume items are stationed close to the staging (loading) area, so that less effort is expended in intrafacility movement of these heavily demanded products.

29 The picking slot (also called the pick face) refers to the area housing "live" pallets. These are the pallets that are ready for case selection (pallets often arrive at the distribution center encased in cellophane wrapping; this wrapping is not removed until the pallet has been transferred to the pick face). The picking slot is generally restricted solely to the lowest rack level, which in practice usually means the ground floor of the distribution center.

30 Picking order papers are also called pick sheets.

31 There are actually several options for selecting and moving cases to the staging area. In the grocery industry, two methods dominate, both of which employ human pickers. With the first method, pickers operate some form of moving equipment; the equipment is either mechanically- or manually-powered (examples include carts, four-wheel flatbed trucks, tuggers and driverless tractors). Under this method, there are two options: the long selection line, in which pickers range throughout the distribution center to pick an entire store order individually, or the short line, in which pickers stay within a zone and select only those items in their respective zones, then pass the items on to the staging area, where they are merged into a complete store order. The second method involves rotating equipment fixed in place, such as overhead or in-floor tow lines that attach to carts, or conveyor belts. This method is similar to the short line in that the distribution center is divided into zones, and products are picked separately in the zones, then merged at the staging area into complete orders. A third picking method consists of automated equipment. In this scenario, the distribution center is set up like a giant vending machine: products are stored, in their cases, in gravity-fed angled racks, and orders are picked by first releasing cases onto a series of conveyor belts, then merging the cases into a complete order at the staging area. These systems range from full human control to complete computer automation. Because the first two methods are the most common in the grocery industry today, the analysis in this thesis is based on human picking, i.e.,
rate: 182 cases per hour

Load Truck—"The time it takes to load warehouse pallets onto outgoing trucks for delivery to the stores...[including] the time it takes to strip the returning trailers, double up pallets on outgoing loads, and 'top off' loads."

rate: 23.93 pallets per hour

Occupancy (Space)—"The annual direct costs of operating the warehouse that can be assigned to a particular product category. Each product moving through the warehouse incurs space costs according to (1) the cubic feet that its average inventory occupies and (2) the amount of time it spends in the warehouse (days in inventory)."\textsuperscript{32}

Equipment—"The total annual direct costs of running and maintaining the warehouse equipment. Each product moving through the warehouse incurs equipment costs according to its case cube."

rate: $0.038 per cubic foot of product

Inventory—includes two parts:

Warehouse Inventory—"An estimate of the average amount of time, measured in days, that a unit of product remains in inventory at the warehouse."

rate: 12 days

Interest Rate—"The user's cost of money, as determined by management's philosophy and practice."\textsuperscript{33}

automated distribution centers are not considered in this thesis. (For a very effective description of the advantages and disadvantages of different distribution center selection options, see Kochersperger, \textit{Warehousing}, pp. 183-218.)

\textsuperscript{32}Occupancy costs include the expenses for capital assets (i.e., the building), as well as expenses for utilities, insurance, trash removal, indirect supervision and other operational expenses.

\textsuperscript{33}It is common logistics practice in many fields to combine the occupancy and inventory costs into one charge known as the carrying cost. This is the expense to maintain the inventory and is usually expressed as an annual percentage of the dollar value of the inventory; 25 percent is a commonly used rule-of-thumb. Included in this cost are storage, capital, insurance, taxes and obsolescence. Under the DPC model, the inventory cost refers purely to the financial cost of the capital used to purchase the product,
rate: 8.4 percent

Between the distribution center and the store is the transportation activity:

**Average Cost per Cubic Foot**—"The cost of shipping the product from the regular warehouse to the store." Note: incorporated in the calculation of the cost for this activity are the average quantity of product per load, which is 1307 cubic feet, and the average roundtrip haul distance per load, which is 120 miles.\(^{34}\)

rate: $0.16 per cubic foot

It is assumed that under both the current and the proposed systems, Product A is transported in a trailer which is drop-shipped\(^{35}\) at the retail outlet.

At the store, the activities are:

**Place Order**—"The time it takes stocking clerks to check the shelves for current inventory and then write and place the order for replacement product. This period should reflect the time it takes to prepare an order for a single SKU, regardless of the number of cases ordered."

rate: 9.29 seconds per delivery

**Receive**—"The time it takes stocking clerks to (1) unload and check in unitized pallets from the wholesaler/retailer's truck and (2) move the product into the store's backroom."

rate: 16.6 pallets per hour

---

while the other expenses are integrated into the occupancy cost. Depending on the assumptions of the party running the model, the inventory expense can be considered a straight interest charge, an opportunity cost, or some combination of these and other factors.

\(^{34}\)In some instances, the frequency of deliveries per week is also incorporated in the DPC calculations. In this thesis, the delivery frequency is assumed to remain constant under the proposed system, therefore this factor can be ignored.

\(^{35}\)Drop-shipping refers to leaving a loaded trailer at the destination and picking up a separate, empty one for the return trip to the origin. Distributors employ drop-shipping so that trailers can be unloaded at the store's discretion, without requiring that truck drivers stay at the store until this task is completed. Drop-shipping is very common in the grocery industry, primarily with dry grocery products.
**Sort and Load**—"The time it takes stocking clerks to sort incoming cases of product by aisle and load cases onto carts for delivery to the aisles."

rate: 9.23 seconds per case

**Move to Aisle**—"The time it takes stocking clerks to move loaded carts from the backroom to the aisle. The return time to the backroom [is also included]."

rate: 4.93 seconds per cubic foot

**Position Case for Opening**—"The time it takes stocking clerks to position cases for opening."

rate: 5.1 seconds per case

**Open Case**—"The time it takes stocking clerks to open a typical case."

rate: 5.2 seconds per case

**Price**—includes two parts:

**Setup**—"The time it takes stocking clerks to prepare to price a product. This includes positioning open case(s) and setting the stamper to the correct price."

rate: 5.02 seconds per delivery

**Variable**—"The time it takes stocking clerks to price each unit."

rate: 0.46 seconds per unit

**Place on Shelf**—includes two parts:

**Setup**—"The time it takes stocking clerks to stock the shelf. This includes positioning the case on the cart or in the aisle for efficient stocking and making room on the shelf for stocking."
rate: 12.77 seconds per delivery

**Item Stocking**—"The time it takes stocking clerks to take a consumer unit from the case and put it on the shelf."

rate: 1.80 seconds per item

**Clean Up Packing Material**—"The time it takes stocking clerks to clean up empty cardboard packing materials."

rate: 10.2 seconds per case

**Condition Shelf**—includes two parts:

**Time**—"The time it takes stocking clerks to arrange units flush with the front of the shelf."

rate: 0.26 seconds per item per occurrence

**Frequency of Occurrences**—"The number of times a week that stocking clerks condition the shelf."

rate: 6 occurrences per week

**Checkout**—includes five parts:36

**Ring Time**—"The average time it takes the cashier to ring a consumer unit, regardless of whether the store uses scanners."

rate: 2.44 seconds per item

**Set Up Bag, Set Aside Bag**—"The time it takes the bagger or the cashier to set up the empty bag and then put the full bag into the grocery cart."

---

36In addition to the activities listed, checkout also includes factors concerning (a) large products that do not require a bag, and (b) the percentage of transactions that involve a bagger (used to calculate a weighted average of store labor rates for the bagging activity). These factors are not included in the analysis in this thesis since it is assumed that (a) Product A is placed into a bag, and (b) there is a single wage rate at the store.
rate: 5.50 seconds per bag

**Put Consumer Unit in Bag**—"The time it takes the bagger or the cashier to put a consumer unit into the bag. The time for this activity begins when the product is picked up after being rung or scanned and ends when it is put in the bag."

rate: 2.05 seconds per item

**Average Space used in Bag**—"The average amount of space actually used in a grocery bag. When stores use both paper and plastic, a weighted average should be used."

rate: 0.56 cubic feet per bag

**Cost of Bag**—"The cost of a grocery bag. When stores use both paper and plastic, a weighted average should be used."

rate: $0.024 per bag

**Occupancy**—"The store shelf space and equipment occupancy costs per square foot of shelf display selling area." Note: incorporated in the calculation of the cost for this activity are shelf depth, which is 21 inches, and shelf packout\(^{37}\), which is 1.5 cases.

rate: $29 per square foot

**Inventory**—Same as distribution center inventory, except pertaining to the time the product spends in the store.

rate: 22 days

---

\(^{37}\)Shelf packout refers to the number of cases of a product that are housed on the supermarket shelf, when the shelf is fully stocked.
5.3.3.2. Results analysis

The results generated by the DPC model are shown in Table 5-2. The values in this table represent the actual costs that Product A imposes on the distribution system, by activity and by stage. For instance, the process of receiving Product A at the distribution center costs 0.09 cents, moving it to storage 0.13 cents, and so on. In sum, the total direct cost to distribute Product A, from the distribution center to the supermarket checkout counter, is 19.67 cents.

For the purposes of the analysis in this thesis, the most meaningful aspect of Table 5-2 is not so much the absolute dollar values of the activities, but rather their relationship to each other and to the activities of the proposed system. Thus the more pertinent column in Table 5-2 is the one to the far right, which lists the percentage breakdown of each cost relative to the total.\(^{38}\)

Upon examination of the percentage breakdowns in Table 5-2, it is plainly evident that of the three stages, the supermarket is by far the largest cost category, representing 83.9\% of the total cost. The other stages account for much lower percentages of the total cost: the distribution center expense represents 10.7\% of the total, and outbound transportation accounts for 5.4 percent.

Within both the store and the distribution center stages, labor and occupancy are the most important elements. For example, labor and occupancy (including equipment) account for 83.8\% of the distribution center expense, and 95.6\% of the supermarket cost.

However, because of the large difference between the store expense and the distribution center cost, the relative significance of the labor and occupancy functions differs tremendously depending on the stage at which the activities are undertaken. For instance, the expenses for labor and occupancy at the distribution center represents only 9.0\% of the total cost, while the same components at the store account for 80.2\% of the total. The main reasons for this wide gulf in relative importance are: (a) product handling is far more intensive at the store than at the distribution center, and (b) real estate and other

\(^{38}\)Note that the absolute dollar values for the activities change as the underlying assumptions are modified. However, as long as the modifications are reasonable, the percentage values do not vary considerably (i.e., the order of magnitude for the percentages remains nearly constant).
Table 5-2
ALLOCATION OF COSTS
UNDER CURRENT DISTRIBUTION SYSTEM

DISTRIBUTION CENTER

ASSUMPTIONS

<table>
<thead>
<tr>
<th>Activity</th>
<th>Rate</th>
<th>Cost/Item</th>
<th>PCT.</th>
</tr>
</thead>
<tbody>
<tr>
<td>LABOR</td>
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<td>$18.60</td>
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</tr>
<tr>
<td>CASE COUNT</td>
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</tr>
<tr>
<td>CASE CUBE</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Activity</th>
<th>Rate</th>
<th>Cost/Item</th>
<th>PCT.</th>
</tr>
</thead>
<tbody>
<tr>
<td>RECEIVE</td>
<td>24.40</td>
<td>$0.0009</td>
<td>0.5%</td>
</tr>
<tr>
<td>PUTAWAY</td>
<td>16.41</td>
<td>$0.0013</td>
<td>0.7%</td>
</tr>
<tr>
<td>REPLENISH SLOT</td>
<td>20.04</td>
<td>$0.0011</td>
<td>0.6%</td>
</tr>
<tr>
<td>SELECT CASE</td>
<td>182.00</td>
<td>$0.0066</td>
<td>3.3%</td>
</tr>
<tr>
<td>LOAD TRUCK</td>
<td>23.93</td>
<td>$0.0009</td>
<td>0.5%</td>
</tr>
<tr>
<td>TOTAL LABOR</td>
<td></td>
<td>$0.0108</td>
<td>5.5%</td>
</tr>
<tr>
<td>OCCUPANCY</td>
<td>12</td>
<td>$0.0043</td>
<td>2.2%</td>
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<tr>
<td>EQUIPMENT</td>
<td>$0.038</td>
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<td>1.3%</td>
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<tr>
<td>INVENTORY</td>
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<td>$0.0034</td>
<td>1.7%</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>$0.0210</td>
<td>10.7%</td>
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TRANSPORTATION

ASSUMPTIONS

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<th>PCT.</th>
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</thead>
<tbody>
<tr>
<td>COST</td>
<td>$1.74</td>
<td>/MILE</td>
<td>120 MI/ROUND TRIP</td>
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</tr>
<tr>
<td>CUBE</td>
<td>1307</td>
<td>CF/TRIP</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TOTAL TRANSPORTATION     $0.0107     5.4%
### Table 5-2

**ALLOCATION OF COSTS**

**UNDER CURRENT DISTRIBUTION SYSTEM**

**STORE**

**ASSUMPTIONS**

<table>
<thead>
<tr>
<th>Labor</th>
<th>Rate</th>
<th>Cost/Item</th>
<th>PCT.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shelves</td>
<td>$12.00/HR</td>
<td>$29.07/SQFT/FAC/YR</td>
<td></td>
</tr>
<tr>
<td>Shelves</td>
<td>21 INCHES</td>
<td>SPACE COST</td>
<td></td>
</tr>
<tr>
<td>Shelves</td>
<td>1.5 CASES</td>
<td>BACK ROOM</td>
<td></td>
</tr>
<tr>
<td>Bags</td>
<td>0.56 CF</td>
<td>$3.05/CF/YR</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Activity</th>
<th>Rate</th>
<th>Cost/Item</th>
<th>PCT.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Place Order</td>
<td>9.29 SEC/DEL</td>
<td>$0.0041</td>
<td>2.1%</td>
</tr>
<tr>
<td>Receive</td>
<td>16.80 PAL/HR</td>
<td>$0.0009</td>
<td>0.4%</td>
</tr>
<tr>
<td>Sort &amp; Load</td>
<td>9.23 SEC/CA</td>
<td>$0.0021</td>
<td>1.0%</td>
</tr>
<tr>
<td>Move to Aisle</td>
<td>4.93 SEC/CF</td>
<td>$0.0011</td>
<td>0.6%</td>
</tr>
<tr>
<td>Position Case</td>
<td>5.10 SEC/CA</td>
<td>$0.0011</td>
<td>0.6%</td>
</tr>
<tr>
<td>Open Case</td>
<td>5.20 SEC/CA</td>
<td>$0.0012</td>
<td>0.6%</td>
</tr>
<tr>
<td>Price Setup</td>
<td>5.02 SEC/DEL</td>
<td>$0.0011</td>
<td>0.6%</td>
</tr>
<tr>
<td>Price</td>
<td>0.46 SEC/ITEM</td>
<td>$0.0015</td>
<td>0.8%</td>
</tr>
<tr>
<td>Set Up Shelf</td>
<td>12.77 SEC/DEL</td>
<td>$0.0028</td>
<td>1.4%</td>
</tr>
<tr>
<td>Stock Item</td>
<td>1.80 SEC/ITEM</td>
<td>$0.0060</td>
<td>3.1%</td>
</tr>
<tr>
<td>Cleanup</td>
<td>10.20 SEC/CA</td>
<td>$0.0023</td>
<td>1.2%</td>
</tr>
<tr>
<td>Condition Shelf</td>
<td>0.26 SEC/ITEM</td>
<td>$0.0163</td>
<td>8.3%</td>
</tr>
<tr>
<td>Ring Time</td>
<td>2.44 SEC/ITEM</td>
<td>$0.0081</td>
<td>4.1%</td>
</tr>
<tr>
<td>Set Up Bag</td>
<td>5.50 SEC/BAG</td>
<td>$0.0022</td>
<td>1.1%</td>
</tr>
<tr>
<td>Put In Bag</td>
<td>2.05 SEC/ITEM</td>
<td>$0.0068</td>
<td>3.5%</td>
</tr>
<tr>
<td>Total Labor</td>
<td>$0.0577</td>
<td>29.3%</td>
<td></td>
</tr>
<tr>
<td>Bag Cost</td>
<td>$0.024 PER BAG</td>
<td>$0.0009</td>
<td>0.5%</td>
</tr>
<tr>
<td>Occupancy</td>
<td>22 DAYS</td>
<td>$0.1001</td>
<td>50.9%</td>
</tr>
<tr>
<td>Inventory</td>
<td>22 DAYS</td>
<td>$0.0063</td>
<td>3.2%</td>
</tr>
<tr>
<td>Total Store</td>
<td>$0.1650</td>
<td>83.9%</td>
<td></td>
</tr>
<tr>
<td>Total Distribution Center</td>
<td>$0.0210</td>
<td>10.7%</td>
<td></td>
</tr>
<tr>
<td>Transportation</td>
<td>$0.0107</td>
<td>5.4%</td>
<td></td>
</tr>
<tr>
<td>Total Store</td>
<td>$0.1650</td>
<td>83.9%</td>
<td></td>
</tr>
<tr>
<td>Grand Total</td>
<td>$0.1967</td>
<td>100.0%</td>
<td></td>
</tr>
</tbody>
</table>

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occupancy costs tend to be much higher, per square foot of floor-space, in a supermarket environment than at a distribution center.\textsuperscript{39}

The net result is that under the current system, the bulk of the total distribution cost—from distribution center to checkout counter—is accounted for by store labor and store occupancy. (Note that store occupancy has by far the largest share of any single component; indeed, by itself, store occupancy represents over half of the total cost.) Thus, it should be readily apparent that a distribution system which restructures these elements—in particular store occupancy—will enable a substantial reduction in the total distribution cost.

This analysis points up a major flaw of the ECR program, as discussed in Chapter Three: its scope is too narrow. To illustrate, Table 5-2 shows that the combined inventory cost at the distribution center and the supermarket represents only 4.9\% of the total distribution expense, as measured from the distribution center to the supermarket checkout counter. Although this proportion represents the end result of full implementation of ECR, a sensitivity analysis is conducted in the following section in which the inventory periods are increased to today's averages. That analysis will demonstrate that even under the present situation, the combined inventory expense represents only 7.9\% of the total cost.

Yet the inventory expense is exactly where the ECR program is focusing much of its efforts. Instead, it would seem that greater overall distribution savings can be gained by restructuring the most influential component (i.e., the supermarket) rather than a much smaller element (i.e., inventory). Indeed, this is exactly the type of restructuring proposed by this thesis.\textsuperscript{40}

5.3.3.3. Sensitivity analysis

\textsuperscript{39}The difference in occupancy costs stems mainly from the fact that supermarkets must be located close to where consumers live. For instance, a commonly used rule-of-thumb in the industry is that the market area radius of a conventional supermarket is approximately 2-3 miles. In contrast, distribution centers can be located where the costs (including real estate, labor and transportation) are lowest.

\textsuperscript{40}Two points should be reemphasized. First, ECR seeks to reduce cost throughout the supply channel; the program covers activities which are clearly beyond the scope of this thesis, such as the supply channel prior to the distribution center. Second, the proposal in this thesis is not intended to be a substitute for ECR; rather, it aims to build upon the strengths of the ECR program.
Empirical evidence exists with which to compare the DPC calculated for Product A. In the Marsh Super Study, the average DPC for non-edible grocery products was found to be $0.15.\textsuperscript{41} This result is about 28.1% lower than the cost calculated for Product A. Much of this disparity can probably be explained by the difference in inventory time at the supermarket: in the Super Study, non-edible grocery products cycle through in approximately 15 days, or 31.8% less time than that assumed for Product A. Because the other underlying assumptions of the Super Study were not provided, it is difficult to assess the source of the remainder of the discrepancy.\textsuperscript{42}

With respect to the assumptions of this thesis, note that as mentioned earlier, there are two types of elements which can be varied in the DPC model: the cost data and the activity data (i.e., the time to carry out activities). In terms of the cost assumptions, modifications are unnecessary in this thesis, for two reasons. First, any changes would result in figures which no longer represent national averages, and the work in this thesis is intended to be unbiased (i.e., this research is not meant to favor particular regions or companies). Second—more importantly—identical assumptions are employed in the analysis of the proposed distribution system in Chapter Six; thus on a comparative basis of the two systems, reasonable modifications of the cost assumptions would have little or no effect on the net outcome.

In regard to the activity data, modifications of some of these assumptions would have a substantial impact on the net outcome. Of particular importance is the assumption pertaining to the number of days that Product A spends in inventory. As noted, the goals of ECR for this category are employed as the inputs in this thesis, i.e., Product A is assumed to spend 12 days at the distribution center and 22 days at the supermarket. However, if the cycle times are changed to 40 days at the distribution center and 26 days at the supermarket in order to reflect the current situation,\textsuperscript{43} then the combined occupancy and inventory expense rises significantly. At the distribution center, the combined expense increases by 1.81 cents, and at the supermarket, by 1.93 cents. The overall cost thus rises

\textsuperscript{41}Garry, "Pathway," p. 53.

\textsuperscript{42}Note that the DPC values calculated in the Super Study are based on data supplied by five superstores owned by the same company—Marsh; hence, this data (including store cycle time) does not reflect national averages.

\textsuperscript{43}Efficient Consumer Response, p. 28.
by 3.74 cents to a total of 23.41 cents, which is 19.0 percent higher than the value entered in Table 5-2.

In terms of the other assumptions for activity data, these rates, like the cost data, also represent national averages which were last revised in 1993. Therefore, this researcher chose not to make any modifications to these assumptions.44

Overall, it should be clear that the DPC assumptions employed in this chapter are conservative, i.e., the assumptions are biased in favor of the current system. For example, had this researcher chosen to utilize the distribution system as it exists today—rather than as ECR proposes—as the basis for the current system, the distribution cost for the current system would be approximately 19 percent higher than that recorded in Table 5-2.

5.4. Summary

This chapter has investigated the current distribution system for grocery products in two ways: through a generalized description covering all products, and via an in-depth analysis of one sample product, for which the DPC model was used. It has been demonstrated in this chapter that a large proportion of the current distribution expense, from the time an item arrives at the distribution center until it is purchased by a consumer at the supermarket checkout counter, is concentrated solely in the supermarket. For the sample item, the supermarket expense was found to account for 83.9 percent of the total cost. This chapter has provided empirical evidence with which to compare the cost calculated for the sample product. This chapter has also established that the cost calculated for the current distribution system is based on very conservative assumptions.

44Note that the supplier (see Section 5.3.2.) utilizes this data on a regular basis; in fact, the company employs this data in negotiations with distributors.
Chapter Six

Proposed Distribution System

6.1. Introduction

This chapter examines the alternative distribution system for grocery products proposed in this thesis, by building on the information introduced in Chapter Five. A channel map—similar to the one presented in Chapter Five—is created for Product A, but in this chapter the channel map is used to analyze the costs and activities involved in the proposed system. This analysis illustrates two key aspects: first, the way in which functions and activities change with implementation of home grocery shopping; second, the estimated economic impact of these changes on the distribution process. By following the same format to analyze both the current and the proposed systems, it is possible to conduct an objective evaluation of the distribution costs of the two models.

This chapter is structured as follows. Section 6.2. provides a brief overview of the proposed system, as well as a short discussion about other home grocery shopping services; this section will illustrate the key differences between the home grocery shopping concept proposed in this thesis and other services. Section 6.3. renders the channel map analysis of the proposed distribution system. By individual stage, this section offers a comprehensive examination of the proposed system, a comparative analysis relative to the current system, and a sensitivity analysis. Section 6.4. summarizes the findings from Section 6.3. so that the aggregate costs under each system can be compared. In addition, this section discusses the degree to which the findings for Product A can be scaled across other grocery products, and calculates an estimate of the net savings based on typical household spending on grocery products. Section 6.4. also analyzes the benefits to consumers, such as increased convenience, that result from home grocery shopping. Section 6.5. considers the issue of the expense for telecommunications network access, which is treated differently than the costs involved in other activities. Section 6.6. examines different approaches with respect to distributing the cost savings of the proposed system, i.e., the effect on the consumer and the distributor of different sharing strategies.

This chapter will demonstrate that new value can be created by fundamentally restructuring the grocery product supply channel. In the long term, the gains are likely to
measure in the billions of dollars. Significantly, the benefits of the proposed system will accrue to both consumers and distributors—as well as other companies involved in the grocery industry.

For instance, this chapter will show that the proposed system enables at least a sixty percent reduction in the total amount of time that consumers expend on the activity of grocery shopping. In addition, home grocery shopping is likely to create an overall shopping experience that most consumers find much more pleasant than that available in a supermarket-based system. And for distributors, this chapter will demonstrate that if these company retain just a small fraction of the cost savings generated by the proposed system, they will be able to increase their net profitability by a factor of one hundred percent or more relative to the current system.

But, in what is perhaps the most exciting aspect of this proposal, this chapter will also demonstrate that these gains can be achieved at no added cost, either to the consumer or to the distributor. In fact, not only does the cost not rise, it is likely that under the proposed system the total expense will actually be reduced, due to the many efficiencies that home grocery shopping enables. Note that this is true even after the cost for new telecommunications technology has been incorporated into the total expense.

This chapter will also show that the benefits of the proposed system extend far beyond those offered by ECR. Primarily, this outcome results from linking the consumer directly into the supply channel. Such integration enables the realization of benefits that are simply not available in a supermarket-based system. Indeed, even assuming ECR Phase II as the base case for the current system, the proposed system offers significant advantages in a variety of areas, including distribution, which is discussed in this chapter, as well as marketing, production, sales volume and product quality, all of which are examined in Chapter Seven. In aggregate, many of the gains—in both this chapter and Chapter Seven—could be highly significant, with potential long term benefits likely to be measured in the billions of dollars.¹

There are many explanations as to why the proposed system leads to both a sub-

¹It is important to note that some of the benefits of the proposed system are long term in nature, i.e., they will only become evident when a large number of consumers shop via home grocery shopping; other gains will be available from the launch of the first home grocery shopping operation. This chapter and Chapter Seven will distinguish short term from long term gains.
stantial increase in value and a sizable reduction in cost. This chapter investigates the enabling factors thoroughly. The key overriding element is that these benefits are made possible by fundamentally rethinking the structure and organization of the grocery product supply channel.

Yet from a distribution perspective, the proposed system is in many ways similar to efforts undertaken in a variety of industries, including the grocery industry. Essentially, this researcher is proposing nothing more than the creation of an integrated supply channel in which product flow is driven by the end user—i.e., the consumer—and in which non-value-adding activities are eliminated; note that this is very similar to the goals put forth in the ECR report.² What is innovative about this work, from a distribution perspective, is the idea of extending the supply channel beyond the supermarket, to link the consumer—at the home—directly into the distribution process.

6.2. Home grocery shopping

6.2.1. Brief description of the proposed system

Before beginning an analysis of the proposed distribution system, it is beneficial to describe what it might look like. The model in this chapter involves the following:³ a facility, designed to enable product picking by the individual item, is assembled either within or adjacent to the current distribution center; this operation is linked into a high-capacity telecommunications network, which also connects to homes, offices and other locations; highly sophisticated software is employed to convert electronic orders generated by consumers into the equivalent of a pick sheet at the distribution center; individual consumer orders are picked by distributor employees into reusable totes, each of which has some form of identification, such as a bar code label, applied to the side; and the totes are transported to a location selected by the consumer.

In the model in this chapter, it is assumed that the totes are transported to a neighborhood pick-up facility, known hereafter as an order pickup. This facility differs radically from a supermarket in several essential aspects. First, the order pickup is closed

² Refer to Chapter Three for a discussion about ECR.

³ This is a generalized overview; more detail is provided in ensuing sections.
to public access—employees bring the order to the consumer, either directly to the car if so desired, or to a walk-up counter. Second, the order pickup has far less floor space than a supermarket—the order pickup is at least 60 percent smaller than a conventional supermarket, and over 75 percent smaller than a superstore. Third, the amount of surrounding land is greatly reduced, since the facility is essentially a drive-through operation. Fourth, relative to a supermarket, the order pickup houses very little inventory on-site.

Although the model in this chapter is based on the use of an order pickup, there are other destination possibilities for customer orders, including "mail stops" and the home. As Chapter One mentioned, these options are not incorporated into the model used for the channel analysis in this thesis. However, the structure and economics of these options should be investigated in the same manner that the order pickup is examined in this thesis. Therefore, these distribution methods have been identified as areas for future research.

6.2.2. Background of other home grocery shopping services

The home grocery shopping concept as proposed in this thesis may or may not be unique—it depends on one's perspective. For example, self-service supermarkets began operations in the early 1930s; for many years prior to this time, consumers would phone or drop off their orders at the corner grocery store, and the grocer would do all of the order picking for them. The consumer would then go to the store and pick up the order directly or, more than likely, the grocer would deliver it to the home. Although having grocers pick orders at local stores is not the same as having the orders picked at large distribution centers, there are definitely some analogies.

On the other hand, a review of current and planned home grocery shopping efforts has shown that this proposal differs significantly from others for which information is

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4 In other words, the order pickup does not require a large tract of land to house parked cars for extended periods of time.

5 The mail stop is a pure pick-up-only depot. No inventory is stored at the mail stop; the only items housed at this facility are completed customer orders.

6 It is important to note that home grocery shopping and home delivery are two distinct functions. Home delivery can be provided as an add-on service; relative to customer retrieval at the order pickup, the service would most likely result in a fee for the consumer. However, it must be stressed that home delivery is not integral to the home grocery shopping concept as proposed in this thesis.
publicly available. The main reason is that other home grocery shopping services are either layered on top of the existing supermarket-based distribution system, or else they are niche operations; either way, these services do not impart truly significant change upon the supply process. In contrast, the proposal in this thesis calls for a genuinely novel distribution system which also appeals to the consumer mass market.

To illustrate, consider other home grocery shopping services. These services can be divided into two categories: bulk goods and supermarket-based.\(^7\) Bulk goods operations are not supermarket-based, so in this sense they similar to the proposal in this thesis. However, for a variety of reasons, these services tend to be niche operations which appeal to a very small segment of the population.\(^8\) Thus, they are truly limited in their ability to effect basic change, and any distribution system restructuring that these services might offer is considerably less comprehensive and far-reaching than that proposed in this thesis.

The other home grocery shopping services are supermarket-based. With these services, a surrogate shopper selects the customer’s order off of store shelves—just like the neighborhood grocer did seventy years ago. Nothing has changed except the way the customer does the ordering: previously it was by the phone, now it might be via the personal computer or through a television monitor.\(^9\)

In general, the strategic shortcoming of other home grocery shopping services is that they appear to be designed primarily—possibly exclusively—around the goal of increasing consumer convenience, rather than the far broader goal of restructuring the distribution system. By not adopting a more global perspective, other home grocery shopping services tend to end up adding to the total distribution expense, usually by a substantial amount.

\(^7\)Refer to Appendix A for a detailed analysis of other home grocery shopping efforts.

\(^8\)The consumer appeal of the bulk goods services is limited primarily by the fact that they do not sell individual items in less than half case quantities; also, these services tend to require that the consumer purchase a minimum of several hundred dollars worth of products with each order. In general, most customers of bulk goods services use such services occasionally (i.e., two to three times a year) to stock up on a narrow assortment of grocery products. See Appendix A for more information.

\(^9\)Note that "drive-through supermarkets" exist in some areas. In general, these operations are dissimilar from home grocery shopping in that they are not geared toward (and many do not even allow) advanced ordering from the home. However, in one very important aspect, drive-through supermarkets are similar to existing home grocery shopping services: primarily, these businesses operate as an add-on to the current distribution system.
For example, home delivery is an integral aspect of every home grocery shopping service examined by this researcher. However, home delivery imparts a significant added expense. More relevant to the proposal in this thesis is that, if consumers are ordering from their homes, it is obviously very inefficient to first stock grocery products onto store shelves only to later pick the items off of those same shelves; rather, it would be far more efficient to not stock the products in the supermarket in the first place—indeed to eliminate the supermarket altogether. Essentially, other home grocery shopping services appear to be so focused on the sole goal of maximizing consumer convenience that they basically exclude the removal of cost from the distribution system.

In contrast, this thesis proposes a fundamental restructuring of the distribution system for grocery products. Home grocery shopping as proposed in this thesis does not operate out of existing supermarkets; instead, this proposal embodies an altogether new method of distribution. This restructuring not only increases consumer convenience, it also—of equal if not greater importance—provides for a substantial decrease in total distribution system cost. Therefore, it should be clear that the system proposed in this thesis is far more than simply a novel way to order grocery products from the home.

6.3. Analysis of the proposed system

6.3.1. Background

The analysis in this chapter is based on the same methodology employed in Chapter Five. A channel map is created, beginning at the distribution center, for Product A. The activities involved in the proposed distribution system are analyzed, and the associated costs are derived using the DPC model. Several activity costs are developed independently by this researcher; these will be noted as they arise.

Many of the activities integral to the proposed distribution system are radically different from those in the present supermarket-based system. In fact, one could make a strong case that almost all aspects of a distributor's operations would require some modification. However, the analysis in this thesis is concentrated on four—albeit major—functional areas: the distribution center, store operations, computer-related

10 Approximately twenty to thirty home grocery shopping services have been investigated.
activities and telecommunications network access. Each of these functions will be thoroughly examined in turn.\textsuperscript{11}

The format in this chapter differs from that in Chapter Five. In this chapter, each functional area is analyzed individually, in three subsections: (a) description of the activities under the current and the proposed systems; (b) cost analysis, including a comparison to the current system; and (c) sensitivity analysis. This discussion will serve to highlight the ways in which the activities and costs change under the proposed system.

It is important to point out that the network access function is treated differently from the other functions. In contrast to the other activities, this thesis does not derive an explicit allocated cost for network access. The reason stems from the analysis in Chapter Four. As that chapter discussed, there exists a range of different advanced network technologies that telecommunications providers can deploy, and each technology has its own cost characteristics. The assumption made in Chapter Four was that the total network access cost for advanced infrastructure enabling home grocery shopping is $18 per household per month, regardless of which telecommunications technology is actually installed.

However, Chapter Four did not determine what the actual network access cost would be for the home grocery shopping application. Indeed, rather than make a judgment as to the access cost incurred by home grocery shopping, this researcher has chosen to employ a different methodology. What this thesis will do, in Section 6.4., is document the total savings—both costwise and timewise—that the proposed distribution system offers compared to the current system. Then, in Section 6.5., these savings will be related to the assumed overall cost for network access (i.e., $18 per household per month). This analysis will demonstrate the potential impact that home grocery shopping can have on the total expense to deploy an advanced telecommunications network to the home.

\textbf{6.3.1.1. Assumptions and other important issues}

Before analyzing the proposed system, there are several important issues which must be addressed. The first matter concerns distributor functions which are not explicitly included in the channel map analysis. These include such functions as general and

\textsuperscript{11}Outbound transportation is also analyzed in detail, but as Section 6.3.3. demonstrates, this component does not change as dramatically as the other functions under the proposed system.
administrative, merchandising, data processing not related to home grocery shopping, and buying; collectively, as mentioned in Chapter Five, these items are known as the general ledger. The impact that the proposed system is likely to have on these activities is examined in Section 6.3.6. However, to be conservative, this researcher assumes that the cost for any activity which is not explicitly included in the channel map analysis remains constant under the proposed system.\textsuperscript{12}

The second issue pertains to the speed with which customer orders are processed by the distributor. From a marketing perspective, it would be beneficial—possibly imperative—for the distributor to offer same day, or at least overnight, order fulfillment.\textsuperscript{13}

Clearly, a certain amount of time, to be determined, is necessary to process orders. Today, well-managed distributors can pick an entire supermarket order in under six hours; a similarly well-run home grocery shopping operation might allow an equivalent level of consumer orders to be picked in a comparable amount of time. Even if the necessary picking time increases by fifty percent under the proposed system, it would still be possible for the distributor to offer overnight service.\textsuperscript{14} Thus, this thesis assumes that any order transmitted by midnight will be ready for customer retrieval the following morning (presuming, of course, that the distributor employs an early morning delivery schedule).\textsuperscript{15} Note that under some scenarios, same day service may even be available.\textsuperscript{16}

\textsuperscript{12}As Section 6.4.1. will show, the proposed system is likely to lead to cost reductions in a variety of distributor functions not included in the channel map analysis; hence, the constant cost assumption is conservative.

\textsuperscript{13}Although this thesis does not have any empirical evidence, it would seem somewhat unreasonable to ask customers to wait two days or more, under normal circumstances, to receive their orders.

\textsuperscript{14}Note that orders will be received throughout the day, thereby granting the distributor considerable flexibility in the picking operation. Indeed, most customers are likely to order well before midnight.

\textsuperscript{15}This is a shorter amount of time than that needed by other home grocery shopping services currently in operation. For example, one of the leading home delivery services examined in this thesis—Shoppers Express—requires that orders be received by 10 PM for next-day \textit{afternoon} delivery (see Appendix A).

\textsuperscript{16}Many distributors currently make more than one delivery per day to individual supermarkets. A home grocery shopping distributor that operates similar delivery frequencies to order pickups would be able to provide customers with same day service. For instance, a customer could transmit his or her order in the morning, then retrieve it on the way home from work. Alternatively, a different home grocery shopping model involves housing inventory at the order pickup, and executing all picking at this facility. In that scenario, same day service can be guaranteed (the tradeoff is that because additional product is stored at the facility, the distribution cost is likely to be higher than it is for the model analyzed in this chapter). Another option would be for the distributor to offer a two-tiered system in which certain products are
The third issue concerns the type of products that are picked at the distribution center under the proposed system. Most perishable products, such as meat, produce, frozen foods and dairy, must be maintained in a temperature-controlled environment. To pick these items into individual customer orders, the distributor essentially has two options: centralized picking at the distribution center (similar to the activity for dry grocery products), or distributed picking at each order pickup. The dilemma is that centralized picking of perishable goods adds tremendously to the logistical complexity of the system, but at the same time, this arrangement is also likely to offer the greatest reduction in cost (as with dry grocery products).

To be conservative, it is assumed in the model in this chapter that dry grocery products are picked at the distribution center, and perishable items are picked at the order pickup. Thus the order pickup houses an inventory of perishables on-site, though for reasons explained in Section 6.3.4., the inventory level is lower than that found in a comparable supermarket. When the customer order is transmitted, the distributor's computer automatically breaks the order down by category, and assigns the relevant portions to the appropriate location for picking. Thus when the customer arrives at the order pickup, all items are already prepicked and ready for retrieval.

In terms of the cost analysis in this chapter, it is sufficient to state that the savings established for Product A may not be fully applicable to perishable products. Section 6.4. will discuss the matter of quantifying cost savings in more detail.

The fourth matter pertains to the number of home grocery shopping customers that the distributor serves. In order to address this issue, it is critical to consider the time horizon. Over the long run, home grocery shopping may become very popular; indeed, the proposed system may actually become the dominant mode of supply for grocery products. In the short to medium term however, consumers' acceptance of home grocery shopping is likely to be somewhat limited.

With this in mind, the distributor in the model is assumed to serve 10 percent of its overall customer base through home grocery shopping. The reason is that this distributor is currently very large: it operates 100 supermarkets, and supplies a total of 270,000

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housed at the order pickup and are available for same day retrieval, while other items are stored solely at the distribution center and have to be ordered the day prior to retrieval.
households per week. In the near term—perhaps three to five years after launch—inducing 10 percent of this large a base of customers to use home grocery shopping would appear to be a realistic goal. In the long run, if home grocery shopping achieves broad-based market appeal, then obviously a much larger percentage of the distributor's customer base will utilize the service. The net result is that in the analysis in this chapter, the distributor is assumed to serve 27,000 home grocery shopping households per week, but with the caveat that the number could expand significantly in the long term.

In terms of the number of orders, this thesis assumes that each household shops for grocery products via the proposed system once per week, thus resulting in an average of 27,000 orders per week at the distribution center. With respect to the number of items per order, this value is calculated as follows. The total dollar value of each order averages $68, of which the dry grocery portion represents 50-60 percent (see section 6.4.1.). Assuming that the retail price averages $1.56 per item (i.e., the price for Product A—see section 6.3.5.2.4.), each order thus contains an average of 22 to 26 dry grocery items. To be conservative, this thesis assumes that the number of items per order is 30.

6.3.2. Distribution center

6.3.2.1. Description of activities

The first stage in the analysis of Product A is the distribution center. Currently, as was described in Chapter Five, products are picked by the case, assembled into pallets, then transported to the supermarket. Under the proposed system, the functions carried out at the distribution center expand greatly. The biggest change is that products are picked by the individual unit. After picking, the items are placed into totes, which are staged onto pallets. Thus it is the totes, rather than cases, which are then transported to the order pickup.

As envisioned by this researcher, the way in which order picking takes place is as follows. The distributor establishes a picking area, or selection unit, at the distribution center.\(^{17}\) The selection unit is assumed to be housed under the same roof as the main

\(^{17}\)Note that it is assumed that the distributor serves 27,000 home grocery shopping customers per week. To meet this demand, the distributor may need to establish more than one selection unit. The actual number of orders that can be processed by one selection unit will be determined with implementation of home grocery shopping.
distribution center; this can be achieved either by reorganizing the existing facility or by constructing a connected wing.\textsuperscript{18}

In the selection unit, products are stored in open cases in angled, gravity-fed racks, and the racks are approximately five to six feet high. Activities carried out in this area, including picking and restocking, are performed manually. As in the main section of the distribution center, the selection unit is designed for distribution efficiency. Thus the middle racks throughout are reserved for high volume items, and the fastest moving goods are positioned close to the staging area. Another feature incorporated into the selection unit is one-way-only movement through the aisles.

A big difference between the selection unit and the main part of the distribution center is that the selection unit is primarily designed to meet human needs, not the requirements of machinery. Therefore, the aisles are much narrower than those typically found in a distribution center, which must accommodate forklifts and other large equipment.

Restocking of the selection unit is achieved in a manner similar to the way in which supermarket orders are currently prepared, i.e., mixed pallet loads of full cases are assembled in the main part of the distribution center. The difference is that instead of being placed onto trucks, the pallets are transported to the selection unit, where the cases are stocked into the correct picking slots.

Picking items into totes is wholly a manual operation. Similar to the process in the pallet storage area, a picker uses a pick sheet to identify, in sequential order, the exact location of each product needed. To move the totes around, the picker pushes a wheeled cart. With respect to the picking activity, this researcher assumes the following: (a) each customer order is picked solely by one picker, i.e., the long selection line; (b) multiple picking is employed, i.e., each picker picks several—to be determined—customer orders at a time.

Table 6-1 provides an illustration of distribution center activities under the current

\textsuperscript{18}This is the short term scenario. In the long run, with sufficient volume, the distributor is likely to construct distribution center facilities dedicated to the needs of the home grocery shopping business. (See section 6.3.2.3.3.)
Table 6-1
CLASSIFICATION OF ACTIVITIES
UNDER CURRENT AND PROPOSED SYSTEMS

DISTRIBUTION CENTER

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>CURRENT RATE</th>
<th>PROPOSED RATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>RECEIVE</td>
<td>24.40 PAL/HR</td>
<td>24.40 PAL/HR</td>
</tr>
<tr>
<td>PUTAWAY</td>
<td>16.41 PAL/HR</td>
<td>16.41 PAL/HR</td>
</tr>
<tr>
<td>REPLENISH SLOT</td>
<td>20.04 PAL/HR</td>
<td>---</td>
</tr>
<tr>
<td>REPLENISH CASE</td>
<td>---</td>
<td>86.76 CA/HR</td>
</tr>
<tr>
<td>SELECT CASE</td>
<td>182.00 CA/HR</td>
<td>---</td>
</tr>
<tr>
<td>SELECT ITEM</td>
<td>---</td>
<td>11.02 SEC/ITEM</td>
</tr>
<tr>
<td>LOAD TRUCK</td>
<td>23.93 PAL/HR</td>
<td>23.93 PAL/HR</td>
</tr>
<tr>
<td>OCCUPANCY</td>
<td>12 DAYS</td>
<td>12 DAYS</td>
</tr>
<tr>
<td>EQUIPMENT</td>
<td>$0.038 /CF</td>
<td>$0.230 /CF</td>
</tr>
<tr>
<td>INVENTORY</td>
<td>12 DAYS</td>
<td>12 DAYS</td>
</tr>
</tbody>
</table>

KEY TO ABBREVIATIONS

CA       CASE
CF       CUBIC FOOT
PAL      PALLET
system and under the proposed system. The table shows that the proposed system results in several changes at the distribution center. First, three activities have been added:

**Replenish Case**—"The time it takes to (1) take cases from reserve storage to the picking slot and (2) place them in the picking slot, one case at a time." rate: 86.76 cases per hour

**Select Item**—The time it takes to (1) get the picking order papers, (2) walk to the picking slot, (3) pick the required number of units from the first slot and put them in the tote(s), (4) walk to the next slot and repeat the picking process until the order is complete, and (5) prepare the full totes for delivery to the order pickup. This activity also includes the time needed to affix bar code labels on each tote, and the time needed to clean up packing material.

rate: 11.02 seconds per item

**Tote Cost**—The cost of the tote, based on (1) the capital and operational tote costs, (2) the number of times the tote is reused, and (3) the space that the product occupies in the tote. (See the following section for a derivation of the tote cost.)

Second, two activities which are part of the current system have been deleted: "Replenish Slot" and "Select Case." Third, both the space cost rate and the rate for "Equipment" have been modified upward, to $3.94 and $0.230 per cubic foot of product, respectively. These changes have been made so as to account for (a) the fact that home

---

19 Unless otherwise noted, the cost and activity rates used in the DPC model in this chapter are provided by the same source that supplied the input data used in Chapter Five. It is important to point out that the data in this chapter which pertain to the activities of item selection and transportation of totes are based on nationwide surveys of firms that presently engage in such operations.

20 Defined by FMI for the DPC model.

21 This explanation is adapted from FMI's definition of "Select Case."
grocery shopping incorporates at least one selection unit, which requires additional equipment relative to the current system, and (b) the possibility that additional distribution centers may be necessary under the proposed system (see Section 6.3.2.3.2.). Other than these three major changes, the activities and rates under the proposed system are identical to those under the current system.

6.3.2.1.1. Derivation of the tote cost

The proposed system incorporates the use of totes for item picking. In this thesis, the cost for such equipment is designated as a distribution center expense.

There are a variety of totes that a home grocery shopping distributor can utilize. Currently, a number of companies, such as service merchandisers and pharmaceutical suppliers, employ totes to handle grocery products and similar items. These companies generally utilize stackable, plastic totes that have attached lids.

A leading supplier of such totes offers them in a variety of sizes. This company also supplies the totes with a design that allows them to fit into interlocking spaces on specially-built pallets, enabling the totes to be efficiently shipped.23

According to this company, the typical capacity of a tote used in a system analogous to the home grocery shopping system is approximately 2.20 cubic feet. For a tote of this size, the company charges $7 to $10 per tote, depending on the number of totes purchased. The company estimates that at a usage rate of one to two times per week, each tote can last seven years or more.24

22 When utilizing the DPC model, facilities that pick by the individual unit use a version of data known as the repack composite, while the standard version is known as the dry grocery composite. According to the source of the input data, the nationwide average equipment cost for the repack composite was $0.115 per cubic foot of product in 1993. To be conservative, this researcher assumes that the equipment expense for the selection unit used in the model in this thesis is two times the national repack average. Note that the repack equipment rate is significantly higher than the dry grocery rate due to the fact that item picking requires a greater amount of equipment per cubic foot of product than does case picking.

23 Interview with a representative of a tote supplier, April, 1994.

24 Ibid.
This researcher estimates that with efficient packing, one to two totes would be sufficient to house the dry grocery portion of a $68 order. Since dry grocery and perishable products are likely to be housed in separate totes, this researcher assumes that each customer order thus requires the use of three 2.20 cubic feet totes, two for dry grocery products and one for perishables.

The tote cost allocated to Product A is derived as follows. Assuming an average purchase price of $8.50 per tote, a usage rate of once per week, and a life span of seven years, the tote capital cost per use is 2.34 cents. In addition, other expenses result from the utilization of totes. For example, the totes must be recycled back to the distribution center and periodically cleaned (the tote supplier estimates that totes are cleaned 2 to 10 times a year); identifying bar code labels must be purchased, as well as affixed and removed with each use; and the distributor is likely to purchase a number of the corresponding pallets. Altogether, this researcher estimates that these costs account for an additional 7.5 cents per use,\(^{25}\) for a total of 9.84 cents per tote per use.

In terms of Product A, the theoretical packing density is 33 units per tote; however, this researcher assumes that because of oddly shaped products, it will be impossible to utilize the full space available. Instead, it is assumed that the packing density is the equivalent of 27 units of Product A, or 81.8 percent of tote capacity. The net tote cost allocated to Product A is thus 0.36 cents.\(^{26}\)

6.3.2.2. Cost analysis

Table 6-2 tabulates the costs for activities carried out at the distribution center under both the current and the proposed systems. Also shown in the table is the percentage change in each cost under the proposed system, where applicable.

---

\(^{25}\)This cost is calculated as follows. Each time a tote is returned old labels must be stripped off. This researcher estimates that the time required to complete this activity is 7 seconds per tote. At the assumed distribution center labor rate ($17.91 per hour) this activity costs 3.5 cents per tote. Labels are conservatively assumed to cost 1 cent each. Periodic cleaning should cost less than 0.5 cents per tote use on an allocated basis. The replacement cost for lost or stolen totes is estimated to be one half the tote capital expense, or 1.2 cents per use. These expenses thus total to 6.2 cents. To be conservative, this researcher assumes that the total cost for these elements is actually 7.5 cents.

\(^{26}\)Note that this is the tote cost resulting from the use of totes solely within the distributor's operation. Section 6.3.4.3. examines the costs involved in also using totes for customer retrieval of orders.
### Table 6-2

**Allocation of Costs**
**Under Current and Proposed Systems**

### Distribution Center

#### Assumptions

<table>
<thead>
<tr>
<th>Component</th>
<th>Current</th>
<th>Proposed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labor</td>
<td>$17.91</td>
<td>$18.60</td>
</tr>
<tr>
<td>Case Count</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Case Cube</td>
<td>1.0</td>
<td>CF</td>
</tr>
<tr>
<td>Cases</td>
<td>55 /UL</td>
<td></td>
</tr>
<tr>
<td>Space Cost (Curr)</td>
<td>$ 1.97</td>
<td>/CF/YEAR</td>
</tr>
<tr>
<td>Space Cost (Prop)</td>
<td>$ 3.94</td>
<td>/CF/YEAR</td>
</tr>
<tr>
<td>Interest Rate</td>
<td>8.40%</td>
<td></td>
</tr>
</tbody>
</table>

#### Current vs. Proposed

<table>
<thead>
<tr>
<th>Activity</th>
<th>Cost/Item</th>
<th>% Tot</th>
<th>Cost/Item</th>
<th>% Tot</th>
<th>Cost Diff</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receive</td>
<td>$0.0009</td>
<td>4.2%</td>
<td>$0.0009</td>
<td>0.9%</td>
<td>$0.0000</td>
<td>0.0%</td>
</tr>
<tr>
<td>Putaway</td>
<td>$0.0013</td>
<td>6.3%</td>
<td>$0.0013</td>
<td>1.3%</td>
<td>$0.0000</td>
<td>0.0%</td>
</tr>
<tr>
<td>Replenish Slot</td>
<td>$0.0011</td>
<td>5.1%</td>
<td>---</td>
<td>---</td>
<td>($0.0011)</td>
<td>-100.0%</td>
</tr>
<tr>
<td>Replenish Case</td>
<td>---</td>
<td>---</td>
<td>$0.0138</td>
<td>13.4%</td>
<td>$0.0138</td>
<td>---</td>
</tr>
<tr>
<td>Select Case</td>
<td>$0.0066</td>
<td>31.2%</td>
<td>---</td>
<td>---</td>
<td>($0.0066)</td>
<td>-100.0%</td>
</tr>
<tr>
<td>Select Item</td>
<td>---</td>
<td>---</td>
<td>$0.0548</td>
<td>53.4%</td>
<td>$0.0548</td>
<td>---</td>
</tr>
<tr>
<td>Load Truck</td>
<td>$0.0009</td>
<td>4.3%</td>
<td>$0.0009</td>
<td>0.9%</td>
<td>$0.0000</td>
<td>0.0%</td>
</tr>
<tr>
<td>Total Labor</td>
<td>$0.0108</td>
<td>51.2%</td>
<td>$0.0717</td>
<td>69.8%</td>
<td>$0.0609</td>
<td>566.2%</td>
</tr>
<tr>
<td>Occupancy</td>
<td>$0.0043</td>
<td>20.5%</td>
<td>$0.0086</td>
<td>8.4%</td>
<td>$0.0043</td>
<td>100.0%</td>
</tr>
<tr>
<td>Equipment</td>
<td>$0.0025</td>
<td>12.0%</td>
<td>$0.0153</td>
<td>14.9%</td>
<td>$0.0128</td>
<td>505.3%</td>
</tr>
<tr>
<td>Tote</td>
<td>---</td>
<td>---</td>
<td>$0.0036</td>
<td>3.5%</td>
<td>$0.0036</td>
<td>---</td>
</tr>
<tr>
<td>Inventory</td>
<td>$0.0034</td>
<td>16.3%</td>
<td>$0.0034</td>
<td>3.3%</td>
<td>$0.0000</td>
<td>0.0%</td>
</tr>
<tr>
<td>Total</td>
<td>$0.0210</td>
<td>100.0%</td>
<td>$0.1027</td>
<td>100.0%</td>
<td>$0.0817</td>
<td>388.3%</td>
</tr>
</tbody>
</table>

175
It is evident from Table 6-2 that the total cost at the distribution center is significantly higher under the proposed system than under the current system. From a total of 2.10 cents under the current system, the distribution center expense rises to 10.27 cents under the proposed system, for a net increase of 388.3 percent.

This increase is entirely attributable to the addition of new activities. For example, of the activities which are part of both systems, "Equipment" and "Occupancy" are the only ones for which the costs have changed. But these gains are directly attributable to the need for additional equipment and space under the proposed system. For each of the other activities which are part of both systems, the cost remains constant. Thus the net increase in the distribution center expense is wholly due to the addition of new activities.

Of the new activities, it is clear that the labor involved in picking products by the item accounts for the bulk of the gain. For example, the activities "Select Item" and "Replenish Case" represent 61.4% and 15.5 percent, respectively, of the total increase. The new equipment required for the selection unit is also a significant factor, accounting for 14.3% of the gain. The costs for the other activities—occupancy and the tote—represent smaller shares of the overall rise, 4.8% and 4.0 percent, respectively.

One interesting observation is that because the new activities are so labor-intensive, the ratio of labor expense to total cost has risen substantially. Under the current system, labor-related activities account for 51.2 percent of the total expense; under the proposed system, the ratio is at least 69.8 percent.27 The long term effect of this increase in the relative magnitude of the labor cost may be to provide impetus for the deployment of automated distribution centers.28

Table 6-2 also illustrates the effect of one of the conservative assumption made by this researcher: for functions affected by ECR, the proposed system does not result in any benefit additional to that which can be achieved through ECR. Thus the time that Product A spends at the distribution center is assumed to remain unchanged under the proposed system. The following section conducts a sensitivity analysis of the distribution center expense, including the effect of relaxing various assumptions. As that section will show,  

\[27\] Note that some of the "Tote" cost is labor-related.  

\[28\] As was discussed in Chapter Five, automated distribution centers have been purposely excluded from the analysis in this thesis so as to maintain conservative consistency.
the distribution center cost under the proposed system is probably significantly inflated in Table 6-2.

6.3.2.3. Sensitivity analysis

Table 6-2 illustrated that the total distribution center cost rises by over 388 percent under the proposed system. However, there are many factors which, taken together, may cause the expense to rise by a lesser amount; indeed, some factors may actually lead to a reduction in distribution center expenditures under the proposed system. These influences will be analyzed in this section, in terms of the three main elements of the distribution center: labor, inventory and occupancy.

6.3.2.3.1. Distribution center labor

For most of the labor activities listed in Table 6-2 under the proposed system, the rates appear reasonable (refer to Section 6.3.2.1). However, for one activity, "Select Item," the rate used in the analysis—11.02 seconds per item—is most likely too high. Based on this rate, the total time required per customer order (assumed to contain 30 items each) is 5.5 minutes. As mentioned, this rate stems from nationwide surveys of companies that have operations already set up to pick by the unit. However, it is unclear whether such facilities incorporate into their operations all of the features aimed at increasing efficiency which are included in the selection unit design, i.e., one-way flow, volume slotting, and—most importantly—multiple order picking. Indeed, since the selection unit would be a new operation for the distributor, it would probably have numerous state-of-the-art features that are unlikely to be present in current facilities.

Thus the picking rate employed in this thesis is most likely conservative. If the rate is reduced by 25 percent, for example, to 8.27 seconds, then the cost for the picking activity decreases by 1.37 cents, to 4.11 cents. This leads to a similar reduction in the total distribution center expense, to 8.90 cents, for a net decrease of 13.3 percent from the value tabulated for the proposed system in Table 6-2.29

6.3.2.3.2. Distribution center inventory

29Note that in the long run, it may be possible to automate much of the distribution center picking operation, reducing the cost even further.
Home grocery shopping provides the distributor with a great opportunity to reduce systemwide inventory. To illustrate, consider that it is assumed that under the proposed system, the inventory duration and cost remain unchanged from the current system. However, with home grocery shopping, the distributor will be able to collect a much broader range of information, with far greater accuracy, than is possible both at the present time, and with full implementation of ECR. This information will allow for more reliable forecasts of product needs, more precise ordering from suppliers, and consequently lower systemwide inventory.  

To demonstrate why the data collected under home grocery shopping will be much more accurate than with a supermarket-based operation, consider just the following three examples. First, scanning at the checkout counter. As discussed in Chapter Three, attaining 100 percent scanning accuracy is a critical element of the replenishment process. But, even if a supermarket operator implements ECR Phase II best practices, the company may still not entirely eliminate such problems as flavors not being correctly entered, and bar codes not being read due to poor quality labels. Indeed, inaccurate scanning is such an extensive problem in the industry that third-party companies have been established to help remove "checker and other errors" and to "clean" scan data. A different issue concerns scanning of a variety of perishable products, including produce. This type of scanning is rarely practiced in the industry, and in fact is not even included in the ECR program.

In contrast, with home grocery shopping, consumer orders are automatically entered electronically. Thus the problem of not attaining 100 percent accurate product movement data essentially does not exist under the proposed system. And, the flow of all products can be monitored, not just packaged and/or bar coded goods.

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30 In addition to the benefit of freeing distributor capital that is tied up in merchandise, a lower inventory level leads to other benefits, such as a reduction in the shrinkage rate (for example, less product is liable to be damaged or go past its expiration date) and a decrease in storage space requirements (see section 6.3.2.3.3.).

31 Efficient Consumer Response, p. 54. Refer to Chapter Three for more information.


The second example pertains to the development of a database measuring purchasing activity at the consumer level. Such information is very helpful not only in making the replenishment process more efficient, but also for marketing purposes.\textsuperscript{34}

Again, assuming that ECR Phase II has been implemented, the only such data that can be collected is from regular customers who have—and remember to use each time they go shopping—certain pieces of identification, such as checks, credit cards, or "frequent shopper membership cards."\textsuperscript{35} In contrast, with home grocery shopping, data on purchasing activity can be automatically captured and maintained at the household level, every time a consumer does the shopping (and it can be done anonymously, so that privacy laws are not violated).

The third example concerns forecasts of systemwide product demand. The ability to accurately forecast consumer demand is seen as one of the most significant benefits of the entire ECR program. In fact, the report states:

This information, when integrated into the suppliers' planning systems can provide tremendous value in the manufacturing planning and scheduling processes. It is this forecast information, not raw POS data, that will facilitate the smoothing of manufacturing operations with a subsequent reduction in manufacturing costs and excess inventory at the supplier level.\textsuperscript{36}

With ECR, indeed with any supermarket-based system, product needs are forecast first at the store level, then aggregated to an overall systemwide forecast.\textsuperscript{37} There are two crucial drawbacks inherent to this type of distributed forecasting process. First, forecasts are basically just good estimates, and each introduces a certain amount of error. Second, the greater the number of forecasts, the more complex—and expensive—the support system necessary to handle them. With the typical supermarket chain consisting of dozens or more stores, the degree of error is likely to be quite high, as is the cost. In contrast, under the proposed system, consumer orders are fed directly into one central location,

\textsuperscript{34}See Chapter Seven for a discussion about the marketing benefits offered by home grocery shopping.

\textsuperscript{35}\textit{Efficient Consumer Response}, p. 91. See Chapter Three for more information.

\textsuperscript{36}\textit{Ibid.}, p. 69.

\textsuperscript{37}\textit{Ibid.}
thereby reducing (a) the number of forecasts, (b) the overall forecast error, and (c) the complexity of the support system.\footnote{It will also likely be possible for consumers to create standing orders under the proposed system, which is standard practice in industrial supply channels. For example, a consumer could indicate that he or she always wants a gallon of milk and two cans of vegetable soup every week, a box of spaghetti every two weeks, and a container of detergent every month, in addition to whatever other items he or she chooses that particular week. A system which allows consumers to create standing orders would revolutionize the ability of distributors and suppliers to forecast consumer demand. See Chapter Seven for a much more detailed analysis of this topic.}

There are numerous other examples which can be cited, but these serve the purpose. Essentially, simply by the nature of its design, the proposed system will provide information which is more precise, offers greater depth and is less vulnerable to error than data collected under even the best-managed supermarket-based operation (i.e., a distributor which has fully implemented ECR Phase II practices). The result is that product needs can be forecasted with far greater accuracy, leading to a sizable reduction in the inventory level, and hence, the inventory cost.\footnote{In fact, the inventory function may actually result in net income for the distributor under the proposed system relative to the current system. To illustrate, consider the typical scenario in which the supplier grants the distributor a 30 day grace period before payment is required. With ECR, the total cycle time for dry grocery products at the distribution center and at the supermarket is 34 days, 22 of which are spent to the supermarket. The result is that the distributor must reimburse the supplier before it collects payment from the customer. Under the proposed system, products are in the order pickup for an average of one day before customer retrieval (and some customers may choose to prepay electronically). Thus the total time that the distributor is in possession of products before receiving payment from the customer averages 12-13 days (and may even be less, if the assumption that the proposed system does not result in any reduction in inventory time at the distribution center relative to ECR is relaxed). Since the distributor has up to 30 days before it must reimburse the supplier, it can collect interest on the money during the interim period. Indeed, the net result is that a home grocery shopping distributor is likely to be in a better cash flow position than a comparable supermarket operator, even one that has implemented ECR Phase II practices.}

6.3.2.3.3. Distribution center occupancy and equipment

In Table 6-2, the costs for distribution center occupancy and equipment are 100\% and 505\% greater, respectively, than the values under the current system. As mentioned, these results stem from assumptions made by this researcher. Essentially, it is assumed that the proposed system (a) requires a much greater level of equipmen. at the distribution center, and (b) probably necessitates additional distribution center facilities altogether. Although these assumptions may underestimate the occupancy and equipment costs at the distribution center, it may also be the case that these assumptions are conservative.
The difficulty in assessing these costs arises from the different time frames under which the proposed system can be evaluated. For instance, over the short to medium time frame, the distributor is assumed to process up to 27,000 orders per week. This researcher assumes that the distributor can manage this level of demand with one or two initial selection units, each of which is constructed either inside or next to the existing distribution center. The cost to outfit the selection unit is folded into the higher equipment expense rate employed in the DPC calculations.\textsuperscript{40}

However, even at this level of demand, the distributor may find it necessary to build several selection units. Moreover, if home grocery shopping becomes highly popular in the long run, then many additional selection units beyond the initial one or two would need to be built.

Due to space constraints, it is highly unlikely that more than two selection units could be built in or near the existing distribution center; therefore, any additional facilities would likely have to be located at greenfield or converted sites. The higher assumed space cost for the proposed system is intended to capture at least a portion of this additional expense. However, it is clearly difficult to estimate at this time how many additional facilities will be necessary in the long term, even whether additional facilities will be required at all.\textsuperscript{41}

Nevertheless, to provide an indication of the extent to which the distribution center expense may rise, an analysis has been conducted in which both the occupancy cost and the equipment expense are assumed to be four times the rate for the current system.\textsuperscript{42} Under this scenario, the occupancy cost rises by 0.86 cents from that listed for the proposed system in Table 6-2, and the equipment expense by 1.54 cents, for a total expense of 12.67 cents; this represents a 23.4 percent increase relative to the total listed in Table 6-2. As Section 6.4. will show, even at this high level of distribution center expense, the proposed system still results in considerable savings in the overall distribution cost.

\textsuperscript{40}See Section 6.3.2.1.

\textsuperscript{41}For example, it may be possible to retrofit existing facilities, such as superstores. These buildings would combine the functions of distribution center, selection unit and order pickup into one facility, and serve as mini hubs for surrounding order pickups.

\textsuperscript{42}Note that the base rate for equipment is the repack rate.
Moreover, should home grocery shopping ultimately become the dominant mode for distribution of grocery products, it is possible—even probable—that existing distribution centers will be replaced by entirely new facilities, such as mini distribution centers, which would likely have different cost structures. These facilities might blend traditional distribution center functions with those of a crossdock. For example, products would arrive in LTL quantities, be broken down into cases, then be broken down once more into the individual units. The average product dwell time would probably be less than that in the ECR program, i.e., under twelve days. And instead of one hundred supermarkets per distribution center, the ratio of order pickups per mini distribution center would likely be far lower.\textsuperscript{43}

Note that one factor may partially counteract the increased distribution center space cost: the lower overall inventory level of the proposed system. As the previous section pointed out, home grocery shopping should enable faster cycle times relative to a supermarket-based system, even a supermarket system managed entirely according to ECR Phase II practices. Faster cycle times mean that less stock is necessary at any one time in order to meet the same level of demand; hence, less space is needed. This outcome should be true despite the fact that implementation of home grocery shopping results in the replacement of supermarkets currently holding large inventories with order pickups housing very lean inventories.

The end result is that the distribution center occupancy expense—including the equipment cost—may rise by a significant amount under the proposed system, or the gain

\textsuperscript{43} Note that the concept of a much higher number of mini distribution centers is somewhat at odds with the proposal of Non-Stop Logistics. For instance, as Chapter Three discussed, Non-Stop's plan is to build a very small number of regional consolidation facilities, each of which is designed to service many more supermarkets than today's distribution centers. On the other hand, there are significant similarities between the two concepts; for example, both the mini distribution center and the consolidation facility would function as cross-dock operations, in which rapid product flow is predicated on timely and accurate information flow. There may even be room for the two types of facilities to coexist, i.e., the mini distribution centers could be supplied by the regional consolidation facilities. This would likely depend on the economics of direct delivery to the mini distribution centers. To illustrate, all else being equal, the fewer the number of stops, the lower the distribution cost, which favors direct delivery. However, the mini distribution centers would likely be limited to LTL quantities for all but very high volume products, which may favor the use of consolidation facilities. (Of course, inbound transportation to the mini distribution centers could be optimized around the operations of such facilities; for instance, suppliers could ship TLs of a single product in trucks that stop at several mini distribution centers, unloading a limited number of pallets at each stop, as well as increase their use of mixed loads.)
could be mild; conceivably, the expense may even fall. On the one hand, additional facilities will undoubtedly be necessary; on the other hand, innovative systems can be explicitly designed and optimized around the new pattern of distribution implied by home grocery shopping. Thus it is difficult to assess not only the magnitude of possible changes in the distribution center occupancy expense, but even whether, in the long run, the cost will ultimately increase or decrease under the proposed system. Nevertheless, to be conservative, it is assumed in this thesis that under the proposed system, the space cost doubles and the equipment expense rises by over 500 percent, relative to the respective costs under the current system.

6.3.3. Transportation

6.3.3.1. Description of activities

The second stage is outbound transportation. Note that this function refers to the movement of Product A from the distribution center to the retail outlet; it does not refer to home delivery.

Under the proposed system, one of the underlying assumptions for the transportation function changes: the average quantity of product carried per load. Under the current system, this rate is 1307 cubic feet, which represents the dry grocery composite rate for 1993; under the proposed system, the rate is 1076 cubic feet, which is the repack rate. Two of the possible explanations for this change are (a) the individual totes are utilized at less than full capacity (i.e., there is empty space in each tote), and (b) items shipped in totes tend to be small in size relative to other grocery products, therefore the average total cubic load tends to be lower. With respect to the other transportation factors—cost per mile driven and roundtrip distance—these elements are assumed to remain the same under the proposed system.

6.3.3.2. Cost analysis

Table 6-3 shows that the transportation cost rises under the proposed system, from 1.07 cents to 1.29 cents, for a net increase of 20.6 percent. This rise results solely
## Table 6-3
TRANSPORTATION COST
UNDER CURRENT AND PROPOSED SYSTEMS

### ASSUMPTIONS

<table>
<thead>
<tr>
<th>ITEM COUNT</th>
<th>15</th>
<th>/CF</th>
<th>CUBE (CURRENT)</th>
<th>1307</th>
<th>CF/TRIP</th>
<th>HAUL DIST.</th>
<th>120</th>
<th>MI/ROUND TRIP</th>
<th>CUBE (PROPOSED)</th>
<th>1076</th>
<th>CF/TRIP</th>
<th>COST</th>
<th>$1.74</th>
<th>/MILE</th>
</tr>
</thead>
</table>

### CURRENT PROPOSED

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>COST/ITEM</th>
<th>COST/ITEM</th>
<th>COST DIFF</th>
<th>% CHANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRANSPORTATION</td>
<td>$0.0107</td>
<td>$0.0129</td>
<td>$0.0023</td>
<td>21.5%</td>
</tr>
</tbody>
</table>
from the reduction in the average quantity of product carried per load.

6.3.3.3. Sensitivity analysis

There are several factors which affect the transportation cost. Modifications to some of the assumptions lead to an increase in the transportation cost, while adjustments to others lead to a decrease.

The first component is the cubic load per truck, which is assumed to decline under the proposed system. There are two factors which indicate that such a decrease will not necessarily occur under the proposed system, while there is another factor which indicates that the decline may actually be greater than that assumed. First, as mentioned earlier, totes are available in a variety of sizes; if the distributor employs two or three different sized totes, it can utilize tote space—and truck capacity—more efficiently than with a "one size fits all" strategy. Second, the theoretical capacity of a typical truck trailer is at least three times the assumed average load. Thus a home grocery shopping distributor can transport average loads similar to that under the current system (and even higher if required).

On the other hand, a home grocery shopping distributor may operate a greater number of order pickups than supermarkets. It is possible that the quantity of product which flows through an order pickup may be less than that moving through a typical supermarket. Assuming that the delivery frequency remains constant, this factor would lead to a decrease in the average load.

A second important component affecting the transportation cost is the average roundtrip haul distance, which is assumed to remain constant under the proposed system. However, this component may also rise or fall under the proposed system. For example, the distributor may choose to bring order pickups closer to where consumers actually live. Such a strategy might lead to an increase in the overall average haul distance. On the other hand, if the current large distribution center is replaced by several mini distribution centers, then the average distance for outbound transportation would decrease.

Thus, there are certain factors which will influence the transportation expense to

44See Chapter Seven for a discussion about order pickup deployment strategies.
rise even higher than that listed in Table 6-3, while there are other factors which may lead to a lower rate of increase, or even to a reduction in the cost. In the previous section, it is assumed that under the proposed system, the load size decreases by over 17 percent while the distance remains constant, resulting in a rise in the transportation cost of more than 20 percent. Based on the sensitivity analysis in this section, it would appear that overall, this thesis has adopted a conservative position with respect to the transportation cost.

6.3.4. Retail operations

6.3.4.1. Description of activities

The third stage in the analysis is the retail outlet. For this stage, the current system utilizes a supermarket, while the proposed system employs an order pickup.

As envisioned by this researcher, the order pickup functions in the following manner. Dry grocery products arrive in totes, already picked into customer orders; the totes are placed onto shelves. Perishable products are housed at the order pickup—in limited quantities—in dedicated areas, such as walk-in freezers and coolers; these items are picked at the order pickup and stored in the proper area prior to customer retrieval.\(^{45}\) For fast retrieval, the totes—or bags\(^{46}\)—are stored in numbered slots, and this information, as well as the corresponding customer's name and/or account number, is entered into the order pickup's computer system.

The arrival of the customer triggers the retrieval process. An employee gathers the entire order; note that if the order contains perishable products, it is housed in two or possibly three locations (i.e., the dry grocery area and either a single perishable area or separate refrigerated and frozen sections). The employee then brings the order to the customer, along with portable equipment used to secure payment. Coupons can be redeemed

\(^{45}\)Depending on the average time between picking and customer retrieval, it may be possible to house all perishable products, once they have been picked, in the same location. For instance, in a room maintained at just above the freezing point, frozen items can be stored for several hours and refrigerated products indefinitely; this room could either be the walk-in cooler itself or a subsection of it. If this is not feasible, the refrigerated and frozen portions of a customer order would be stored separately.

\(^{46}\)Note that under the proposed system, the customer is not required to utilize totes when retrieving the order; rather, he or she has the option of using either totes or bags (additional information is provided in this section).
on-the-spot. In addition, the employee is able to make corrections to the order, assuming that such adjustments are feasible.\footnote{For example, since perishable products are assumed to be stored on-site at the order pickup, last minute changes involving these items are possible. With respect to dry grocery products, although it is assumed that the order pickup houses only those items which have been customer preordered, the distributor may choose to stock a limited assortment of dry goods, such as high volume items, in order to be able to accommodate last minute requests involving these products as well.}

The customer has the choice of using the order pickup's enclosed walk-up counter, or waiting in his or her car.\footnote{Note that except for the walk-up counter, the order pickup is closed to public access.} If the customer chooses to wait in the car, he or she is directed to a numbered parking spot upon arrival via a drive-up intercom. For the customer, the entire transaction process at the order pickup consists of (1) signaling one's presence upon arrival, (2) waiting either in the car at the designated space or at the walk-up counter, (3) paying for the order when it is brought forth, and (4) possibly returning totes.

This researcher estimates that for an auto-bound customer retrieving an order which does not require adjustment, the entire transaction process should take no more than five minutes. Consider the following: upon first arriving at the order pickup, the customer signals his or her presence;\footnote{The customer may also be able to call ahead, including by carphone, to signal his or her arrival in advance.} even as he or she is moving to the designated parking spot, an employee has already begun the retrieval process; since the entire order is prepicked, all the employee has to do is collect the appropriate bags or totes and bring them to the customer; the bill has been automatically totaled, and in fact may have already been paid by the customer via electronic funds transfer at the time of the ordering. All of these features (and others, such as electronic couponing) help keep the average wait time for the customer at the order pickup to a minimum.\footnote{Note that some customers may want to check the order for accuracy, particularly when first using the proposed system. This activity may slightly increase the total transaction time.} 

Regarding the operations of the order pickup, there are several important issues to consider. The first concerns whether the customer will take the order home in totes or in traditional disposable bags. While there are many benefits associated with the end-to-end use of totes (see Chapter Seven), it seems unlikely that all customers will want to use
totes.\textsuperscript{51} Indeed, to be conservative, this researcher assumes that totes are not used for customer retrieval at all, i.e., only bags are utilized.

This means that perishable items should be picked directly into bags, while dry grocery products must be moved from totes to bags at the order pickup.\textsuperscript{52} To reposition dry grocery products into bags, there are several options as to when and where this activity can take place, including: upon arrival of the totes at the order pickup, in the staging area; in the aisle, before being placed into the slot; in the aisle, after being removed from the slot; and at the car or at the walk-up counter. Since the distributor would probably want to keep the customer wait-time to a minimum, bagging-related activities at the order pickup would most likely be performed prior to customer arrival (i.e., either of the first two options).\textsuperscript{53}

A second matter is the time that products are assumed to spend at the order pickup. Presumably, most customers will want to retrieve their orders as soon as the orders are ready. Thus the majority of dry grocery products are likely to dwell in the order pickup for less than one day. For example, with morning delivery, most orders are likely to be retrieved that evening, and thus remain in the order pickup for no more than twelve to fourteen hours. Some customers may forget that their orders are available, or be unable to retrieve them the same day. To be conservative, this researcher assumes that the average dwell time for all dry grocery products is twenty-four hours.

A third issue pertains to DSD items. Under the proposed system, DSD products can continue to be delivered directly to the retail outlet, where they would be picked and merged into customer orders, or they can be delivered to the distribution center like any other dry grocery product. This choice is left to the discretion of the distributor.\textsuperscript{54}

\textsuperscript{51}For example, the customer needs to have space to store the totes, and must to remember to return them on a regular basis.

\textsuperscript{52}Placing products into bags at the distribution center would be a cumbersome process; moreover, it may not even be feasible (see Chapter Seven).

\textsuperscript{53}Note that although it is conservatively assumed that all customers use bags, clearly there will be some customers who prefer to utilize totes. To assist the distributor in making the transfer process more efficient—and to minimize the customer's wait-time—the display interface can have a box that allows the customer to indicate his or her preference at the time of the shopping; in fact, the interface can be programmed to display a default value, such as, "Bags are used unless otherwise indicated."

\textsuperscript{54}Note that in the long run, as mentioned in Section 6.3.2.3.3., the distributor's one large existing
Table 6-4 provides a portrayal of order pickup activities and supermarket activities. This table shows that many changes take place at the retail outlet under the proposed system, including a reduction in the total number of activities and a modification of some of the rates. As Table 6-4 illustrates, nine activities have been eliminated under the proposed system, while two activities have been added:

**Deliver Order to Customer**—The time it takes to (1) move the order from the shelf to the customer, either to the walk-up counter or to customer's vehicle, and (2) complete the transaction process.

rate: 420 seconds per order

**Stack and Load Totes**—The time it takes to (1) stack empty totes onto pallets, and (2) load the pallets onto the truck for the return trip to the distribution center.

rate: 4.00 seconds per tote

In addition, changes have been made to several of the rates. For example, the time rates for "Move to Aisle" and for bagging-related activities, such as "Set Up Bag" and "Bag Item," have been lowered, the former by 50 percent and the latter two by 25 percent each. In the case of "Move to Aisle," the reduction reflects the fact the order pickup is much smaller than the supermarket, thus less time is required to move Product A to the aisle. With respect to bagging-related activities, this researcher assumes that these processes are carried out more efficiently at the order pickup than at a supermarket, as the order pickup lends itself to handling these activities in an "assembly line" fashion.

Another change concerns the activities "Sort and Load," "Move to Aisle" and "Stock Item." Under the current system, the basis of measurement for these activities is, respectively, seconds per case, seconds per cubic foot, and seconds per item. Under the distribution center may be replaced by several mini distribution centers. For the distributor and DSD vendors, such facilities would be more amenable to handling DSD products than today's very large distribution centers. In general, as with other items, the distributor will have to evaluate for itself the costs and benefits associated with stocking and picking products at the order pickup versus undertaking the same activities at the distribution center.
### Table 6-4
CLASSIFICATION OF ACTIVITIES
UNDER CURRENT AND PROPOSED SYSTEMS

RETAIL OUTLET

<table>
<thead>
<tr>
<th>Activity</th>
<th>Current Rate</th>
<th>Current Unit</th>
<th>Proposed Rate</th>
<th>Proposed Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLACE ORDER</td>
<td>9.29</td>
<td>SEC/DEL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RECEIVE</td>
<td>16.80</td>
<td>PAL/HR</td>
<td>16.80</td>
<td>PAL/HR</td>
</tr>
<tr>
<td>SORT &amp; LOAD</td>
<td>9.23</td>
<td>SEC/CA</td>
<td>9.00</td>
<td>SEC/TOTE</td>
</tr>
<tr>
<td>MOVE TO AISLE</td>
<td>4.93</td>
<td>SEC/CF</td>
<td>2.47</td>
<td>SEC/TOTE</td>
</tr>
<tr>
<td>POSITION CASE</td>
<td>5.10</td>
<td>SEC/CA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPEN CASE</td>
<td>5.20</td>
<td>SEC/CA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PRICE SETUP</td>
<td>5.02</td>
<td>SEC/DEL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PRICE</td>
<td>0.46</td>
<td>SEC/ITEM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SET UP SHELF</td>
<td>12.77</td>
<td>SEC/DEL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STOCK ITEM</td>
<td>1.80</td>
<td>SEC/ITEM</td>
<td>3.00</td>
<td>SEC/TOTE</td>
</tr>
<tr>
<td>CLEANUP</td>
<td>10.20</td>
<td>SEC/CA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONDITION SHELF</td>
<td>0.26</td>
<td>SEC/ITEM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RING TIME</td>
<td>2.44</td>
<td>SEC/ITEM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SET UP BAG</td>
<td>5.50</td>
<td>SEC/BAG</td>
<td>4.13</td>
<td>SEC/BAG</td>
</tr>
<tr>
<td>PUT IN BAG</td>
<td>2.05</td>
<td>SEC/ITEM</td>
<td>1.54</td>
<td>SEC/ITEM</td>
</tr>
<tr>
<td>DELIVER ORDER</td>
<td></td>
<td></td>
<td>420.00</td>
<td>SEC/ORDER</td>
</tr>
<tr>
<td>STACK &amp; LOAD</td>
<td></td>
<td></td>
<td>4.00</td>
<td>SEC/TOTE</td>
</tr>
<tr>
<td>BAG COST</td>
<td>$0.024</td>
<td>PER BAG</td>
<td>$0.024</td>
<td>PER BAG</td>
</tr>
<tr>
<td>OCCUPANCY</td>
<td>22</td>
<td>DAYS</td>
<td>1</td>
<td>DAY</td>
</tr>
<tr>
<td>INVENTORY</td>
<td>22</td>
<td>DAYS</td>
<td>1</td>
<td>DAY</td>
</tr>
</tbody>
</table>

**KEY TO ABBREVIATIONS**

CA        CASE
CF        CUBIC FOOT
DEL       DELIVERY
proposed system, the basis for all of these activities is the same: seconds per tote. This modification reflects the fact that Product A is moved around the order pickup in its surrounding tote, rather than in a case or as an individual unit. Note that under the proposed system, "Stock Item" refers to placing either the bag or the tote into the shelf slot.

6.3.4.2. Cost analysis

Table 6-5 tabulates the retail outlet costs under the current system and the proposed system. Also shown in the table is the percentage change in each cost under the proposed system, where applicable.

It is clear from Table 6-5 that the use of an order pickup results in huge cost savings compared to a supermarket. In fact, the retail stage is the source of the entirety of the DPC savings achieved by the proposed system. As shown in Table 6-5, the total store expense has been reduced from 16.50 cents to 1.22 cents, for a net reduction of 92.6 percent.

The bulk of the savings results from the tremendous reduction in the store occupancy expense. As illustrated in Table 6-5, the occupancy cost drops by 99.4% under the proposed system; because of the significance of this activity to the total store cost, this reduction accounts for 65.1% of the overall decrease. Labor and inventory costs are also lowered—labor by 82.0 percent, and inventory by 95.5 percent. The labor cost reduction represents 31.0% of the overall decrease, while the inventory savings accounts for 3.9 percent.

There are two reasons why the occupancy expense drops by such a large amount under the proposed system. First, Product A spends far less time in the order pickup than in the supermarket (i.e., one day instead of twenty-two days, which represents a 95.5 percent decrease). This stems from the removal of Product A's case size as a constraining factor, since Product A can be picked in a minimum order quantity as small as one unit. ECR stresses the importance of reducing case sizes, stating:

The case quantity represents a push into the store independent of the pull of consumer demand. It represents a variable number of weeks of supply which can under stock certain items. More frequently it overstocks the

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# Table 6-5
## ALLOCATION OF COSTS
### UNDER CURRENT AND PROPOSED SYSTEMS

## RETAIL OUTLET

### ASSUMPTIONS

<table>
<thead>
<tr>
<th>Assumption</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labor</td>
<td>$12.00</td>
<td>/HR</td>
</tr>
<tr>
<td>Case Count</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Case Cube</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Items Per Tote</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td>Tote Cube Used</td>
<td>1.80</td>
<td>CF</td>
</tr>
<tr>
<td>Bag Cube Used</td>
<td>0.56</td>
<td>CF</td>
</tr>
<tr>
<td>Display Space Cost</td>
<td>$29.07</td>
<td>/SQFT/FACING/YR</td>
</tr>
<tr>
<td>Back Room Space Cost</td>
<td>$3.05</td>
<td>/CF/YEAR</td>
</tr>
<tr>
<td>Shelf Depth</td>
<td>21</td>
<td>INCHES</td>
</tr>
<tr>
<td>Shelf Pack Out</td>
<td>1.5</td>
<td>CASES</td>
</tr>
</tbody>
</table>

### CURRENT (SUPERMARKET) vs. PROPOSED (ORDER PICKUP)

<table>
<thead>
<tr>
<th>Activity</th>
<th>Cost/Item</th>
<th>% Tot</th>
<th>Cost/Item</th>
<th>% Tot</th>
<th>Cost Diff</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Place Order</td>
<td>$0.0041</td>
<td>2.5%</td>
<td>---</td>
<td>---</td>
<td>($0.0041)</td>
<td>-100.0%</td>
</tr>
<tr>
<td>Receive</td>
<td>$0.0009</td>
<td>0.5%</td>
<td>$0.0005</td>
<td>4.0%</td>
<td>($0.0004)</td>
<td>-44.4%</td>
</tr>
<tr>
<td>Sort &amp; Load</td>
<td>$0.0021</td>
<td>1.2%</td>
<td>$0.0011</td>
<td>9.4%</td>
<td>($0.0009)</td>
<td>-44.4%</td>
</tr>
<tr>
<td>Move to Aisle</td>
<td>$0.0011</td>
<td>0.7%</td>
<td>$0.0003</td>
<td>2.5%</td>
<td>($0.0008)</td>
<td>-72.2%</td>
</tr>
<tr>
<td>Position Case</td>
<td>$0.0011</td>
<td>0.7%</td>
<td>---</td>
<td>---</td>
<td>($0.0011)</td>
<td>-100.0%</td>
</tr>
<tr>
<td>Open Case</td>
<td>$0.0012</td>
<td>0.7%</td>
<td>---</td>
<td>---</td>
<td>($0.0012)</td>
<td>-100.0%</td>
</tr>
<tr>
<td>Price Setup</td>
<td>$0.0011</td>
<td>0.7%</td>
<td>---</td>
<td>---</td>
<td>($0.0011)</td>
<td>-100.0%</td>
</tr>
<tr>
<td>Price</td>
<td>$0.0015</td>
<td>0.9%</td>
<td>---</td>
<td>---</td>
<td>($0.0015)</td>
<td>-100.0%</td>
</tr>
<tr>
<td>Set Up Shelf</td>
<td>$0.0028</td>
<td>1.7%</td>
<td>---</td>
<td>---</td>
<td>($0.0028)</td>
<td>-100.0%</td>
</tr>
<tr>
<td>Stock Item</td>
<td>$0.0060</td>
<td>3.6%</td>
<td>$0.0004</td>
<td>3.0%</td>
<td>($0.0056)</td>
<td>-93.8%</td>
</tr>
<tr>
<td>Clean Up</td>
<td>$0.0023</td>
<td>1.4%</td>
<td>---</td>
<td>---</td>
<td>($0.0023)</td>
<td>-100.0%</td>
</tr>
<tr>
<td>Condition Shelf</td>
<td>$0.0163</td>
<td>9.9%</td>
<td>---</td>
<td>---</td>
<td>($0.0163)</td>
<td>-100.0%</td>
</tr>
<tr>
<td>Ring Time</td>
<td>$0.0081</td>
<td>4.9%</td>
<td>---</td>
<td>---</td>
<td>($0.0081)</td>
<td>-100.0%</td>
</tr>
<tr>
<td>Set Up Bag</td>
<td>$0.0022</td>
<td>1.3%</td>
<td>$0.0016</td>
<td>13.5%</td>
<td>($0.0005)</td>
<td>-24.9%</td>
</tr>
<tr>
<td>Put In Bag</td>
<td>$0.0068</td>
<td>4.1%</td>
<td>$0.0051</td>
<td>42.2%</td>
<td>($0.0017)</td>
<td>-24.9%</td>
</tr>
<tr>
<td>Deliver Order</td>
<td>---</td>
<td></td>
<td>$0.0008</td>
<td>6.6%</td>
<td>$0.0008</td>
<td>---</td>
</tr>
<tr>
<td>Stack &amp; Load</td>
<td>---</td>
<td></td>
<td>$0.0005</td>
<td>4.1%</td>
<td>$0.0005</td>
<td>---</td>
</tr>
<tr>
<td>Total Labor</td>
<td>$0.0577</td>
<td>35.0%</td>
<td>$0.0104</td>
<td>85.2%</td>
<td>($0.0473)</td>
<td>-82.0%</td>
</tr>
<tr>
<td>Bag Cost</td>
<td>$0.0009</td>
<td>0.5%</td>
<td>$0.0009</td>
<td>7.4%</td>
<td>$0.0000</td>
<td>0.0%</td>
</tr>
<tr>
<td>Occupancy</td>
<td>$0.1001</td>
<td>60.7%</td>
<td>$0.0006</td>
<td>5.1%</td>
<td>($0.0995)</td>
<td>-59.4%</td>
</tr>
<tr>
<td>Inventory</td>
<td>$0.0063</td>
<td>3.8%</td>
<td>$0.0003</td>
<td>2.3%</td>
<td>($0.0060)</td>
<td>-55.5%</td>
</tr>
<tr>
<td>Total</td>
<td>$0.1650</td>
<td>100.0%</td>
<td>$0.0122</td>
<td>100.0%</td>
<td>($0.1528)</td>
<td>-92.6%</td>
</tr>
</tbody>
</table>

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shelf and provides an excessive number of weeks of supply. Reducing case quantities will address this weakness by providing smaller minimum order quantities.\textsuperscript{55}

The decrease in the amount of time that Product A spends at the retail outlet enables the size of the facility to be reduced, while allowing the number of items flowing through to remain constant. The net result is a decrease in the occupancy cost per unit.\textsuperscript{56}

The second reason why the occupancy cost drops significantly is that the rate at which the expense is calculated for the order pickup is considerably lower than that used for the supermarket.\textsuperscript{57} This is because the order pickup does not require many of the features associated with operating a supermarket, including fancy fixtures, signage, aisle displays, checkout counters, and so on. Since the order pickup is closed to public access, the interior can be relatively bare. For example, the inside of the order pickup can be designed to resemble the interior of a distribution center, e.g., multiple aisles of spartan shelving. Such a design is far less expensive than outfitting a supermarket.

Other large cost savings result from reductions in the store labor expense. As Table 6-5 illustrates, many labor activities are eliminated entirely, and for the majority of the ones that remain, the costs are considerably less under the proposed system than under the current system.

6.3.4.3. Sensitivity analysis

In the calculation of order pickup activity costs above, several of the underlying assumptions are conservative, particularly the assumptions concerning the activities of bagging and delivering the order to the customer. This section will examine the effect of relaxing assumptions pertaining to these activities. In addition, this section will analyze the result from adopting a position even more conservative than that employed above regarding the average dwell time at the order pickup.

\textsuperscript{55}Efficient Consumer Response, p. 70.

\textsuperscript{56}Note that alternatively, a decrease in occupancy time enables more product to flow through while allowing the size of the facility to remain constant. This scenario also reduces the cost allocated to a given product, since the fixed facility expense can be spread over more products.

\textsuperscript{57}Note that the basis of measurement at the supermarket is square feet of facing (display space), while the basis at the order pickup is cubic feet of storage space.
The first factor is the cost involved in placing items into bags. This includes the activities of "Set up Bag," "Put in Bag" and "Bag Cost," which combined total to 0.76 cents, or 62.3 percent of the total order pickup cost. It is assumed above that all customers utilize bags. However, if a customer uses totes instead, then the combined bag costs would be replaced by a single, lower tote expense.

This expense is calculated as follows. For each customer who uses totes to take the order home, the number of totes allotted to that customer is at least twice that allotted to customers who use bags. For instance, the totes that a customer uses to retrieve a given order most likely will not be returned until he or she picks up the following order. Since some customers will forget to return their totes with each new order, this researcher assumes that for every tote allotted to bag-using customers, three totes have to be allotted to tote-using customers.

In Section 6.3.2.1.1., the expense allocated to Product A associated with the use of totes within the distributor's operations was calculated to be 0.29 cents. This cost can be separated into two categories: the capital cost (including the expense for lost or stolen totes), which is approximately 0.13 cents, and the operational expense, which is 0.23 cents. As mentioned, when a customer uses totes, the distributor needs two additional totes for every one already in the system; hence the incremental capital cost is 0.26 cents. With respect to the tote operational expense, this cost remains roughly constant, since the rate at which most activities are performed does not increase with customer use of totes. To be conservative, this researcher estimates that the incremental operational expense is actually 50% of the existing expense, or 0.12 cents.

Thus, the total cost associated with customer use of totes is 0.38 cents, which represents a 50.0% reduction compared to the cost associated with the use of bags. Overall, customer tote use reduces the order pickup expense to 0.84 cents, which is a 31.1% decrease from the expense listed in Table 6-5.

The second activity for which the cost may be high in Table 6-5 is "Deliver Order,"

58 For example, the distributor has to affix and remove bar-code labels with every customer order, whether or not the customer utilizes totes for pick-up. On the other hand, if the customer does use totes, the totes may have to be cleaned more frequently.
which is assumed to require seven minutes. However, it was discussed earlier that except for orders which require adjustment, the total delivery time should average less than five minutes per customer; hence the cost for this activity may be slightly exaggerated in Table 6-5.  

With respect to the time that Product A spends at the order pickup, it is assumed above that this duration is one day. However, if the average dwell time is raised to three days, the occupancy cost increases by 0.12 cents, the inventory expense by 0.06 cents, and the total order pickup expenses rises to 1.40 cents, which represents a 14.8 increase over the cost listed in Table 6-5. But, as discussed earlier, it seems unlikely that the average order pickup dwell time for a customer order will be more than one day.

6.3.5. Computer-related activities

6.3.5.1. Description of activities

The fourth major stage of the proposed system concerns computer-related activities. This function pertains to the development and maintenance of the necessary computer software and supporting distributor hardware. Under this heading are expenses for such major components as: software to receive and handle electronic orders, and translate this information into picking lists; the development and continual upgrade of the display interface; the maintenance of a database containing information about products, prices and customers; and equipment to support these activities. These elements are all necessary in order for home grocery shopping to function, and they represent items that are not present under the current distribution system.

Note that in Chapter Four, it was mentioned that it is likely that the consumer's CPE will communicate with the database via an on-line server operated by the telecommunications provider. Therefore, this thesis assumes that the distributor does not need to install similar equipment of its own in order to offer the home grocery shopping service.

59 Note that during peak periods, some customers may have to wait longer than seven minutes at the order pickup. However, this aspect is different from the amount of time required for an employee to retrieve an order. Refer to Section 6.4.2. for information about customer wait-time at the order pickup.

60 This researcher assumes that for any piece of CPE not purchased by the customer directly, for example a set-top box, the cost is folded into the charge for network access.
Note also that there are a variety of computer-related activities which are currently undertaken by distributors, particularly large distributors. Therefore, this researcher assumes that the model distributor—which operates 100 retail outlets as well as its own distribution center—already has an information systems division, mainframe computers, etc. Hence the analysis in this section concerns only those additional computer-related activities which are necessary to offer home grocery shopping.

6.3.5.2. Cost derivation

Under the heading of computer-related activities are many different components, each of which imparts a cost. Broadly, these elements can be divided into three areas: the database, equipment, and miscellaneous activities. This section will analyze each of these expenses, and derive a single combined cost which can be allocated to Product A.

6.3.5.2.1. Database

The first broad component pertains to the cost to establish and maintain the database of products and prices. There are two key factors affecting this cost: (a) the number of products in the database, and (b) the sophistication of the display.

First, in 1993, the average number of SKUs stocked in a typical supermarket was 18,466.61 With home grocery shopping, the single database is used to cover a wide region, which means that a larger number of customers access the database than access any given supermarket. Consequently, the number of products in the database should be higher, so that a wide variety of consumer tastes can be accommodated. Therefore, this researcher assumes that the initial home grocery shopping database contains 23,000 SKUs.

The second factor pertains to the sophistication of the display. In general, the greater the degree of sophistication, the higher the cost. As mentioned in Chapter Four, this researcher has seen a highly advanced display that is currently under intense development. This interface creates a simulated shopping experience. For example, it recreates the aisles in a supermarket, allowing the consumer to maneuver an electronic shopping

61"61st Annual Report," p. 34.
cart through the store, remove products from shelves, and place the items in the cart. Utilizing three-dimensional renderings of products, the display enables the consumer to literally rotate an item completely around in order to see the packaging from all sides. According to the individual who is developing the display, this interface is probably the most advanced home grocery shopping display presently under development—62—and therefore, it is among the most costly.

This researcher assumes that the display for the proposed system will be comparable in sophistication to the GUI that the above individual is developing.63 In order to create the database for such an interface, images of product packaging must be scanned into the computer system. The scanning procedure involves placing the physical product packaging in front of a camera, and capturing digitized images of the packaging. Once digitized, the images can be efficiently transmitted electronically, and manipulated in a variety of ways. Based on the prices charged by commercial scanning services, the cost for this process is estimated to be $35 per SKU.64

Thus the total cost to establish the database—at 23,000 SKUs and $35 per SKU—is estimated to be $805,000. See Section 6.3.5.3. for a sensitivity analysis regarding this cost.

6.3.5.2.2. Equipment

The second major computer-related cost pertains to the equipment expense. Home grocery shopping requires three basic types of equipment: computers to store the database, computers to allow programmers to create and update the interface(s) and other software, and auxiliary equipment.

For the first element, it is estimated that for the advanced system described above,

62 Interview with the developer of the display, who is a professor at one of the leading business schools in the U.S., March to April, 1994.

63 As mentioned in Chapter Four, it may be possible to implement a voice recognition system; in fact, a home grocery shopping distributor may ultimately be able to offer a variety of different interfaces, allowing the consumer to use that which is most appropriate. Note that a voice recognition system would have different cost characteristics than a sophisticated GUI.

64 Interview, op. cit.
each SKU requires 2 megabytes (MB) of storage capacity if the data is stored in an uncompressed form, but only 0.2 MB per SKU if the information is compressed. Current costs for data storage are approximately $1 per 1 MB. Assuming that the data is compressed to 1.1 MB per SKU, the computer storage capacity cost for 23,000 SKUs is around $25,300.

With respect to the second element—the computers used by the programmers—this researcher estimates that two sophisticated workstations are sufficient; the cost for each is assumed to be $10,000. As for the third element—auxiliary equipment, such as printers to dispense pick sheets—this researcher estimates that this cost should be under $40,000.

Altogether, the total equipment cost is less than $100,000. To be conservative, this thesis assumes that the equipment cost is actually $175,000.

6.3.5.2.3. Other computer-related activities

Aside from the database and equipment, there are several miscellaneous computer-related activities. One is the creation of software that automatically converts (a) electronic data from suppliers, such as price changes, into a format that can be understood by consumers; and (b) electronic consumer orders into pick sheets, as well as into properly-formatted data that can be transmitted to suppliers. Another is the creation and continual upgrading of the display, for example the programming of new features into the system. And a third is the possible need for data entry, support staff and supplementary office space.

The cost for these functions is based on the following assumptions: (a) two software engineers are necessary to handle the programming; (h) each programmer costs the

65 Ibid.
66 Interviews with computer equipment vendors, April, 1994.
67 With respect to data entry, this cost should be minimal, since all communication, whether with suppliers or with consumers, is assumed to be retained in electronic form; thus very little rekeying of data should be necessary. (Note that the data entry costs associated with the creation and maintenance of the database are folded into the database cost.)
68 According to the individual who is developing the advanced GUI, very little ongoing maintenance is
distributor $60,000 annually in wages, benefits, etc.; (c) the expenses for data entry, support staff and office space sum to $200,000. Thus, these costs total to $320,000. To be conservative, this researcher assumes that these activities actually cost $400,000.

6.3.5.2.4. Allocation of computer-related costs to Product A

The combined cost for all of the computer-related components totals to $1.38 million, which this thesis has rounded up to $1.4 million. Note that some of this expense—such as the cost to create the display, establish the initial database, obtain the equipment, or program the software—is a one-time, introductory investment. Indeed, the ongoing expense for the computer-related activities is likely to be considerably less than $1.4 million. However, to be conservative, this thesis assumes that this sum will be spent every year, not just as a one-time capital expenditure.

In order to calculate the computer-related cost as it applies to Product A, certain assumptions are necessary. First, Product A is purchased once a week.\textsuperscript{69} Second, the distributor gross margin\textsuperscript{70} (GM) is 25.4 percent.\textsuperscript{71} The other assumptions, which are the same as in Chapter Five, are: $68 as the average weekly household expenditure on groceries, and $9.53 million as the annual revenue per supermarket.

The allocation of the cost to Product A involves two steps. First, the cost as a percentage of sales must be calculated. Based on 100 stores, the distributor's total annual sales are $953 million. However, it was assumed earlier in this chapter that 10 percent of the customer base utilize home grocery shopping; therefore, the yearly revenue from the home grocery shopping business is $95.3 million. From above, the expense for the computer-related activities is assumed to be $1.4 million annually, thus as a percentage of

\textsuperscript{69}Actually, the assumption is that the \textit{money} spent on Product A is spent every week, not that this particular item is purchased every week. Therefore, in terms of ascribing a computer-related cost for the proposed distribution system, Product A represents a fixed dollar value, not a specific product. However, for the sake of clarity, it can be assumed that Product A is purchased once a week.

\textsuperscript{70}Recall from Chapter Three that the gross margin is the distributor's share of the sales revenue. The distributor's costs are subtracted from the gross margin to render net profit. See Section 6.4.1. for more information.

\textsuperscript{71}This figure is based on the latest available data, as found in "Supermarket Facts," n.p. Note that this figure refers to distributors that operate their own distribution centers.
sales, the cost for these activities is 1.47 percent.

The second step is to apply this percentage to Product A. In Chapter Five, it was established that the wholesale cost of Product A is $1.24. Adding a distributor GM of 25.4% renders a consumer price of $1.56.\textsuperscript{72} Multiplying this price times the computer expense as a percentage of sales (1.47%) produces a value of 2.29 cents. This figure represents the total cost for the computer-related activities required by home grocery shopping, as allocated to Product A, and is illustrated in Table 6-6.

6.3.5.3. Sensitivity analysis

The expense for computer-related activities listed in Table 6-6 is most likely significantly inflated. Supporting this assertion is a wealth of evidence, which will be analyzed in this section.

The first factor is the assumption that the total cost of $1.4 million is spent every year. As noted above, some of this cost consists of one-time investments that are not incurred to the same extent after the start-up period. For example, it was assumed that the initial database consists of 23,000 SKUs. But the number of new products introduced each year is far less; in recent years, this number has averaged around 15,000.\textsuperscript{73} Moreover, individual distributors rarely accept more than a small fraction of this number of new products. Nevertheless, to be conservative, this researcher assumes that all new products will be incorporated into the database. Still, this reduces the number of SKUs that need to be scanned each year by 35 percent from the previous assumption, which lowers the annual scanning expense by $280,000.

As another example, it was assumed that the purchase cost for various pieces of equipment, such as workstations and storage devices, is spent every year. However, if the replacement schedule is adjusted to once every three years, then this expense is reduced by at least $100,000.

\textsuperscript{72} The actual consumer price can vary widely based on a number of factors, such as markdowns, distributor pricing strategy, etc. For the purposes of the analysis in this thesis, these factors can be ignored.

\textsuperscript{73} Gorman's New Product News, cited in Efficient Consumer Response, p. 87.
### Table 6-6
COMPUTER-RELATED COST
UNDER PROPOSED DISTRIBUTION SYSTEM

ASSUMPTIONS

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>YEARLY SALES</td>
<td>$95.3 M</td>
</tr>
<tr>
<td>YEARLY COST</td>
<td>$1.4 M</td>
</tr>
<tr>
<td>COST/SALES</td>
<td>1.47%</td>
</tr>
<tr>
<td>RETAIL PRICE</td>
<td>$1.56</td>
</tr>
</tbody>
</table>

TOTAL COMPUTER-RELATED COST PER ITEM $0.0229
A second factor pertains to the assumption that the scanning cost is borne entirely by the distributor. It is by no means unreasonable to turn this supposition around and instead assume that the scanning cost will actually be borne by suppliers. Indeed, there is precedent for such an assumption: slotting fees, which distributors pay to get their products onto store shelves. With home grocery shopping, the distributor could require that suppliers furnish the complete scanned images—at no cost to the distributor—in order to get their products onto the display. This policy would reduce the distributor's cost by approximately $800,000 relative to the base case.74

A third factor concerns the size of the customer base, which impacts the value of the computer cost as a percentage of sales. It is assumed in this chapter that 10% of the customer base utilize home grocery shopping. However, if home grocery shopping becomes popular, this percentage could increase to 50% or more. But, the computer-related expenses are almost entirely fixed costs; the only variable costs are for some of the equipment and a portion of the labor.75 Assuming that the fixed cost represents 80% of the total expense, a rise in the level of usage to one half of the current customer base would reduce the computer-related cost allocated to Product A by 64% relative to the base case.

Other factors pertain to the assumed price for scanning the images, and even whether scanning is necessary. With respect to the price for scanning, it is almost certainly true that as the volume of scanning activity grows, the cost per SKU will fall. With respect to the general need for image scanning, there are two relevant points of importance. First, it is assumed that the home grocery shopping display is highly sophisticated,

74 Note that the expense for scanning would not go away in such a circumstance, and would therefore still need to be allocated to Product A. However, if the supplier—or a third party—assumes the responsibility for creating scanned images, then this cost can be spread over many home grocery shopping distributors, and not absorbed entirely by each individual distributor. In fact, this would be a more efficient process, since there would be little or no duplication of effort. Indeed, an industrywide clearinghouse could be established with firm standards defining the requirements for scanned images, much like the existence of present standards for EDI transaction sets, such as purchase orders, promotion announcements and advanced shipping notices.

75 For example, the images need only be scanned once, regardless of the number of home grocery shopping customers. Also, it is assumed that communication between the consumer and the distributor occurs via an on-line server maintained by the telecommunications provider. The significance of this assumption is that as the number of home grocery shopping customers rises, it is primarily the capacity of the telecommunications provider’s equipment which must be increased in response, not the capacity of the distributor’s equipment.
and incorporates three-dimensional renderings of products. However, as Chapter Four discussed, it may be several years before the telecommunications network has sufficient capacity to handle such a display. In the meantime, the distributor can offer a less advanced—but still attractive—interface, which would be far less expensive to establish and to maintain than the simulated shopping version. On the other hand, if sophisticated interfaces become widely utilized, then images can be transmitted directly from the packaging designer's computer to the database or clearinghouse. This would eliminate the redundant—and costly—intermediate step of scanning physical copies of the packaging.76

Finally, there is one other, very important factor concerning the computer-related activities. It pertains to the distributor's expenses for current computer-related activities, such as data processing and accounting. Like other general ledger activities, these costs have been assumed by this researcher to remain constant under the proposed system.77 However, it is likely that the proposed system will enable large cost reductions in the area of data processing. For example, with home grocery shopping, consumer orders are automatically entered electronically. This should largely eliminate the manual entry (and repeated reentry) of data, as well as the errors inherent in such a process, both of which are associated with supermarket-based ordering systems.

In fact, by automating much of the ordering and transaction process, the proposed distribution system should be able to provide to the distributor considerable savings, savings that may even finance the added computer-related expenditures specific to home grocery shopping. For instance, according to a recent study, information-related functions—such as data processing and accounting—represent at least 2.5 percent of a large distributor's total costs.78 For the model distributor in this chapter, these functions thus account for over $23 million in costs annually. Through electronic consumer ordering, home grocery shopping will be able to rationalize many current information-related operations and reduce a portion of this expense. However, none of this cost reduction, which is likely to be significant, has been claimed by this thesis.

76Note that a home grocery shopping system based solely on the use of a voice recognition interface would completely eliminate the need for the scanned images required by a sophisticated GUI.

77Refer to Section 6.3.6. for more information.

Overall, it should be apparent that the expense for computer-related activities specific to the proposed system is most likely significantly inflated in Table 6-6. By making some very mild adjustments to the assumptions in the previous section, this expense can be reduced by approximately 28 percent, relative to the base case. Slightly more liberal modifications reduce the cost by at least 50 percent. Finally, if the cost is considered from a more global perspective (i.e., the impact that electronic consumer ordering can have on current distributor operations), then it is apparent that not only will the added expenditures likely pay for themselves, but they may actually result in overall cost reductions for the distributor.

6.3.6. Other distributor costs

The analysis of the proposed system has so far covered four major stages—the distribution center, outbound transportation, the retail outlet and computer-related activities specific to home grocery shopping. Altogether, these stages account for approximately 75-80 percent of the distributor's total expenses. The remainder represents the costs for activities such as general and administrative, merchandising, buying, and data processing. As noted elsewhere, these items are collectively referred to as the general ledger.

In Section 6.3.1.1., it was mentioned that all distributor costs not explicitly included in the channel analysis are assumed to remain constant under the proposed system. However, this will most likely not be the case. Indeed, as this section will demonstrate, in many areas outside of the four stages, home grocery shopping is likely to result in considerable cost reductions.

6.3.6.1. Instore shrinkage

One of the more important factors concerns instore shrinkage. Distributors currently experience significant losses due to shoplifting, spoilage, damage caused by consumers, and other aspects inherent in a supermarket-based operation. Many of these problems disappear under the proposed system.

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This estimate is based on several sources, including the product manufacturer, FMI, and Supermarket Study. Note that the expense for computer-related activities represents an incremental cost that is not part of the current system.
For example, consider shoplifting. Almost all supermarkets experience some amount of customer pilferage; in fact, chain distributors recently rated this issue to be the fifth out of fifteen most serious problem affecting supermarket operations today.\footnote{61st Annual Report, p. 57.}

Predominately, shoplifting at supermarkets is a crime of opportunity: it is estimated that at least 50 percent of consumer theft is on impulse, and 95 percent of those caught shoplifting at supermarkets have sufficient funds to pay for the items.\footnote{Terry Williams, "Supermarkets Wage Hi-Tech War on Theft," The New York Times, December 26, 1993, Section 13LI, p. 1.} Related to shoplifting is another problem, known as "sweethearting," in which the cashier purposely does not scan items for certain shoppers, such as friends or relatives.\footnote{Nannery, "Holding Promise," p. 15.}

Customer (and store employee) pilferage results in significant costs for supermarket operators. There are the losses from the theft itself, as well as expenses associated with installing expensive anti-theft devices (purchased by over 20 percent of supermarket operators in 1993)\footnote{61st Annual Report, p. 45.}. Overall, the costs attributable to shoplifting can be significant, particularly in light of the very low profit margin in the industry. In fact, at some supermarkets, the losses resulting just from customer theft exceed the stores' net profits.\footnote{Williams, op. cit. At other supermarkets, sweethearting accounts for the majority of the losses resulting from theft (Nannery, op. cit.).}

Under the proposed system, the problem of shoplifting is essentially eliminated; since the order pickup is closed to customer access, consumers simply do not have the opportunity to steal. Hence, relative to a comparable supermarket operator, a home grocery shopping distributor saves a substantial sum of money because (a) the home grocery shopping distributor does not have to purchase anti-theft devices, and (b), more significantly, it does not encounter the problem of customer pilferage in the first place.

Note that a home grocery shopping distributor also largely eliminates losses resulting from accidental customer-induced damage. And, perhaps more important than any financial savings, the proposed system almost completely removes the possibility of
customer product tampering.\textsuperscript{85}

Another element of the instore shrinkage problem is spoilage. In a supermarket-based system, all products are, to a certain extent, "pushed" into the store, even for an ECR Phase II distributor. In other words, while the distributor may base the level of replenishment stock on past sales data, and while the data may be highly accurate, in the end the distributor does not know for sure whether the items will actually sell.

For dry grocery products, this is not a major problem; given enough time, most goods will eventually be sold, and the time before a dry grocery product goes out of code\textsuperscript{86} is usually quite lengthy. On the other hand, not knowing in advance whether an item will sell is a significant problem with perishable products, which usually have very short time windows during which they must either be sold or else disposed of at a financial loss. Indeed, supermarket operators regularly have to absorb losses due to out of code perishable items.

In contrast, with home grocery shopping almost all goods delivered to the order pickup have been customer preordered. Thus, the distributor essentially has a guaranteed sale for the products in the order pickup. This is true even with perishable items, of which a limited inventory is maintained at the order pickup.\textsuperscript{87} Therefore, instore spoilage is largely reduced under the proposed system.\textsuperscript{88}

6.3.6.2. General ledger activities

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\textsuperscript{85}Theft and tampering are not completely eliminated under the proposed system, as they can still be inflicted by employees (though sweethearting—which is probably the most serious form of employee theft—is largely abolished with home grocery shopping). Note, however, that employees can be monitored and controlled in ways that are not acceptable to the general public. Refer to Chapter Seven for more information.

\textsuperscript{86}Go past the expiration date.

\textsuperscript{87}For instance, under the proposed system, the distributor is assumed to receive customer orders each day for pick-ups the following day. This information can be transmitted to the proper location (i.e., produce vendors, meat suppliers, the distributor’s perishables distribution center, etc.) each night so that the correct amount of stock is delivered to the order pickup the following morning. Note that the distributor can set the quantity of safety stock maintained at the order pickup according to its own policies.

\textsuperscript{88}In addition, because of the more precise information flow associated with home grocery shopping, spoilage outside of the retail outlet, such as at the vendor’s location, can also be substantially reduced.
The proposed system should result in considerable savings in operations not captured in the DPC analysis. These include operations at the retail outlet and at the distribution center, as well as headquarters functions. For example, Section 6.3.5.3. noted the likely cost reductions in the area of information-related activities at the home office; beyond this example, several other functions may also experience savings under the proposed system. In general, such savings stem from the basic design of the system, namely that it incorporates (a) electronic consumer ordering and (b) closed-access pick-up facilities.

For instance, home grocery shopping will allow for the reduction or elimination of several processes that exist under the current system. These include space allocation, category management and the buying function.

The first activity is space allocation, which pertains to decisions regarding how to allot supermarket shelf space and floorspace. Clearly, the expense involved in this process is eliminated under the proposed system.

The other functions—category management and buying—both pertain to the management of products. A key job for these functions is to deal with decisions about new products, such as whether an item should be placed in the store, how much stock should be purchased initially, and the reorder quantity during follow-up purchases. With respect to these functions, it should be apparent that the proposed system is entirely a coordinated system, i.e., it is driven wholly by consumer demand. Creating this type of supply channel is one of the goals of the ECR program. However, the proposals in the ECR program are limited almost entirely to the replenishment process for existing products.

In contrast, under the proposed system, there are a number of ways in which the coordinated distribution process can be extended to include new products as well—a very important factor in the grocery industry, considering the thousands of new products introduced each year. This expansion of the coordinated distribution process to new products produces considerable cost decreases and/or better use of resources in the category management and buying functions. Note that this is also a benefit which may not be

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89 Refer to Chapter Three for more information about coordinated versus noncoordinated replenishment.
feasible in a supermarket-based system.\textsuperscript{90}

Another important benefit of the proposed system concerns Dynamic CAO and Dynamic Allocation, first discussed in Chapter Three. These activities are key elements of ECR Phase II practices. They enable the creation of a very efficient ordering and distribution process involving the supermarket. They are also costly, with total expenses for the distributor ranging from $800,000 to $3.5 million, depending on the distributor's base level of sophistication.\textsuperscript{91}

With home grocery shopping, the only products sent to the order pickup are items which have already been customer preordered. Thus, there is no need to create complex systems designed to optimize store ordering around such factors as sales volume, product size, case quantity, etc. Indeed, the shelf space in the order pickup is automatically "dynamically allocated" each and every day, depending on that day's orders.\textsuperscript{92}

The examples in this section and Section 6.3.6.1. are just a few of the many which can be cited. Essentially, these examples illustrate the important point that the proposed system should reduce distributor costs in a variety of areas beyond those accounted for in the channel map analysis. But, as noted previously, this researcher has made the conservative assumption that the proposed system results in no distributor cost savings in functions outside of the channel map analysis.

6.4. Estimate of total savings

Previous sections have identified the costs involved in distributing Product A, broken down by stage and by activity. This section will aggregate these results, in order to generate an estimate of the total savings offered by the proposed system.

This section will also analyze the value created for the consumer by home grocery

\textsuperscript{90}See Chapter Seven for more information.

\textsuperscript{91}Efficient Consumer Response, p. 76.

\textsuperscript{92}Note that the need for sophisticated system optimization tools at the distribution center does not disappear under the proposed system. However, even if home grocery shopping results in the establishment of several mini distribution centers, there will be far fewer such facilities than order pickups. Thus the cost for optimization tools is significantly lower under the proposed system.
shopping. This is a very important aspect of the proposed system. Essentially, by allowing the consumer to shop at home—as well as employ drive-through pick-up facilities—home grocery shopping liberates a tremendous quantity of consumer time which is currently locked up in supermarket-based shopping. As this section will demonstrate, such a reduction in shopping time generates a tremendous amount of consumer value.

Overall, this section will provide a full accounting of both the distributor's cost savings, and the consumer's time savings. This analysis uses the household as the base; in other words, all values are analyzed in terms of household activity, e.g., average household spending on grocery products, and average household expenditure of time on grocery shopping. Included in this examination is a sensitivity analysis, to illustrate the range of total savings offered by the proposed system.

6.4.1. Distributor cost

Table 6-7 provides a summary of the costs, by stage, under the current and proposed systems. As illustrated, each system incorporates the distribution center, outbound transportation and the retail outlet, while the proposed system adds computer-related activities. Table 6-7 shows that the total cost reduction of the proposed system is 23.3 percent. Note that this is a very conservative assessment; see Section 6.4.1.1. for a sensitivity analysis.

In order to relate this cost reduction to consumer spending, a few calculations are necessary. The first step is to identify the proportion of consumer spending that is amenable to the cost reduction offered by home grocery shopping. Note that it is assumed that average household spending on grocery products is $68 per week.

In Section 6.3.1.1., it was mentioned that in order to be conservative, the savings of the proposed system are assumed to not be fully applicable to perishable products. In addition, this researcher assumes that home grocery shopping results in no reduction in costs for any item distributed via DSD.

According to a recent summary of consumer expenditures on grocery products, non-perishable items account for 50.4% of the dollar value of consumer spending, and
### Table 6-7
TOTAL COST BY STAGE
UNDER CURRENT AND PROPOSED SYSTEMS

<table>
<thead>
<tr>
<th>STAGE</th>
<th>CURRENT</th>
<th>PROPOSED</th>
<th>COST DIFF.</th>
<th>% CHANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>COST/ITEM</td>
<td>% TOT</td>
<td>COST/ITEM</td>
<td>% TOT</td>
</tr>
<tr>
<td>DIST. CTR.</td>
<td>$0.0210</td>
<td>10.7%</td>
<td>$0.1027</td>
<td>68.1%</td>
</tr>
<tr>
<td>TRANS.</td>
<td>$0.0107</td>
<td>5.4%</td>
<td>$0.0129</td>
<td>8.6%</td>
</tr>
<tr>
<td>RETAIL OUTLET</td>
<td>$0.1650</td>
<td>83.9%</td>
<td>$0.0122</td>
<td>8.1%</td>
</tr>
<tr>
<td>COMPUTER</td>
<td>---</td>
<td>---</td>
<td>$0.0229</td>
<td>15.2%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>$0.1967</td>
<td>100.0%</td>
<td>$0.1508</td>
<td>100.0%</td>
</tr>
</tbody>
</table>
dry grocery DSD items represent an additional 4.5 percent. Subtracting out these products leaves approximately 45% of the dollar value of the order, which this researcher assumes is fully amenable to the proposed system.

However, cost reductions for some of the perishable and DSD products may be feasible as well. For example, within the perishable category, there are certain items, such as baked goods, which might be open to picking at the distribution center. These products account for an additional 6.6% of spending, for a total of about 51.6% of the dollar value. Furthermore, it should be the case that even among the other perishable products—as well as among the DSD items—the proposed system will induce some reduction in cost; although the savings are not likely to be as great as with non-DSD dry grocery products, they should still be considerable.

Based on these factors, this researcher assumes that 60 percent of the overall dollar value of household expenditures is amenable to the proposed system. Thus, $40.80 in weekly spending are open to the cost reductions offered by the proposed system, and $27.20 are assumed to remain unaffected.

The next step is to identify the proportion of distributor costs that are impacted by the proposed system. The assumptions are: (a) the distributor GM is 25.4 percent, (b) the distributor net profit is 0.74 percent, and (c) the household expenditure affected by home grocery shopping is $40.80. Based on the first and the third factors, the GM dollar value is $8.26; based on the second and the third factors, the net profit is $0.31. Thus, $40.80 in household spending results in an average of $7.95 in distributor cost and $0.31 in distributor net profit.

The proposed system does not impact the entirety of this cost; there are many distributor expenses that are assumed to remain constant under the proposed system. In fact, it was established in Section 6.3.6. that these other costs represent 20-25 percent of the distributor's total expense. To be conservative, this thesis uses the higher figure. Therefore, of the total distributor expense of $7.95, 25 percent, or $1.99, is assumed to be unaffected by the proposed system. The result is $5.96 in distributor costs that are (a)


941993 U.S. average (see Chapter Three.)
involved in the distribution process, and (b) affected by the proposed system.

In Table 6-7, it was shown that the proposed system produces a 23.3 percent reduction in distributor costs. Applying this decrease to the value of $5.96 means that distributor costs are reduced by $1.39 per household per week, or $6.02 per household per month. In terms of consumer spending, home grocery shopping results in a 3.4 percent decrease in expenditures on applicable items, or a 2.0 percent decrease in total spending on grocery products.

6.4.1.1. Sensitivity analysis

Overall, there are many factors which indicate that the value just calculated is extremely conservative. This evidence stems from various assumptions made about the current distribution system, the proposed system, other distributor costs, and certain miscellaneous aspects as well. This section will briefly summarize the most significant factors, and illustrate the effects of reasonable modifications to the assumptions. To maintain conservative consistency, this section will also analyze the outcome from making certain assumptions more, rather than less, conservative.

The first factor is the current system. This thesis has assumed that as the basis for the current system, ECR is fully implemented. However, consider the outcome if instead the basis for the current system is the distribution system as it exists today. As found in Chapter Five, the cost involved in distributing Product A would be at least 18 percent higher under such a scenario. Note that this is by no means a radical modification of the assumption; many distributors have to undertake a great deal of investment before achieving even the first phase of ECR, and as Chapter Three discussed, there is a great deal of hesitation in the grocery industry in general regarding implementation of the program.95

Second is the distribution center under the proposed system, specifically the labor activities involved in the selection unit. From Table 6-2, item picking represents the larg-

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95 An indication of how wide the gulf is between current practice and ECR Phase II is provided by scanning. As mentioned in Chapter Three, accurate scanning is the key to the efficient replenishment process. Yet as of the end of 1993, 15 percent of all supermarkets in the U.S. still lacked scanners. ("61st Annual Report," p. 33) Clearly, this equipment must be installed before a distributor can achieve even ECR Phase I, let alone Phase II.
est single cost at the distribution center under the proposed system. (In fact, item picking is the largest single cost overall under the proposed system.) However, it was demonstrated in Section 6.3.2.3.1. that the rate employed to calculate this cost is likely too high. It was found that with reasonable modifications to the assumed rate for this activity, the distribution center cost declines by 13.4 percent, which leads to a 9.1 percent reduction in the overall expense under the proposed system.

Third is the order pickup, in particular the assumption that all home grocery shopping customers utilize shopping bags. As Section 6.3.4.3. found, for a customer who utilizes totes instead of bags, the order pickup expense is reduced by 31.1 percent. This produces a 2.5 percent reduction in the overall cost.

The fourth factor concerns the computer-related activities under the proposed system. As shown in Section 6.3.5, home grocery shopping results in significant outlays in this area. But it was also demonstrated that the cost allocated to Product A in the channel map analysis could be reduced significantly with minor modifications to the assumptions. Furthermore, it was shown that not only could the computer-related activities of home grocery shopping lower distributor expenses elsewhere in the organization, but that such savings may be more than sufficient to pay for the entire incremental computer-related cost.

The fifth factor pertains to other distributor activities. As mentioned in Section 6.3.6., there are numerous ways in which the proposed system can reduce distributor costs that are not captured in the channel map analysis. These include reducing (or eliminating) instore shrinkage, and lowering overhead costs. This thesis has assumed that the expenses for all such activities remain constant under the proposed system. However, relaxing this assumption produces savings that this researcher estimates at 2 to 3 percent of total costs.

Sixth is the dollar percentage of the customer order amenable to home grocery shopping. It is assumed that 60% of consumer spending is open to the reduction in cost offered by the proposed system, while the expense for the remaining 40% is assumed to remain constant. Relaxing this assumption slightly, to 65% of the customer order, increases the net savings by 8.3% relative to the base case.

As for the assumptions which are made more conservative, these pertain to the distribution center space and equipment costs under the proposed system. In Section

213
6.3.2.1., it was assumed that the under the proposed system, the rate for space is 100 percent more, and the rate for equipment over 500 percent more, than the respective rates under the current system. Section 6.3.2.3. analyzed the effect of doubling these higher rates. It was found that the outcome from making these assumptions more conservative is a 23.5 percent increase in the distribution center expense, which leads to a 16.0 percent rise in the total cost.

The net effect of these factors is summarized in Table 6-8. This table illustrates the base case and a more liberal case in which the assumptions have been partially relaxed (note that in the more liberal case, the assumptions about the distribution center costs have been made more conservative, as discussed above). As this table shows, the proposed system may result in a net distributor cost reduction of 58% or more relative to the current system. This represents at least a 148% greater decrease in cost compared to the base case. With respect to consumer spending, the higher value results in a 5.1% decrease in overall cost; this is equal to savings of $3.47 per week, or $15.04 per month, on $68 in weekly spending.

6.4.2. Consumer time

The analysis until now has focused exclusively on the distributor's cost. It has been demonstrated that the proposed system significantly reduces this expense. Section 6.6. will examine different ways in which this cost reduction can be disbursed among the distributor and the consumer.

However, home grocery shopping offers another tangible benefit, one that for many consumers may actually outweigh the decrease in distribution cost: a reduction in the expenditure of time on the activity of grocery shopping. To illustrate this finding, this section compares the time required to complete a grocery transaction under the current distribution system with that necessary under the proposed system.

According to a recent study, consumers in the U.S. engage in one major and at least one minor grocery shopping trip each week. The major trip is used for weekly stocking up, while the purpose of minor trips is to fill in selected items. Different studies

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Table 6-8
BASE CASE VERSUS
MODIFIED CASE

BASE CASE

<table>
<thead>
<tr>
<th>CURRENT</th>
<th>PROPOSED</th>
<th>COST DIFF.</th>
<th>% CHANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>COST/ITEM</td>
<td>COST/ITEM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>$0.1967</td>
<td>$0.1508</td>
<td>($0.0459)</td>
</tr>
</tbody>
</table>

MODIFIED CASE

<table>
<thead>
<tr>
<th>CURRENT</th>
<th>PROPOSED</th>
<th>COST DIFF.</th>
<th>% CHANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>COST/ITEM</td>
<td>COST/ITEM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>$0.2321</td>
<td>$0.0970</td>
<td>($0.1351)</td>
</tr>
</tbody>
</table>
have measured the instore time for the various trips with different results. In the Marsh Super Study, stock-up trips were found to take 39 minutes and fill-in trips 11 minutes,\textsuperscript{97} while in a study sponsored by Campbell Soup Company, the respective times were 66 minutes and 16 minutes.\textsuperscript{98} Taking the averages, this thesis assumes that consumers are presently spending 53 minutes per major trip and 14 minutes per minor trip, resulting in a total of at least 67 minutes expended on the activity of grocery shopping, each week.

To be conservative, this researcher uses as the base for the current system only the time that is required for the weekly stock-up trip. Thus the total instore time under the current system is assumed to be 53 minutes per week.

For the proposed system, the total time needed to do the shopping consists of (a) the time interacting with the display plus (b) the time spent retrieving the order. The first element can be estimated from the experience of Peapod, which is a personal computer-based home grocery shopping service currently in operation.\textsuperscript{99} According to the company, a consumer can "order $100 worth of groceries within 10 or 15 minutes."\textsuperscript{100} For a $68 order, product selection should therefore require 7 to 10 minutes; this researcher assumes the higher figure. With respect to the second component, it was assumed in Section 6.3.4.1. that this process requires 7 minutes to complete, starting with customer arrival either at the order pickup parking lot entrance or at the walk-up counter, and ending with conclusion of the transaction. Thus the total shopping time for the proposed system is 17 minutes per week.

Transportation to and from the store is also an important time consideration. However, it is assumed in this chapter that (a) the customer travels to the order pickup to


\textsuperscript{98}Russell, \textit{op. cit.}

\textsuperscript{99}Because this service is based on the use of personal computers, rather than catalogs, it serves as an ideal proxy, in terms of the display in the home and consumers' interaction with it, for home grocery shopping as proposed in this thesis.

\textsuperscript{100}Ravo, "High-Tech," p. 10. Note that Peapod's interface is entirely text-driven. This researcher estimates that with a more sophisticated display, as well as the use of programmable shopping lists, navigation aids and other tools designed to help the consumer quickly identify desired products, the total product selection time can be reduced to under ten minutes for a $100 order. (With a voice recognition system, the total interaction time might be even less.)
retrieve the order, and (b) the order pickup replaces an existing supermarket at the same location. Therefore, the roundtrip transportation time is assumed to remain constant under the proposed system. Note that this is a conservative assumption; refer to the sensitivity analysis in Section 6.4.2.1, for more information.101

The net result of this analysis is that home grocery shopping reduces the consumer shopping time by 36 minutes per major grocery shopping exercise. In terms of how this benefit is valued financially, the answer essentially depends on the consumer's perceived opportunity cost associated with the time spent grocery shopping.

For example, one study found that individuals range from those for whom demand for leisure is perfectly inelastic with respect to time savings (i.e., all time savings are applied to work), to those for whom demand for income is inelastic with respect to time savings (i.e., more work produces no added income).102 Therefore, in terms of the time savings offered by home grocery shopping, individuals who identify more with the first category would tend to value the benefit highly, while those who lean toward the second category would value it less (though some consumers may value their leisure time higher than their work time).

To provide an illustration of the possible financial value of the time savings, consider a consumer who values the time that he or she expends on grocery shopping at $15 an hour. The proposed system lowers the shopping time by 36 minutes per week. Therefore, home grocery shopping provides this consumer with the equivalent of $9 per week in utility.103 Note that this savings is greater than the cost reduction identified in the Section

101 It is important to point out that roundtrip transportation is a critical element when considering the benefits of home delivery.

102 Leon N. Moses and Harold F. Williamson, Jr., "Value of Time, Choice of Mode, and the Subsidy Issue in Urban Transportation," Journal of Political Economy, Vol. LXXI, June, 1963, pp. 251-52. The actual issue under consideration was whether public transportation should be subsidized. However, both the concept and the tools of analysis are similar to those involved in an evaluation of the opportunity costs associated with the use of time on the activity of grocery shopping.

103 This accounting does not include the many other benefits offered to consumers by home grocery shopping, including: 24-hour a day shopping (available in less than 30 percent of supermarkets—"6lst Annual Report," p. 34.); effortless item deletion; creation of an essentially stress-free shopping environment; elimination of unpleasant aspects associated with supermarket shopping, such as jostling among other customers in crowded aisles; and elimination of the need to physically traverse several aisles to find the desired item, which is a particular problem in large stores (see Michael Garry, "Showdown! Standing Up to Supercenters," Progressive Grocer, February, 1993, pp. 48-50). It may turn out that for

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Thus, one of the primary advantages of the proposed system compared to a supermarket-based system is the time savings that it grants to the consumer. On average, the proposed system reduces the consumer's time spent grocery shopping by 36 minutes per week. This results in a financial benefit equivalent to 60 percent of the consumer's perceived value for one hour of time currently spent in the supermarket. For many consumers, the financial equivalent of the time savings offered by home grocery shopping may actually exceed any reduction in retail prices.

6.4.2.1. Sensitivity analysis

There is evidence to indicate that the assumptions employed in the previous section are conservative, and thus the estimated time savings are also conservative. This evidence is based on four main factors, described below. To be conservative, a possible countervailing factor is also discussed as well.

First, the time assumed to be necessary to use the display—10 minutes for a $68 order—is probably too high. For the first few uses, the selection time is likely to be above 20 minutes as the consumer learns how to work the display. But, once this initial learning process is complete, the selection time could probably drop to under 6 minutes for a consumer who is determined to finish quickly. For instance, he or she will be able to program a regular shopping list; this feature will allow the consumer to restrict his or her selections each week to just a limited number of additions and deletions to and from the programmed list.

Second, the time at the order pickup—7 minutes for an order which does not require modification—is also probably too high. Considering that all orders are ready in the appropriate totes or bags, and that receipts for the purchases have been pretotaled (in fact funds may have already been transmitted electronically prior to customer retrieval), this time appears to be exaggerated. Indeed, presuming that staffing levels at the order pickup are suitable, it should be feasible to reduce this time to 5 minutes or less.

Third, for a customer arriving in an automobile, the time at the order pickup is as...
sumed to begin when he or she enters the order pickup's parking lot, while for the current system, only the instore time is incorporated. However, if the time spent (a) finding a parking space, (b) walking to the store entrance, and (c) walking from the store exit back to the car with the grocery purchases is also included, then the overall time under the current system rises considerably. In some circumstances, the resulting increase would be equivalent to the total time spent at the order pickup under the proposed system.

Fourth, the roundtrip transportation time is identical under both systems, since it is assumed that order pickups are deployed as replacements for supermarkets at existing locations. However, as Chapter Seven will demonstrate, the order pickups are likely to be located closer to where consumers actually live than are supermarkets. This would lead to a reduction in the roundtrip transportation time for the consumer under the proposed system.

A possible countervailing factor is the time that the consumer would have to wait under the proposed system to (a) gain access to the system and (b) download the database and other necessary software to the CPE in the home. With respect to the first point, this time is dependent primarily upon network capacity and the number of users attempting to access the system. If network capacity is sufficient—in particular, the capacity of the online servers—then this time should be minimal. As for the second issue, once the network connection is made, the time to complete this activity should be trivial, especially if—as mentioned in Chapter Four—portions of the necessary software are stored in the CPE in the home.

6.5. Telecommunications network access

6.5.1. Description of activities

Telecommunications network access refers solely to the back-and-forth communication of data between the distributor and the consumer. Included under this heading are transmission of the display interface and the contents of the database from the distributor to the consumer, and transmission of the order from the consumer to the distributor. Also included under network access are any auxiliary transmissions necessary to complete the transaction, such as communication to banks.

As mentioned in Section 6.3.1., this thesis does not assign a particular cost for
network access to Product A, or even to the home grocery shopping application in general. Instead, this researcher has chosen to relate the distribution savings offered by the proposed system to the telecommunications cost derived in Chapter Four. This association provides a very powerful illustration of the importance of this one application in the context of the expense to deploy an advanced telecommunications network.

6.5.2. Derivation of the network access cost

In Chapter Four, it was conservatively assumed that in order to finance the cost of the advanced network, the telecommunications provider would have to generate revenues of $18 per household per month. From the analysis in this chapter, it is clearly evident that the proposed distribution system creates a considerable amount of new value, both to the consumer and to the distributor. In fact, the gains from home grocery shopping are so significant that they are comparable to a large fraction of the total network cost; indeed for some customers, it is conceivable that the value provided by home grocery shopping equals or even surpasses the total network expense.

There are two important aspects to this analysis: (a) the reduction in distribution cost, and (b) the time savings. First, it was found in Section 6.4.1. that the proposed system offers a distribution cost decrease equivalent to at least 2.0 percent of total retail sales. For a household that spends $68 per week, this level of savings produces a net cost reduction of $1.39 per week, or $6.02 per month.

Second, Section 6.4.2. established that home grocery shopping produces considerable savings with respect to the amount of time consumers spend grocery shopping. For a consumer who values the time that he or she currently expends in the supermarket at $15 an hour, the proposed system produces $9 a week in utility, or $39 per month.

The implication of these results is twofold. First, for the average household, the distribution cost reduction alone represents 33.4 percent of the total network installation expense. Second, inclusion of the time savings produces a large benefit that for many consumers may be valued at several times the total network expense. In fact, based on the assumption the proposed system reduces the time spent grocery shopping by 36 minutes each week, consumer shopping time would only have to be valued at $6.92 an hour in
6.5.3. Sensitivity analysis

As the previous section illustrated, the value provided by home grocery shopping is theoretically equal to most, if not all, of the network access cost by itself. However, there is evidence that the actual network access cost incurred by this application, based on its use of network resources, is likely to be fairly limited. Indeed, it is entirely possible that there will be a wide gulf between the value that the application creates, and the true cost that it imposes on the telecommunications infrastructure.

To illustrate, consider the communication between the household and the distributor. It was assumed in Section 6.4.2. that the consumer requires an average of ten minutes with the display interface to complete a weekly $68 order. But the display itself does not have to be on-line for this entire time. Instead, as discussed in Chapter Four, the only communication that is necessary is (a) the initial upstream transmission from the CPE indicating that the consumer is ready to shop, (b) the return downstream transmission from the database, (c) the concluding upstream transmission of the completed order, and (d) some minor additional signaling and confirming transmissions.

There are three factors which will tend to minimize the cost for these transmissions. First, because this communication is entirely electronic, the on-line time can probably be limited to a total of under one minute. An important influence is the sophistication of the CPE, particularly how much memory it has.105

Second, in many circumstances, this communication will be the equivalent of a local telephone call; at most, the transmissions will be confined to a limited geographical area.106 In just about every region of the country, the cost for a peak-period one minute

104 It is very important to stress that the assumption that the network access cost is $18 per household per month is very conservative. The actual expense may be a small fraction of this number. Refer to Chapter Four for more information.

105 As noted in Chapter Four, it may be possible to reduce the communication time by downloading the shopping interface to the CPE once, and having it stored there for repeated use. Downstream communication beyond this initial transmission could thus be limited to such items as price and product changes, advertisements, and upgrades of the display interface, without requiring the transmission of the entire database with each session.
telephone call, either local or regional, is less than twenty-five cents.

Third, there will likely be much greater competition in the telecommunications industry than is the case today. Such competition will lead to general reductions in telecommunications rates.

Therefore, at four to five orders per month, the network access charge for home grocery shopping is likely to be under $2 per household per month. This cost may rise somewhat if longer transmission times are required, or if the distributor must employ the telecommunications provider's on-line server for extended periods of time. However, if the telecommunications rates of the future are based on network usage (as they are today), rather than on consumer willingness to pay, it is unlikely that the access charge for the home grocery shopping application would exceed 200 percent of this value, or $4 per household per month.

6.6. Application of the savings

There are numerous possibilities as to how the gains from home grocery shopping can be distributed. One extreme is complete retention of the benefits by the distributor; the other extreme is to fully pass the benefits on to the consumer. Between these points lies a range of possibilities for sharing the benefits among both parties.

Most likely, the consumer and the distributor will both reap major gains from the proposed system. For example, the consumer will clearly experience a reduction in the expenditure of time, resulting in an increase in convenience; the distributor will be able to build stronger links to suppliers, increasing backchannel efficiency.

With respect to the distributor's cost savings, the disbursement of this money will be a function of the marketplace. For instance, it may be possible for a home grocery shopping distributor to charge prices identical to those of its supermarket competitors, and retain all of the added margin for itself. Or, the distributor may want to pass some or all of the savings on to the consumer, thereby creating an overall product that would be very difficult for its supermarket competitors to match, and hence resulting in a tremendous

106For example, if a distributor sets up home grocery shopping operations in several different regions of the country, it would probably establish a local database in each region. In addition, even within a region the distributor may establish remote servers.
strategic advantage for the home grocery shopping distributor.

Table 6-9 illustrates the two extremes for the application of the distribution savings. The table shows that if the savings are retained entirely by the distributor, the result is a 279.7 percent increase in distributor net profit. The reason the gain is so large is because of the very low profit margins in the industry. On the other hand, if the savings are passed entirely on to the consumer, the outcome is a 2.0 percent cost reduction. The reason the gain appears to pale in comparison to that realized by the distributor (at least on a percentage basis) is because approximately 75 percent of the retail price is accounted for by the cost of goods.¹⁰⁷ Note that even if the savings are fully passed on to the consumer, the distributor still gains by generating a higher return on assets.

It is important to point out that the charge for network access has to be paid, which has the effect of reducing the cost savings. This expense can be paid by the consumer directly, or it can be fully or partially absorbed by the distributor, which would allow the consumer to access the home grocery shopping service at reduced or even no charge. In either event, the money must be paid out, which lowers the total cost savings.

Table 6-10 illustrates the effect of a $3 per household monthly access charge, assuming an average household expenditure of $68 per week. Even with this fee, which is probably high, it is clear that home grocery shopping results in significant financial benefits, ranging from a 138.7 percent increase in distributor net profit (if benefit and cost are fully absorbed by the distributor) to a 1.0 percent reduction in consumer cost (if benefit and cost are fully absorbed by the consumer).

6.7. Summary

This chapter has examined the distribution system proposed in this thesis in great detail. It has been shown that conservatively, home grocery shopping reduces the distributor's total costs by 23.3 percent for the sample product, from 1.67 cents to 15.08

¹⁰⁷Note that as mentioned earlier, this thesis does not claim any cost reduction in the supply channel up to the distribution center. However, this is likely to be a very conservative assumption. For example, it has been demonstrated that home grocery shopping will generate much more accurate information than a supermarket-based system. This higher quality data will lead to improvements in demand forecasting and purchasing. In the long run, these improvements may in turn allow suppliers to better synchronize production and distribution with actual consumer demand, leading to substantial increases in efficiency, and likely decreases in the cost of goods. For more information, see Chapter Seven.
Table 6-9
EFFECT OF COST SAVINGS OF PROPOSED SYSTEM ON DISTRIBUTOR AND CONSUMER

DISTRIBUTOR NET PROFIT

ASSUMPTIONS

$68 CONSUMER ORDER
BENEFITS FULLY RETAINED BY DISTRIBUTOR

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<thead>
<tr>
<th>CURRENT</th>
<th>PROPOSED</th>
<th>$ CHANGE</th>
<th>% CHANGE</th>
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<tbody>
<tr>
<td>$0.5032</td>
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<td>$1.3900</td>
<td>276.2%</td>
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CONSUMER WEEKLY SPENDING

ASSUMPTIONS

$68 CONSUMER ORDER
BENEFITS FULLY RETAINED BY CONSUMER

<table>
<thead>
<tr>
<th>CURRENT</th>
<th>PROPOSED</th>
<th>$ CHANGE</th>
<th>% CHANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>$68.00</td>
<td>$66.61</td>
<td>-$1.39</td>
<td>-2.0%</td>
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Table 6-10
EFFECT OF COST SAVINGS OF PROPOSED SYSTEM ON DISTRIBUTOR AND CONSUMER

DISTRIBUTOR NET PROFIT

ASSUMPTIONS

$68 CONSUMER ORDER
$3 MONTHLY NETWORK ACCESS FEE PER HOUSEHOLD
BENEFITS FULLY RETAINED BY DISTRIBUTOR
NETWORK ACCESS FEE PAID IN FULL BY DISTRIBUTOR

<table>
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<th>CURRENT</th>
<th>PROPOSED</th>
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<td>$0.6977</td>
<td>138.7%</td>
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CONSUMER WEEKLY SPENDING

ASSUMPTIONS

$68 CONSUMER ORDER
$3 MONTHLY NETWORK ACCESS FEE PER HOUSEHOLD
BENEFITS FULLY RETAINED BY CONSUMER
NETWORK ACCESS FEE PAID IN FULL BY CONSUMER

<table>
<thead>
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<th>CURRENT</th>
<th>PROPOSED</th>
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<td>$68.00</td>
<td>$67.30</td>
<td>-$0.70</td>
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</tbody>
</table>
cents. It has also been demonstrated that with slight modifications to the assumptions, the cost reduction offered by the proposed system may actually be much greater, with a decrease of 58.2 percent or more relative to the current distribution system possible.

This chapter has shown that in addition to reducing the distribution cost, the proposed system results in a significant decrease in the time consumers expend on the activity of grocery shopping. It has been demonstrated that for some consumers, this benefit alone may outweigh any possible cost savings. It has also been shown that because the proposed system allows the consumer to shop from home and retrieve the order at a drive-through neighborhood depot—referred to as an order pickup—home grocery shopping eliminates many of the hassles associated with shopping in supermarkets; although difficult to quantify, these gains are both tangible and important.

This chapter has shown that the benefits offered by the proposed system extend far beyond those possible solely through implementation of ECR. For example, this chapter used ECR Phase II as the base case for the current system. Therefore, both the consumer time savings and the conservative estimate of the distribution cost reduction are relative to full implementation of ECR. Note that the modified estimate of the cost reduction is relative to the current, non-ECR system.

This chapter has established the reasons why the proposed system is fundamentally different from other home grocery shopping efforts. It has been demonstrated that other home grocery shopping services are essentially add-ons to the existing supermarket-based distribution system, while the concept proposed in this thesis is centered around an altogether new distribution structure.

Finally, this chapter has analyzed the issue of the cost for telecommunications network access incurred by the home grocery shopping application. It has been shown that the actual costs incurred by the application, based on its use of network resources, is likely to be relatively small. However, it has also been demonstrated that the value associated with home grocery shopping, in terms of the decreases in distribution cost and consumer shopping time that it produces, may be sufficient to fully finance the deployment of advanced network infrastructure to the home.
Chapter Seven

Additional Benefits and Other Issues

7.1. Introduction

In Chapter Six, the discussion about the benefits offered by the proposed distribution system was limited exclusively to an evaluation of the distribution cost reduction and the savings in consumer shopping time. Even with a focus restricted to these factors, Chapter Six demonstrated that the home grocery shopping concept can be supported solely by (a) increasing distribution system efficiency for the distributor, and (b) making the shopping process more convenient, and ultimately less expensive, for the consumer.

However, there are numerous additional benefits that result from implementing the proposed system. The benefits unfold in a variety of areas, including sales volume, product quality, advertising and marketing, the environment and product manufacturing. This section examines the gains that home grocery shopping offers in these areas. It is important to stress that in many areas, the gains are quite significant, with potential long run benefits measuring in the billions of dollars.

Note that some of these benefits will be present at the start of the first home grocery shopping operation, but other gains are long term in nature, i.e., they will only become visible when a large number of consumers do their grocery shopping via the proposed system; this chapter will distinguish long term from short term benefits. Note also that since these gains are somewhat speculative, and do not form the core of this thesis, they are treated primarily in a qualitative rather than quantitative manner. Nevertheless, effort has been directed at providing rough estimates wherever possible.

This chapter is structured as follows. Section 7.2. investigates the area of product quality, including product freshness and product security. Section 7.3. analyzes the benefits offered by home grocery shopping with respect to advertising and promotion. Section 7.4. considers the issue of sales volume. This section shows why, despite the fact that consumers lose physical access to products under the proposed system, sales volume does not necessarily have to decline; indeed, as this section demonstrates, there are several
factors which indicate that sales volume may actually increase under the proposed system, at least for the initial home grocery shopping distributors in each market. Section 7.5. examines the environmental gains offered by the proposed system. Section 7.6. analyzes several of the ways in which suppliers benefit from home grocery shopping.

7.2. Product quality

Home grocery shopping offers clear benefits in the area of product quality. These improvements can be broadly grouped into two categories: product freshness and product security.

7.2.1. Product freshness

The proposed distribution system produces important gains in terms of product freshness. There are two main reasons why this occurs. First, as discussed in Chapter Six, highly accurate and up-to-date information regarding product movement is collected by the distributor; this data allows for more precise ordering from the supplier. Both the distributor and the supplier should ultimately be able to achieve faster order cycle times, leading to a considerable reduction in the amount of time product spends in the supply channel. And, as pointed out in Chapter Six, these gains are in addition to those resulting from ECR.

Also very important, particularly for perishable items, is the fact that the proposed system provides the distributor with advance knowledge of consumer demand. For example, the distributor will know the exact number of cartons of milk that have been customer-ordered for the following day, and this information can be transmitted to the milk supplier. Using this information, the milk supplier will be able to deliver a more accurate count and better manage its stock compared to a supermarket-based system, thereby reducing (a) the supplier's and the distributor's risk that the milk will not be sold and thus will ultimately have to be destroyed, and (b) the consumer's risk that the purchased milk is too close to the expiration date.¹

¹In general, this is the difference between the low risk situation of coordinated distribution with respect to consumer demand (i.e., the proposed system) versus the more risky predicament of noncoordinated distribution (i.e., a supermarket-based system). Refer to Chapter Three for more information about this issue.
The second factor pertains to the fact that under the proposed system, product picking of dry grocery products (and possibly perishables) is aggregated from the retail level to the distribution center level. As a result, shelf time at the retail level is dramatically reduced.

To illustrate, consider the hypothetical example of Product Q, a dry grocery product. Consumer demand for Product Q averages 3 units per week at the retail level, but the smallest case size is 12 units. Since the distribution center is not equipped to open cases under the current system, the supermarket must order an entire case of Product Q and utilize a 4 week order cycle.

With this structure, Product Q spends an average of two weeks at the supermarket before consumer purchase. At the end of the order cycle, the remaining units of Product Q have been sitting on the store shelf for over three weeks, and the last unit in each case is literally on the shelf for four weeks before purchase. In fact, these results are conservative: from previous chapters, it has been established that the average time a dry grocery product spends at the store is 26 days.

Contrast this situation with that of the proposed system. Based on the model distributor (i.e., 100 retail facilities, 10 percent of the customer base employ home grocery shopping), 30 units of Product Q are picked into customer orders at the distribution center each week. Thus the order cycle time for a case of Product Q is 2.8 days, and the average wait time for Product Q in the selection unit (which is equivalent to being on a shelf in a supermarket) is 1.4 days.\(^2\) Conservatively assuming that the total time from the point of distribution center picking to customer retrieval at the order pickup averages 30 hours, Product Q should be out of its case for no more than 3 days before it is acquired by the consumer. This total represents an 88 percent reduction from the equivalent time under the current system.\(^3\)

Thus, simply by the nature of its design, it is evident that the proposed system will provide the consumer with fresher product than is feasible with a supermarket-based

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\(^2\)In other words, 2.5 cases are distributed through the system each week.

\(^3\)Note that to be conservative, this thesis assumes that the proposed system results in no gains with respect to the time products spend at the distribution center. However, as Chapter Six discussed, the proposed system is likely to have a beneficial impact on this time as well as the time spent at the retail outlet.
system. Currently, the distributor has little choice but to stock items at the supermarket in case lot quantities. The result is that often, by the time a given dry grocery product is purchased, it has been sitting on the shelf for several weeks. Even with implementation of the ECR program, the average dwell time at the supermarket will only be reduced by 4 days, from 26 to 22 days.

However, with home grocery shopping, this cycle time is reduced by an order of magnitude, to a period measuring less than one and a half days. This outcome occurs because the picking activity (i.e., consumer demand) formerly expressed at many individual supermarkets is aggregated into one distribution center facility. Therefore, irrespective of any time advantage that the proposed system offers prior to the selection unit at the distribution center, it is evident that home grocery shopping's capacity to distribute all products on a near-JIT basis to the consumer results in a clear time advantage over a supermarket-based system.

7.2.2. Product security

Product quality will also improve under the proposed system, due to the increased security that the concept provides. To illustrate, consider the fact that supermarkets are, by design, self-service operations. This method of business can create problems, ranging from the mundane (i.e., a piece of fruit accidentally knocked to the floor, where it becomes dirty and bruised) to the horrific (i.e., tampering—which, although rare, can have terrible repercussions). The difficulty with running a supermarket is that the operator has relatively little control over what takes place in the store, and this lack of continuous oversight means that products are susceptible to a variety of harmful outcomes. As one individual with experience in the industry observed:

It is hard to imagine an industry of this size being so public, open and exposed. There is nothing to stop anyone from wandering around in stores, observing, examining, and...yes, at times even tampering with product on the shelves. The supermarket, by its nature, is a self-service time bomb. By its nature, it invites vandalism, theft, and other forms of crime.4

Under the proposed system, these problems are largely eliminated, since the order

4Ken Partch, "There, but for the Grace...," Supermarket Business, December, 1992, p. 5.
pickup is closed to customer access. Though employees will have greater access to products, workers can be closely supervised. Certainly, company employees can be monitored and controlled with much greater scrutiny than can the public walking through a supermarket.

7.3. Advertising and promotion

One of the greatest potential benefits of the home grocery shopping system involves the marketing function. Both the interactive display and the information in the database are extremely valuable resources individually; in conjunction, they create an opportunity to market products in a fundamentally new way. In fact, because of certain aspects that are unique to the concept, home grocery shopping may ultimately enable both an increase in distributor advertising income and a reduction in supplier promotional costs, particularly for new products.

7.3.1. Advertising revenues

The advertising revenue that the distributor can gain through home grocery shopping is potentially quite large. To illustrate, consider the following scenario. A consumer is sitting at home, compiling his or her weekly order using the interactive display. As the consumer reaches the soda selection, the name of Brand X automatically pops up first with an eye-catching presentation, while the jingle from Brand X's latest commercial plays in the background. Extending the interactive marketing even further, the system could be programmed, for example, to occasionally offer the consumer 20¢ off the regular purchase price of Brand X, with the caveat that this incentive is only offered when the consumer initially selects Brand Y.\(^5\)

To the distributor, but particularly to the supplier, this benefit of home grocery shopping is extremely valuable. Manufacturers currently spend large sums of money attempting to persuade consumers to purchase their products and brands. Generally, this advertising is of a delayed nature as far as the consumer is concerned, because it occurs at a time and place far removed from when and where he or she makes the actual purchasing decision. In contrast, advertising on the home grocery shopping display offers the

\(^5\)The display could also be programmed to offer specials targeted to individual consumers, based on historic purchasing activity data.
consumer almost instant satisfaction: an ad pops up and all the consumer has to do is indicate "Yes." There are few, if any, other advertising channels that can match home grocery shopping's capacity for impulse buying.

Another important reason to note the power—specific to an adaptive electronic presentation—of the home grocery shopping display pertains to impulse buying. This method of consumer purchasing is considered by distributors to be a critical element of the grocery retailing business. For example, virtually all distributors, regardless of pricing philosophy, use weekly "hot specials" to stimulate additional consumer purchasing activity. Indeed, according to various companies contacted by this researcher, it is estimated that over 60 percent of all consumer purchases are selected on an impulse basis.7

With a cleverly designed, attractive interface, it should be possible to drive consumer demand and stimulate impulse buys. For instance, sound plus pictures or videos of freshly washed produce and meat barbecuing on a grill can be incorporated into the display; also, the interface can be programmed to promote certain products in association with others, such as rolls and condiments with hot dogs, mayonnaise with tuna fish, and fabric softener with laundry detergent. Indeed, marketers should be able to design ingenious advertising that takes advantage of the unique environment provided by the display.8 Overall, because the electronic presentation allows for a certain level of freedom and creativity, home grocery shopping may eventually more than compensate the distributor for any lost impulse purchases that result from consumers losing physical access to products.9

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6 The two basic types of pricing strategy in the grocery retailing industry are "Hi/Lo" and "Everyday Low Price" (EDLP).

7 Private interviews with representatives of distributors and suppliers, August to November, 1993. Note that this value differs significantly from the results obtained in a recent nationwide survey of consumers; see Section 7.4. for more information.

8 Note that marketing on the interface would probably have to be sophisticated and subtle, since consumers would likely object to a blatant display of advertising which interferes with the ordering process. It is also important to note that a home grocery shopping distributor retains the ability to employ the pricing strategy of its choice; for example, the distributor can use either Hi/Lo or EDLP, and it can offer hot specials if it so chooses.

9 One related benefit of home grocery shopping compared to today's shopping method is that unlike with a physical supermarket shopping cart, the electronic cart in advanced GUIs can be programmed to never "fill up." This feature should stimulate further buying activity and thus aid the distributor in increasing the average consumer purchase.
Another reason why marketing on the home grocery shopping display is significant pertains to the more general efforts currently underway in the area of interactive advertising. Although this field is presently under intense development, to date almost all of the ideas put forth—even those considered very forward-looking—have lacked the immediacy that results from advertising on the home grocery shopping interface. In fact, not one of the proposals that have been discussed publicly combines the marketing and product ordering functions into one integrated whole in the way that the home grocery shopping system does.

While it is difficult at this juncture to estimate the level of advertising revenue that home grocery shopping could generate, since the concept has yet to be implemented, it is worth noting that the amount could be substantial. For example, in 1992, over $10.8 billion was spent on advertising across the U.S. just in the following product categories: food; toiletries and cosmetics; drugs and remedies; candy, snacks and soft drinks; beer and wine; soaps and cleansers; and pet foods. This figure includes the money spent on all major forms of media, including television, radio, magazines and newspapers. Based on the discussion in this section, it is evident that marketing on the home grocery shopping display should be at least as effective as these other channels; hence, the service should be able to garner a significant share of overall advertising spending.

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11In addition, almost all proposals for future marketing in an interactive environment require the consumer to take an active role by requesting information. This type of marketing makes advertisers nervous, due to the difficulty of designing advertisements that pique consumers' interest enough so that they actually seek additional information (see Weaver, op.cit.). In contrast, advertising on the home grocery shopping display—though shaped by each consumer's individual shopping activity—is entirely passive.


13Note that a home grocery shopping distributor can still utilize weekly newspaper inserts, direct mail circulars and other standard promotional vehicles, allowing it to reap any advertising support that suppliers offer for the use of these materials. While the home grocery shopping distributor may lose some income due to the elimination of instore promotions, according to one distributor this money is fairly trivial (interview with an independent operator, April, 1994); moreover, the revenue gain resulting from advertising on the at-home display should be far in excess of any advertising loss experienced elsewhere in the system.
7.3.2. Product introduction

In addition to advertising gains for the distributor, home grocery shopping should also enable the supplier to realize a reduction in the cost to promote products, particularly new items. This is significant considering that in recent years, over 16,000 new products have been introduced annually, and less than 1 percent of these items achieve yearly sales greater than $15 million.\footnote{Efficient Consumer Response, p. 88.}

Introducing a new product to the marketplace is expensive: it is estimated that it costs the supplier $15 to $20 million to successfully launch a new grocery product in the U.S. Much of this cost results from inefficient and ineffective test marketing. For instance, consumers frequently react favorably to a new product in a test marketing situation, only to reject the item once it arrives at the supermarket. Also, as noted in Chapter Three, it is quite common for suppliers of new products to have to pay slotting fees to distributors in order to secure space on the supermarket shelf.

With home grocery shopping, it should be possible to launch products more cost effectively, for several reasons. First, demographic data in the distributor database can be cross-referenced with product movement information, allowing suppliers to be very selective in their choice of test markets.\footnote{ECR aims to gain a similar correlation between demographic data and purchasing activity by proposing that consumers utilize frequent shopper membership cards or similar types of “consumer cards” (Efficient Consumer Response, p. 91). However, this method of capturing information has significant drawbacks, including its cumbersome design and the fact that it requires active participation by the customer. In contrast, data capture on the home grocery shopping system would be automatic, requiring no active involvement on the part of the customer. The home grocery shopping method of data capture thus allows for the collection of a much richer and more precise set of consumer data than a supermarket-based system.} In fact, home grocery shopping creates the opportunity to employ very effective micromarketing, possibly targeted to the individual consumer.\footnote{Note that the opportunity to use micromarketing applies to new and existing products.} Second, home grocery shopping enables increased use of pull marketing, an inherently less risky strategy than the push marketing which is standard in the industry today. For instance, new items can be cheaply "trialed" on the display, reducing the need
to build up huge prelaunch inventories of giveaways.\textsuperscript{17} Third, the distributor can eliminate supermarket slotting fees, since supermarket shelf space is no longer a constraint (note that a home grocery shopping distributor may choose to assess fees for the use of the distribution center or to include a product in the display).\textsuperscript{18}

It is currently estimated that it costs up to 4 percent of sales to launch a new product; ECR seeks to gain a savings of 0.9 percent of dry grocery sales, or between $1.5 and $2 billion if fully applied across the U.S. Under the proposed distribution system, any decrease in product introduction costs will in the short term be fairly trivial overall (though the savings will certainly be significant to the companies involved). In the long run however, should home grocery shopping become widespread, the savings that it enables could approach or even surpass those estimated under ECR.

7.4. Sales volume

In the course of this research, one concern that has been repeatedly expressed—primarily by distributors—is the possibility that sales volume will drop under the proposed system. There are three key reasons underlying this concern. First, as noted earlier, impulse purchases currently account for a significant percentage of total sales volume. The perception on the part of many of the distributors contacted by this thesis is that impulse purchases will decline precipitously under the proposed system. Second, distributors strive to "jazz up" the grocery shopping process—by nature a rather pedestrian activity—in order to stimulate the consumer. Several distributors have indicated that

\textsuperscript{17}Note that a very interesting possibility is that the display can include a "new product" section, allowing consumers to investigate recently introduced items. This part of the display—which is clearly driven by advertising—could be designed to be very entertaining, perhaps even more so than the section devoted to existing products, where consumers might object to excessive advertising. Indeed, the new product section could become an aspect of the display that consumers look forward to exploring with each shopping activity.

\textsuperscript{18}Actually, it should be the case that if the supplier furnishes the necessary scanned images for the database, the cost to the distributor to add a new product will be minimal, assuming that the distributor has sufficient incremental capacity at the distribution center. This comes back to the issue of physical versus electronic display: it is less expensive and less risky to promote products electronically rather than physically. With a supermarket-based system, it is often necessary for the supplier to display a new product prominently in the store in order to gain consumers' attention. In contrast, under the proposed system, the new product can achieve electronic prominence at relatively low cost, while being housed in some out-of-the-way corner of the distribution center (or perhaps not being prestocked at all) until demand is proven.
any effort aimed at integrating the consumer into the supply channel will automatically render the shopping process sterile and unappealing. Third, if consumers have to plan their grocery shopping in advance, or have to wait until the following day before their orders are ready, then the number who will be drawn to such a system is likely to be very limited.

While these are legitimate concerns, they are probably overstated. With respect to the first two issues, Section 7.3. discussed several ways in which the distributor can creatively employ both the interface in the home and the database of purchasing activity to stimulate consumer demand. Also, when network capacity is sufficient to support full-motion video and three-dimensional graphics, it should be possible to design presentations that are actually more appealing than typical supermarket shelf displays. Furthermore, a voice recognition system deployed in the kitchen would enable consumers to compile their orders exactly as they identify their needs. Finally, the proposed system will enable products to be targeted to individual consumers in such a way that is not available in a supermarket-based system. The net result is that there is no reason to assume that impulse purchases, and consequently sales volume, will necessarily decline substantially or at all.19

With respect to the third issue, the proposed system does not require any more advance planning on the part of the consumer than the status quo. In fact, by enabling the consumer to program shopping lists and possibly use a voice recognition system, the level of preparation should actually decline. Also in regard to the third issue, it is by no means certain that the consumer would have to wait until the following day to retrieve his or her order. For example, well-managed distributors can currently pick an entire supermarket order in under six hours. A similarly well-run home grocery shopping operation might allow a consumer to order in the morning and pick up in the evening on the way home from work.20

19It is important to point out that according to a recent nationwide survey of consumers, impulse buying actually accounts for a small fraction of overall consumer buying activity, and in fact is significantly outweighed by purchases which are planned in advance. For example, 84 percent of the surveyed consumers almost always or frequently "make a list," but only 37 percent almost always or frequently "make an unplanned or impulse purchase;" 53 percent make an impulse purchase occasionally, and 10 percent never make unplanned purchases. ("61st Annual Report," p. 52.) Note that these results differ significantly from the assessment of impulse purchasing activity estimated by distributors and suppliers (refer to Section 7.3.1.).

20Also, as mentioned in Chapter Six, there are other home grocery shopping distribution models besides the one examined in that chapter. For instance, one model calls for all picking to be done at the order
At a more basic level, it is important to understand that the proposed system does not have to capture 100 percent of household spending on grocery products in order to be successful. In reality, this is not likely to happen. Consumers will still need to engage in frequent fill-in trips, just as they go to convenience stores and even supermarkets for this purpose today.\(^2\!\!1\)

Actually, there are several reasons which indicate that overall sales volume for a home grocery shopping distributor may in fact be greater than for a comparable supermarket competitor. Some of these factors may benefit only the first one or two home grocery shopping distributors in each market (i.e., companies which still have the luxury of competing primarily against traditional supermarket operators), but other factors may actually encourage additional consumer spending and thus result in absolute gains in sales volume.

The first factor pertains to the size and the structure of the order pickup, as envisioned by this researcher. The facility itself is relatively small, and the requirement for surrounding land is much lower than that needed for a supermarket, since customers will be driving through in a short period of time rather than parking for an extended duration. Also, the order pickup is closed to public access.

For several reasons, these features are likely to lead to an increase in sales volume. First, at a given cost level, the distributor can deploy more retail outlets under the proposed system than under the current system. In other words, for every supermarket that is replaced, some number greater than one of order pickups can be established at no increase in cost. Second, because of the reduced land requirement, the distributor can locate order pickups further out into the neighborhood than is possible with supermarkets, thus bringing the company's physical retail presence closer to the customer.\(^2\!\!2\) Third, the pickup, and another model involves a two-tiered system. These options would allow orders which involved product maintained at the order pickup to be prepared for customer retrieval in a shorter period of time than picking solely at the distribution center.

\(^2\!\!1\) Even in this respect, home grocery shopping may benefit. For instance, unless the customer's need for a product is immediate, he or she may be content just to order the item at the time the need is identified, and then wait until it is ready for retrieval.

\(^2\!\!2\) In other words, there are many small parcels of land which could support the order pickup's space requirements, but which are not sufficient for a supermarket.
construction time for a new order pickup would be less than that for a new supermarket, allowing the distributor to generate sales volume at the order pickup during the time that a supermarket would ordinarily be under construction. Fourth, since the order pickup is closed to public access, it can be located in areas that are off-limits to supermarkets. For instance, many communities have zoning regulations that restrict the type of retail activity involved in a supermarket business, but which do not regulate as stringently the order pickup’s closed-access type of operation; in addition, the decreased need for parking at the order pickup would benefit the distributor in obtaining zoning approval.

The net result is that the distributor gains a great deal of freedom over where to locate its facilities. For the initial home grocery shopping distributors in each market, this freedom can translate directly into sales volume increases relative to competing supermarket operators.

The second reason why sales volume may rise under the proposed system pertains to the convenience factor, which supermarkets clearly cannot match. This is another advantage that will be realized primarily by early adopters of the proposed system. Note that the convenience factor includes both the ordering and the retrieval processes (i.e., the fact that the order pickup is a drive-through operation).\(^\text{23}\)

The third reason concerns stockouts. In a supermarket-based system, if the desired product is not on the shelf when the customer arrives, and the customer does not substitute another item for the desired one, the sale is lost. If the customer goes to a competing supermarket and locates the product, then decides not to return to the first distributor, the customer is lost.

In the supermarket industry, stockouts occur frequently. For instance, in a practice which is common in the industry, one of the large chain distributors contacted by this researcher sets four levels of instock goals. The targets range from 88 to 96 percent, depending on the average sales volume of the product (i.e., the greater the volume, the higher the targeted instock position). However, the implication of these goals is that even if the targets are met, the distributor finds it acceptable to be out-of-stock 4 to 12 percent

\(^{23}\)At the home, an important element of the convenience factor is that consumers can order 24 hours a day, 7 days a week, without the need to make the type of commitment or effort involved in shopping at a supermarket.
of the time.

In contrast, under the proposed distribution system, stockouts resulting from anything other than highly unusual circumstances should largely be eliminated. To illustrate, the lead time between the moment the order is received by the distributor and the point at which it must be ready for customer retrieval should enable the distributor to procure essentially any item not already in stock.24 Another contributing factor is that the proposed system will enable customers to program standing orders, thereby granting the distributor additional lead time.25 Any reduction in the number of stockouts leads to an increase in sales.

The fourth factor concerns the ability of the distributor to better plan its product mix. The use of large supermarkets and even larger superstores has created somewhat of an impersonal layer between the distributor and the customer, particularly with respect to chain operators. The following statement is from Efficient Consumer Response:

Mass marketing radically changed the relationship between retailer and customer. Suppliers communicated directly with customers through advertising and promotion, creating demand for products and reducing the retailer's role in selecting products. The consolidation of the retail segment with the growth of chains and expansion of store sizes also reduced the contact between the store owner and his customers, making it much more difficult to objectively evaluate new products against the needs of the store's customers.26

Home grocery shopping can erase the barrier between customer and distributor. For instance, the display interface can include a comment area, granting customers an easy way to transmit their suggestions for items that should be added to the assortment. Indeed, a truly customer-oriented distributor would allow most or all of the product mix to be shaped by customers. In this way, both the customer and the distributor benefit: the customer is able to obtain almost any product he or she wants, and the distributor is able

24But, since a home grocery shopping distributor will have a very efficient system of information flow, it should be possible to minimize the need for such emergency shipments.

25The distributor may choose to encourage customers to establish standing orders, since such orders allow the distribution process to become extremely efficient.

to operate at less risk.\textsuperscript{27} The net result of allowing customers to drive the \textit{entire} product mix—not just new products—might be a return to a previous era in which corner grocers knew their customers' tastes intimately, and shaped their offerings accordingly.

The fifth reason pertains to the timing of decisions regarding the delisting of products. Under the proposed system, the minimum sales volume that a product must maintain, in order to avoid being dropped, is much lower under than under the current system. This stems from the concept—discussed in Section 7.2.1.—of aggregating demand from the retail level to the distribution center level.

To illustrate, consider a situation where the distributor sets the threshold level for a particular product at a minimum of one case per month. If the item does not meet this level—either at the supermarket under the current system or at the distribution center under the proposed system—then it is deleted from the selection. Suppose that consumer demand for the item at the store level declines to half a case per month. Under the current system, the product would be dropped, even though viable demand still exists.

In contrast, under the proposed system, the distributor would continue to carry the product, because the total demand at the distribution center—which supplies several order pickups—amounts to well over one case per month. Thus, particularly for slower moving items, a home grocery shopping distributor is able to generate incremental sales revenue relative to a supermarket operator, by extending the sales lives of products.

The sixth reason sales volume may increase is because home grocery shopping allows the distributor to offer items not usually found in a supermarket, such as prepared meals from local restaurants. Customers could order their selections from a menu of choices on the display, in the same manner that they do the grocery shopping (some customers may even choose to use this feature in-between regular grocery shopping activity). The distributor would then forward the orders on a daily or more frequent basis to participating restaurants, such as those with a high reputation in the community. Since all meals are preordered by customers, this feature is much more feasible under the proposed system than under a supermarket-based system.\textsuperscript{28} Eventually, the distributor may choose

\textsuperscript{27}The distributor's risk is lowered because it knows that essentially all of the products in its inventory can be sold at its preferred price, rather than artificially marked down to a distress sale price.
to set up its own meal preparation facility, in the same manner that distributors operate facilities to fix prepared foods—but generally not full meals—today.\textsuperscript{29}

There are yet more features that can be incorporated into the home grocery shopping concept to boost revenue even further. For instance, the distributor could operate a produce stand next to the order pickup, and it could partner with other businesses, such as a dry cleaner, to allow non-grocery items to also be retrieved at the order pickup.\textsuperscript{30} However, the above factors serve the point, which is to illustrate that under the proposed system, sales volume need not necessarily decline. Indeed, for the initial home grocery shopping distributors in each market, sales volume may actually increase relative to comparable supermarket operators. Perhaps of even greater importance to distributors is the likelihood that the proposed system will allow profit margins to rise significantly relative to the current system.

7.5. Environment

The proposed system benefits the environment in several ways. First, it saves energy in store operation; second, it may reduce the use of disposable shopping bags; and third, it enables a reduction in the quantity of packaging. Although these gains are difficult to quantify, in a time of heightened environmental awareness, they should not be ignored.

First, the proposed system results in energy savings in store operation. This benefit results primarily from the fact that energy is not wasted creating a physical display environment, in each retail facility, for literally hundreds of thousands of individual items.

\textsuperscript{28}In a supermarket-based system, meals can be offered for sale but the distributor does not have an accurate count in advance of how many are needed each day. Thus a supermarket operator is likely to stock either too few meals or too many; either way, its revenue is not maximized.

\textsuperscript{29}A very important benefit of offering prepared foods, particularly ready-to-eat meals, is that the margins are extremely high, especially compared to dry grocery products.

\textsuperscript{30}Operating a produce stand in conjunction with the order pickup offers several advantages. First, it would allow the distributor to capture consumers who might be hesitant about delegating to the distributor the responsibility for picking produce. Second, it would enable the distributor to demonstrate to consumers that, since all produce originates from the same source, the quality of the items supplied via the home grocery shopping system is no different from the quality available with self-picking. Third, the produce stand could generate incremental revenue from non-home grocery shopping customers, as well as serve as a means with which to interest such consumers in the home grocery shopping system.
With the implementation of home grocery shopping, the energy necessary for store operation is conserved in two key ways. First, the order pickup is smaller than a supermarket, meaning that there is less area to heat, cool and light. Second, as mentioned in Chapter Six, separate temperature-controlled rooms, designed to limit heat inflow, are used to store temperature-sensitive products.\textsuperscript{31}

Presently, supermarket operators spend about 1.2 percent of sales on utility-related expenses,\textsuperscript{32} or over $114,000 annually per supermarket for the model distributor (i.e., $9.53 million in yearly sales volume). Although the energy cost reduction offered by home grocery shopping is difficult to quantify at this time, it is envisioned that the order pickup will measure at most one third the size of a supermarket. Therefore, the proposed distribution system should be able to achieve at least a 50 percent reduction in store-related energy use, and cost, compared to a supermarket-based system.\textsuperscript{33}

Second, home grocery shopping may help to reduce the use of disposable bags. For instance, as Chapter Six demonstrated, it is less expensive for the distributor if customers employ totes rather than bags for product pick-up. Also, the likelihood of error is lower if totes are employed end-to-end, instead of moving orders from totes to bags. Thus the distributor is likely to encourage customers to use totes. With respect to the environment, any use of totes means that the need for disposable bags is reduced, yielding all of the environmental benefits that such a decrease implies.

Third, home grocery shopping may lead to a reduction in the in the quantity of packaging material. This results from aggregating product demand from the store level to the distribution center level.

To illustrate, consider that under the current system, in order for products to be merchandised, they must be physically displayed in the supermarket. But store shelf space

\textsuperscript{31}For example, in a supermarket, energy is drained by the constant influx of heat into frozen and refrigerated display fixtures designed for unrestricted customer access.


\textsuperscript{33}Some of this gain may be offset due to the possible creation of mini distribution centers and other facilities not present under the current distribution system.
is limited, and one of the results is that subtle pressure is exerted on suppliers to reduce the number of units per case, since such a reduction allows the distributor to (a) more efficiently stock a greater variety of products in the store, and (b) better match its product flows with customer demand. Thus, under a supermarket-based system there is a tendency for case sizes to become smaller with time.\textsuperscript{34}

The opposite is true under the proposed distribution system. At the distribution center level, the most efficient grouping of products is in cases which are larger than that considered ideal at the supermarket level. The proposed system may thus result in subtle pressure being exerted on suppliers to increase, rather than decrease, the number of units per case. Such an increase leads to a reduction in both the necessary quantity of packaging, and the amount of waste material generated.\textsuperscript{35}

There are still other ways in which the proposed system may benefit the environment. For instance, better managed inventories imply less waste; the use of an electronic display may cause suppliers to design innovative packaging that uses less resources; and if home delivery ultimately does become popular, the total number of vehicle miles traveled related to the activity of grocery shopping may be reduced.\textsuperscript{36} Overall, it is clear that home grocery shopping can benefit the environment in many ways, both near term and in the long run.

\subsection*{7.6. Supplier benefits}

The proposed distribution system offers many benefits to suppliers. Some of these were noted earlier, such as reduced product introduction costs, and possible sales increases due to higher quality data on consumer behavior. Other gains were alluded to but not explicitly discussed. For example, by retaining information in an electronic format, starting with the consumer and extending back to the supplier, the proposed system can help the supplier to reduce costs in many areas, including data entry and resolving invoice

\textsuperscript{34}Refer to \textit{Efficient Consumer Response}, p. 70.

\textsuperscript{35}To see why, imagine one case of 24 units positioned alongside two cases of 12 units placed end-to-end. Between the two smaller cases lies a double wall of packaging that is eliminated by the single larger case.

\textsuperscript{36}The total number of vehicle miles traveled is less if one vehicle is used to bring orders to several customers instead of each customer driving his or her own car to the retail outlet.
discrepancies.37

Several of the benefits offered to suppliers by the proposed system can be achieved by implementing ECR. But, similar to the situation with distributors discussed in Chapter Six, even in those areas that the ECR program addresses, the advantages offered by home grocery shopping generally surpass what is feasible in a supermarket-based system.

For instance, product movement data is likely to be much more accurate and up-to-date under the proposed system than under a supermarket-based system, even one managed according to ECR best practices. The beneficiaries of this higher quality data include distributors and suppliers. As was discussed in Chapters Two and Three, timely and accurate product movement data serves suppliers in a variety of ways, ranging from manufacturing, where production swings can be flattened, to distribution, where use of resources such as vehicles, storage space and manpower can be made more efficient. Higher quality information also helps suppliers forecast future raw material needs with much greater precision.

Therefore, with respect to channel restructuring, the strength of the proposed system is that information on final consumer demand is collected accurately and automatically. Essentially, since much of the system will be built from scratch—in particular the electronic interaction with consumers—it is possible to ensure that the correct structures are put in place from the start. This would reduce or eliminate the need to later modify the structure in as far-reaching a manner as ECR proposes for the current distribution system.

In addition to gains mentioned in the ECR report which are enhanced under the proposed system, home grocery shopping offers some unique benefits to suppliers. Probably the most significant pertains to the possibility of establishing consumer standing orders. If home grocery shopping becomes popular and this feature is widely used, it could have a dramatic impact on supplier operations. This is because when a supplier has information about actual future consumer demand—not just data on the movement of products the previous week or even the previous day—it can forecast its needs and plan its operations to a high degree of accuracy. In fact, such forecasts would be much more

37In fact, as Chapter Three discussed, creating exactly this type of paperless information flow is one of the main goals of ECR.
precise than that feasible under any type of system—including a home grocery shopping system—which is limited solely to responding to previous activity.

Note that this type of advance planning is only available in a system that allows for the widespread use of consumer standing orders. Ultimately, such planning may result in huge cost savings—measuring in the billions of dollars—for suppliers.

Another benefit to suppliers under the proposed system is that they can modify the packaging of their products. In a home grocery shopping environment, electronic presentation replaces the physical display of products. Suppliers can take advantage of this fact by not only enhancing the electronic representation of their products, but also by deemphasizing the physical markings on the items themselves. For instance, a supplier could reduce the intensity or quantity of coloring on the package. Such moves would result in cost reductions for the supplier.

Section 7.5. mentioned that the proposed distribution system may lead to an increase in average case size, and hence a decrease in the quantity of shipping container packaging. In addition to benefiting the environment, such a reduction serves the supplier by enabling it to use resources more efficiently, thereby leading to cost decreases.

Another benefit offered by the proposed system is the possibility of implementing electronic couponing. Under the current system, coupon redemption can be a difficult process for distributors and suppliers alike; in addition, it is a process that frequently experiences fraud, with the supplier often ending up as the victim. Under home grocery shopping, it should be possible to devise new forms of electronic coupons to replace current printed versions. Like the other data in the proposed system, this information can be retained in electronic format as it is transferred from one channel member to another.

Suppliers would benefit from electronic couponing by reducing their costs associated with coupon redemption. In addition, electronic couponing would help suppliers achieve more effective marketing; for example, as noted in Chapter Three, over 97 percent

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38 The current system allows distributors to create standing orders, which they do with a limited number of mostly high volume items. But the correlation between distributor demand and consumer demand is, as Chapter Three pointed out, tenuous at best. In contrast, the proposed distribution system—if properly structured—enables suppliers to become much more attuned to final consumer demand.
of all coupons currently go unredeemed and end up as waste. Electronic couponing also benefits distributors, by both reducing their costs and by speeding up the time to payment.

Overall, similar to the situation with distributor savings, any supplier savings offered by the proposed system may ultimately be passed on to the consumer through lower prices. The main difference is that while the proposed system offers cost reductions to the distributor from the start, supplier savings will most likely not be visible for a long time, essentially not until home grocery shopping becomes very popular with consumers.

7.7. Summary

Chapter Six established that home grocery shopping reduces the cost to distribute grocery products and increases consumer convenience. This chapter has shown that the proposed distribution system also results in gains in a variety of other areas, including product quality, advertising and promotion, sales volume, the environment, and production. With respect to one aspect which is of particular concern for distributors—sales volume—it has been demonstrated that although consumers lose physical access to products, home grocery shopping will not necessarily result in a reduction in distributor sales volume; indeed, this chapter has discussed several reasons why sales volume may actually rise under the proposed system. In general, it has been shown that many of the benefits examined in this chapter are unique to the type of system proposed in this thesis, i.e., such benefits are not available under any type of supermarket-based system. Altogether, this researcher estimates that the long term gains in the areas discussed in this chapter are likely to be measured in the billions of dollars.
Chapter Eight

Conclusions and Future Research

8.1. Conclusion

The grocery industry is currently pursuing a major restructuring of the supply channel, extending from the point of production to the point of sale. Ultimately, this program, known as ECR, should produce significant gains for consumers, including a reduction in product cost and an increase in product quality.

However, this thesis contends that if the goal of the grocery industry is to improve efficiency throughout the supply channel, then the ECR program is not complete, because it ends the restructuring process at the supermarket. This thesis contends that the restructuring process should instead be extended to directly include the actual end user of grocery products—the consumer—at the point of end use—the home.

Therefore, this thesis proposes that the distribution system be reorganized around the following three essential elements: (1) home ordering of grocery products, (2) distributor picking of customer orders at the distribution center, and (3) customer pick-up at a neighborhood depot, or home delivery. In addition to improving distribution efficiency, such a restructuring can produce gains in a wide variety of areas, including consumer convenience, production, marketing and product quality.

This thesis has thoroughly examined the costs and benefits associated with restructuring the supply channel in the manner above. Based on an in-depth channel analysis that tracked a sample product through the current and proposed distribution systems, it has been demonstrated that under the current system, the supermarket accounts for a very large percentage of the combined distribution expense, from distribution center to retail checkout counter. For the sample product, costs attributable solely to the supermarket represent 16.50 cents out of a total cost of 19.67 cents, or 84 percent of the combined expense.

Under the proposed system, the cost associated with the distribution center rises
by 8.17 cents (a 388% increase relative to the current system), the expense attributable to outbound transportation increases by 0.23 cents (a 22% gain), and the cost associated with the retail outlet decreases by 15.28 cents (a 93% reduction). The proposed system also produces new costs for the distributor—such as for computer-related activities—of 2.29 cents. Altogether, home grocery shopping lowers the distributor's costs by over 23% relative to the current system, from 19.67 cents to 15.08 cents.

It has been shown that this estimate is very conservative, for several reasons. For example, as the base case for the current system, this thesis assumes full implementation of ECR; but, as has been demonstrated, such implementation is unlikely to occur for several years. Also, for several of the activities, including picking of customer orders and computer-related activities, the costs attributed to the sample product are likely significantly inflated in this thesis. And, for elements not included in the channel map analysis, such as data entry and shrinkage, this thesis has assumed that the expenses remain unchanged under the proposed system; however, it has been shown that home grocery shopping is likely to lower the distributor's costs associated with these functions. Overall, with a slight relaxation of the assumptions made in this thesis, it is estimated that the proposed system can lower the distributor's total costs by more than 58 percent relative to the current supermarket-based distribution system.

In addition to decreasing the distributor's costs, the proposed system produces a significant reduction in the time that it takes the consumer to complete the activity of grocery shopping. The reduction in this area is conservatively estimated to be at least 68 percent relative to the current system—from 53 minutes to 17 minutes per week—with a decrease of up to 81 percent possible.

Incorporated into the analysis in this thesis is an examination of new telecommunications technologies—including ISDN, ADSL, fiber/coax, FTTC, FTTH and PCS—many of which will soon be widely available. This thesis has shown that these technologies represent the key enabler that will make it feasible to fundamentally restructure the grocery product distribution system as proposed in this thesis, for the first time.

This thesis has put forth the concept of linking telecommunications network development to restructuring in non-telecommunications industries. With respect to the grocery industry, it has been demonstrated that advanced telecommunications network in-
frasstructure can dramatically alter the method by which grocery products are distributed to the consumer. With respect to the telecommunications industry, this thesis has illustrated that the home grocery shopping application may have a significant impact on the deployment of new telecommunications technologies, both by helping to finance the installation cost, and by speeding up the rollout schedule.

This thesis has also shown that the proposed distribution system is likely to produce gains in a myriad of areas. These include sales volume, product freshness and security, new product introduction, production efficiency, and the environment.

In total, it is estimated that the proposed distribution system will ultimately produce gains measured in the billions of dollars. The three key members of the grocery product supply channel—consumers, distributors and suppliers—will all benefit from these gains.

8.2. Future research

The home grocery shopping concept opens up numerous areas for further research. This section will briefly discuss some of the more significant topics.

Perhaps the most important area for future research concerns consumer behavior. While some work has been done in the area of general electronic shopping, more research is necessary, particularly with respect to the specific application of home grocery shopping. Such research is critical because the benefits developed in this thesis are explicitly conditioned on consumers shopping for grocery products electronically.

It is also important to understand the degree to which consumers are willing to plan their grocery shopping ahead of time versus spur-of-the-moment shopping. For instance, it may be the case that the majority of consumers want to be able to do "fill-in" shopping and in general receive their orders within a short period of time after ordering; on the other hand, it may be that most consumers are content to plan ahead and are not adverse to a system which requires one day lead time for many items.

Research should be directed toward understanding the issues associated with implementation of home grocery shopping. There are several aspects to be examined. For
instance, the concept clearly offers benefits for telecommunications providers. At the moment however, home grocery shopping is not being effectively considered by telecommunications companies as they gauge future consumer demand for interactive and other applications that will operate on a high-capacity network.

Another element that pertains to implementation concerns the degree to which home grocery shopping and other methods of distribution, such as supermarket-based shopping, can coexist. It is important to understand how the market of the future will be divided among different methods of shopping and distribution.

A key aspect of the implementation issue pertains to independent operators and wholesalers. In the model analyzed in this thesis, the activity of picking customer orders is carried out at the distribution center. For independent operators and wholesalers, there are matters surrounding their role in this type of system, including the division of activities, how to allocate and assess costs, and which party is ultimately responsible to the customer.

Indeed, to effectively address these concerns and also to retain as much control as possible, an independent operator may choose to reconfigure its existing supermarkets and utilize these facilities as combination selection unit and order pickup operations. Note that a chain operator may also choose to redeploy its existing facilities in this manner. In fact, all current distributors may one day be forced to choose between (a) continuing to deploy traditional supermarkets and similar facilities designed around picking of products by the consumer him- or herself, or (b) launching home grocery shopping, complete with selection units and order pickups, or their equivalent.

This leads to another area for future research: analysis of other distribution models. While the low cost solution would appear to be to centralize as much of the picking activity into one location as possible, a distributor may choose instead to decentralize this activity, i.e., to have picking of customer orders handled at the order pickups themselves. The advantages of distributed picking include faster turnaround time, increased ability to handle fill-in orders and convenience shoppers, and decreased likelihood of misplaced orders and other mistakes. The tradeoff of course are higher labor, space and inventory costs relative to centralized order picking.
Alternatively, a distributor may choose to implement greater centralization relative to the model analyzed in this thesis. For instance, the distributor may opt to centralize order picking of perishable products in addition to dry grocery goods. Hence, it is important to examine both the economics and the marketing advantages/disadvantages of other distribution models.

Also, the issue of home delivery requires further research, particularly with respect to the concept proposed in this thesis. Greater understanding is needed of the economics of home delivery, particularly whether such a service results in a cost premium relative to using an order pickup for distribution, and what the order of magnitude is for the premium. A very critical point that requires further research is to understand the extent to which the majority of consumers are willing to pay for the added convenience of home delivery relative to retrieving orders at the order pickup.

Marketing is another field that requires further research. Home grocery shopping creates an opportunity to market products to consumers in a fundamentally new way. Further research is needed in order to understand the important implications of this key aspect of the concept.

Another area of research concerns other consumer products. Although this thesis has focused exclusively on grocery products, clearly the concept applies to many other items as well. Products for which the concept is most applicable include goods purchased on a regular basis by the consumer and/or items for which the consumer does not require a personal examination before purchase. Such goods include office supplies, stationary, hardware products and garden supplies.

The above are but a few of the topics that should be investigated. Many other areas of research will become clearer once home grocery shopping has been implemented and has achieved a measure of success in the marketplace.
Appendix A

Home Grocery Shopping Case Studies

A.1. Introduction

This chapter is devoted to an analysis of home grocery shopping services, including past, present and even planned operations. This discussion should prove helpful in understanding how the concept proposed in this thesis differs fundamentally from other efforts.

Much of the material in this chapter was gathered through field research. Such information has proven to be extremely valuable in highlighting the economics and mechanics of various activities that relate to home grocery shopping, ranging from maintaining a computerized database to running a home delivery operation. In addition, the information has provided insight into various aspects of home grocery shopping operations that can not be gleaned through publicly available documents.

Six services are described below. All combine home delivery with home ordering. Indeed, these two features are the essential elements of each service. With respect to the interaction with the consumer, a variety of mechanisms are employed, including the traditional telephone, the smart phone, the fax machine, the personal computer, and even the television monitor in the case of one service currently in the planning stage. Note that with the first three mechanisms, printed catalogs are used to disseminate the information about available products.

For each of the services, the primary marketing tool to the consumer is convenience, though some services also stress the high quality of their food, in particular, their meat products. However, the consumer is not likely to save any money by using these services. In fact, once delivery charges and other fees have been factored in, the total cost is usually significantly higher than if the consumer had instead shopped at a supermarket him- or herself. Essentially, consumers who use these services are paying a premium for convenience.
Broadly, home grocery shopping services can be grouped into one of two categories: supermarket-based, or no retail outlet. Within each classification there are of course many differentiating features, but this characteristic provides a natural dividing line. The analysis in this chapter is organized around this structure.

This collection is intended to be representative, not exhaustive; indeed, across the U.S., there are literally hundreds of home grocery shopping services. Essentially, this analysis is an attempt to highlight the types of home grocery shopping services currently in existence—as well as envisioned—and describe their operations. Thus the six services discussed below can be viewed as representative models for other home grocery shopping services.

A.2. Supermarket-based

Services in this category provide home delivery out of a local supermarket. With each of these services, customer orders are picked by surrogate shoppers off of supermarket shelves, then delivered to the home. Although the services differ in how they present themselves to the customer, the essential element shared by all of these services—aside from home delivery—is the use of a supermarket for product selection.

The services may be operated by the distributor, by a third party, or by some combination of the two. For example, there are some services in which all of the activities, including picking, bagging and delivery, are handled by the distributor. Such services are akin to those which existed fifty or sixty years ago. There are other services in which distributor employees do the picking, and a separate company handles the delivery operation. And there are services in which the activities are handled entirely by a third party.

Note that third party companies are not distributors; rather, these firms manage all of the functions necessary for home ordering and delivery. Typically, a third party company forms a relationship with one distributor in each market area, and it is the distributor that is responsible for setting prices, supplying product to the supermarket, and the other processes customary to supermarket operation. The role of the third party company is solely to facilitate the movement of grocery products from the supermarket to the home. Thus, when the customer orders or takes receipt of the delivery, he or she interacts with the third party, but if the customer has a question about product prices, the in-
quiry would be directed to the distributor.\(^1\)

In general, supermarket-based services work in the following manner. The customer compiles his or her order at home, then transmits it to the appropriate location. Depending on which type of service is being operated (i.e., distributor in-house, third party, etc.), the order may go either directly to the particular supermarket, in which case it is processed on-the-spot, or to a headquarters location. If the order goes to a headquarters location—which is generally how third party companies operate—the procedure typically involves first translating the order into a "shopping list," then transmitting the list by fax machine to the appropriate supermarket.\(^2\)

At the supermarket, the picker operates like any other shopper, i.e., he or she pushes a shopping cart through the aisles and picks items off of store shelves. Some services allow customers to request that items be picked according to various product attributes, such as the ripeness of a piece of fruit, or the thickness of a cut of beef. Note that no products are picked either at the distribution center or in the backroom of the store. Once the order is complete, it is boxed or bagged, then delivered to the home. Usually, the customer pays for the order upon delivery, though some services permit payment to be made electronically prior to delivery.

**A.2.1. Shopper's Express**

Shoppers Express is a catalog-and-telephone-based service\(^3\) that works in conjunction with local distributors in each market. The company has been in existence since the late 1980s,\(^4\) and currently operates in 200 markets around the U.S.\(^5\)

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\(^1\)Note that some third party companies may contract out the actual delivery of the order to yet another company.

\(^2\)The "appropriate supermarket" varies. With some services, the operations for an entire metropolitan area are based out of two or three supermarkets, while other services employ a much larger number of facilities. In general, the appropriate supermarket is the particular store which is participating in the service and is closest to the customer's home.

\(^3\)Shoppers Express recently announced that it would make its service available via America Online, which is an on-line personal computer network, but this venture is not yet in operation. (See Gail Roberts, "Shoppers Express Joins America Online Service," *Supermarket News*, February 14, 1994, pp. 27-28.)

\(^4\)Ravo, "High-Tech," p. 10

\(^5\)Roberts, *op. cit.*
The catalogs are distributor-specific, i.e., a different one is created for each participating distributor. Shoppers Express and the distributor jointly develop that distributor's catalog. Typically, because of space constraints, the catalogs do not include all of the products available. For example, the catalog of one former distributor participant—Farm Fare in Concord, NH—lists just 4,000 items (note that an average-sized supermarket contains 15,000 to 20,000 different products). Although this catalog consists almost entirely of one-line descriptions of each product, it still requires over 60 pages. The catalog states, "Every item in our store, even those items not listed, are available for home delivery."

The Shoppers Express service works as follows. The customer chooses his or her order from the catalog, then telephones or faxes the order to Shoppers Express' headquarters in Maryland. A Shoppers Express employee in turn telephones or faxes the order to the appropriate participating supermarket. Distributor employees pick the order at the store, and delivery is typically made either by distributor employees, or by a local courier service.

The customer chooses a delivery window, and with the Farm Fare program, two periods were offered: 1:00-4:30 PM or 6:30-9:00 PM, Monday through Friday; weekend delivery was not available. Orders must be received by 10:00 PM for next-day delivery.

The cost to the customer varies, depending on the location. The Farm Fare program charged $9.95 per delivery, irrespective of the size of the order. The delivery fee in other markets may be higher or lower. Product prices are identical to those found in the supermarket, and the call to Shoppers Express' headquarters, whether by phone or by fax, is free. With the Farm Fare program, fax users received a small (50¢) discount.

In general, there are several major drawbacks of this and other catalog-based services. One is that product prices are not included in the catalog. Since distributors

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6 Catalog from Farm Fare Grocery Express, n.d. Note that the catalog contains a very small number of pictures, but these appear to be included mainly for advertising reasons, rather than to inform the consumer. For instance, ingredient lists and nutritional information are not included in the catalog, even for those items which are pictured.

7 Ibid. Farm Fare has since discontinued the Shoppers Express service.
alter their prices on at least a weekly basis, it is essentially impossible to include such information in a printed catalog. The problem for the customer is that he or she often has no idea of how much an individual item costs until the order is delivered. In fact, according to one individual who used the Shoppers Express service, even company employees had no knowledge of product prices at the participating supermarket.\textsuperscript{8}

The second problem is that the service is inherently unwieldy. For example, customer orders are transmitted first to Shoppers Express' headquarters, then relayed—often by voice—to the appropriate supermarket. This process is time-consuming and prone to error. In addition, there is very little connection between the consumer and the distributor. For example, orders are placed through Shoppers Express, and delivery personnel often are employed by a courier service, not the distributor.

Such fundamental problems are likely to mean that catalog-based services have a very limited future. Indeed, Farm Fare quit the program after three months due to lack of consumer interest.\textsuperscript{9}

\textbf{A.2.2. Peapod}\textsuperscript{10}

Peapod initiated operations in the late 1980s, in a suburb north of Chicago. The company has since enlarged its Chicago service area, and is expanding to other regions of the country, including San Francisco. In each market, Peapod works in partnership with a local chain distributor. As of April 1993, the firm had 2,500 customers.\textsuperscript{11}

Peapod's service is personal computer-based. The company provides the customer with the software necessary to use the service, as well as an instruction manual for system operation. The company does not equip the customer with a personal computer, nor does it supply a modem, which is required in order to operate the system.

\textsuperscript{8}Interview with a customer of the Shoppers Express service, April, 1994.

\textsuperscript{9}\textit{Ibid.} Factors which contributed to the insufficient demand include the delivery fee and the delivery time constraints.

\textsuperscript{10}Unless noted otherwise, the source of the information in this section is an interview with an executive of Peapod, September, 1993.

\textsuperscript{11}\textit{Ravo, op. cit.}

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The display is entirely text-driven. The customer selects products by typing on the computer keyboard. Customers can search for products by brand names or by categories, and can create personalized shopping lists.

The service works as follows. The customer uses a personal computer to compile and transmit the order. The order is processed at Peapod's headquarters, then sent to the appropriate supermarket, where picking is done by prestationed Peapod employees, who often work in teams. The company estimates that each order requires approximately one hour to pick. Another employee then delivers the order to the home via a company-operated van.

Peapod delivers orders five days a week, Tuesday through Saturday, during both day and evening hours. The customer must schedule a delivery appointment. Peapod requires a 3 hour lead time and a 90 minute window for order drop-off. The company estimates that 50 percent of its orders are delivered the same day they are transmitted.

For the customer, the cost to use the system includes delivery charges, a one-time expense for the computer software, and an annual membership fee. In Chicago, the delivery charge is $4.95 plus 5 percent of the total grocery bill per delivery, the software costs $69.95, and the annual fee is $49.95. In San Francisco, the delivery charge is a flat $9.95 per delivery, and the annual membership fee of $49.95 includes the software. Note that the retail prices for the grocery products are the same as in the particular supermarket.

Peapod has indicated that customers tend to order 2 to 3 times a month. Overall, the average order size is roughly $75. The company estimates that customers do approximately 80 to 90 percent of their total grocery shopping via the service.

The company has stated that the two biggest barriers that it faces in generating customers are (a) customer hesitation to purchase perishables electronically and (b) the expense of delivery fees. With respect to the first issue, this concern may be partly due

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13 Ibid.
to the fact that the service employs a text-only display interface.

According to the company, over 50 percent of its total costs consist of computer-related activities. The main computer-related expense pertains to the need to program software that enables Peapod’s system to link into the distributor’s mainframe computer.

In other words, Peapod does not maintain its own database of products and prices; this information is stored in the distributor’s mainframe. Peapod has created a proprietary software program that converts the data in the mainframe into a display that can be accessed by customers.

Peapod has said that, in the communities in which it operates, it expects to capture a five percent market share within five years of service initiation.\textsuperscript{14} According to the company, the most significant obstacle blocking this growth—from an operational perspective—is the expense to link its system with the particular distributor’s in-house computer systems.

\textbf{A.2.3. Prodigy}\textsuperscript{15}

Prodigy is a nationwide, on-line computer network owned and operated by Sears and IBM. It initiated operations in the mid-1980s. Beginning in 1989, and lasting for a period of three years, a home grocery shopping service was included on the Prodigy system in eight markets. The service did not prove to be successful, and was ultimately canceled. As of this writing, the company has no plans to reintroduce a home grocery shopping service on its network.

In many respects, the particulars of Prodigy's home grocery shopping service are very similar to those of Peapod, and thus do not require detailed elaboration. Prodigy worked with local chain distributors in the eight markets in which the service was offered. Each distributor was responsible for product picking and arranging home delivery. Prodigy provided the display and compiled the electronic orders.

\textsuperscript{14}\textit{Ravo, op. cit.}

\textsuperscript{15}Unless noted otherwise, the source of the information in this section is an interview with an executive of Prodigy, October, 1993.
According to the company, there are two primary reasons as to why the service failed. First, the market demand did not materialize. The company has said that the total number of customers in the eight markets was less than 1,000.\textsuperscript{16} Second, operational costs were too high. Unlike Peapod, Prodigy did not establish links between its system and the distributors' databases. Hence, Prodigy had to employ personnel to manually enter price changes and other data as they were updated by the particular distributor.

\textbf{A.2.4. ShopperVision}\textsuperscript{17}

ShopperVision is a subsidiary of Marketware, which is a retail space management company and developer of planogram software. Planograms are tools that are widely used by supermarkets, pharmacies and other retail operations in the planning of interior store layouts. Marketware uses its own proprietary software to design planograms, and this background has provided the company with software expertise which it is applying in the creation of a home grocery shopping service.

Shoppervision's initial venture will be as part of the Full Service Network\textsuperscript{18} in Orlando, Florida. The company's service is similar to that of Prodigy: ShopperVision will provide the display and compile the electronic orders, while a distributor partner will be responsible for handling product supply. One difference is that ShopperVision will not handle product picking or delivery of the orders; these operations will be handled by yet another company.

In fact, for the venture in Orlando, ShopperVision intends to partner with three companies: a distributor (Winn-Dixie), a pharmacy operator (Eckerd), and a delivery service (Shoppers Express). Note that the Shoppers Express service is already available in the participating Winn-Dixie and Eckerd stores.\textsuperscript{19}

\textsuperscript{16}Ravo, \textit{op. cit.}
\textsuperscript{17}Unless noted otherwise, the sources of the information in this section are an interview with an executive of ShopperVision, January, 1994, and interviews with the developer of the software used for the display interface, March to April, 1994.
\textsuperscript{18}The Full Service Network is a state-of-the-art, fully interactive fiber/coax network that is being built by Time Warner; refer to Chapter Four for more information.
\textsuperscript{19}Aho, "Winn-Dixie, Eckerd go Interactive," p. 16.
The display interface will be the most sophisticated available when the service becomes operational, which should be by the end of 1994. The display incorporates three-dimensional graphics and simulates the shopping environment. It is designed to function on a television monitor and allow the consumer to use a remote control for interaction.²⁰

With respect to grocery products, ShopperVision intends to offer both home delivery and customer pick-up at the supermarket. For home delivery, the cost will be $9.95 per delivery, and orders will be ready for delivery by the following day.²¹ For pick-up, the charge will be $5 per order, and it is not clear how much lead time is required. All product prices are the same as in the supermarket. There is no fee to access the service; however, in order to obtain access, the customer must subscribe to the cable television system, and it is not clear at this time what the minimum monthly fee will be for such a subscription.

It is important to note that while ShopperVision will have the most sophisticated interface available when it is running, the service itself is essentially no different from Peapod, Shoppers Express, or even the old-time corner grocer. For example, according to a spokesman for Winn-Dixie:

It's not going to make any difference whether they [consumers] see it on a television or look at a catalog, it's just another way of communicating.²²

Furthermore, the president of ShopperVision has indicated the role of the service is to "complement the grocery stores."²³

It is also important to note that this service is not intended to reduce the consumer's shopping costs. For example, the following is from the president of ShopperVision:

²⁰For more information about the display that will be used in the ShopperVision service, refer to Chapter Six.

²¹Roberts, "Interactive TV Shopping," pp. 9, 14.

²²Aho, op. cit.

²³Sandy Goldman, as quoted in Aho, op. cit.
those people that don't have the time to invest in shopping are going to be looking for other methods that are more convenient and time-saving for them. And we definitely feel people are willing to pay.\textsuperscript{24}

A.3. No retail outlet

These services provide home delivery through a company-owned, mini distribution center. With most of the services, customers order in bulk, either by phone or through a company sales representative who visits the home. This class of services is illustrated by the example of Countryside Food Delivery Company (name disguised).

One other service belongs in the category of no retail outlet. This service is known as Menutronics 2000. Of the six home grocery shopping services described in this chapter, this one most closely approximates home grocery shopping as proposed in this thesis.

A.3.1. Menutronics 2000\textsuperscript{25}

Menutronics 2000 is a small, personal computer-based service located in Kansas that began operations in 1984. The service is a division of a larger company, Guaranteed Foods; note that Guaranteed Foods is in the business of supplying grocery products to customers in bulk quantities, similar to Countryside's operation (see section A.3.2.). Menutronics 2000 evolved out of Guaranteed Food's background in the grocery home ordering and delivery business. Annual revenues for Guaranteed Foods are approximately $3 million, and according to the company, the revenues from Menutronics 2000 are a small fraction of that total.

Guaranteed Foods controls its own distribution center, and customer orders are shipped out of this facility. To handle the requirements of the Menutronics 2000 service—primarily the need for open-case picking—a section devoted to the service has been established within the distribution center. This section functions in a manner similar to

\textsuperscript{24}Ibid.

\textsuperscript{25}The information in this section is based on an interview with an executive at Guaranteed Foods, October, 1993.
the selection unit described in Chapter Six. Pickers manually pick customer orders, and
the products are arranged so as to increase distribution efficiency. The company main-
tains its own fleet of vehicles to deliver the orders.

The customer can order either through his or her own personal computer, or via a
terminal supplied by Guaranteed Foods. The interface is text-driven, and includes menu-
based displays. Orders are transmitted directly to computer equipment maintained by
Guaranteed Foods.

The charges to the customer to use the service include delivery fees, monthly ac-
cess charges, and higher product prices. For delivery, Guaranteed Foods charges $5 if
the order is less than $50, but no charge for orders worth $50 or more. For access, the
fee is $12.50 per month, plus an additional $12.50 per month for customers who employ
company-supplied terminals. With respect to the cost for products, the prices are ap-
proximately 5 percent higher than the average retail prices in area supermarkets.

According to Guaranteed Foods, the company has scaled back its plans for
Menutronics 2000 in recent years. At one time, Guaranteed Foods was seeking to ex-
pand the availability of the Menutronics 2000 service, but the company now appears to
be focusing on its core business of bulk delivery. For the most part, Menutronics 2000
has been viewed by the company to be a trial service. Since its inception, Menutronics
2000 has never had more than 500 customer households, and currently, the service sup-
plies less than 250. At the moment, there are no plans to expand the service, and as cu-
stomers drop out of the program, they are not replaced.

A.3.2. Countryside

Countryside Food Delivery Company is a supplier of grocery products in bulk
quantities. The company has been in business for over 40 years, and currently has be-
tween 7,000 and 8,000 customers. It delivers approximately 275,000 cases of items per
year. Annual revenues range from $15 million to $20 million.

The company offers a full range of name brand dry grocery products, health and
beauty care items, and frozen foods. Countryside also supplies frozen meat, which it cuts
to customer specifications. If necessary, the company will install and maintain a large-
capacity freezer in the customer's home.
Countryside stocks over 15,000 SKUs. The company estimates that it can service 80-85 percent of a household's total food and nonfood grocery needs, although the actual percentage supplied varies by customer. Major product categories which Countryside does not supply include produce, dairy, eggs and fresh baked goods. These products, as well as low volume dry grocery items, must be purchased elsewhere.

Countryside delivers most products to its customers in half-case or case quantities. With rare exceptions, such as for some health and beauty care items, a half-case is the minimum order quantity. As a result of the large volumes involved, Countryside typically makes just two to three deliveries a year to an individual household.

The customer orders with the assistance of a company sales representative, who visits the customer's home. For the initial order, the customer describes his or her needs to the sales representative; the employee then takes stock of the customer's current inventory, and the order is planned accordingly. Reorders are usually handled in the same manner, though the customer can call the company and order directly over the phone.

On average, each customer's initial order is worth about $1,000, though this figure varies widely from customer to customer. Once a baseline inventory has been established, the amount for a reorder drops to a lower level. Overall, a typical order contains around 20-25 cases, and costs the customer approximately $850.

As a condition to join the service, the customer must sign a service contract, which costs $600. According to Countryside, this contract accomplishes several objectives: it pays for freezer maintenance, missed delivery appointments that occur as a result of customer negligence, and other nonscheduled visits (i.e., replacement of products that don't meet customer satisfaction); it helps the company recoup some of its lead costs in generating new customers, which the company estimates are about $300 per customer (Countryside experiences a ten percent annual attrition rate); and it creates a binding agreement between the customer and Countryside.

Countryside's primary marketing characteristics are convenience and high quality, particularly in regard to its frozen meat selection. For example, some customers use Countryside's service only for meat products, and purchase the rest of their grocery needs at the supermarket. In terms of costs for the customer, the company's prices about match...
those found at competing local supermarkets.

With respect to customer costs, the key influencing factors are the quantity of product that the customer purchases via Countryside, and the timeliness with which the bill is paid. First, if a household does the majority of its grocery shopping through Countryside, its total food bill should be slightly lower than if it shopped exclusively at a supermarket. Second, because each order usually involves a large lump sum of money, the majority are financed through credit arrangements (Countryside has its own subsidiary finance company); by paying the bill within thirty days of order receipt, the customer can take advantage of a 1.5 percent discount that the company offers.

The biggest cost driver in Countryside's operations is its personalized service. For example, sales representatives visit customers' homes to introduce the program, work out the initial order and help plan reorders; delivery workers bring the order right into the home, and even rotate the stock in the freezer if necessary; freezers are replaced promptly if they break down; and delivery appointments are rescheduled if the customer is not home at the appointed time and does not want products left exposed. Finally, one of the most important, if costly, aspects of the company's service is its quality guarantee: if the customer is not fully satisfied with any item, the company will replace it free-of-charge.

Countryside is supplied primarily by a wholesaler (some items arrive via a service merchandiser). Countryside's volume is not large enough to support DSD; in fact, the company has indicated that it would have to double the size of its facility in order to buy direct.

Countryside works to maintain inventory at its mini distribution center at a low level, generally a maximum of two to three weeks. To assist in this process, most of the product arrives at the facility in mixed pallet loads. A limited number of items, such as high volume items or products bought on deal, arrive in full pallet quantities.

A.3.2.1. Delivery cost

Countryside provides a benchmark with which to measure delivery expenses. Before examining Countryside's delivery cost, it is necessary to provide a brief description of the company's delivery operations. Countryside makes deliveries Monday
through Friday, from 9 A.M. to 7 P.M. The company employs four drivers. For equipment, Countryside has twelve trucks, each measuring 29 feet long by 11.5 feet high; the trucks consist of split boxes, with one section for frozen goods and another for dry grocery. The company utilizes a three day rotation with its vehicles: one day on the road, one day for loading and one day for service. Therefore, on any given day, four trucks are making deliveries, four are being loaded, and four are being maintained.

Delivery routes are planned one week in advance. Each route is handled by a single employee. On average, a day-long route (there are no overnight itineraries) lasts ten hours, covers 225 miles roundtrip, and involves twelve stops. Each stop requires about forty-five minutes to complete, which includes the time to bring the order into the customer's home, rotate the existing stock in the freezer, load the new items, and resolve any discrepancies or customer complaints.

The delivery function costs Countryside a total of about $490,000 per year. This expenditure can be analyzed several ways. First, per mile: the company's fleet travels a total of 5,000 miles per week, thus the per mile cost is $1.88. Second, per delivery: the company makes approximately 12,500 deliveries annually, which results in an average per delivery cost of $39.20. Third, per case: Countryside distributes 275,000 cases yearly, thus its per case cost is $1.78. Fourth, per unit: at an assumed packing density of 15 units per case (i.e. the packing density assumed for Product A), the per unit delivery cost is $0.1188. Fifth, as a percentage of the customer order: based on an average order size of $850, the delivery expense represents about 4.6 percent of the order value.

Based on this information, it is evident that Countryside's per mile transportation cost is in line with the value employed in Chapters Five and Six. However, the company's transportation cost per consumer unit is much higher.

There are several factors which account for Countryside's higher transportation cost per consumer unit. The single most influential element, the labor-intensive nature of the company's delivery operations, was noted earlier. Other important considerations include lower throughput economies of scale for Countryside (i.e., semi-trailers are used to deliver product to a distribution center, but for obvious reasons such vehicles cannot be employed for deliveries in residential neighborhoods) and the need to maintain a temperature-controlled environment in the company's delivery vehicles (note that Product A is a dry grocery product which does not require temperature-control).
A.4. Summary

This chapter has described several home grocery shopping services, including services which are currently functioning, as well as one which should be operational by the end of 1994 and which is likely to have the most advanced display interface at that time. In general, these services can be broken down into two categories—supermarket-based or no retail outlet—depending on where the picking activity takes place. This chapter has shown that with each service, home delivery is a key aspect. It has been demonstrated that delivery results in a significant fee for the consumer; typically, the fee is a minimum of $5, though for some orders and for some services the charge can be $10 or more. Overall, this chapter has shown that rather than effecting a fundamental restructuring of the grocery product supply channel as proposed in this thesis, other home grocery shopping services essentially function as add-ons to the existing distribution system.
Appendix B

Telecommunications technology

B.1. Introduction

This chapter offers a detailed review of new telecommunications technology. This examination is intended to provide support for earlier analysis. Note that some of the material may repeat earlier discussion.

This chapter is structured as follows. Section B.2. considers local telephone technology, Section B.3. examines cable television technology, and Section B.4. analyzes telecommunications technology in other industries. For each technology, the discussion in this chapter includes (a) a comprehensive description, in particular with respect to home grocery shopping, (b) an analysis of its advantages and disadvantages, and (c) an estimate of its deployment costs, based on latest available data.

B.2. Local telephone

The discussion in this thesis concerns the network from the central office to the home, and not the network between central offices. For example, there are certain technologies, such as asynchronous transfer mode (ATM) and synchronous optical network (SONET), which aid some facets of network communication, and which phone companies are in the process of installing. These technologies are a precursor to increased phone network functionality, but for the purposes of the home grocery shopping service, such technologies are neither sufficient nor, in some instances, necessary.1 Therefore, ATM, SONET and similar technologies are not examined in this thesis, and the costs for such technologies are not included in the following analysis.2

1SONET and ATM are technologies used to transport and switch telecommunications signals. There are many critical issues related to these technologies that have yet to be resolved, particularly with respect to transmitting video-on-demand (VOD) signals to the home. For more information, see Carol Wilson, "ATM: All-Purpose Technology is Put to the Test, Telephony (Supplement), November 29, 1993, pp. 5-11, and Mitch Shapiro, "ATM=Asset to Multimedia," Cablevision, December 6, 1993, pp. 98-100.

2This position is consistent with other investigations of network technology. See, for example, Gelman and Smoot, Interactive Applications.
B.2.1. ISDN

ISDN converts a twisted-pair phone line into a digital pathway from end to end. This increases the capacity of the network, since digitized information can be transmitted much more efficiently than analog signals. Standard ISDN, known as basic rate interface ISDN, offers 144 Kb/s of capacity, which is split into three channels: two "B" channels operating at 64 Kb/s, and one "D" channel operating at 16 Kb/s.\(^3\) (Basic rate ISDN is sometimes referred to as 2B+D ISDN.) Another version of ISDN, known as multirate ISDN, provides up to 1.5 Mb/s of capacity.\(^4\) With both versions, the capacity is bidirectional, which means that information can be transmitted both to and from the home.

ISDN would be sufficient for the requirements of home grocery shopping. The technology permits all of the essential information from the distributor's database to be transmitted to the home. Basic rate ISDN would allow still photos and sound to be communicated, and possibly slow-motion video, while multirate ISDN might enable the transmission of more advanced GUIs, including three-dimensional product renderings.

ISDN can function by means of a screen-based "smart" phone and by a modem-equipped personal computer. ISDN may also be able to function via television monitor, with the appropriate set-top box. The cost to install ISDN is under $500 per household.

B.2.1.1. Advantages of ISDN

The chief advantages of ISDN are cost, inevitability of implementation and experience. First, ISDN can be implemented using the existing twisted-pair network. It avoids the large costs associated with the installation of new network infrastructure. Also, if a screen-based phone is utilized, the CPE cost is less than that other technologies.

Second, most telcos are in the process of installing ISDN anyway. By 1995, five of the RBOCs plan to have basic rate ISDN available to more than 65 percent of their telephone lines, and a sixth will have the technology available to about 60 percent of its net-

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\(^3\)Karpinski, "ISDN Train," p. 18.

work. Note that access to ISDN does not mean that the telephone line will automatically receive the technology; however, it does signify that the household at the end of this line could order ISDN—and the services which it makes available—at any time.

Third, ISDN is a known technology. It has been in existence for several years, and has been implemented in many areas, such as downtown business districts, suburban office parks and college campuses. This background has given telco personnel experience in working with the technology.

B.2.1.2. Disadvantages of ISDN

With respect to basic rate ISDN, the main disadvantage is its limited capacity. The top transmission rate of 144 Kb/s means that the grocery shopping interface would probably have to be primarily text-based. Basic rate ISDN might allow some use of still photos or computer-type menus, but it would not permit the use of full-motion video or three-dimensional graphics. Furthermore, depending on the type of interface, basic rate ISDN may not permit a very high degree of user interactivity. For example, a home grocery shopping distributor may want to design an interface that rapidly adjusts to individual users, allowing targeted specials in order to stimulate impulse buys. If this presentation is based on high-quality graphics or digitized photos rather than text, basic rate ISDN would probably prove incapable of such a display. In sum, basic rate ISDN would likely result in a rather sterile interface, at least compared to what is possible with other technologies.

With respect to multirate ISDN, this technology would allow very sophisticated GUIs, including three-dimensional graphics, to be transmitted. However, it appears that the telcos are targeting multirate ISDN to commercial users, and it is unclear whether the telcos plan to offer the technology in the residential market.

B.2.2. ADSL

A much greater increase in capacity for the existing twisted-pair phone network would be provided through the use of ADSL technology. According to the most recent developments, ADSL can provide up to 7 Mb/s of capacity, which is divided into: four "A" channels of 1.5 Mb/s each; either one ISDN "H0" channel of 384 Kb/s or one 144 Kb/s

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2B+D ISDN channel; and one signaling/control channel. The A channels are asymmetrical: they can only transmit information downstream. The other channels are symmetrical, or bidirectional.

One potential concern is that this advancement is based on the use of discrete multitone (DMT) technology. This technology is so new that the standards for it are still evolving, and it is unclear whether it will be widely adopted. In fact, the 6-7 Mb/s capacity for ADSL that DMT makes available has emerged only during the past year. Before this development, the top transmission rate for ADSL—which has been under study since 1989—was 1.5 Mb/s.

The distinction between offering 6-7 Mb/s and 1.5 Mb/s is crucial. The higher capacity technology (known as ADSL3) is capable of offering certain services which previously were thought to be impossible with ADSL. For example, by using compression, 1.5 Mb/s is sufficient to deliver a single VCR-quality video signal. With 6 Mb/s of capacity, four signals could be distributed to the home simultaneously. Furthermore, two of the A channels could be combined into one 3 Mb/s channel, which would allow for the delivery of what is known as a "sports-quality, real-time" signal, and all four channels could be merged to possibly deliver a high-definition television-quality video signal.


7There exists another twisted-pair technology, known as high-bit-rate digital subscriber line (HDSL), which is similar in many ways to ADSL, but which differs in some important features. The main difference between the two technologies is that HDSL offers 1.5 Mb/s of bidirectional capacity, but requires the use of two twisted-pair telephone lines in order to do so. Because of this requirement, HDSL is not considered a viable option for the residential market, but is being pursued for business applications.

8Karpinski, op. cit.


10Compression is a procedure that reduces the amount of information needed to describe a situation—whether it is text, graphics or video—thereby decreasing the amount of data that must be transmitted through the network. For video signals, there are many different compression techniques, including MPEG1 (Motion Pictures Experts Group) and MPEG2. An uncompressed standard video signal contains around 110 Mb/s worth of information. MPEG1 compresses video signals to a rate of around 1.1-1.5 Mb/s; MPEG2 to 3-6 Mb/s. Because the quality of a video signal is diminished as less information is transmitted, MPEG1 at 1.1 Mb/s is currently the minimum limit for effective transmission of full-motion color video.

11Fleming and McLaughlin, op. cit.
The future of ADSL is currently unclear. It is a relatively recent development, particularly as conceived using DMT technology. To date, ADSL has yet to make the transition from the lab to the field, except on a limited trial basis. And in the one significant trial currently underway, DMT technology is not being used; rather, the network is being operated at 1.5 Mb/s.\textsuperscript{12} Thus, there are many unanswered questions about ADSL, particularly concerning whether over 6 Mb/s of capacity is sustainable in the field.

Still, regardless of whether ADSL is implemented at 6 Mb/s or 1.5 Mb/s, it would be sufficient for the home grocery shopping service. All of the necessary upstream and downstream communication would be feasible with ADSL. And, even at 1.5 Mb/s, ADSL is capable of transmitting a full-motion GUI, provided the information is compressed.

The implementation cost for ADSL is estimated to be under $750 per household. Actually, ADSL provides an effective demonstration of the general difficulty in assigning a cost to a technology that is not fully defined and has yet to be installed.

To illustrate, Bellcore is currently testing VOD services using ADSL technology. At current prices, the equipment used for this test would cost around $2000 per household.\textsuperscript{13} However, this figure is based on manufacturing very small quantities of the equipment. In fact, one equipment vendor has stated that given a sizable order, it could supply ADSL3 equipment for $500 or less per household, by as early as mid 1994.\textsuperscript{14} This figure corresponds to the goal of those telcos that are interested in ADSL technology; which have been asking vendors to achieve a target cost of about $600 per household.\textsuperscript{15}

\textbf{B.2.2.1. Advantages of ADSL}

The main advantages of ADSL are capacity, implementation characteristics, and cost. First, ADSL in any form makes available at least 1.5 Mb/s of capacity. This capacity opens up opportunities which previously were not possible with twisted-pair. For example, in the residential environment, ADSL would allow such applications as movies on demand,

\textsuperscript{12}O'Shea, "Video Future," pp. 60-62.

\textsuperscript{13}Interview with an engineer at Bellcore, December, 1993.


\textsuperscript{15}Karpinski, "FITL Vendors Show VTTH," p. 9.
electronic libraries and home shopping to be offered over the phone network.\textsuperscript{16}

With respect to home grocery shopping, ADSL would permit a much more stimulating display than is possible with ISDN.\textsuperscript{17} In fact, any type of interface that ISDN is capable of delivering would be available with ADSL, as well as many which are not possible, such as three-dimensional simulated shopping. ADSL would also allow for considerably greater interactivity between consumer and distributor than ISDN, as information can be communicated much more quickly.

The second advantage of ADSL concerns the manner with which the technology can be implemented. There are two key issues. First, ADSL can be installed quickly. Essentially, installation involves the placement of two pieces of equipment, one at the central office and another at the household; relatively little work, such as line conditioning, has to be done along the network between these two locations. This means that ADSL could be deployed across a wide geographical area in a time frame measured in months.

Second, ADSL can be installed selectively, perhaps on a household-by-household basis. Thus ADSL could be targeted to only those households which desire it, and are willing to pay for the services which it makes available.\textsuperscript{18}

Costs are treated here as an advantage, but this is true only if ADSL can be deployed at the low end of the cost estimate range, or for under $700 per household. For $700, ADSL would provide telcos with the capability to offer many types of advanced applications at a relatively small expense. However, should the cost of the technology not decline substantially, and remain at the upper end of the range (around $2000 per household), ADSL would lose the cost advantage.

\textsuperscript{16}\textsuperscript{16}It is important to note that the applications which ADSL is capable of delivering, even at 1.5 Mb/s, comprise the majority of those perceived to be the basis for future local telephone industry revenue growth, i.e., movies on demand, non-grocery home shopping, etc. These applications are not bandwidth-intensive, therefore they do not necessarily require the use of broadband media; however, they still demand more capacity than is currently available, or can be provided with stand-alone ISDN. For additional information, refer to Fleming and McLaughlin, "The On-Ramp," p. 26.

\textsuperscript{17}\textsuperscript{17}Note that this comparison is relative to basic rate ISDN, since the telcos do not appear to be targeting multirate ISDN to residential customers. Nevertheless, with respect to multirate ISDN, ADSL provides at minimum the same level of capacity, and possibly far more.

\textsuperscript{18}\textsuperscript{18}Karpinski, "The Long Road Home," p. 19.
B.2.2.2. Disadvantages of ADSL

The chief disadvantages of ADSL divide along similar lines as its advantages; they primarily concern implementation characteristics and capacity. With respect to ADSL's implementation viability, there exist two significant problems. First, there is a limit on the maximum length of the local loop\textsuperscript{19}: 18,000 feet for ADSL, and 12,000 feet for ADSL3.\textsuperscript{20} This restriction eliminates approximately 10-15 percent of the network.\textsuperscript{21} Second, even on the remaining portion of the network, which according to standard design specifications should be fully receptive to ADSL, it is unlikely that 100 percent of this section could take advantage of the technology in practice.\textsuperscript{22}

The second major disadvantage of ADSL concerns its capacity; this is why the distinction between 1.5 Mb/s and 6 Mb/s is so crucial. An upper limit of 1.5 Mb/s places several constraints on the network.

First, the technology is asymmetrical, so it does not allow for simultaneous upstream and downstream transmission of applications requiring a significant amount of capacity, such as high-quality videoconferencing and advanced interactive video games. Demand for these types of services is expected to grow in the future, as the services become more developed.

Second, the capacity limit does not permit the transmission of live video signals, such as news broadcasts, sports events and other programming telecast by over-the-air stations and CATV networks. ADSL at 1.5 Mb/s is capable only of handling prerecorded video signals.\textsuperscript{23}

\textsuperscript{19}The network from the central office to the household.


\textsuperscript{21}Alan Hutcheson, "HDSL Turns Copper into a Buried Treasure," \textit{Telephony}, December 14, 1992. pp. 34-44.

\textsuperscript{22}Some of the reasons for not attaining a 100 percent implementation rate for ADSL include poorly configured infrastructure, exposure of the network to the elements, and outdated equipment.

\textsuperscript{23}As noted, a standard television signal contains around 110 Mb/s worth of information. In order to compress this signal so that it can be transmitted via 1.5 Mb/s of capacity, several time-consuming compression iterations are necessary, with each iteration improving upon previous efforts. Prerecorded
Third, even prerecorded video signals, such as grocery shopping displays, must first be compressed before they can be transmitted. Most likely, this limitation means that the application provider would have to invest in its own compression equipment.\textsuperscript{24}

Fourth, only one video signal can be relayed per telephone line. The implication is that larger households might find it necessary to install, and pay for, two or more lines.

Fifth, all signals are only available on-demand. This means that (a) viewers may face time-consuming waits after switching channels, while the new programming is loaded onto the system, and (b) the telco may have to make an added investment in switching and storage resources, at least relative to certain other technologies, such as fiber/coax, FTTC and FTTH.\textsuperscript{25}

However, should DMT technology prove to be a viable option, many of these capacity limitations would disappear. As mentioned above, with 6-7 Mb/s of capacity, ADSL would be able to transmit essentially every application currently under discussion. Therefore, resolution of the capacity issue is crucial to assessing the prospects for ADSL.

\textbf{B.2.3. Fiber/coax}

Fiber/coax is one of the three primary FITL options. These alternatives are actually different network architectures. In other words, while each of the three FITL options incorporates the use of fiber cable technology, the key differentiating factor concerns the programming, such as movies, television shows and grocery shopping displays, have the time to undergo such treatment before transmission; this is not the case with live programming.

\textsuperscript{24}Telcos are currently prohibited by law from altering the content of the information which travels over their networks.

\textsuperscript{25}Since only one channel can be sent over the network at a time, when a viewer changes the programming, an indicating signal must first be sent upstream from the household to the phone company, which then alters the programming transmitted downstream; this operation takes several seconds, and is much slower than changing broadcast channels. This entire process of upstream and downstream communication between the household and the telecommunications provider is essentially interactivity, and it should become fairly routine in the future, when each household will get at least one on-demand "channel" to use as it sees fit. However, most telecommunications providers have concluded that in order to reduce the need for expensive centralized switching equipment, dozens or even hundreds of channels of programming—such as what is currently seen over-the-air or on cable television systems—should be broadcast simultaneously to all connected households, and should not be made available on an interactive basis.
extent to which fiber is deployed into the network—fiber/coax uses the least amount of fiber, while FTTH uses the most.

Fiber/coax, sometimes referred to as hybrid fiber/coax, involves two major pieces of construction. First, fiber is extended from the central office to a neighborhood-based fiber node, known as an optical network unit (ONU). Second, either one or two coaxial wires are routed from the ONU to the neighboring households; this routing can be in either a bus (usually called star/bus\textsuperscript{26}) or a tree-and-branch pattern (see Figure B-1). As presently envisioned, one ONU and the associated coax would serve approximately 64-128 households.

A fiber/coax network would offer much greater capacity than can be provided with any twisted-pair technology. The capacity limit for fiber has yet to be determined, while over short distances, coax has proven capable of transmitting up to 1.5 gigahertz (GHz).\textsuperscript{27}

To transform the capacity of a network from hertz to bits per second involves a procedure known as digital modulation. There are many possible methods for digital modulation but according to one report, the one receiving the most attention at the moment is 64 quadrature amplitude modulation.\textsuperscript{28} This process allows up to 45 Mb/s of information to be carried in one 6 megahertz (MHz) channel.\textsuperscript{29} Theoretically, this means that a fiber/coax network would have 10 Gb/s or more of capacity. To put this in perspective, a transmission rate of 45 Mb/s would enable the information in ten average length books to be relayed in one second. However, as is shown below, not all of the 1.5 GHz of bandwidth will be used for digital signals.

\textsuperscript{26}Star/bus is so-called because of its design: fiber radiates out from the central office in a star pattern to the different ONUs, while coax is used to connect the households to the neighborhood ONU much like a bus making a roundtrip journey.

\textsuperscript{27}Karpinski, "FITL Vendors Show VTTH," p. 5. The capacity of coaxial wire is usually measured in terms of hertz rather than bits per second.

\textsuperscript{28}Karpinski, "The Long Road Home," p. 17.

\textsuperscript{29}Ibid.
Figure B-1

Star/Bus and Tree-and-Branch Network Architectures

(a) Star/Bus

(b) Tree-and-Branch
Presently, it is not yet obvious what archetype a fiber/coax network will ultimately assume. One debate of particular importance concerns whether the network should be used to transport all signals, or only video. If a fiber/coax network is used solely for video, it would require that low capacity signals, known as plain old telephone service\textsuperscript{30} (POTS), be transmitted on an alternative, narrowband network. Other ongoing disagreements include: the optimal number of households per ONU; the rate of household network usage, particularly for on-demand signals; how to partition the bandwidth; whether the design should be active or passive; and whether video signals should be solely digital, or a mixture of digital and more traditional analog CATV signals. Because of the ambiguity surrounding these disputes, it is impossible to state definitively exactly how much capacity an individual household would have in a fiber/coax environment. Nevertheless, it can be safely asserted that fiber/coax would be more than adequate for the demands of the home grocery shopping service.\textsuperscript{31}

The cost to install fiber/coax is highly sensitive to the outcome of these debates. For example, a network that transmits both POTS and video would require, among other requirements, greater upstream capacity and a higher degree of reliability than a video-only network. Obviously, the former network would cost more to build than the latter. Two other key issues which affect the cost of a fiber/coax network (aside from those mentioned above) are: whether the network is a newbuild or an overlay on top of an existing network, and the geography and density of the neighborhood, (e.g., suburban single-family detached homes versus urban multifamily apartment buildings).

With respect to the deployment cost, one RBOC, U S West, has announced its intention to install fiber/coax technology as an overlay on top of its existing twisted-pair network. The company has stated that one of its goals is to deploy the network at an average cost per household of $1000, and it is currently working with vendors to achieve this target.\textsuperscript{32}

\begin{enumerate}
  \item POTS refers to narrowband, low capacity signals, such as voice and fax.
  \item One plan that appears to be gaining consensus from both telcos and CATV operators is to partition the bandwidth into four primary sections: broadcast analog television signals, switched digital signals, upstream POTS and downstream POTS. (See Karpinski, "Magic Kingdom," pp. 48-53.)
  \item Karpinski, "U S West Debuts Fiber/Coax," pp. 9-12.
\end{enumerate}
The main advantages of fiber/coax are capacity, deployment area and long run cost. First, the considerable capacity that fiber/coax provides allows it to accomplish many tasks. For example, fiber/coax can offer any application that is available with ADSL, including home grocery shopping. Depending on the outcome of the debates noted above, fiber/coax can also offer applications not available with lower capacity ADSL, such as live television broadcasts and interactive, bandwidth-intensive video games. A major advantage for fiber/coax is that its large capacity enables the simultaneous transmission of hundreds of analog cable television signals. This means that the large base of analog CPE already in place can continue to be used, while an upgrade to more sophisticated CPE can occur gradually, as demand warrants.\textsuperscript{33}

The second advantage of fiber/coax concerns the extent of the deployment area. Theoretically, fiber/coax could be installed throughout the network. In contrast to ADSL, which has strict distance limitations and is affected by the age and condition of the existing network, fiber/coax would face fewer technological restrictions in its rollout, since it involves an almost complete supplanting of the existing twisted-pair network.

The third advantage of fiber/coax is long run cost. Although the installation cost for fiber/coax appears to be roughly comparable to that of ADSL, a fiber/coax network would probably have lower long run operational costs than a comparable twisted-pair network. This is because fiber cable is more reliable and less costly to maintain than twisted-pair.\textsuperscript{34}

**B.2.3.2. Disadvantages of fiber/coax**

The principal disadvantages of fiber/coax concern long term effectiveness, capacity,

\textsuperscript{33}Existing CPE can handle current analog CATV signals. However, most future applications will be digitally encoded and compressed, requiring the use of more sophisticated CPE. It is important to note that in order to function on a television monitor, home grocery shopping requires the use of the more advanced CPE.

\textsuperscript{34}Interestingly, one aspect of the fiber/coax option which was once thought to be a disadvantage may actually turn out to be an advantage. Historically, fiber cable has been more expensive to purchase than twisted-pair, per unit of length. However, recent production breakthroughs have resulted in cost parity, and in the long term, fiber cable may actually become less expensive than copper wire as greater amounts are manufactured, and fiber vendors realize production economies of scale. Note that this factor applies to the other FTTH options as well.
certain implementation characteristics, and network powering. The first issue pertains to
the efficacy of fiber/coax in transmitting POTS and other fully-switched services. Many
telco engineers believe that a hybrid fiber/coax network is not a good solution for transmit-
ting anything other than analog cable television signals; the belief is that coaxial cable does
not meet the very strict engineering specifications required for a telephone network.35 For
example, as noted above, U S West does not plan to abandon twisted-pair when it deploys
fiber/coax; the twisted-pair network will be used to carry POTS and the fiber/coax network
will be used for cable television channels.36 The company is deploying two networks so
that POTS, which includes "lifeline" telephone service, can be maintained even if the fi-
ber/coax network fails.

The second disadvantage of fiber/coax concerns capacity, particularly for VOD
applications. There are several important factors. First, over extended distances, coax
loses much of its capacity. For example, if the coax section is more than one quarter mile
long, a fiber/coax network can not offer 1.5 GHz of capacity. In fact, most telcos that plan
to build fiber/coax networks intend to operate them at 750 MHz.37 Second, with both
tree-and-branch and star/bus network architectures many households are connected to each
particular neighborhood coaxial wire, and therefore have to share its capacity. This means
that there may be blocking problems, i.e., the telco might have difficulty guaranteeing
subscribers unrestricted access to on-demand services at any time. Third, depending on
regulations which have yet to be resolved, it could be the case that several companies, aside
from the telco itself, may be allowed to provide video dial tone (VDT) service.38 A
fiber/coax network may not offer enough capacity to support multiple VDT providers.

The third significant disadvantage pertains to implementation. In contrast to ADSL
or ISDN, fiber/coax must be installed into an entire neighborhood before any households in
that neighborhood can use it. This means that phone companies can not be as selective in
their choice of where to deploy fiber/coax as they can be with twisted-pair technologies.

35Karpinski, "FTTL Vendors Show VTTH," p. 5.
38VDT is the underlying video "shell" or applications menu. Analogous to computer operation, the VDT
menu is what the subscriber would initially see upon accessing the system, while a particular application,
such as home grocery shopping, would be one of the many options presented on the menu.
Furthermore, deployment of fiber/coax would take a relatively long time, because most of the residential network would have to be replaced. Estimates of how long it would take to install fiber/coax into the majority of residential areas range from five to over ten years.

The fourth disadvantage of fiber/coax concerns powering. Wire made out of metal, such as twisted-pair and coax (both of which are fabricated from copper), can carry electrical signals, while fiber cable, which is made out of either glass or plastic, cannot. Currently, phone companies take advantage of twisted-pair's electrical conductivity to send electricity along the network; this charge is used to power phone ringers, perform network tests, and, of crucial importance, to maintain phone service in case power from the electricity grid is cut off. Because fiber lacks the capability to conduct electricity, phone companies that install fiber/coax networks will have to find a replacement for twisted-pair in this respect.

B.2.4. FTTC

FTTC is similar in many ways to fiber/coax. FTTC also incorporates installation of fiber from the central office to a point other than the house; in this case, fiber is extended from the central office to an ONU located at the pedestal. From the pedestal, FTTC utilizes either the existing twisted-pair drop, or a new coax drop is installed. The result is that each household receives its own connection to the fiber. Because of this network design, FTTC is sometimes called double-star architecture (see Figure B-2).

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39 The concept of network-provided power is very important to local telephone companies, since the network is a vital means of communication during emergencies. Consequently, telcos engineer their networks, at great added expense, to work even when the electricity grid fails.

40 There are a variety of methods phone companies can use to power equipment in the field as they evolve to the use of fiber. They can maintain existing twisted-pair wire, use the electricity grid or install a parallel wire along with the fiber cable.

41 The pedestal is a piece of equipment located at the neighborhood level which "steps down" signals from the central office, so that the signals can be branched off to the appropriate household.

42 The drop is the connection from the pedestal to the household. Each telephone line is a distinct drop.
Figure B-2
Double Star
Network Architecture
In one sense, the most significant difference between a fiber/coax network and a FTTC system that utilizes coaxial drops is the reach of the fiber, which in turn affects the number of households per ONU and per coax. With a fiber/coax design, the number of homes sharing these facilities can range into the hundreds. In contrast, with a FTTC system, fiber is extended much further into the neighborhood, allowing one node to serve approximately four to eight homes, which permits each household to receive its own coaxial wire.

Depending on which medium is used for the drop, FTTC could offer even greater capacity than fiber/coax. For example, using a coax drop, one vendor is currently testing a system that offers 45 Mb/s of fully-switched capacity to each home.\textsuperscript{43} Even if the existing twisted-pair drop is utilized, FTTC would allow each home to have over 6 Mb/s of capacity, assuming ADSL3 technology is also used.

At the moment, there are many unanswered questions regarding FTTC technology. Issues currently open to debate include whether to install new coax or use existing twisted-pair for the drop; whether the network should be used for narrowband POTS only, or POTS and broadband video; and some of the matters mentioned in the analysis of fiber/coax in Section B.2.3., such as the optimal number of homes per ONU, and whether the network should be passive or active.

The issue of narrowband versus broadband FTTC is important to the home grocery shopping application. While a broadband FTTC network would provide more than enough capacity for the service, including for any type of GUI, a narrowband FTTC system would not offer sufficient capacity for a video-based display. However, it is likely that in the event that a telco decides to install a narrowband FTTC system, the telco will also install a fiber/coax network to carry VOD and other broadband signals.

Currently, it appears that a broadband, fully-switched FTTC network could be deployed for about $1000-$1500 per household.\textsuperscript{44} As with the cost estimates for fiber/coax, this assessment is significantly influenced by numerous factors, including the population density of the neighborhood, the number of homes per ONU, and the reliability engineered

\textsuperscript{43}Karpinski, "The Long Road Home," p. 16.

\textsuperscript{44}See Karpinski, "1500 Channels," p. 10, and Wilson, "Bellcore Revisits," pp. 9-10.
into the network..

B.2.4.1. Advantages of FTTC

The main advantages of FTTC are capacity and growth flexibility. In terms of capacity, FTTC gains a major advantage if coax is used for the drop. Under this scenario, FTTC would be able to provide sufficient downstream capacity for transmission of analog cable channels and the various digitized on-demand services already discussed, as well as enough upstream capacity to handle such applications as work-at-home, videoconferencing, interactive video games, and in fact almost all other bandwidth-intensive bidirectional uses of the network.

FTTC also has the advantage of being a long run solution. There are two factors of importance. First, FTTC provides a migration path for the network. Regardless of whether coax or twisted-pair is used for the drop, FTTC provides both a substantial amount of capacity upon installation, and a means to upgrade the network in the future. For example, a large portion of the cost involved in installing new network infrastructure is labor-driven, such as digging trenches or working in existing conduits and telephone poles. With a FTTC design, most of this work only has to be done once. In contrast, a fiber/coax network, unless it includes dark fiber\textsuperscript{45}, would require a revisit at a later date in order to extend the reach of the fiber.

Second, FTTC removes many of the barriers encountered by ADSL technology. For example, as noted in Section B.2.2.2., ADSL faces strict limitations on the total length of the twisted-pair wire, as well as other obstacles due to the condition of the existing infrastructure. FTTC eliminates many of these barriers, allowing ADSL to reach a higher percentage of the network than if it were to be implemented alone.

B.2.4.2. Disadvantages of FTTC

The main disadvantages of FTTC concern capacity, implementation characteristics, and cost. The first issue, capacity, only creates a problem in a situation where twisted-pair

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\textsuperscript{45}Dark fiber is fiber cable which is not immediately activated upon installation. It is often left unused for months or even years. When demand for additional capacity warrants, it can be quickly activated. Because the cost of extra fiber cable is relatively insignificant compared to labor and other installation costs, dark fiber is often put into place when network demand is expected to grow.
is used for the drop and the network is intended to be used for VOD and other broadband services. In such a case, the network cannot be fully exploited, since the twisted-pair drop creates a bottleneck. Note that this is true even if ADSL3 technology is used.

Second, FTTC encounters the same disadvantages in terms of implementation as does fiber/coax: (a) it must be installed into an entire neighborhood before any individual household can receive its benefits, and (b) lengthy construction time. The time needed to build a FTTC network should be comparable to that required for a fiber/coax system, i.e., 5 to 10 years for wide coverage.

The third disadvantage pertains to cost, but this is a disadvantage only if the cost is at the upper end of the $1000-$1500 range. At $1500 per household, FTTC may be beyond the threshold of what telcos are willing to spend at this time. This figure represents a considerable premium over the estimated cost to deploy fiber/coax. However, if the installation expense for a FTTC network falls at the low end of the range, then the architecture does not face a cost penalty in comparison to fiber/coax.

B.2.5. FTTH

FTTH refers to the installation of fiber cable from the central office all the way to the home. At the home, the fiber cable would terminate at a piece of equipment housing necessary electronics, most likely mounted on the exterior of the home. (Because this equipment is located at, but not inside, the customer's premises, it is sometimes referred to as CLE—customer located equipment). Coax would be used for wiring inside the house, carrying the signals from the CLE to the phone, television monitor, set-top box and other CPE.

FTTH would offer a tremendous amount of capacity, both downstream and upstream. FTTH would be more than sufficient for the home grocery shopping service.

The cost of a FTTH network is open to much disagreement. Similar to the other FITL technologies, the cost to deploy a FTTH network is dependent upon a multitude of factors (see sections B.2.3. and B.2.4.) In the late 1980s, the RBOCs conducted a great deal of research—including extensive field trials—investigating the feasibility of installing

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46An analogous situation is water flowing from a large pipe into a small hose.
FTTH networks. Much of this development work was stopped in 1989, when it was deemed that the expense was too high. At the time, installation costs for FTTH were estimated at $3000 per subscriber, while FTTC was estimated at about $1800 per subscriber. Because of the high cost, the RBOCs shifted away from FTTH development and instead focused their efforts primarily on ADSL, fiber/coax and FTTH.

However, since that period, costs for many FTTH components, including fiber cable, lasers and microprocessors, have fallen dramatically. As a result, one researcher at Bellcore recently estimated that FTTH could be installed for about $1500-$1800 per household. While this estimate still represents a cost premium over FTTC—mainly because of less sharing of components among households under FTTH than under FTTC—in absolute terms the differential has been reduced by a factor of six, from $1200 to as little as $200.

B.2.5.1. Advantages of FTTH

The advantages of FTTH are capacity, versatility and operational cost. First, FTTH would provide the most capacity of any option under consideration. In fact, there may not be another technology available which could match the capacity of an all-fiber network. Any services which can be offered on any other technology can therefore be provided with FTTH.

Second, FTTH is a long term solution. Once installed, it would function as a workable solution for many decades. For example, should demand for network capacity increase as applications become more advanced, FTTH would eliminate the need to replace the network a second time. Aside from saving money, FTTH spares the phone company the embarrassment of having to dig up a home owner's lawn twice in a period of a few years.

Third, a FTTH network would probably have the lowest operational costs of any of the FITL options. For example, as noted earlier, the operational costs of fiber cable are less than that of twisted-pair; also, it is less expensive to conduct network tests using FTTH technology compared to fiber/coax or FTTC. Typically, a local telephone network is designed and engineered to last for forty years or more. Over the course of this period,

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Wilson, "Bellcore Revisits," pp. 16-17.
the operational cost savings of a FTTH network may more than compensate for its installation cost premium relative to fiber/coax of FTTC.

B.2.5.2. Disadvantages of FTTH

The main disadvantages of FTTH concern the cost-to-benefit ratio, and network powering. First, in actuality, a FTTH network may not provide more capacity than other technologies. For example, while fiber is connected directly to the home, coaxial wire is used for in-house wiring. In other words, television monitors and other CPE do not connect directly to fiber cable; rather, they are linked into the network via a coaxial wire in the home. Thus the capacity of a FTTH network may not be greater than that of a FTTC-plus-coax system; even if the capacity is larger, it will be a very long time before a residential household requires this level of bandwidth (i.e., more than 45 Mb/s). In the meantime however, the deployment of FTTH involves an installation cost premium over other technologies.

Second, the issue of network powering must be addressed. The electronics and other termination equipment at each household require power. As mentioned above, fiber cable is unable to conduct electricity. Unless a separate, telco-operated electricity wire is deployed (or the existing twisted-pair used), a FTTH network would necessitate the installation of powering equipment and connections to the electricity grid at each household. Furthermore, phone companies design their networks to have a backup source of power, such as a battery, should the primary power source fail; this equipment would have to be positioned at the household in a FTTH network. Locating battery backup equipment at the household raises serious questions about which party, the household or the telco, is responsible for maintenance, in particular for ensuring that the battery remains fully charged.

B.2.6. Wireless technologies

B.2.6.1. WFA

WFA involves the replacement of the twisted-pair drop with a wireless drop. A

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48To put the need for capacity at the household level into perspective, consider that at the moment, relatively few businesses have even what is known as a T-1 phone line, which supplies 1.5 Mb/s of bandwidth to the subscriber. Coaxial wire offers many times this amount of bandwidth, and the capacity of fiber cable is far greater still. Today, even for large businesses, a direct fiber drop is considered novel.
transceiver is positioned at the pedestal, and a corresponding piece of equipment is attached to the exterior of the home. Either twisted-pair or coaxial cable is used to link the exterior equipment to interior CPE. The infrastructure from the pedestal to the central office is deployed independently, and it could consist of any of the media discussed in previous sections.

It is presently unclear what level of capacity a WFA network could provide. It does appear that this technology will likely be used for narrowband signals only, such as POTS. If this is the case, then a WFA network would allow the transmission of only the most rudimentary home grocery shopping interface, such as a simple text-based display. Should WFA technology enable the transmission of broadband signals, then a more advanced display could be offered.

The cost to install WFA has been estimated in one study to be 12 percent less than FTTH.\textsuperscript{49} Using the figure of $1300 per household for FTTC developed above, this estimate would place the cost for a WFA network at around $1130 per household.

The advantages of WFA are long run cost and implementation. First, it appears that this technology is substantially less expensive to deploy, and to maintain, the some of the other options examined above. This is especially true in areas with long loops from the central office to the household, where WFA may obviate the need to install a more expensive wired network. Second, a WFA network could probably be implemented much more quickly than a comparable wired network.

The main disadvantage of WFA is capacity. In the work underway, the pedestal mounted unit provides 320 Kb/s of capacity, but this is shared among ten households. At such a low per household capacity, WFA would be capable of delivering only the most basic, text-based display. However, if the capacity of the pedestal-mounted unit is divided among fewer households, it is possible that the quality of the display could be improved, though it might never be feasible to deliver video over a WFA network.

\textbf{B.2.6.2. PCS}

PCS is similar to a cellular telephone system. It involves a collection of transmitters

separated into distinct "cells," and linked together in a local network. Users communicate via wireless equipment, including telephones and data-transmitting devices.

The main difference between PCS and a traditional cellular system is that there is a much larger number of cells in a PCS network than in a cellular system. Thus, a PCS network could conceivably support many more simultaneous users than could a cellular system.50 Another difference is that it is envisioned that the usage fees for PCS will be lower for cellular telephone, thus allowing mobile wireless service to reach the mass market.

Note that in recent years, cellular operators have been creating smaller cells by installing additional transmitters and receivers. Furthermore, these companies are likely to drop their rates in response to competition. Thus it is not clear whether ultimately there will be a large distinction between PCS and cellular telephone.

PCS (and cellular telephone) is a low-capacity system. It allows for narrowband communication, but it does not offer sufficient capacity to transmit full-motion video. The display interface in a PCS system is likely to be restricted to text and sound, and possibly limited graphics.

The cost for PCS is uncertain at this time. In general, the cost per subscriber is highly dependent upon the number of users, and currently there is great variation in estimates about the number of likely subscribers.

B.3. Cable television industry

As discussed in Chapter Four, virtually all cable television networks are non-switched, one-way systems. While the issue of switching is beyond the scope of this analysis, it is an important matter, particularly for those cable companies that wish to offer telephone services. The second issue—creating two-way functionality—is addressed by the technologies discussed in this section. Note that for the purposes of home grocery shopping, an addressable cable network is sufficient, provided the network is connected to the local phone system in order to handle upstream communication.51

50In general, the larger the number of cells dividing a given region, the more the spectrum can be "reused," and the greater the number of users that can be supported.

51Refer to Chapter Four for more information.
Note also that the functionality of switching is markedly different from that of digital compression. Compression enables more channels to be transmitted in the same amount of capacity. For example, a standard television signal requires 6 MHz of bandwidth; a 10:1 compression ratio would allow the transmission of ten signals in the same space previously occupied by one.\footnote{As a result of the 10:1 compression ratio, it has become popular to talk about future cable systems offering 500 channels. This is because today's cable systems generally provide around 50 channels. However, there is nothing inherently correct about this number; a future cable system could just as readily offer more, or less, than 500 channels.} However, these signals are still broadcast, or transmitted to all connected households. Switching, on the other hand, enables a given signal to be delivered to one, and only one, location.

**B.3.1. Upgraded coax**

Upgraded coax is analogous to the use of ADSL on a phone network. It consists of overhauling and modernizing the network, but continuing to utilize the existing coaxial wire. A small amount of fiber may be installed, but this amount is far less than the quantity used in a fiber/coax network. The primary activity under this option is the removal or updating of network components, such as bridges, amplifiers and taps. The result is a network capable of the type of two-way communication necessary for the home grocery shopping service, though the display interface in the home would probably be limited to still photos, menus and sound.

The cost to implement upgraded coax varies based on a number of factors, including the age of the existing plant, the number of components that need to be updated, the geography of the service area, and the size of the network. One company that upgraded its system did so for about $200 per subscriber.\footnote{Nolan, "No Fiber!" p. 39.}

**B.3.1.1. Advantages of upgraded coax**

The primary advantages of upgraded coax are cost and experience. First, depending on the layout of the existing system, upgraded coax could be significantly less expensive to install than fiber/coax. Few sections of the network would have to be abandoned; only
certain pieces of equipment would need to be replaced.

The second advantage of upgraded coax is the fact that coax is a known technology to CATV operators, most of which have worked with coax for many years and are familiar with the technology. In contrast, fiber optic cable is a relatively recent development. Except for the very biggest companies, most CATV operators have little or no experience handling fiber; for these small firms, which represent the majority of CATV companies, the use of fiber creates definite challenges.

B.3.1.2. Disadvantages of upgraded coax

The disadvantages of upgraded coax are capacity and reliability. First, as has already been discussed, the capacity of coax declines over extended distances. Thus an upgraded coax network would have to be fairly small in order to achieve the capacity of a network that utilizes fiber. Second, fiber is a more reliable medium than coax; in addition, it does not require as many pieces of interim electronics between the headend and the household as does coax. As a result, the long run operational expense of an all-coax network would most likely be higher than that of a comparable fiber/coax network.

B.3.2. CATV fiber/coax

CATV fiber/coax is very similar to telco fiber/coax. The biggest difference between the two designs is the extent of the fiber deployment. With a CATV design, fiber is not extended as far into the neighborhood as it is with a telco layout. For example, telco plans call for one fiber node per 64-128 households; CATV companies, several of which have already begun installing fiber, intend to use nodes servicing anywhere from 500-7000 homes, at least initially. At a later date, CATV companies could deploy additional fiber, reducing the size of the fiber serving area\(^{54}\) (FSA). Once that happens, there would be few if any differences between a CATV fiber/coax network and a telco fiber/coax network.

The home grocery shopping service could function effectively on a CATV fiber/coax network. Upstream capacity would be more than sufficient. However, if the size of the FSA is maintained at 500 or more households, the display would probably be limited to still photos, menus and sound.

\(^{54}\) The neighborhood of homes sharing a node is usually referred to as an FSA in the cable industry.
The cost of a CATV fiber/coax network is currently estimated at about $300-$500 per subscriber.55 This cost varies greatly based on numerous factors (see Section B.2.3.); it appears that the variable with most significant influence is the size of the FSA.56

B.3.2.1. Advantages of CATV fiber/coax

The chief advantage of CATV fiber/coax, compared to telco fiber/coax, is cost. There are two reasons why a CATV fiber/coax network is less expensive to deploy. First, much of the fiber-related equipment—such as cable, nodes, etc.—represent large fixed costs; the variable costs for additional connections are relatively small. Therefore, the greater the number of households sharing this equipment, the lower the expense per household. CATV operators plan to have FSAs which are many times larger than telco designs. Second, it has been estimated that up to 75 percent of the cost to install a fiber/coax network is accounted for by the plant at the neighborhood level, from the node to the home. CATV operators already have an installed base of coax extending to the home, which telcos do not have. Thus even if a CATV operator reduces the size of the FSA to a level comparable with a telco design, the CATV operator still gains a major cost advantage over the telco because of its installed coax network.

B.3.2.2. Disadvantages of CATV fiber/coax

The main disadvantage of CATV fiber/coax, relative to telco fiber/coax, is capacity. For instance, the larger the size of the FSA, the greater the number of households sharing a given coaxial wire. Because coax has a fixed capacity, a system with one or two large FSAs would not be as robust as a comparable system which has several smaller FSAs; this is especially true for the transmission of POTS and on-demand broadband applications. Therefore, a network which has FSAs consisting of several hundred or more homes could experience severe blocking problems, particularly if VOD applications become popular; in fact, such a network may not be capable of transmitting POTS.


56Note that this is the cost to install only the fiber/coax subscriptional technology. If the cable operator chooses to also deploy switching, the installation expense would be much higher relative to an unswitched fiber/coax network.
B.3.3. Other cable industry technologies

There are other technologies that a CATV company can implement aside from upgraded coax and fiber/coax, such as FTTC or FTTH. If a cable company were to follow one of these paths, its costs would be almost identical to those for a comparable telco network.\textsuperscript{57} Cable operators are also considering wireless technologies, especially PCS. However, for a CATV operator, only fiber cable currently offers an increase in capacity and functionality relative to coax. Therefore, wireless technologies—including PCS—will likely be deployed as a supplement to, rather than as a replacement for, existing CATV networks.

B.4. Other technologies

As Chapter Four discussed, there are a variety of telecommunications technologies currently under development. Most are not relevant to the home grocery shopping concept, since they do not allow for two-way communication between the consumer and the distributor. Two technologies which are relevant are cellular cable and a combination CATV/phone system.

B.4.1. Cellular cable

Cellular cable\textsuperscript{58} refers to a cellular wireless network, operating in the microwave portion of the frequency spectrum, or around 28 GHz. Similar to PCS and cellular telephone, the system incorporates a network of transmitters divided into distinct cells throughout a given area. At each subscribing household, a receiver is mounted onto a windowsill. The square-shaped receivers are much smaller than typical satellite dishes, measuring about five inches on a side. Coaxial cable is used to connect the dish to the television monitor.

This technology is still in the very early stages of development. At the moment, it is

\textsuperscript{57}With respect to FTTC, the cable company may or may not save money relative to the telco. For instance, while the cable company benefits from having a network of coaxial wire to the home already in place, telco networks are usually engineered, at additional cost, to a much higher standard than CATV networks. With respect to FTTH, because such a system is almost entirely new-build, a CATV network and a comparable telco network would cost approximately the same.

\textsuperscript{58}The technical name for cellular cable is local multipoint distribution service (LMDS).
being positioned primarily as a substitute for CATV networks in the one-way transmission of traditional broadcast television channels. There is still much disagreement about whether the technology is capable of two-way, switched communication, as well as the level of capacity the technology could provide in a switched environment.\textsuperscript{59} Other possible problems include signal interference and weather-related disruptions.

The cost to install a cellular cable network is currently estimated at about $600 per subscriber.\textsuperscript{60} Note that the CPE cost for this technology is likely to be higher than for wireline technologies.

\textbf{B.4.2. CATV/phone system}

The combination CATV/phone system does not actually represent a new network technology. Although a limited upgrade of the CATV network may be necessary in order for the system to operate, the strength of the system rests in its ability to utilize both the CATV and the telco networks in their current state. In fact, this is the primary advantage of a combination CATV/phone system: it brings substantially improved functionality to today's networks.

The disadvantage of this system is its capacity. Although a combination CATV/telco system is capable of delivering color photos, menus and sound on-demand, such systems are not currently set up to handle full-motion video. It may be possible to evolve combination CATV/telco systems in order to gain greater capability, but this aspect remains unclear.

Information about installation costs is not publicly available. However, it appears that this technology can be deployed rather inexpensively. In fact, the network costs are minimal; most of the cost is related to CPE and the headend processing expense. By itself, the network cost is probably significantly less than $100 per subscriber.

\textbf{B.5. Summary}

\textsuperscript{59}Titch, "Network of Networks," p. 25.

\textsuperscript{60}\textit{Ibid.}
This chapter has examined a range of new telecommunications technologies. For each technology, this chapter has examined its advantages and disadvantages, and identified a likely cost per household. Overall, this chapter has shown that a multitude of technologies are now coming available that make it possible to offer attractive display interfaces in the home, thus enabling home grocery shopping to be effectively rolled out to the mass market.
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Food Marketing Institute, September, 1993 to April, 1994.
Package delivery company, October, 1993.
Package delivery company, October, 1993.
Grocery delivery company, October, 1993.
Grocery delivery company, October, 1993.
Engineer, Bellcore, December, 1993.
Tote manufacturer, March, 1993.
Independent supermarket operator, March to April, 1994.
Software developer, March to April, 1994.
User of a grocery delivery company, April, 1994.
Telecommunications consultant, April, 1994.
Computer equipment vendor, April, 1994.