A Methodology for Design of a Customer Service System in a Manufacturing Organization

by

Brereton E. Bissell

Submitted to the Sloan School of Management and the
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Abstract

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Motorola Information Systems Group (ISG) has identified the need to reduce product delivery lead time for all of its products and specifically for a new product - the cable data modem. This thesis examines this problem and presents a methodology for achieving customer satisfaction through improving the product delivery function. As the research for this thesis was completed at ISG, examples and lessons from this study will be presented in support of the methodology.

The foundation for this methodology is the concept of a Product Delivery Service System. The Product Delivery Service System is a way of looking at the entire order fulfillment cycle - from when the customer places an order until the product is delivered - as a customer service to be managed and improved. More importantly, the methodology presents a way to tailor the service to the needs of its primary customers by providing a framework for segmenting groups of service customers. By segmenting the potential customers of the product delivery service, it is argued in this thesis that the service designer will be able to choose the target customers for the service, and will be able to focus on meeting the needs of those customers in the most effective manner possible. Finally, we discuss some of the key differences between services and physical goods, and some of the implications for these differences for the service designer.

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Chapter 1 - Introduction

1.1 - Problem Statement

In many firms, product delivery has traditionally been seen as something which happens only after the following sequence has been completed:

- The customer has expressed a need for the product
- The customer's order has been received and recorded
- The customer's order has been communicated to manufacturing
- The product has been manufactured
- The product has been sent to the shipping dock.

Customer demand, order processing, physical production, and delivery of the product are therefore seen as independent functions which must be managed separately. We believe that this is a dysfunctional way of thinking because the customer is taken out of the system.

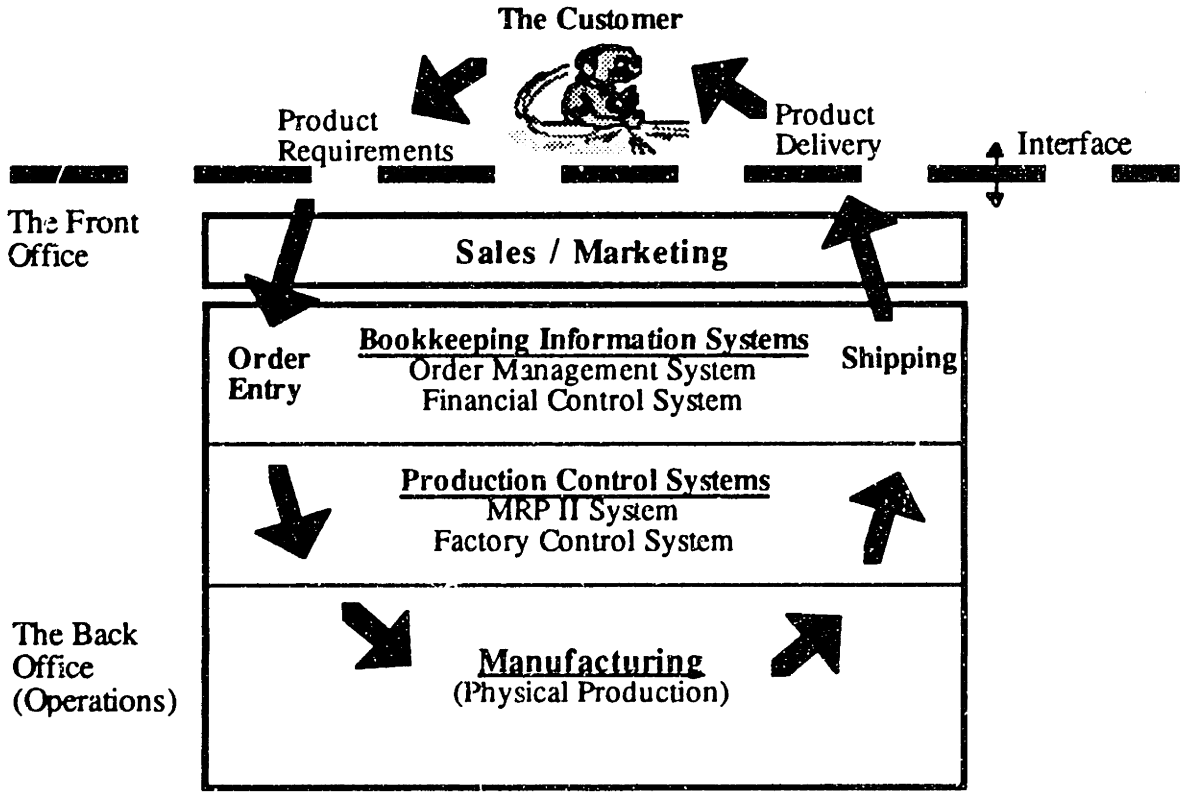

Figure 1 - The Product Delivery Service

In response, this thesis proposes a way of looking at this sequence of events as a holistic cycle. By looking at the whole "product delivery service," (shown in Fig. 1) the firm or organization is more accurately able to assess whether it is truly meeting the needs of its customers.

As Fig. 1 illustrates, the customer is really the focal point of a cycle. The cycle starts when the customer develops a need for the product. It ends when the product is delivered to the customer in a manner which meets his needs. From the customer's point of view, his interaction with the firm ends at what Bitran and Pedrosa (1996) refer to as the interface. Having received the customer's order, the "front office" transfers it to the "back office" (Lovelock, 1992). In the back office, the order is registered, produced, and packaged for shipping. Next, the front office is notified as the order goes out the door so that they know the order has been completed. Finally, the customer receives the product he ordered. Note that if a failure occurs anywhere in the cycle, the customer will not get the product he ordered. Thus to effectively work towards customer satisfaction, the manufacturing firm must consciously manage and improve this cycle.

This thesis takes the perspective of a firm that is trying to develop or improve its product delivery service. Its contribution will be to explore the following areas:

- the role of benchmarking in the development or improvement of a customer service system
- the implications of uncertainty and multiple customer demand scenarios in the development of a product delivery service
- the differences between physical products and services, focusing specifically on the implications of these differences in operationalizing the voice of the customer, and in using a methodology to design a new service.

Specifically, this thesis will first discuss a study to develop and implement a new product delivery service performed by the author at Motorola's Information Systems Group in Mansfield, Massachusetts. It will present the background of the study, discuss the service challenges revealed in a series of customer interviews, discuss a benchmark study performed by the author, and then attempt to discuss the problems inherent in developing or improving a service. Finally, we will discuss the results of the study at Motorola and our conclusions.

Historically, customer services have tended to evolve out of a defined customer need. Moreover, the structure of the service is often determined through the process by which the

need was first identified. Shostack (1984) supports this by stating, "The development of a new service is usually characterized by trial and error. Service developers often translate a subjective description of a need into an operational concept that may bear only a remote resemblance to the original idea."

For example, it might be argued that many consulting practices are based on the experiences of a few senior partners. In most cases, these senior partners did not consciously design the service they would offer, but rather developed the structure of their service over time. As their practice gains experience, reputation, and additional staff, they are obliged to formalize their methods to ensure a common level of service quality for all of their clients. Thus the service was not really designed; it was standardized into the time-proven methods of the original partners.

The idea that many services are developed through trial and error is validated in the structure of the product delivery services of most companies. This structure is based on the original functional requirements for each component. Each of the departments in the service may be traced to its roots in manually intensive, functional tasks. For example, the function of most order-entry departments has not changed much since the days when every customer mailed in a paper purchase order. Processing these orders required clerks whose function was to receive the order paper, read it, classify it, record it in the firm's books, and then pass it on to the manufacturing group. Today while much of this process has been automated, it is interesting that the fundamental service offered to the customer is unchanged. Orders still come in on paper (albeit by facsimile) and are manually entered into the order management system computer which then completes the tasks originally done by clerks. The structure of this portion of the product delivery service has been dictated by the original need-based manual processes.

For the manufacturing organization, the initial challenge is to realize that they are in fact providing a service. Each of the components must be aware of how they fit into the product delivery service system as a whole. Interestingly enough, instead of focusing on the product itself, Goldratt (1994) frames the entire manufacturing organization as a service provider. In his book, It's Not Luck, the manufacturer of high-pressure steam equipment is transformed into a supplier of the steam itself. This approach is especially worth considering in a two tier distribution system (an increasingly common customer interface for Motorola ISG). The middleman - the distributor - makes his money through having the product available for sale to his customers rather than from the product itself. It is critical that the supplier recognize this fact if he is to achieve true customer satisfaction.

By taking the time to study and understand its product delivery service, the organization will then be in a better position to begin to redesign it. Through a structured evaluation and redesign effort, we believe that the firm will develop a service which is more closely suited to its customers' needs, thus becoming more competitive.

Finally, today's rapidly changing marketplace, technologies, and consumer preferences all drive the need to continuously re-evaluate the firm's product delivery service. The service provider must periodically and proactively examine and re-define its service based on changing customer and market requirements. Thus, this study will present a methodology for developing services, focusing on the challenges to the designer presented by the intangible nature of services.

1.1 - Background

The driving force behind this study was a Leaders for Manufacturing (LFM) Program internship completed by the author at Motorola Information Systems Group (ISG). The internship focused on developing a streamlined process for fulfilling customer sales orders for ISG's newest product - a cable data modem.

ISG's product line at the time of the internship was composed of two categories. The first - data transmission products - was predominantly data modems. The second - network access products - consisted of data networking equipment such as routers, Frame Relay Access Devices (FRADs), and a variety of other computer and telecommunications network products. The majority of products in this second group were built to order. The customer was asked to specify the desired product features or options, after which a product was built to the customer's specifications.

In the Mansfield factory, the manufacturing strategy has been to manufacture products based on individual customer requirements. The company has developed a rather sophisticated production system which allows it to run small batches of products and to minimize line setup times. This strategy is referred to as "High-Mix/Low-Volume." The ISG Mansfield marketing strategy has traditionally been to provide entire network solutions to large corporate customers.

At the time of this study, ISG had come under increasing pressure to reduce delivery lead times. This was driven largely by two factors. The first was increasing competition from niche manufacturers who were able to stock and sell standardized products. The second was a strategic decision by ISG to push into the Value Added Reseller (VAR), consumer and retail

markets. In order to do this, it was recognized that the company would have to develop the ability to respond quickly to changes in customer demand.

In addition, ISG had recently developed a cable modem - a device which allows a personal computer user to connect to an on-line service or the Internet via a cable television hybrid-fiber coaxial (HFC) cable. This product was to be sold to the cable television service companies (hereafter referred to as cable service providers). This was an entirely new market for Motorola. They were faced with uncertainty in such issues as:

- What will customer demand look like (steady or volatile)?
- What will our delivery challenges be?
- What will our manufacturing challenges be?
- What will our competition be like?
- How big will the total market be?
- How will the market (and competition) evolve?

During the course of the internship, the author led an investigation of these issues. Adding to the uncertainty in this study was the fact that the cable modem was aimed at an entirely new market. Although several giant competitors had announced plans to market similar modems, none had progressed beyond the field-trial level. Thus, not only were the customers an unknown for ISG, but even the size of the market was unclear. It was extremely difficult for ISG to project what kind of resources it would have to put in place to serve this market.

Because we initially had only assumptions (but little actual information) about the cable company operators, the author proposed and led a customer site study to learn more about them. This study is discussed in Chapter 2 - Collection of the Voice of the Customer. This allowed ISG to become better acquainted with its new customers, learning about both their strengths and potential weaknesses.

In addition, certain assumptions were made about the product itself (which was still in the prototyping phase). The major assumption was that there would be only one version of the modem (which every customer would order). The second was that the market would expand quickly, resulting in the need to manufacture the modem in high volume. This was another area of concern for ISG. There were significant risks associated with making the transition to a new manufacturing strategy of "Low-Mix/High-Volume." Management had a strong desire to minimize these risks by using existing, proven solutions and resources to speed implementation. This prompted the idea of an internal benchmarking study to learn from other

divisions in Motorola which had more high-volume experience. This study is discussed in Chapter 3.

Still another area of uncertainty was within the corporation itself. Another division - the Multimedia Group (MMG) was also introducing a product which allowed cable subscribers to get telephone service via their television cable. MMG also planned to market this product to the cable service providers. At the time of this study, there was some debate within Motorola as to whether both ISG and MMG should operate independently, or combine resources to better serve the customer. Upper management in both groups felt strongly that it was in Motorola's best interest to present "one face to the customer." However, as the groups were separated both geographically and organizationally, it was unclear how this might be accomplished. The resolution of this conflict is presented in Chapter 6.

Chapter 2 - Collection of the Voice of the Customer

2.1 - Overview

This chapter will discuss a study completed by the author and a cross-functional team at Motorola ISG to determine the attitudes, characteristics, weaknesses and technical skills of its new customers - the cable television provider companies. We will first discuss the problem - that we had made many critical assumptions without the benefit of actual data. We will then describe the process that was used, the empirical data that was obtained, and the conclusions that were made. Finally, we will discuss the importance of obtaining the voice of the customer for designing a service.

Camp (1989) brings up the subtle question that management often asks, "How do you know" in support for benchmarking as a management tool. This question is also critical in developing a successful service. In the design of services, there is an enormous temptation for the designer to assume he knows what the customer wants. Even the gurus, Lovelock and Shostack (the two most commonly quoted authors for design of services) skip straight to the concept stage. Very little emphasis is given to initial assumptions. Yet the concept development process necessarily develops from the designer's initial perceptions of what the customer needs.

In the following section, we describe a study in which a TQM process was used to establish assumptions to be used as a basis for the design of a product delivery service. The methodology used was based on Shiba's (1993) guidelines for customer interviews. Although Shiba goes on to discuss how interview data may actually be used to design a product or service, we will confine our discussion here to the interview process.

2.2 - Methodology for gathering the voice of the customer

Shiba presents the following methodology for developing an understanding of the customer's environment and needs and converting these needs into requirements:

Stage 1: Develop an understanding of the customer's needs and environment.

- Step 1: Plan for exploration (decide how broadly to explore what customers may need).
- Step 2: Collect the voice and context of the customer (go hear what potential customers say they need and see what they are doing).
- Step 3: Develop an image of the customer's environment (integrate and make explicit what you see customers doing).

Stage 2: Convert understanding into requirements.

Step 4: Transform the voice of the customer into customer requirements (on the basis of your understanding of what customers are doing, convert the possibly ambiguous statements of what customers need into unambiguous statements of customer requirements).
Step 5: Select the most significant customer requirements (from among all customers studied, select what seem to be the most important requirements).
Step 6: Develop insight into the relations between requirements (organize the most important requirements so you can see possible relationships between them).

2.2.1 - Preparation for customer contact

Our study was limited by two constraints. The first constraint was a lack of resources - besides the author, there were several people interested in the project. However, these people were extremely busy which limited the time they could spend on customer visits. The second constraint was budgetary - we were only able to visit local customers. Because of these two limitations, we were only able to visit three local cable service provider locations (*head-ends*).

The greatest area of uncertainty for ISG (besides the size of the market) was in the cable companies' ordering and warehousing practices. Thus, we chose to focus our efforts in learning more about the ordering, purchasing, and warehousing practices of our customers. The specific process we used, based on Shiba's methodology, followed this sequence:

- Identify key areas for concern
- Identify key customer processes in each of these areas
- Create an interview guide to allow us to focus on these areas
- Contact and interview customers
- Distill interview data into a usable format using the KJ method.
- Articulate the most important customer requirements

Both the key areas and customer processes were identified through the use of brainstorming. By bringing together several functional experts (including the business operations manager and quality manager), we were able to identify customer practices which were critical for us to understand. For example, receiving, testing, purchasing, stocking, training and repair were all listed as customer practices to study.

Having identified areas for concentration, our study needed to translate them into a format that would be useful in a customer interview. Following Shiba's (1993) guidelines, four open-

ended questions were used to draw out the customer's real feelings, problems and aspirations for the product. For a cable modem product delivery service, these questions might be:

- *What images come to mind when you think about a supplier or vendor of cable equipment?*
- *From your experience, what complaints, problems or weaknesses would you like to mention about suppliers?*
- *What features, services, or criteria do you think about when selecting a supplier or vendor?*
- *What new features, services, or practices might address your future needs from a supplier or vendor?*

Following these questions, the customer was then asked for more specific details in the areas in which we were interested. These questions were then translated into an "interview guide" (Appendix B).

Actually focusing on our product (the cable modem) proved to be a serious problem as the local cable service providers had only a minimal awareness of the product. Thus, our questions focused on their current products (cable channel decoder boxes also known as "set-top" boxes), hoping to learn about their current practices and problems.

2.2.2 - The interview process

A typical customer site tour and interview included the following areas:

- the warehouse where incoming products were stored
- the service and repair facilities where boxes were restored
- an interview with the manager of the facility

Once inside the warehouse, the tour typically included looking at the firm's unpacking procedures, the physical layout of the warehouse, quantity of inventory (both packaged and unpacked, product transport equipment (racks, carriers, lockers), and building conditions. In the service and repair areas, attention was typically given to checking the number and qualifications of technicians, their tools, and the quantity of units under repair. Finally, the interviews with the manager of the facility typically lasted for an hour and a half, and covered purchasing, forecasting and inventory policy. Following each interview, the interview transcripts were typed up to ensure that a centralized, readable record existed for each interview visit.

2.3 - Conclusions from interview data

In all, three local cable service providers were visited. This is significantly less than Griffin and Hauser's (1993) recommendation (20-30 customers) to reach 90% of the customer needs. Thus our study data may be viewed merely as empirical evidence - valuable but incomplete. However, we believe that conclusions may be made from this data with a level of confidence. During each study, each manager was asked for the similarities and differences in their site versus sister sites in other cities. They testified that the systems they used were fairly similar to those in other parts of their respective companies. Indeed, the business systems used in most cable service companies are standard to the industry. In addition, marketing engineers within ISG who had worked with cable service providers in the past were interviewed to get their opinions. With these precautions, we felt slightly more confident that our findings were representative of the cable industry.

This study was successful in that it revealed a surprising gap between initial assumptions concerning the customers and reality. Our initial assumptions about the technical capabilities of the cable service providers were revealed to be overly optimistic. We assumed that the cable providers:

- were skilled at managing inventory levels
- were skilled at producing accurate forecasts
- had sophisticated information systems
- used Electronic Data Interchange (EDI) to communicate with vendors
- had competitive purchasing practices

As ISG's assumptions were based on characteristics of their own customers in other market segments, as well as the characteristics of customers of other Motorola sectors, this gap in perception is not surprising. However, the fact that our findings showed that the cable companies:

- carried high inventory levels
- ordered on a yearly basis in huge lot sizes via express mail
- had only rudimentary information systems
- did very little competitive purchasing (and tried to limit the number of models and vendors with which they did business)
- expected long lead times from suppliers

demonstrates the importance of confirming initial assumptions before beginning to design a service. Clearly, had ISG operated on their initial assumptions and developed a corresponding service, the results might have been completely inappropriate.

With many pages of interview notes, it became a significant challenge to extract the most important customer requirements. In the case of this study, simply listing individual customer statements produced over 200 individual "Post-Its." In order to try to make sense of this, the team chose to use the KJ analysis method (Shiba, 1993) by creating an Image KJ diagram (named after Kawakita, Jiro and otherwise known as an affinity diagram). The KJ method was chosen for it's usefulness in: *"focusing the group on the vital images* [of the interview] *and organizing the qualitative data in a way that would show the relationship among the images"* (Horton and Boger, 1994).

The KJ analysis method starts with a question. In this case, it is: "What are the cable companies' key procurement requirements for cable modems?" In answer to this question, specific customer statements (the "voice of the customer") are grouped by the images they evoke. Each of these groupings is then stated as a customer requirement. This is shown in the groupings of one to four boxes in Fig. 2. The top box of each group is the concluding customer requirement. Finally, these customer requirements are analyzed for cause-and-effect relationships. These final relationships are summarized in the statement at the top right hand corner, "Cable modem vendors must proactively identify and solve end user delivery problems resulting from the cable companies' inexperience in the new high-speed data market." (For a more detailed description of KJ diagrams, the reader is referred to Shiba's A New American TQM.)

Although the analysis took more than a week to complete, in the end the team was able to distill out some rather surprising, high-level customer requirements (see Fig. 2 on the following page for the KJ diagram and Appendix A for analysis of the KJ diagram). The high-level customer requirements revealed in the KJ analysis are listed on page 21.

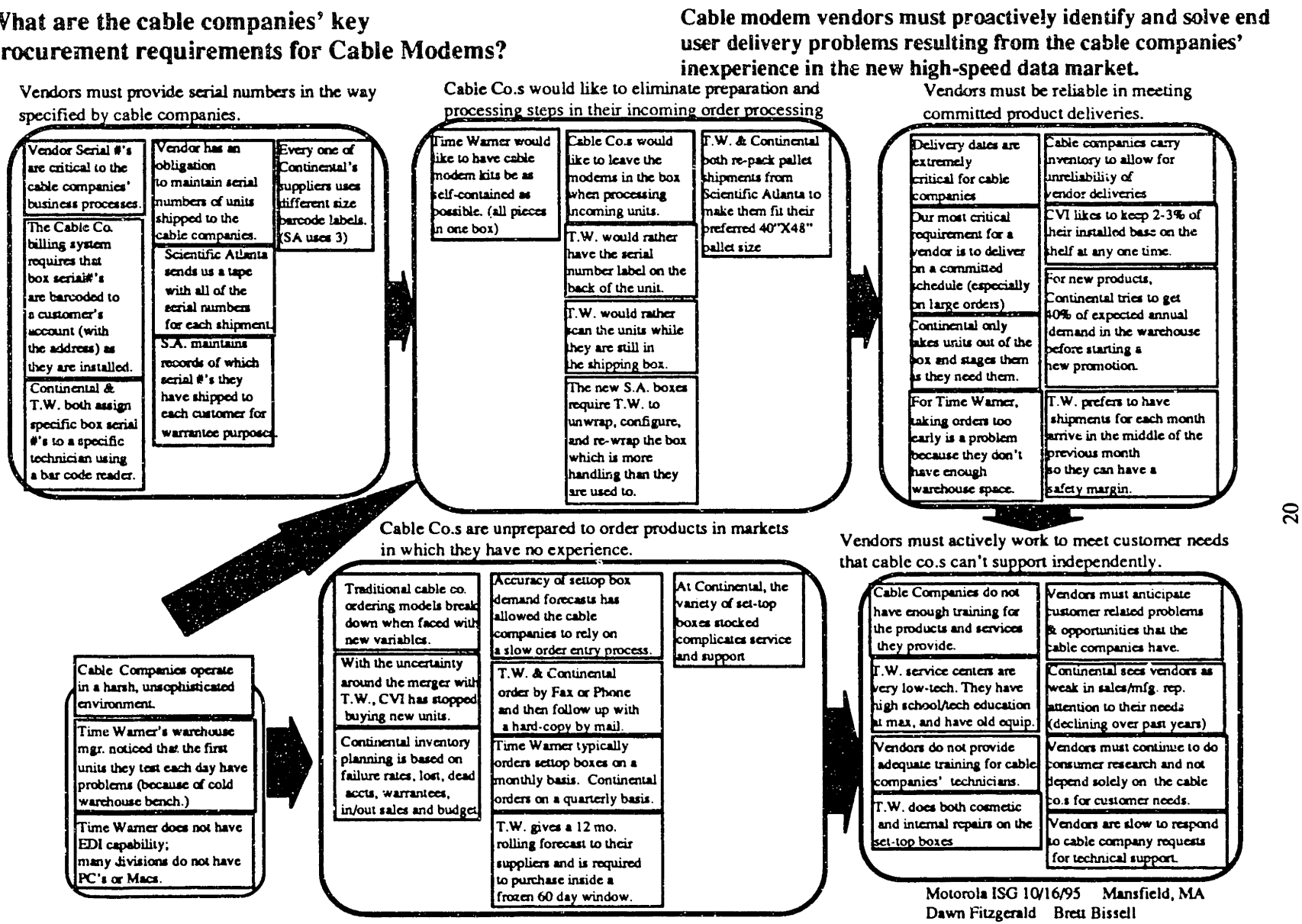

Figure 2 - KJ analysis of customer requirements from cable company interviews

High level customer requirements revealed in KJ analysis:

- Cable modem vendors must proactively identify and solve end user delivery problems resulting from the cable companies' inexperience in the new high-speed data market.
- Vendors must provide serial numbers in the way specified by the cable service providers.
- Cable service providers would like to eliminate preparation and processing steps in their incoming order processing.
- Vendors must be reliable in meeting committed product delivery schedules
- Cable service providers are unprepared to order products in markets in which they lack experience.
- Vendors need to take on an active role in meeting customer needs that cable companies can't support independently.

In particular, the conclusions that the cable service providers were unprepared, or would need help in forecasting and ordering the cable modem were a surprise to many, and contradicted several of the earlier assumptions.

Lovelock (1979) lists three reasons why understanding customer behavior is critical for services. First, a service requires that the customer be present (i.e. a haircut requires that you sit in the barber's chair). Second, customers are required to act to complete a service (i.e. in the product delivery service, the customer must signal a need for the product in some fashion). Third, since services cannot be stockpiled, understanding the time pressures on the customer is critical if the service provider hopes to use capacity efficiently. If a service designer hopes to be successful, clearly following a methodological process to obtain the true voice and practices of the customer is a necessary first step.

Chapter 3 - Segmentation of Service Customer Segments

3.1 - Overview

For a company that wishes to design an effective product delivery service system, it is critical to understand what types of customers will use the service. Thus, understanding what segments exist in the customer base will allow the company to target which segment it wishes to serve. Lovelock (1984) lays out the possible penalties for the company which fails to position its service correctly or target the right customer segment:

- The company is pushed into a position where it faces head-on competition from stronger competitors.
- The organization is pushed into a segment which nobody else wants because there is little customer demand there.
- The organization's position is so fuzzy that nobody knows what its distinctive competence really is.
- The organization has no position at all in the marketplace because nobody has ever heard of it.

It is easy to dismiss these as pitfalls of pure service firms. Yet as we described in Chapter 1, the product delivery service focuses on making a product available to customers - when and how they want it. If the product is vastly superior, the product delivery service may never become a real issue. However, if healthy competition exists, the company's ability to provide the product in a manner closely suited to the customer's needs will become a key sales point. Thus, for a firm facing competition, the ability to correctly identify and design for the customer segments it will serve may be the determining factor for long term success.

3.2 - Factors which shape generic and product delivery services

In a later textbook, Lovelock (1992) lists the key factors which shape the customer service function. For each of these factors, we propose a more specific attribute which relates to customers of the product delivery service in Table 1 on the next page.

Lovelock's generic service shaping factors:	Analogue factor for the product delivery service
1) The presence or absence of intermediaries in the delivery system for different service elements.	Does the customer use a centralized purchasing system, or does each division order based on its own needs?
2) Extent to which contacts with customers are high contact versus low contact.	How is demand for the product communicated? (Direct Order vs. Vendor Managed Inventory)
3) Access to, and acceptance of, technologically based communication and delivery systems.	What is the customer's preference for communication? (EDI, Fax, Mail, Phone)
4) Whether purchases are made by institutional buyers, members of the general public, or both.	Is the customer a distributor of the product or an end user?
5) How long the service delivery process lasts.	What delivery lead time is required?
6) Whether or not the service is capacity constrained.	Is the product delivery service capacity constrained at any point?
7) How frequently customers use the service and require it.	What is the customer re-order frequency? What is the lot size?
8) How complex the service is to deliver and use.	How much customization is required to deliver the product?
9) How much risk is involved for customers in consuming the service and what the consequences of service failure are for them.	What are the consequences for customers if the product delivery service fails?

Table 1 - Guideline for customer segmentation

3.3 - Discussion of product delivery service scenarios

Each of the "analogues" listed above in Table 1 have specific implications for the segmentation of customers for the product delivery service. We will now explore each factor, concentrating on their implications for product delivery service system requirements.

1) Does the customer use a centralized purchasing system, or does each division order based on its own needs?

One of the major questions any service provider must answer is "who am I dealing with?" If the customers use large centralized purchasing systems, the service provider will in most cases be measured by this centralized purchasing group. However, if the customers use a decentralized purchasing scheme, the service provider will have to design a service that is capable of interfacing with the multiple subdivisions of the customer's organization. For example, centralized purchasing organizations are typically driven by the need to achieve economies of scale, and to improve overall

supply quality. Thus, these are important metrics for the service designer to keep in mind.

In many ways, it will be more efficient for the service provider to deal with a central organization. Although they will probably be forced to provide volume discounts, the service organization can usually simplify the service by bargaining for: minimum order quantities, standard ordering formats (making order entry's task simpler), and in many cases standard product delivery lead times. Hence, when designing a product delivery service for customers with large, centralized purchasing organizations, companies may be able to count on larger batch sizes, more educated customers, and simpler order entry procedures.

On the other hand, many companies allow individual divisions and groups to do their own purchasing on the theory that the individuals are most aware of their own needs. This allows each group to negotiate: prices, lead times, ordering formats, shipping methods, and possibly even customized products. In this scenario, the product delivery service provider will often have greater visibility into the end user demand for the product (as well as customer idiosyncrasies in using the product). However, this will be counter-balanced by: more frequent and erratic orders for smaller lot sizes, a greater possibility that individual orders will be canceled, more frequent demands for "customized" products (either in manufacture or packaging), inconsistent ordering practices, possible demands for faster lead times from the more advanced customer groups, and quite possibly increased logistics problems due to constantly shifting customer sites.

Clearly, this second scenario will require more robust information systems to track: customer and division pricing policies, order formats, special product codes, manufacturing changes, different packaging and shipping methods, and a greater number of ship-to locations. This scenario also requires the service system to be more adept at managing varying lot sizes as well as unforecasted and volatile demand. In this scenario, customer demands for fast delivery lead times coupled with higher demand volatility may force the service provider to carry higher levels of semi-finished and finished goods inventory.

2) How is demand for the product communicated? (Direct Order vs. Vendor Managed Inventory)

This factor focuses on whether the service provider or the customer is responsible for identifying product demand (i.e. need for the product delivery service). Traditionally, the customer is responsible for notifying the supplier when he needs the product. This is usually done through the bureaucratic process of "cutting an order." When the customer realizes that his warehouse stock of the product is low (or at a pre-determined re-order point), he sends an official document to the supplier requesting delivery of a specific quantity of the product by a certain date. Although this method of interfacing with the customer may take on various levels of sophistication, obviously the product delivery service provider must have some type of order entry and administration department to support this type of customer.

The other extreme, a practice known as Vendor Managed Inventory (VMI), is revolutionizing the customer interface for many product delivery service providers. According to Mitch Betts (1994), the VMI concept is when: "the supplier gets point-of-sale data (end-user demand), or warehouse data from the customer and uses that data to make inventory replenishment decisions."

Under this scenario, the supplier takes on all responsibility for ensuring that the customer's shelves are fully stocked. VMI adds an interesting twist for the service designer. He may be able to completely do away with the order administration group. In its place, one operator (or none) and an EDI terminal (for receiving automatic inventory and usage updates from the customer's warehouse) will be able to communicate individual and aggregate product usage to the production department. With actual point-of-sale (POS) data, the production department may be able to develop more accurate forecasting models for future production requirements.

Where a product delivery service provider positions itself must be determined by two things: its level of expertise with EDI (and its customers), and where its customers lie with respect to factor number one. If the service provider is dealing with a large number of customers who don't have automated inventory tracking systems (and thus are not capable of supplying accurate and timely usage data), it should clearly think twice before offering the customer VMI. However, with a few large, centralized and sophisticated customers, the service provider may be able to achieve significant cost reductions and

customer satisfaction through implementing VMI (assuming the service provider has the necessary technical expertise).

3) What is the customer's preference for communication? (EDI, Fax, Mail, Phone)

The customer's technical capability for (and preference for) communication with the product delivery service provider will be the largest factor in determining the nature of the customer interface (assuming of course, that the service provider is more technically advanced in this area). At the high end of the technology sophistication scale is the customer using EDI. This customer will expect to send the majority of its communications electronically. The EDI X.12 standard allows for purchase orders, schedule sharing, order acknowledgments, electronic funds transfer (EFT), as well as many other standard business communications (Motorola, 1995). On the whole, the service provider may expect to support an EDI customer using automatic systems. In this case, valuable human order administration specialists are used primarily to manage exceptions or problems rather than the majority of orders which are correct.

Moving down the technology ladder, both facsimile and hard-copy mail are very common means of interacting with customers. However, both of these methods require extensive manual support on the service provider's side (each fax and letter must be read, checked, and processed). Finally, the ubiquitous telephone or direct person-to-person contact is the least efficient and requires the most manual resources from the service provider. Yet this should not be viewed as a sweeping endorsement of EDI. EDI and its related information systems, product bar-codes and scanners can be expensive. The service provider will ultimately make the choice based on the needs and resources of the service it offers.

4) Is the customer a distributor of the product or an end user?

This factor is similar to factor number one, but it brings up an interesting issue. If the customer is a distributor of the product, then packaging and shipping requirements may be very different from those of an end user. For example, a distributor will most likely want to have the product packaged in bulk (multiple units per carton) yet may want to be able to keep track of each individual serial number (for warrantee registration). This will require a shipping system which is capable of tracking multiple units simultaneously as well as rigid inventory control methods to ensure that the wrong serial number is not

listed on a shipping manifest. Moreover, the product delivery service provider will have to decide whether or not to track each unit to its final destination for warrantee purposes. Doing so will require some sort of feedback mechanism from the end customer.

5) What delivery lead time is required?

Nahmias (1993) defines lead time as the amount of time that elapses from the instant that an order is placed until it arrives. Lead time is typically determined by a combination of four factors: plant capacity, backlog, physical manufacturing and shipping time, and customer pressure. The purist may argue that the fourth item does not belong in this list. However, customer pressure is typically the force which motivates the product delivery service provider to seek out new methodologies and technologies to shorten lead time.

Customer requirements for delivery lead time are an important factor in determining the nature of a product delivery service system. For example, one large division in Motorola consistently sees large yet unpredictable product demands from its customers. As the industry is extremely competitive, delivery lead times are typically fairly short. Thus, the division in question chooses to keep a large store of finished goods inventory on hand to help it meet customer lead time requirements.

As a product delivery service provider, a company must understand what the lead time requirements are from the end user. If the industry in question is one in which customers are accustomed to receiving same day deliveries, then the lead time requirements from distributors will also be fairly short. Another factor for the service designer to consider is the use of just-in-time (JIT) in the industry in which the product is used. If JIT is used, the product delivery service will have to accommodate this with short and dependable lead times. Requirements for information systems will reflect the nature of lead time. The shortest lead times may require real-time, first-in-first-out (FIFO) based systems while longer lead times may allow the company to implement information systems which transfer information in batches.

6) Is the product delivery service capacity constrained at any point?

The capacity of a service is often constrained at the initial design level. Lovelock and Young (1979) remind us of the fact the capacity of many services are determined at the contact point - where the service meets the customer. Instead of building new information systems or redesigning the warehouse, they ask the service designer to let the marketing department tackle the task. Using standard marketing tools, service managers can change the way customers interact with the service so that the service system can operate in a more productive and economical manner. Thus, being able to identify potential bottlenecks in the service is key for the designer. Knowing the customers he is designing for, the service designer can identify potential capacity problems and determine whether to attack them with higher service capacity or whether to use the marketing department to change the way customers interact with the system.

7) What is the customer re-order frequency?

This factor is closely related to lead time. Based on the product's useful shelf life, its cost, and its lead time, the customer will develop a re-ordering strategy. Thus in planning for the customer's re-order frequency, the product delivery service designer must first understand what response his product will produce. Having determined this, the service designer can then start to plan the service. The information systems and production systems required to support the service will depend mostly on the first five factors.

8) How much customization is required to deliver the product??

The complexity of the product delivery service provided to the customer will have a great influence on its capacity. Thus, the designer of the system must be aware of the customer base he is designing for and its unique requirements. The effect of each of these requirements on system complexity should be considered in the design stage of the service. For example, in the case of Motorola's cable modem, requests from customers for custom labeled units forced the system designers to look at new manufacturing, packaging and shipping techniques. The problem was addressed by developing a new shipping procedure which allowed packaged modems to be labeled and shipped with minimal effort.

Other customers for ISG's traditional products, however, require highly customized items which are built to order from the board level upwards. Although it is fairly straightforward to ship these products, the level of customization required has forced ISG to develop a sophisticated product tracking system for the manufacturing area. Still other customers order standardized products but insist on using their own purchasing codes and formats. This forces the order entry department to treat these orders differently, sometimes requiring an order checking specialist. Clearly, the nature of the customer's specific requirements will determine where the product delivery system becomes complex.

Another contributor to service system uncertainty (and thus complexity) is customer interaction. For example, some companies offer their customers the right to call in and check the progress of their individual orders as they are processed, manufactured, packaged and shipped. While the nature of the service provider's market may require such a service, it undeniably adds a bit of complexity to the design of the service. The customer contact model developed by Chase and Tansik (1990) suggests that the company designate which portions of the service are high-contact (incumbents interact directly with the customer such as order entry) and which are low-contact (such as baggage handlers or workers in the shipping warehouse). In the low-contact areas, Tansik(1990) suggests that organizations should de-couple and remove the customer from the back-office portion of the service where possible, *and where this does not result in undesired changes in customer's perceptions of the service product.* Thus in designing the service system, the company must specifically plan which of the portions of the service will interact with the customer (and how).

9) What are the consequences for customers if the product delivery service fails?

This is perhaps the most critical factor in segmenting customers for a service. By understanding what the consequences of service failure are for the customer, the service designer will be able to determine the level of security and redundancy that must be built into the system. In thinking about this, the designer must consider whether: substitutes for the product are readily available, failure to deliver will result in loss of life, or simply whether the customer will miss a business opportunity. It is rather difficult to provide guidelines for the extremes in this scenario. For example, how much extra stock should a supplier of key components for liver dialysis machines keep on hand? Clearly, simple inventory management techniques such as the EOQ or even the "newsboy model" will

not suffice here. Yet by thinking through the possible sources of the failure of individual components of the system and by determining the potential consequences to customers, the system designer will be better equipped to evaluate system design tradeoffs.

3.4 - Implications of customer segmentation for product delivery service design

Once an initial choice of product and manufacturing strategy has been made, it becomes increasingly difficult for companies to chose their customers. For the manager of the product delivery service system, the greatest leverage point available at this time is to develop a close understanding of the customers he serves. This chapter provides a framework with which to do this. By considering each factor listed above, the service designer can first determine which customer segments the service currently serves, which segments it would like to serve, and finally what the service needs to do. As the old adage goes, "Divide and conquer."

Chapter 4 - Internal Benchmarking Study

4.1 - Overview

This chapter will discuss a benchmarking study conducted by the author and a cross-functional team from ISG to look for corporate best-practices in high-volume product distribution. In the following sections, we will discuss the reasons for undertaking the study, describe the process that was used, and present the results. We will then examine where the process was successful, where it failed and explore some of the factors for success in benchmarking. Finally, we will discuss the relevance of benchmarking in the design of a service.

As indicated in Chapter 1, market uncertainty and new challenges from a new group of customers caused some concern that Motorola ISG's current product delivery service system (and in particular the order management system) would be a handicap. In addition, ISG's limited experience in high volume manufacturing and distribution indicated a need to develop high volume expertise.

Due to the level of uncertainty concerning their new customers (the cable service providers) and to a lack of expertise in high volume product distribution, ISG management felt that a benchmarking study might be worthwhile. It was hoped that such a study would be a good way to bring some new skills in-house. Moreover, it was hoped that the results of the study might help ISG clarify their strategy for distribution of the cable modem.

We decided to do an internal benchmarking study for three reasons. First, the high-volume manufacturing and distribution skills of both the Motorola cellular and paging groups were widely recognized. Second, the author's previously established contacts within these organizations promised to make access easier. Third, by doing an internal benchmarking study, we were able to allay fears about misuse of proprietary data by outsiders.

The following two sections will first discuss the challenges in both market and customer perceived by ISG, and then discuss why it was felt that ISG's current system was not suited for these challenges.

4.1.1 - Perceived challenges

As was stated in Chapter 2, the cable service providers were surprisingly unsophisticated compared to ISG's other customers. Moreover, their inventory and procurement practices were

such that ISG's current order management and distribution system could easily handle their initial orders for cable modems. As was stated previously, the cable operators surveyed:

- carried high inventory levels
- ordered on a yearly basis in huge lot sizes via express mail
- had only rudimentary information systems
- did very little competitive purchasing (and tried to limit the number of models and vendors with which they did business)
- expected long lead times from suppliers

However, there were several factors which led us to believe that we could not expect the customers to remain this way for long. The first was the explosive growth of the Internet/on-line market. As growth in Internet related services such as America-On-Line, Netscape and others had indicated a huge potential market, most of the popular literature discussing cable modems predicted a huge and competitive industry. This view was fanned by speculation that the Congress would pass a telecommunications bill deregulating the cable industry. If this came to pass (as seemed likely), we speculated that the cable service providers would have to compete toe-to-toe with AT&T and the Regional Bell Operating Companies (RBOCs). Still another indication that the industry would change was a demand by the cable industry that cable modem vendors develop a standard architecture. Within ISG, this was viewed as an indication that, should standard products develop, the cable companies' purchasing practices would become much more competitive and price driven. Nahmias (1993) provides support for this with his discussion of the Product-Life Cycle Curve (see Fig. 3 below).

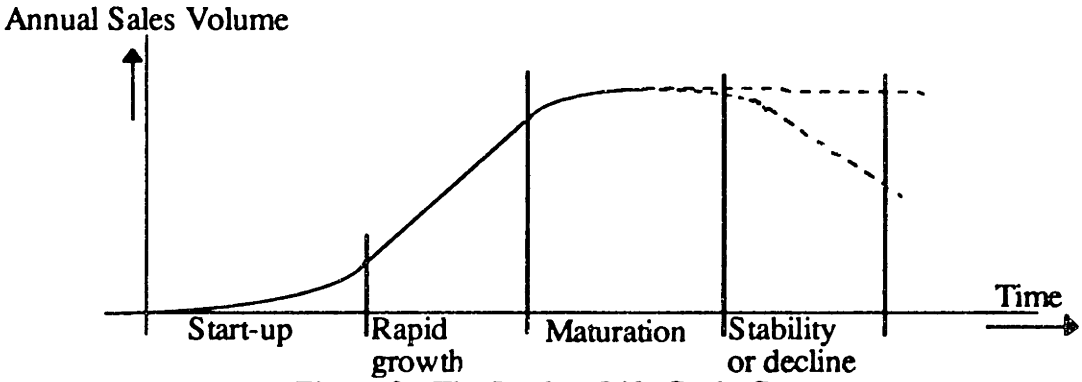

Figure 3 - The Product Life Cycle Curve

As the cable modem was a new product for a new market, there was little doubt that we were still in the "Start-up" phase of the Life-Cycle curve. However, for the reasons listed above, we believed that we would progress quickly into the "Rapid growth" phase. In this phase,

Nahmias warns of the beginning of competition. We also believed that the customers would progress with this curve - rapidly making their facilities and practices more competitive. Support for this idea is provided by the concept of technological discontinuities (Anderson and Tushman, 1990). In describing technological discontinuities, they describe a cycle which springs from the discontinuity, and then goes through an era of rapid ferment until a dominant design emerges. After a dominant design appears, the industry then goes through a period of incremental change until the next technological discontinuity. There are many reasons to believe that the cable modem represents a technological discontinuity. It harnesses new technologies (RF), uses a new medium (the cable plant) to present the home user with an order of magnitude faster connection to the Internet. Thus, we felt justified in anticipating a period of rapid growth and uncertainty in the cable data market as well as radical changes in customer business practices.

Based on the theory that the market for cable modems (and the customers) would quickly mature (this has already begun to happen as we write this section), it seemed appropriate to plan for the customers of the near future. In developing a vision of what these customers would evolve into, we tried to learn from the Motorola Cellular Subscriber Group (CSG). Specifically, one group of CSG's customers - the cellular telephone distributors - had originally resembled what we saw in the cable service providers. However, as competition in the cellular industry increased, the distributors evolved into a group of customers who were characterized as demanding: rapid lead times, customer specific logo labels, and short notice order changes.

- *Rapid order delivery lead times*: The team felt that the ability to do same-day order turn-around for the modems was critical for two reasons. First, during the ramp up stage of production, it was clear that customers would demand additional units if field trials were successful. We believed that system's ability to quickly meet these demands could influence the success of the field trials. Second, it was increasingly clear that the customers would be pushing for standardization among equipment vendors. This meant that orders for equipment could easily be placed with more than one vendor, with the contract going to the vendor which could fill the order first. Other units of Motorola had reported similar customer demands and ISG management felt that it should be prepared for the same sort of behavior.

- *Customer specific logo labels on each unit*: ISG had received inquiries from customers about the possibility of labeling the cable modems with customer logos. We believed that we could handle this in one of three ways. The first method would be to build units entirely to order, with labels affixed to units on the line during the manufacturing process. The second method would be to forecast consumption for all major customers, keeping labeled, packaged units in finished goods inventory (to allow them to be shipped quickly). The third and most desirable method was to build generic units to an aggregate forecast and to label them as part of the shipping

(packing) process. It was believed that this method (similar to Hewlett-Packard's Design-for-Postponement) would allow the fastest delivery lead times for unforecasted orders while minimizing finished goods inventory.

- *Size of order changes on extremely short notice:* During our interviews with the cable service providers, we were told that they would occasionally call up their vendors and change standing order quantities. In addition, our KJ analysis (see Fig. 2) suggested that the customers would not be able to forecast demand for the modems accurately. Thus, we believed that we could expect frequent order changes in both size and due date.

There was no guarantee that ISG's new customers would evolve in the same fashion as CSG's had. However, we believed that looking at their customers as a possible "worst case scenario" would allow us to develop a robust and competitive service. Thus preparing for the "cellular customer" would require ISG to develop capabilities for: rapid order turn-around times (on the order of 24 hours), the ability to build in high volume while adding customer-specific logo labels to the product (for which some cable companies had already asked), and the ability to build and ship in high-volume based on a forecast. In terms of the Product Life-Cycle Curve, we were trying to plan ahead for the mature market we believed would emerge. Each of these capabilities presented specific challenges to ISG's current system which will be discussed in the following section.

4.1.2 - Barriers to a high-volume product delivery service

In preparation for the study discussed in this thesis, the author spent two months becoming familiar with ISG's current order management system, production system and distribution capabilities. Using the "Staple yourself to an order" methodology (Shapiro, Rangan, Sviokla, 1992) we systematically followed standard orders through the Product Delivery Service cycle (see Fig. 1). Focusing on issues which might make high-volume manufacturing and distribution difficult, we uncovered several causes for concern:

- Batch processes slowing transactions in the order management system
- Manufacturing delay of 30 second per unit due to interface with the order management system
- Excess order tracking numbers (control numbers) slowing system performance
- Shortage of MIS resources for reprogramming the system.
- Barriers to efficient high-volume manufacturing and shipping

Each of these areas is discussed in detail below.

- *Batch processes slowing transactions (order entry, manufacturing, shipping):* Due to its basic system design, almost all transactions within ISG's order management system are batched. Thus, whenever system slowdowns occur, batched data becomes delayed. For example, in the shipping area, it is not uncommon for normal shipping transactions to take several hours to complete.

- *Estimated 30 second manufacturing delay per unit:* Due to an extensive manual bar-code reading sequence on each unit being manufactured, it was estimated that using order management system would cause manufacturing time to increase by approximately 30 seconds per unit. For each unit, the factory control system (FCS) required inputs of the bar-coded serial numbers of the motherboard, housing, and various components. In addition, the order management system would not allow a unit to be processed unless it was passed through the "Start of Manufacturing" (SOM) and "End of Manufacturing" (EOM) transactions - basically a redundant check of the unit serial number which then assigned the serial number to a specific customer order. Due to system performance and data batch issues, it was expected that this delay would take up to 30 seconds per unit. Finally, even though the company proposed building the modems to a forecast, this still would have required an order to be created which required the SOM and EOM transactions.

- *Excess control numbers slowing system performance:* ISG's order management system generates three numbers per unit for internal tracking purposes. The first number, the GEM (see glossary at the end of text) order number is assigned to each customer order to differentiate it from other orders. The second is the bar-coded serial number generated by the factory control system (FCS) for manufacturing statistical process control (SPC) purposes and for after-sale warrantee tracking. The third is a control number which was originally designed into the system to allow the company to track highly-customized units destined for specific customer locations. This required that the system generate a unique control number to identify every unit of every order before manufacturing could begin. During the control number generation process, the system would lock all other users out of the relevant order and data files. Thus for large orders (with many control numbers), the system slows down for significant periods of time (sometimes on the order of hours).

- *Shortage of MIS support for reprogramming:* In evaluating the GEM system, we often asked why the system could not simply be reprogrammed or modified. There are three reasons for this. The first was that the MIS staff already had too many other "critical" projects going to devote resources to a reprogramming effort for a new and untested product. The second was that, because of it's highly custom nature, the company could not reasonably expect to bring in outside consultants to do the job. The MIS manager stated that he would not do this because he would have to wait six months for outsiders to familiarize themselves with the system before beginning productive programming. The third reason was the feeling that the system was already a "sunk cost". There was a general reluctance to devote resources to a major redesign of the system.

- *Barriers to efficient high-volume manufacturing and shipping:* Although the company already built several products based on a forecast, this process was found to be impractical for high-volume manufacturing due to characteristics of ISG's GEM order management system. As stated previously, the GEM system assigned a "control number" to each unit in addition to the order number, and the bar-coded serial number assigned to the unit. This presented two problems. The first was that the process of generating and tracking large quantities of control numbers was known to degrade system performance considerably. Indeed, it was the opinion of the MIS manager that the system had already reached its limits. Second, assigning a control number to each box made the shipping process inflexible. When a shipping worker was filling a customer order for a unit that was already packaged and ready to ship, he would have to go and search the warehouse shelves for the specific control number (printed on a large label on the shipping box) assigned to that customer by the system. This rendered quick shipping from stock virtually impossible for high-volume or surprise orders.

It should be stressed here that ISG's order management system is a sophisticated system which is extremely well suited to their current product line. The previous sections attempt to show however, that this system was not quite as well suited to ISG's next product - the cable modem.

4.2 - Discussion of internal benchmarking study

As stated previously, there were significant reasons for ISG's management to begin to investigate new options for a product delivery service (specifically the order management system) for the cable modem. Since several organizations within the company were well known for their expertise in high-volume distribution of consumer/retail oriented products, it was felt that an internal benchmarking study might be an effective method for gaining knowledge in this area. Specifically, the management was very eager to learn more about the manufacturing and distribution practices of other consumer-oriented, high-volume groups within the corporation. As was stated earlier, we hypothesized that the cable companies might evolve into something very similar to the customers with which these groups were used to dealing.

4.2.1 - Benchmarking methodology

Following a process or methodology is one way of assuring the quality of the resulting product (Ulrich & Eppinger, 1995). With this in mind, it was obvious to the team that a process or plan would help to focus the study. Before deciding on a process, several prominent methodologies were considered. Table 2 on the following page shows a comparison of several benchmarking methodologies from Bogan & English (1994), Camp (1989), Chang (1994), and Spendolini (1992). As many of the steps in each method are similar, the table attempts to distill out the

common areas of each methodology into a simple, generic process. This process is shown in the left-most column, "Generic benchmarking methodology."

Generic benchmarking methodology	Bogan&English (Motorola) (5 steps)	Camp (Xerox) (12 steps)	Chang (7 steps)	Spendolini (5 steps)
Plan the benchmark study	1) Decide what to benchmark 2) Find organizations to benchmark	PLANNING 1) Identify what is to be benchmarked 2) Identify comparative organizations	1) Identify what is to be benchmarked 2) Determine what to measure 3) Identify who to benchmark	1) Determine what to benchmark 2) Form a benchmarking team 3) Identify benchmarking partners
Collect data	3) Gather data	3) Determine data collection method and collect data	4) Collect the data	4) Collect...
Analyze study data	4) Analyze data...	ANALYSIS 4) Determine current performance "gap" 5) Project future performance levels	5) Analyze data and determine "gap"	Step 4 cont: .....and analyze data
Make conclusions and implement changes	Step 4 cont: ...and integrate results into action plans	INTEGRATION 6) Communicate benchmark findings and gain acceptance 7) Establish functional goals ACTION 8) Develop action plans 9) Implement specific actions and monitor progress	6) Set goals and develop action plan	5) Take action
Reflect on process	5) Recalibrate and recycle the process	10) Recalibrate benchmarks MATURITY 11) Attain leadership position 12) Fully integrate practices into processes	7) Monitor process	

Table 2 - Examination of benchmarking methodologies

The actual process used for this study closely resembles Motorola's 5 step process although it has been modified slightly to incorporate the strengths of some of the other methodologies. It should also be noted that rather than simply seeking to identify the company's position relative to competitors (the gap), this study was actively seeking new ideas and systems to improve

ISG's product delivery service. For each stage of the process, a detailed list of actions is laid out as follows:

Stage 1 - Plan the benchmark study

- Define the company's strategy
- Identify target areas for improvement
- Identify customer needs
- Define the scope of the study
- Define metrics to be used
- Identify organizations to study

Stage 2 - Collect data

- Visit target sites
- Interview knowledgeable people
- Evaluate metrics at each site

Stage 3 - Analyze study data

- Compile and evaluate visit notes
- Compare metrics for each visit
- Discuss aspects of visits not covered by pre-defined metrics

Stage 4 - Make conclusions and implement changes

- Translate benchmark data and customer requirements into system design concepts and specifications for new system
- Develop implementation plan
- Implement

Stage 5 - Reflection on process

- Identify areas of process which can be improved
- Document learning for future reference

Bogan and English (1994) stress the importance of having companies develop their own benchmarking methodology. They state that the benefits of a benchmarking process design that suits one's individual culture are far greater than the benefits of establishing a national process standard. McNair and Leibfried (1992) believe that a logical sequence to the learning process is embedded in the benchmarking process. Thus, having a process tailored to the organization seems to facilitate the organization's learning. Indeed, the benchmarking process above was developed because we felt it most closely fitted our needs.

4.2.2 - Results of internal benchmarking study

Before discussing the information revealed in this study, it is first necessary to understand how ISG fits into its sector, the Messaging, Information & Media Sector (MIMS) and how it fits into Motorola. Fig. 4 illustrates ISG's relation to some of the other sectors in Motorola.

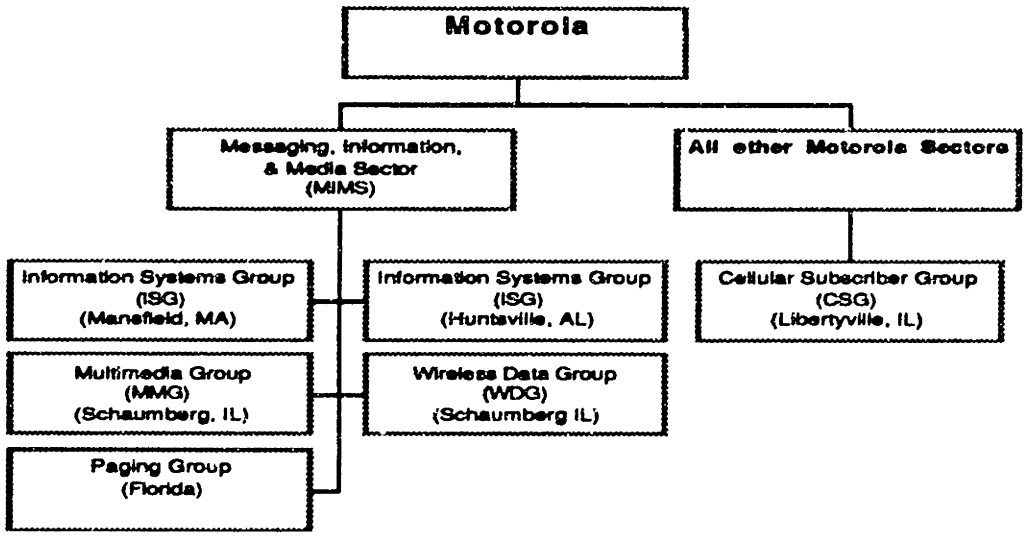

Figure 4 - ISG in relation to Motorola corporate structure

Moreover, another group within Motorola - the Multimedia Group (MMG) also played a significant role in the study described here. As described in Chapter 1, MMG was also introducing a cable product which allowed cable subscribers to get telephone service via their cable television cable. Thus Motorola wanted to ensure that each cable customer only had to interact with the company one time per order. However, due to geographic distance and organizational issues, it was unclear how this might be accomplished.

Planning the benchmark study

Having settled on a benchmarking methodology, the team began to implement the process. The benchmarking team's results for each of the process stages is described below:

Plan step one - Define the company's strategy

Although much had already been done in early work by the author, the benchmarking team began by discussing and defining ISG's strategy for the cable modem.

First, it was agreed that because the cable router (the infrastructure component) would be sold in relatively low volume (and therefore was no different from the rest of ISG's

products), the study would concentrate on the modem itself. This was followed by making a list of primary assumptions about how the product would be ordered by customers, manufactured, and shipped. These are:

Order Entry

- Orders will come both from salesmen and directly from customers
- Some orders will be changed and/or canceled
- Orders will only have to be checked for Due Date, Quantity and Destination
- There will be both forecasted and unanticipated demand from customers

Manufacturing

- The line will build to an aggregated forecast
- It is most efficient to customize as late in the process as possible
- Units are generic up to application of the customer's label

Shipping

- ISG will ship to multiple locations for each customer (local warehouses)
- There will be a minimum order quantity (>1) for standard orders
- The unit serial number will be tied to the sales order is it is packaged for shipping

Based on these assumptions, the team defined ISG's strategy for the cable modem product delivery service. The market and operational strategies were determined through a process of interviewing upper management and analyzing customer requirements. These strategies are as follows:

Market Strategy:

- To be first to market
- To gain a dominant market share (and thus influence the standards process)
- To re-use proven technology and processes where practical
- To present one face to the customer for all Cablecomm products:
    - with one salesman per customer
    - one billing process

Operational strategy:

- To develop high-volume distribution center capability
- To develop pulse-regulated manufacturing capability
- To manufacture to a forecast
- To build generic units and customize as late in the cycle as possible
- To develop a flexible product delivery service which may be expanded as demand growth requires new levels of service system performance

Plan step two - Identify target areas for improvement

Based on previous experience, customer feedback, and the KJ analysis of customer interviews, the team was able to identify the following areas for improvement in the benchmarking study. The following list presents the major questions from a trip questionnaire developed for the benchmark study.

Order Management System

The characteristics of incoming orders:

- Type of order management system used?
- How are orders entered into the system (Manual vs. EDI)
- Do all incoming orders go through the same system?
- How long does it take an order to travel to the various stages of the order fulfillment process?
- What are your typical order sizes and frequencies?

Order processing practices:

- What is the process followed for incoming orders?
- What are the manual interfaces or potential "hang-up points?"
- How is demand communicated to the factory?
- How many people are required to process a typical order?

Distribution and shipping:

Build-to-Forecast vs. Build-to-Order:

- What percentage of your products are built-to-order?
- Do you stock finished goods inventory?
- How many units do you process per day? (Range?)
- How does the shipping area get the product from the factory?

Customer Requirements:

- Do you use the First-In-First-Out (FIFO) rule for orders?
- What are your customer requirements for customization?
- What are typical customer requirements for delivery lead times?

Storage of Finished Goods Inventory:

- Quantity of inventory in the factory? In the distribution center?
- Where is this inventory held?

General:

- What are your typical delivery lead times?
- What are your head counts for the product delivery service?
- How many product codes do you have?
- What are your "worst case scenarios?"

Plan step three - Identify customer needs

Due to ISG's experience in shipping customized products, the team felt that the organization had a good grasp on fundamental customer shipping requirements. We chose instead to focus on some of the unique requirements we had uncovered through the course of our interviews. Based on the KJ analysis (see Fig. 2 and Appendix A) we believed that, from a product delivery service point of view, the three most important requirements were:

1. To ensure that shipping methods are consistent with customer purchasing, receiving and installation practices:

    - Ability to fill 24 hour delivery requirements
    - Consistent due-date delivery performance
    - Ship the modems as self-contained kits (where all necessary cables, manuals and accessories are included in the same package)
    - Minimize packaging waste

2. To provide, and maintain a bar-code/serial numbering scheme consistent with the business information systems used by the cable companies. This included:

    - Standard bar code label size and type
    - Serial numbers on the back of the unit (or accessible location)
    - Serial numbers on the outside of the shipping carton
    - Ability to scan serial numbers while still packaged in shipping carton
    - A tape or diskette with serial numbers of each shipment

3. To provide training and anticipate problems cable companies may have in forecasting, ordering and repairing modems.

    - Provide training in demand forecasting for dynamics of new market
    - Provide training and possible assistance with implementation of EDI at customer sites
    - Move towards development of Vendor-Managed-Inventory relationship with customers

Although clearly we would not find the solutions to all of these requirements through a benchmarking study, we believed that it was very important to bring back as much information as possible on how other divisions met delivery requirements and provided a shipping service which met their customers' needs.

Plan step four - Define scope of the study

Setting the scope of the study was arguably the most critical part of the planning phase. Although we were interested in reviewing and improving the entire product delivery service (from sales through to shipping), we knew that this would be too large a goal with which to start. Thus, we decided to concentrate on our most pressing need - the distribution function. It was agreed that the team would tour the order entry and manufacturing sites of the other divisions, but that we would concentrate on each division's distribution center.

Plan step 5 - Define metrics to be used

A good portion of the study was intended to be spent looking for "a better way." As such, it was apparent that relying exclusively on pre-defined metrics might blind the team to some unforeseen innovation. Many of the metrics used in the study were defined above in step two. However, there were several "fuzzy" things we were looking for that were difficult to measure and depended more on our impression:

- Overall philosophy of the system? (With respect to the customers? With respect to manufacturing?)
- Are there custom interfaces to the system? (How many?)
- How easily can the system be modified? (Flexibility? Resources required? Scaled for better performance?)
- How easy/intuitive is the system to use? (How long does it take to learn?)
- Ability of manufacturing to build to a forecast / level-load the factory.
- Typical customer (both internal and external) complaints about the system?

Obviously, these are closer to guidelines than to measurable metrics. This is due to a conscious decision by the team to explore the "character" of the product delivery services of the other organizations. Although this made it more difficult to do comparisons of systems, we believed that this would give us a better overall feel for the potential strengths and weaknesses of each system.

Plan step 6 - Identify organizations to study

Finally, the benchmarking team decided to visit and/or talk to three organizations within the corporation. The first, the Cellular Subscriber Group was a fairly obvious choice. With extremely large volumes being shipped monthly from their distribution center, we believed that we would learn a lot about the future problems and challenges our product

would face. Second, the Paging group was chosen for phone interviews (due to geographic constraints), because of its reputation within the company for high-volume (semi-custom) manufacturing expertise. Finally, the Wireless Data Group was chosen for its focus on shipping standard, and prepackaged products (albeit in lower volume).

Collecting data

In the following section, the actual benchmarking trips will be discussed, focusing on the key insights and lessons learned from each organization.

Cellular Subscriber Group (CSG): The team met with the director of world-wide distribution who walked us through the manufacturing, order administration, credit, scheduling, distribution, and shipping areas. In each area, the team received an explanation of the type of equipment in use, the number of people required, and problem areas. Our trip to CSG taught us an important lesson; it is critical for a high-volume distribution operation to treat the factory just as they would treat any of their other suppliers. This meant placing forecasted orders on the factory, getting regular deliveries from the factory, and having completely separate information systems. He shared with us that early attempts to have the factory build direct customer orders by sharing an order management system had failed because the factory's incentives were to level load production rather than to build individual orders to meet delivery deadlines.

Wireless Data Group (WDG): Over two visits to this site, the team was able to tour both the order administration area and the distribution area. The first visit focused on the order management system. We spoke with system operators and watched a demonstration of the system. The second visit focused on the distribution system; the team watched as orders were released to the distribution center, and as they were picked from stock, processed and shipped. These visits produced several conclusions. The first was that by using a commercially available, industry standard information system, this group was able to minimize their IS resources. Rather than trying to customize the third party system, this group chose to use an "off the shelf" approach, avoiding custom interfaces and work-arounds. By doing this, they were able to:

- have a very small support staff
- easily bring in outside consultants
- easily upgrade to newer versions of the software
- easily scale to higher performance hardware

However, they also stressed that this sometimes forced them to use less-than-optimal business practices because of limitations in their system. The second lesson from this visit was that by building purely generic products to stock, information tracking and storage requirements were significantly reduced. For example, in this group, unit serial numbers were not even entered into the order management system until they were pulled from stock for a customer order. Because of this, the shipping staff was able to operate on a physical FIFO basis - shipping whichever boxes were closest to the front of the gravity-feeder shelves used in the warehouse. This allowed them to maintain a fairly simple, fast shipping system.

The Paging Group: Although this portion of the study was done exclusively through phone conversations and email, the team was able to develop a fairly good understanding of their system. Paging was very different from the other two groups studied in that all of their products were built to customer order. Due the variety of options and frequencies available, their order management, manufacturing and shipping systems were designed to check orders and handle a high mix of products (very similar to ISG's system yet with much higher volume). The major lesson learned was that Paging was also trying to set up a distribution center focused on customer orders to improve order delivery lead times. Although their lines had been designed to build lot sizes of one for quick customer orders (similar to the Bandit line[1]), order backlogs had caused order delivery lead times to lengthen.

A more detailed look at the lessons learned from each organization is provided below:

System philosophy with respect to the customer:

CSG:	Focus on meeting quantity and delivery lead time requirements for key customers.
WDG:	Ship standard products from stock with quick turn around and minimal overhead.
Paging:	Build at capacity and try to divide output among key customers.

System philosophy with respect to manufacturing:

CSG:	Treat manufacturing the same as any other supplier (supply forecasts).
WDG:	Provide manufacturing with an aggregate forecast and ship whatever is available.
Paging:	Closely tied: all orders are passed to manufacturing to be assembled and shipped.

[1] For more information, please refer to Harvard Business School case study 9-960-043: Motorola, Inc.: Bandit Pager Project

How flexible is the system?:

CSG:	Fairly flexible (in terms of meeting diverse customer requirements)
WDG:	Slightly less flexible than CSG, but scaleable for performance improvement.
Paging:	No information

Resources required to maintain the system (compared to ISG):

CSG:	Large IS group
WDG:	Minimal (less than 10 people)
Paging:	Large IS group

Ease of use/easy to learn? (compared to ISG):

CSG:	Easy to use (minimal training to learn)
WDG:	A bit tedious to use, easy to learn
Paging:	No information

Head count required (compared to ISG):

CSG:	High (much variation over a period of a month)
WDG:	Low
Paging:	High (but fairly stable)

Delivery lead time:

CSG:	Medium
WDG:	Fast
Paging:	Longer

How does manufacturing build?

CSG:	To an aggregate forecast.
WDG:	To an aggregate forecast.
Paging:	To order.

Typical complaints about the system:

CSG:	Monthly demand swings require huge inventory buffer.
WDG:	Not optimized for this application.
Paging:	Slow, many manual processes.

Analyze study data

Following each visit or interview, the team's trip notes were typed into a transcript of the session. These transcripts were then used to educate team members who had not been on the trip, to maintain a common data base, and for use as a reference during the actual system redesign and implementation at ISG. Finally, the transcripts enabled the team to discuss the visit with team members who had not been present which several times led to new ideas, conclusions or further questions.

Make conclusions and implement changes

Following the process developed for the benchmarking study, we arrived at the concept development stage in which we had planned to use Concept Engineering (Shiba, 1993) to work towards a final design model. However, we were forced to deviate from the planned process due to certain Motorola corporate decisions beyond our control. Specifically, ISG was required to share sales and order entry resources with the Multimedia Group (MMG) and Wireless Data Group (WDG) in Schaumberg, IL. By requiring both of the product groups focused on cable products to use the same order entry resources, Motorola management hoped to develop "one face to the customer" for all of the cable industry customers. Because we would be using WDG's order administration and order entry resources, we were now obliged to at least pass all cable modem orders through WDG's system into ISG's.

Although we found it necessary to modify our service development process, the background work done in preparation for concept development was still useful. By documenting specific customer requirements as well as other product delivery services, the team was able to develop a design for a new product delivery service using WDG's system. In several areas, the team used ideas gleaned from the benchmarking study to identify areas in the system that could be enhanced to provide a nearly optimal solution for our requirements. For example, the system that WDG had been using for bar-code readers in shipping was rather slow and required several operator key strokes per unit, yet the functional shipping process fit our needs for speedy picking and shipping. Because fast delivery lead time had been identified as a customer requirement, the team was able to identify and fix this system weakness.

Reflect on process

By many measures, this project was a failure. The design team was not given the opportunity to complete the benchmarking and design process. Instead, we were obliged to use an information system from another group. However, at the end of the project, ISG had plans in place for implementation of a new order management process and product delivery system that was much closer to meeting customer requirements than their old system. This system met most of the goals outlined in ISG's market and operations strategies (section 4.2.2). In addition, it silenced most of the concerns laid out in section 4.1.2. We believe that there are three reasons for the limited success of this project:

1) By speaking to the customers early on, the team was able to identify critical issues which were addressed during implementation.

2) By following a methodology (even if only to the half-way point), the team was able to gain a better understanding of the key issues, as well as to generate a trove of data which was used to define the system requirements.
3) By benchmarking other divisions in Motorola, we were exposed to new ideas we might not have seen. Specifically, we were able to implement WDG's system in a way which enabled us to operate like CSG's system.
4) Because we had customer data and benchmarks from other divisions, it was easier to sell ideas for changes to the new WDG system to management.

On a more general note, Camp (1989) lists several factors for success in benchmarking:

- Management provides supportive leadership in planning and organizing the benchmarking effort.
- Management and the benchmarking team agree early on the benefits to be achieved, the partnership companies, the approach to be used, the roles of each member of the benchmarking team, and determining the barriers to benchmarking.
- The company integrates benchmark findings with the organization's objective setting, performance appraisals, and operating plan processes.

Although following a process for the benchmarking study allowed us to achieve limited success, there were two shortcomings in the process which must be addressed. They were our failure to:

1) Put the entire team in place before starting the project: This was one of the most problematic areas in this project. Because most of the team was assembled after much of the initial customer studies and benchmark planning had been done, they were unable to contribute to developing the process. They were able to participate in the final decisions on implementation, but probably would have contributed more had they been present from the beginning. It should be noted that setting up the team before the project starts has long been a staple of the product design and organizational behavior literature. This shortcoming is entirely due to the inexperience of the author.

2) Narrow the scope of the study: Although apparent to the team that we needed to be open-minded and look for new ideas, it was also clear that the scope of our benchmarking exercise was too broad. This was partly due to an initial lack of resources - we felt that if we would only have time and money for one visit each, that it would be important to see as much as possible. It was also due to inexperience. As no one on the team had ever conducted an in-depth benchmark study before, we overestimated what we thought we could achieve. In hindsight, several trips to each site

with a more focused agenda would have helped us to gain a clearer view of the processes and metrics we were trying to observe.

Bogan and English (1994) provide an example of achieving service excellence through benchmarking; they describe Federal Express' Service Quality Indicator (SQI) which allows them to measure themselves against their competitors. By moving beyond purely financial measurements to such metrics as lost packages, aircraft delays, wrong day late deliveries, and missing proofs of delivery, they are able to use benchmarking to improve their service in the eyes of their customers.

Lastly, McNair and Leibfried(1992) remind us that, by doing benchmarking, the company is looking outward for clues on how to improve its performance. Benchmarking forces the company to go out and talk with the customer (and other organizations) with a clear goal: to increase the level of value-added service to the customer. This is done by identifying the primary disconnects between what the customer values, and what services are actually being provided. Just as critically, looking outside the organization will help the company spotlight waste - activities which add little or no value to the customer. The following quotation makes this ever so clear:

> *Inevitably, the culture within which we live shapes and limits our imaginations and, by permitting us to do and think and feel in certain ways, makes it increasingly unlikely or impossible that we should do or think or feel in ways that are contradictory or tangential to it.* -Margaret Mead (*Male and Female*)

Chapter 5 - Methodology for Design of a Customer Service System

5.1 - Overview

Complex services such as the product delivery service discussed in this thesis are intricate processes possessing difficult and fascinating design characteristics. Yet all to often, service design is "largely an ad hoc, uncontrolled process" (Shostack, 1981). Although services are often marketed as products, the literature makes it clear that the rigorous, rational design methodologies that are used to design products do not yet exist for services. One step towards developing such a methodology is to understand the differences between physical products (goods) and services. This chapter will first outline and discuss the differences between goods and services. It will then consider the implications of each of these differences for service design.

Finally, this chapter will present a methodology for the design of a customer service. The methodology will focus on the example of designing a product delivery service. Drawing on the previous chapters, this section will examine the lessons learned over the course of the LFM internship project discussed in this paper, and attempt to provide a methodology which avoids the pitfalls while capitalizing on the stronger areas.

5.2 - Outline of the differences between goods and services

Lovelock (1984) and Shostack (1984) present six characteristics of services that are different from physical products: services are intangible, the customer participates in the creation of the service, quality and uniformity are harder to control, services cannot be held in inventory, electronic and other non-traditional distribution channels can be used, service completion requires that the customer be present, and finally, because it is difficult for customers to sample the service they tend to rely on "experience qualities" or word-of-mouth to choose services. These characteristics along with several contributions from the author are presented with their product counterparts on the following page in Table 3.

Characteristic	Key considerations of services	Counterparts for physical products
Nature	Predominantly intangible	Predominantly tangible
Consumption	Immediate	Delayed
Customer Role	Participative	Distant
Customer Impression	Focused on interface and "circumstantial tangible evidence"	Focused on predominantly on form and function
Architecture	Difficult to identify	Apparent to the user
Quality	Difficult to quantify and measure	Practical SPC methods exist
Distribution	Electronic, human, non-traditional	Physical
Productivity	Requires customer participation	Mostly independent of the customer
Regulation	Focused on Fairness, Social Responsibility in addition to safety and the environment.	Focused on safety and environment

Table 3 - Characteristic differences between goods and services

Obviously some of these characteristics may be grouped together. In the following section, we will discuss them and their implications for service design.

5.3 - Implications of differences for service design

In Chapter 4, we discussed several ways of segmenting customers based on their service requirements. By understanding which segments the product delivery service designer wished to serve, we argued that the task of designing was made easier and that the service became more focused on appropriate customer requirements. This argument left out a key step - a design methodology. As stated above, much has been done to develop rigorous and effective product design methodologies. We believe that the literature and experience of these methodologies have much to offer the service designer. However, understanding the key differences between product and service design will help the designer make good decisions on which techniques can and cannot be used. Each characteristic difference has specific implications for the service development process:

Nature of Services: Services are intangible. In most cases, a service does more than complete a specific task for the customer; services are usually expected to provide the customer with an emotion or sensation. For example, purchasers of life insurance almost never receive the actual payout of the policy (the beneficiaries do). Instead, they are provided with "peace of mind" - the knowledge that those they care about are protected. Airlines rarely advertise their ability to get the customer from point A to point B. Recent commercials for one airline depict a

weary business traveler being lulled to sleep in his mothers arms (their new business class reclining seats). The service is packaged and sold as a relaxing, comforting experience.

Obviously, the customer of a product delivery service gets something tangible - the product. Yet there are several important emotional aspects of this service. Again, "peace of mind" is important. By knowing that a product will appear on his warehouse shelves when and how he needs it, the customer is freed up to work on other issues. The means by which the service provides this knowledge may make all the difference in which supplier a customer chooses. For example, one supplier may see fit to send the customer a fax on the evening the product has been shipped. Another supplier may go so far as to provide an alpha-numeric pager to the customer which updates the customer on the status of his order. In an extremely high-paced market, the latter supplier may provide the customer with greater peace of mind. If the two products cost the same, the customer will chose the latter.

The challenges for the service designer are threefold. First, to identify key customer emotions and sensations associated with the service. Second, find a way to measure or gauge those emotions and sensations consistently. Third, to find a way to incorporate those emotions and sensations into the design of the service. It is doubtful that these challenges may be met through a technical, CAD-based design process. Methodologies such as Quality Function Deployment (QFD) and Concept Engineering (CE) are better suited because of their strengths in converting emotions, feelings and ambiguity into a design. In fact, CE has been used to successfully develop a product delivery service (Horton, Boger, 1994) because of its ability to focus on "fuzzy" customer needs and to produce an effective service that was capable of being implemented.

The Role of the Customer (production, consumption and distribution): Most services are produced and consumed simultaneously on a continuous basis. Because services depend on interaction with the customer, the service is actually produced and consumed when the customer enters the service system. In our example of the airline, the customer starts receiving the service from the moment he purchases the ticket (he is reserving the right to travel, and typically pays more for the knowledge that he will not have to worry about getting "bumped"). Correspondingly, the airline starts producing the service from the moment a representative picks up the phone. If either side breaks down at any stage during the process (either the steward is rude, or the passenger gets obnoxiously drunk), the service will be a failure.

In designing the service, Shostack (1984) stresses that the designer must isolate all potential fail points where the service can go awry. It is not simply enough to tell stewards not to be rude. Sir Colin Marshall, CEO of British Airways points out that to, "deliver consistent service quality, our employees must understand their role in delivering superior service and must have the power and ability to deal with customer problems" (Prokesch, 1995). Provisions for employee training (and stress relief)must be designed into the system.

There are several lessons in this for the designer of the product delivery service. The first is to determine how the service will interact (and thus determine the delivery method) with the customer (EDI, phone, email, etc.). The second is to clarify how the customer is expected to contribute to the production of the service. Will he be expected to supply inventory data, forecasts, complaints about the product, and new product ideas, or will he simply be a passive participant. The third is to chose where in the system the customer will be allowed to interact with it. The Theory-of-Constraints (Goldratt, 1984) urges us to put the system bottleneck where capacity is the most expensive. Thus, if order entry is the most expensive to maintain (on a per-customer-contact basis), then the system designer must ensure that all other portions of the system have higher capacity than the order entry area.

Quality Control in Services: As we noted above in Table 3, products are first produced and then after some delay, consumed. Thus, it becomes possible to check for conformance to quality standards. At a minimum, defective products may be sorted out and thrown away or recycled. At best, statistical process control (SPC) can be implemented to keep the manufacturing process within quality limits to ensure good results. However, quality assurance is much more difficult to implement with a service.

The first problem is in actually measuring the service consistently. As we stated earlier, most aspects of services are intangible, and thus very difficult to measure consistently. The factors that matter most to the customer may be highly subjective. Even if we could find a way to measure a few key variables, we run up against two huge sources of uncertainty: the customer and the service employee. As humans are highly unpredictable, there is no guarantee that any service interactions *not* being measured will meet quality guidelines. In fact, the problem becomes similar in nature to Hiesenburg's Uncertainty Principle. By getting close enough to actually measure a service interaction, the measuring party actually changes the dynamics of the interaction. If employees know they are being measured, their performance may improve. Yet

once the measuring device or person is taken away, there is no way of knowing that the employees are still working hard.

The second problem is that by measuring a service interaction, the service capacity will often be reduced. As subjective measures must be checked by humans, 100% measurement would require an additional person to check and record each service interaction. Obviously this possibility must be dismissed for most service providers. Deming (1986) addresses this problem with the third of his fourteen points for management. Exhorting management to cease dependence on inspection to achieve quality, he states that quality must be designed into the product. The same holds true for the service designer. Instead of taking a "Big Brother" approach and watching over each service interaction, the design of the system should encourage high quality customer interactions. An example of this is found in the order entry departments of many companies. By making their products highly complex and confusing without providing adding appropriate training for customers and the salesforce, companies can actually count on a certain level of erroneous purchase orders. Taking Deming's approach, the system designer in this situation must strive to produce an ordering format which educates the user while eliminating the possibility for order errors.

Architecture: Many product designers are familiar with the concept of product architecture as a tool which allows them to decompose their products into more manageable subsystems. Ulrich (1993) defines product architecture as "the scheme by which the function of a product is allocated to physical components." "More precisely, it is (1) the arrangement of *functional elements*; (2) the mapping from *functional elements* to *physical components*; (3) the specification of the *interfaces* among interacting *physical components*." By tracing this to the development of services, we may gain some insights into the service design process.

Clearly within service, functional elements still exist. Each service is made up of a combination of functional elements (i.e. the product delivery service consists of: identifying customer demand, allocating product for the customer, bringing the product to the customer, etc.). These functional elements are accomplished by mapping them onto *organizational components*. The customer interacts with the service at the *service interface*. *Physical components* still exist in services. Airlines still need to use machinery and airplanes to fulfill their service. The product delivery service needs to use computers, paper, packaging equipment and trucks to deliver its service.

The lesson for the service designer here is to understand how the various components within the system architecture interact. This understanding will allow the designer to create subsystems which fit together seamlessly, and to develop a system architecture which is robust. In his seminal 1964 book, Notes on the Synthesis of Form, Christopher Alexander provided guidelines for system designers. He proposes looking at the relationships between modules as either conflicts (denoted by a minus[-] sign), or as interactions (denoted by a plus[+] sign). By looking for the areas where there are the least number of interactions or conflicts, the designer can define system and subsystem boundaries which make sense. This is illustrated below in Fig. 5.

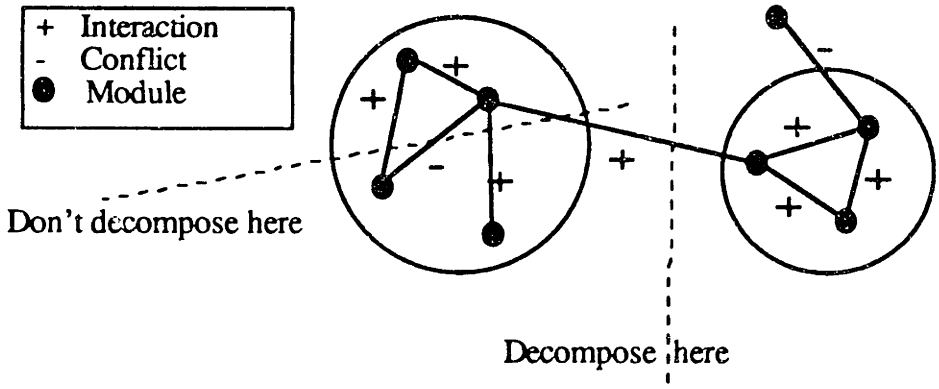

Figure 5 - Alexander's guide for decomposition of a system

Customer Satisfaction: Of all the differences discussed here between goods and services, customer satisfaction is perhaps the most nebulous. This is because, as Shostack (1984) points out, customer satisfaction in services is often based on "circumstantial tangible evidence" rather than on the effectiveness of the service itself. Often, "the extras" or "incidentals" of the service are the only things which are tangible. Consider the example we gave previously for a product delivery service choosing to use either a fax or pager to send order updates. Both the fax and pager are tangible objects which are incidental to the service. Whether or not the fax or page reach the customer, the service itself (of providing the product) can continue unhindered. Yet the customer's impressions of the system (and thus satisfaction) may be largely shaped by an unreadable fax or by an unclear printing format. Shostack urges the service system designer to "incorporate the orchestration of tangible evidence" into the design. In other words, to identify and coordinate all of the tangible incidentals which the customer uses to verify the service's effectiveness.

Another aspect of customer satisfaction is in attracting the initial customer to the service. Shostack reminds us that consumers cannot do much "searching" or shopping around before purchasing a service. "As a result, they tend to rely more on 'experience qualities' which can only be discerned after purchase or during consumption." In other words, because they cannot sample the product, they ask their friends or decide based on previous experiences. Thus influencing *word-of-mouth* becomes an important factor for the service designer to consider.

Regulation: In all of the service development literature explored by the author, the subject of regulation on the design of services was given very little attention. However, very great differences exist in the implications of regulations for the design of goods and services. Most product designers must consider federal, state and local regulations for safety and environmental impact in both the product and in the manufacturing process. The service designer must of course consider these two areas. However, the service designer must also take into account the concepts of "fairness" and "social justice." For example, financial institutions must constantly check whether their lending guidelines discriminate against certain social classes or racial groups. Failure to consider these issues in the initial design of the service may lead to an unprofitable or even illegal service.

Obviously, these issues carry less weight for a product delivery service. However, by keeping them in mind, the service designer may be able to avert disaster, or perhaps even develop a more effective service.

5.4 - Discussion of requirements for a service design team

Following a step-by-step design methodology is one way of ensuring the success of a service design effort. However, having a well-planned and led team is at least as important. It is therefore necessary to examine this issue a little more closely. Wheelwright and Clark (1992) list four types of development teams: the functional team, the lightweight team, the heavyweight team and the autonomous team. Each of these team types has associated strengths and weaknesses and are therefore suited to different types of development tasks. Thus, the organization must determine the nature of the service design project, and then decide which team structure is best suited to the project at hand.

We will not devote much space here to the characteristics of each of the team types listed above as this has already been the topic of much discussion in the literature. We will instead briefly

discuss some of the characteristics of successful development teams. Ulrich and Eppinger (1995) present some of these characteristics:

Design teams are successful when:	Design teams are unsuccessful when:
• the team is able to identify all of the stakeholders in the product (or service).	• the team does not feel or have the power to implement change.
• the team ensures that the product (or service) is robust and meets the needs of the customer.	• functional alliances transcend project goals.
• the team is able to deliver new designs at a faster rate than the market for the product (or service) changes.	• there is a lack of crossfunctional representation on the team.
• the team learns and brings in feedback from the design process.	• the entire team is not assembled at the beginning of the project.

Clearly, upper management has a responsibility here for ensuring that these factors are considered during the formation of the design team. As the last point in the above right hand column makes clear, the team should be assembled before beginning the process. When there is the need for innovative, coordinated action, teams need both the time and motivation to develop "operational trust" where each member can count on the actions of his team mates (Senge 1990). We acknowledge that it is very tempting to plan to add members to the team late in the process to save money and to free others up for different projects. Yet it has been shown (Burchill and Fine, 1995) that skipping steps or excluding team members from early stages of the process can cause the design objective of the project to lose credibility. Thus, it is important to assemble and involve the team in all stages of the design process.

5.5 - A methodology for service design

Ulrich and Eppinger (1995) state that the economic success of manufacturing firms depends on their ability to identify the needs of customers and quickly create products that meet these needs and can be manufactured at low cost. Given that most manufacturing firms must also provide a product delivery service to supply their customers, we take this statement one step further. We argue that the economic success of a manufacturing firm ultimately depends on its ability to identify the product delivery service needs of its customers and on its ability to provide such a service in a timely fashion. Ulrich and Eppinger go on to state that in product development, following a process or methodology is a way of assuring the quality of the resulting product. In other words, it ensures that critical steps are not passed over or forgotten.

The product delivery service as defined in this study encompasses quite an array of organizations and functions. To properly evaluate the entire service (much less redesign it) requires a practical, step-by-step methodology. Moreover, because the product delivery service crosses so many organizational boundaries, it may be fairly difficult for one or two people from a single department to analyze. Thus, a cross-functional team should be assembled to carry out the task of evaluating or designing the service system. Although one person from each business function should be on the team, practicality may dictate that only the most critical functions are represented.

5.5.1 - Methodology overview

Bitran and Pedrosa(1996) present a generic five-step methodology for service design. Following a sequence of steps - Strategic Assessment, Concept Development, Component Design, Implementation, and Feedback and Learning - this methodology allows an organization to design a service from scratch. In the case study discussed in this thesis however, the author realized the importance of several distinct new steps. First, the collection of the voice of the customer (VOC) is made an independent step because of its impact on the company's operational strategy. Second, benchmarking has been made an independent step for two reasons. Benchmarking will allow the firm to see how it stands in relation to its competitors (and thus how much energy it wants to put into the service design process) and it is an extremely useful tool for generating new ideas. Finally, assessment of operational strategy is given its own distinct step because it depends on the results of the VOC and benchmarking steps. In Fig. 6, we present our methodology for evaluation and design of a customer service (and in particular, a product delivery service).

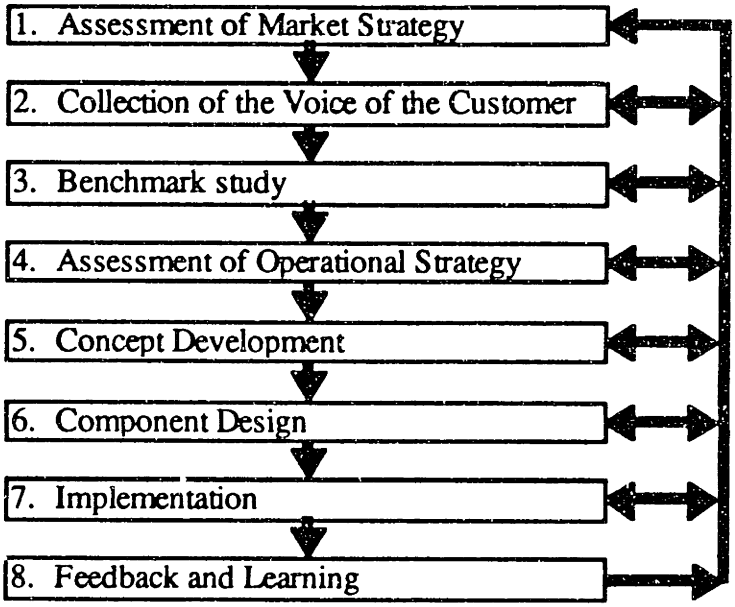

Figure 6 - Methodology for design of a customer service

The following sections will define and discuss each of the steps in Fig. 6.

5.5.2 - Assessment of market strategy

What is strategy? Many textbooks and papers have addressed this issue (and have probably more than done it justice). We will simply offer one of the more interesting definitions here and discuss how it sheds light on the design of services.

> **Military Strategy:** Military strategy, operational art and tactics are the broad divisions of activity in preparing for and conducting war.
> Military strategy is the art and science of employing the armed forces of a nation or alliance to secure policy objectives by the application or threat of force. Strategy sets the fundamental conditions of operations in war or to deter war. It establishes goals in theaters of war and theaters of operations. It assigns forces, provides assets, and imposes conditions on the use of force. Strategy derived from policy must be clearly understood to be the sole authoritative basis of all operations.
>
> Roots:
> ***Strategos*** was the Greek word for general. Strategy was the art of the general, or the art of setting up forces before the battle began. Therefore, strategy must precede operations and tactics in time.
>
> -US Army Field Manual FM 100-5, Operations

In order to evaluate a customer service, the company must first determine its own market strategy for its service. In the US army's definition (above), the market strategy is analogous to setting goals for theaters of war and operations, while the management of the company is

analogous to a general or warlord planning a conquest. (In our discussion, we will take the point of a conquesting army and to heck with the United Nations.) Just as the general must pick in which theaters to fight and in which to retreat, so must the management of the company choose in which markets to compete, which customers to serve, and what service to provide. Assessment of market strategy forces the company to decide who are their customers and what are their products.

Choosing a specific product, market and customer base are all examples of market strategy. In the case considered in this thesis, assessment of the market strategy revealed that the Motorola ISG wished to: be first to market with a successful cable modem, gain dominant market share, re-use existing technologies and processes, and to present one face to the customer. Having clarified these issues, ISG was then able to start developing a product delivery service which more closely met the needs of their market strategy. The manner in which customers order and use a product is determined by the type of market they are in. Because of this ISG was not able to go ahead with the more detailed design of the service until they had decided their market strategy.

The company's market strategy should also take into account the possible responses of competitors. Urban and Hauser (1993) state that services' low protection against competitive imitation makes innovation risky. If the company innovates and raises the expectations of the customer, it must also consider the ramifications if its competitors do likewise. Still, companies must have a competitive product delivery service. They are at risk of competitive imitation, but even more at risk if they fall behind the competition. The time required to fully study, evaluate, and copy a competitor's service may be prohibitive. By the time they have implemented the copy, the market may have already made the system obsolete. Thus, their only sustainable hope (outside of offering products vastly superior to those of competitors) lies in service innovation which anticipates or initiates developments in the market.

5.5.3 - Collection of the voice of the customer (VOC)

In the customer study discussed in this thesis, the service design team initially made a series of assumptions on the capabilities and needs of the service's customers. Although these assumptions were based on ISG's experience in other market segments, as the cable service providers were interviewed, some of these assumptions were proven to be false. For example, ISG had assumed that the majority of cable service providers were technically proficient in such techniques as Electronic Data Interchange (EDI). However, the VOC data indicated that this assumption was false. Because the customer interview analysis contradicted initial

assumptions, ISG was forced to re-evaluate its operational strategy. It was unable to count on customer skills in forecasting or in EDI capability.

Ulrich and Eppinger (1995) outline the goals for collecting the voice of the customer. These are: to ensure that the product (or service) is focused on customer needs, to identify latent or hidden needs as well as explicitly stated needs, to provide a fact base for justifying specifications, to create an archival record of the needs activity of the development process, to ensure that no critical customer need is forgotten, and to develop a common understanding of customer needs among team members.

Although both Ulrich and Eppinger (1995) and Bitran and Pedrosa (1996) list collection of the voice of the customer under Concept Generation, this thesis treats this as a separate step. This is because it is quite possible that collection of the VOC will reveal new requirements for the operational strategy such as manufacturing or information technology. Until these issues are settled, it will be very difficult for the service designer to focus the concept development process. Thus, this step is not concerned with the detailed analysis of customer information (which will be discussed under Concept Development), but rather with presenting a framework for gathering enough quality data to ensure the success of the design effort. In Chapter 2, we presented Shiba's (1993) model for gathering the voice of the customer. In brief this was:

Plan:

- What subject to concentrate on
- Which customers to talk to
- What questions to ask

Do:

- Interview the customers

Analyze:

- What images are invoked
- What are the customer requirements
- What are the relationships between requirements

In developing a plan for gathering information from both the customers and from the other stakeholders identified by the market strategy, the design team should identify potential interview candidates under each of the stakeholder categories. Although it may be difficult to identify enough customers to ensure that all relevant needs are identified, the team should strive to interview at least twenty customers. This will provide confidence that at least 90% of the

customer needs have been revealed (Griffin and Hauser, 1993). At the very least, the team should identify the service's primary customers.

Shiba (1993) stresses the importance of encouraging the customer to speak freely of his concerns with the product or service. This is accomplished through open-ended questions which "prompt the customer for images and feelings." To ensure that no important details are missed, the team may also develop a questionnaire, or list of interview questions and topics that it would like to cover. This may be done through a brainstorming session. In the study discussed here, the questionnaire included the major categories for the product delivery service included the customer's: purchasing practices, receiving practices, stocking or inventory practices, shipping practices, returns practices, and training and service.

Having settled on the main categories of the questionnaire, the team can then focus on developing detailed or probing questions. This may take the form of a list of key details the interview should reveal in each category. For example, under the receiving category, the interviewer may ask the customer how they process or record data on incoming shipments. Finally, the team should prepare an interview guide which will help them keep the interview on track, and will help them ensure that they have not missed any questions (see Appendix B for the questionnaire used at Motorola ISG).

The Interview: The interview is a valuable tool for collecting customer data. In order to generate an exhaustive, useful trove of customer needs, it is essential that the interview process be well conducted. Shiba (1993) recommends that:

- the interviewers go in groups of two or three people. (More than three people may tend to intimidate the interviewees, making them less likely to volunteer information.)
- at least one person must be a dedicated scribe throughout the entire interview. As the interviewers ask questions, the scribe must try to copy the customer's answers down verbatim. This is important because if the scribe attempts to paraphrase, or abbreviate, critical comments or nuances may be lost.
- following the interview, the interview notes (as well as visual impressions) should immediately be typed into a clear, organized transcript. This accomplishes two things: it ensures that all members of the team will be able to read the notes, and it allows the scribe or scribes to fill in blanks or questionable areas while the interview is still fresh in their minds.

Finally, many of the team members will be familiar with only segments of the customer data since each member will have been involved with only some of the interviews. Thus, summarizing or analyzing customer interview data as a group is difficult. In the study

discussed in this thesis, customer data analysis was accomplished by having team members complete a KJ analysis. This helped to articulate customer needs, and helped the team agree on which were the most important. Although customer needs are more thoroughly analyzed in the Concept Development section, the early KJ analysis will serve to make all team members aware of key issues.

5.5.4 - Benchmarking study

> *"Benchmarking is the continuous process of measuring products, services and practices against the toughest competitors or those companies or organizations recognized as industry leaders."*
>
> -Robert Camp (1989)

Camp (1989) describes the benchmarking process as providing a structured methodology for achieving superior performance. By becoming familiar with your operation, acquainting yourself with the operations of your competitors, and incorporating best practices, you can gain superiority. At the heart of this argument is the idea that your competitors or "industry leaders" must know more than you about what your customers need and want. Camp supports this argument by stating that, because a best practice must by definition come closer to meeting a customer need, understanding the work practices of industry leaders results in close conformance to what customers need or want.

We reject this argument for the following reason. Although benchmarking may reveal better ways of doing something, there is no guarantee that even the industry's best have actually evaluated the needs of their customers. This position is supported by numerous examples from the Japanese consumer electronics and automobile industries. In the 1970's, any benchmarking study in the American automotive industry would have revealed that customers wanted and needed bigger, faster cars. Yet as history shows us, Honda (and other small Japanese imports) was extraordinarily successful because it provided what customers really needed - better gas mileage. One might argue that this was merely luck; the Japanese only knew how to make small cars and happened to stumble upon a prime market opportunity. However, Honda and Toyota's long term success stories reveal that they have often managed to provide what customers needed before anyone else was aware of these needs.

We present this example, not to devalue benchmarking so much as to re-define its purpose. If the company chooses to be the best in the industry, then an effective benchmarking study will

achieve that goal. However, if the company truly wants to meet its customers' needs, then a more customer-centered methodology must be used. Benchmarking can play a valuable role in this process. Instead of using it as the main design engine, the team will find benchmarking to be an extremely valuable source of ideas and innovative concepts. As the design phase moves into Concept Development, ideas gleaned from a benchmarking study can provide the team with new and exciting ideas (as was the case in the research project reported in this thesis).

Thus, we present benchmarking, not as the entire process, but as a step in the process of designing a customer-centered service. By exposing the design team to new ideas as well as possibly providing models for imitation, benchmarking will help to invigorate the Concept Development step. Moreover, by benchmarking competitive services, the service designers will have a basis for assessing their operational strategy. If they are already competitive, then they may decide to innovate and set a new industry standard. If they discover that they lag behind their competitors, then the design team can start to put together a plan to achieve parity. In either case, benchmarking helps the service designer to gain perspective on where the system should strive to be.

The type of benchmarking the design team chooses should be dictated by the market strategy. If the strategy is to develop a best-practice service, then the team must look outside of the organization to those of competitors and non-related industries. However, if the strategy is simply to improve the service, a less extensive study may suffice. If there are other organizations within the company which have services known to be better than the one being re-designed, then an internal benchmarking study maybe an ideal solution.

5.5.5 - Assessment of operational strategy

The assessment of operational strategic needs determines the details of how the service will be offered. By the US army's definition, this step is concerned with determining the tactics of the service. For a product delivery service this includes: how the product will be ordered by customers (directly, phone, fax, mail or EDI), whether the product will be built-to-forecast or built-to-order, what types of information systems will be required, how returns of unwanted or defective products will be handled, and finally, how the product will be shipped to the customers. The operational strategy is the basis for determining how the company's products will be ordered, how they will be manufactured (build-to-order vs. build-to-forecast), how they will be shipped, what kind of information technology will be used, and how the customers actions and expectations will be shaped. Clearly, the operational strategy requires a rather

detailed, current understanding of the capabilities and needs of the customers and other stakeholders in the process.

It is in this step that many of the customer segments discussed in Chapter 3 enter the development process. For the designer of a product delivery service, knowing whether:

- the customer uses a decentralized or centralized purchasing system
- demand for the product will be identified by the customer or the supplier
- the customer's preference for communication is telephone or EDI
- the customer wants the product for personal use or to distribute
- the customer requires a short or long product delivery lead time
- the customer's re-order frequency is high or low
- the customer requires customized service or standard
- the consequences for service failure are severe or mild

will place the service designer in a better position to assess tradeoffs in the operational strategy. Obviously, each of the items above will force the designer to choose information, production and service systems with specific capabilities. For example, what kind of system will the designer produce knowing that the customer: is a distributor, uses a central purchasing system, uses EDI, does not want to use VMI, does not require short lead times, orders regularly, does not require customized service, or will not have extreme consequences if the service fails? Most likely, it will be a fairly simple, efficient system with minimal inventory, and driven by automated order processing and factory control systems.

Thus, the process of defining the operational strategy becomes the process of first stating initial assumptions about the nature of the service and its design and then verifying these assumptions with the VOC and through benchmarking. This allows the design team to narrow its focus in the design effort, and ensures that the service design will meet a large group of identified needs. It should also be noted that these assumptions must be based on the overall market strategy. Doing so will ensure that the service design meets the requirements of the primary market and customers that the company has chosen.

This stage has not actually defined how the operational problems will be solved. Issues of which information system to purchase, what machines to buy, etc. are left until the service concept has been finalized. However, by making some general operational assumptions, the design team gives itself the freedom to more deeply explore system concepts which more closely fit the needs of the service's customers.

5.5.6 - Concept development

Having developed a database of customer needs, internal customer needs and strategic considerations, the design team may begin developing a final service concept. Bitran and Pedrosa (1996) describe this process as systematically transforming the voice of the customer into a service concept. Ulrich and Eppinger (1995) define this as: developing product specifications, concept generation, concept selection, and design (development of final concept). The structure for this process is revealed in Fig. 7:

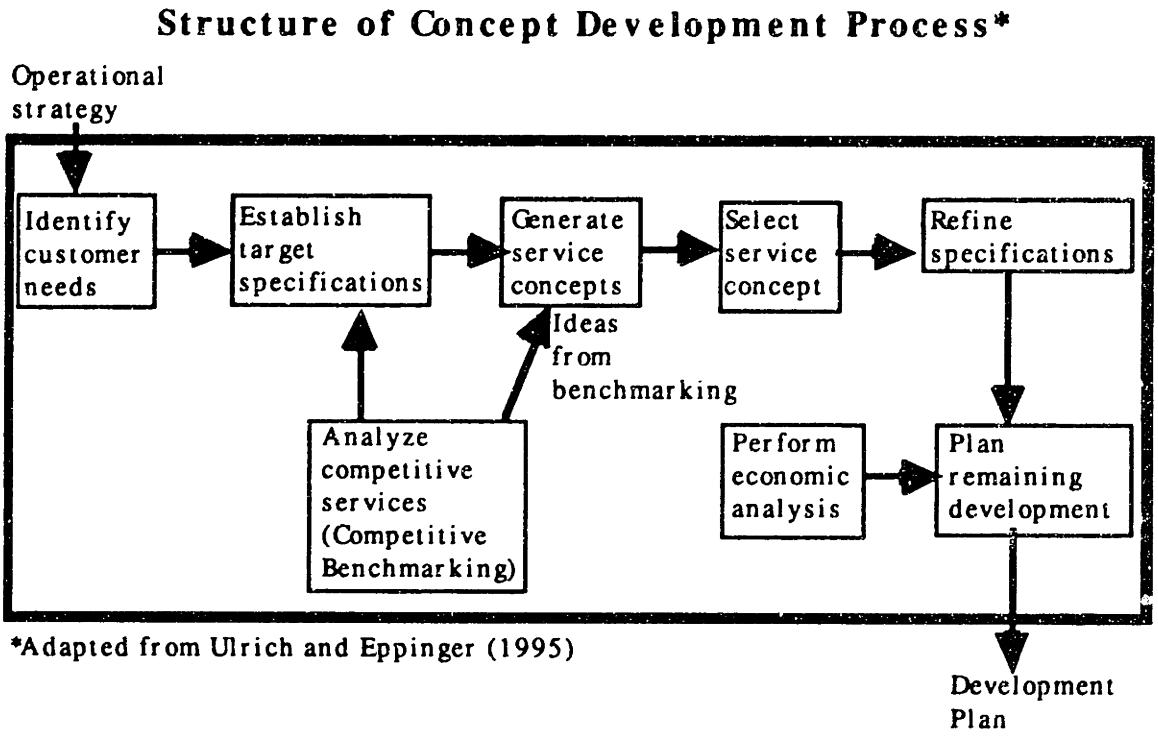

Figure 7 - Structure of the concept development process

The process of concept development is more than a mere exercise in creativity. It is in this step that the needs of the internal and external customers are analyzed. Focusing on these needs, the design team begins to explore ideas for potential solutions.

Customer Needs

In order to proceed, the design team must first come to a common understanding of the customer needs. Although they may not be able immediately agree on a ranking, it is important that the group is all working off the same list. To ensure that all of the customer data is used, the team now needs to extract all of the customer requirements identified in the interview process. An example of this (from the ISG case) might appear as shown in Table 4:

General Need Category	Specific Need of Customer
Product shipping needs:	• Unit bar-codes must be on outside of shipping box • Shipping box must be under 35 lb. • No excess packing materials
Sales order needs:	• The customer sales order is correct - asks for the right product codes in correct format. • Customer information is correct and up-to-date - credit, price and ship-to address information have all been correctly entered by the salesman.

Table 4 - Example of breaking down customer needs

Working through the interview notes from all interviews - both internal and external customers, the design team should be able to produce a list like the one in Table 4 which divides the needs into general categories, and then into specific customer needs. Ulrich and Eppinger present a six step methodology for identifying customer needs:

1) Define the scope of the effort
2) Gather raw data from customers
3) Interpret raw data in terms of customer needs

Griffin & Hauser (1993) discuss the problems of multiple analysts translating the same data into different needs. We found this to be true during our own study at ISG. Although there is no easy answer for this, some possible methods include: express needs in terms of what the product has to do, express the needs as specifically as possible, use positive phrasing, and avoid use of the words *must* and *should*.

5) Organize needs into a hierarchy of primary, secondary, tertiary
5) Establish relative importance of needs

Although the team may choose to rank the needs themselves, there are a number of methods for creating customer surveys to rank customer needs. Shiba (1993) presents a format for creating Kano questionnaires which attempts to rank customer requirements while avoiding the prejudices of the design team.

6) Reflect on process

Having developed a list of customer needs from the customer interview data, the team will have developed a fairly comprehensive understanding of the explicit needs their design must address. However, there is another class of needs - latent needs - which may not appear on the list. Latent needs may be thought of as those needs that customers have not vocalized (or maybe even thought of) yet are revealed through their actions and responses. A good example of a latent need emerged in the Motorola ISG study. Although customers expressed confidence in their ability to forecast and order products, it became clear to the team that the nature of the product would be so far removed from the expectations of the customers that they would need significant training and experience to be able to order the product and to forecast demand.

Hence, the latent need discovered was the need for training as to how to order and forecast demand for the new product.

Latent needs must be developed through inference and intuition. Although several methods for extracting latent needs exist, the KJ is an efficient, practical method for achieving team consensus on customer requirements. (As a thorough methodology is presented for KJ analysis in A New American TQM, we refer the reader to this manual for further details.) As the team begins the KJ analysis, it is very likely that they will be overwhelmed with the quantity of customer data which they must consider. For this reason, Shiba(1993) recommends that each team member pick the ten customer needs that he or she believes are the most important. This will help the team to focus on the most important issues and allow them to speed up the process.

For the remainder of the Concept Development process (establish target specifications, generate service concepts, select service concepts, and refine service concepts), either of the House of Quality (Hauser and Clausing, 1988) or Concept Engineering (Shiba, 1993) methodologies may be used. Both of these methodologies allow the design team to convert intangible and tangible customer needs into design specifications and metrics, and then move through a concept generation and selection process. The major advantage of using either of these methodologies is that by following the process, a "paper trail" is created. Whenever the design team is unsure as to how they have arrived at a certain solution, they will be able to trace back through the process to the original customer needs that sparked the idea. This is also useful when the team must present their ideas. They will be able to demonstrate to outsiders exactly how they arrived at their conclusions.

5.5.7 - Service implementation

Bitran and Pedrosa (1996) present a framework for the implementation of a customer service. This separates implementation into five separate activities. This is shown in Fig. 8.

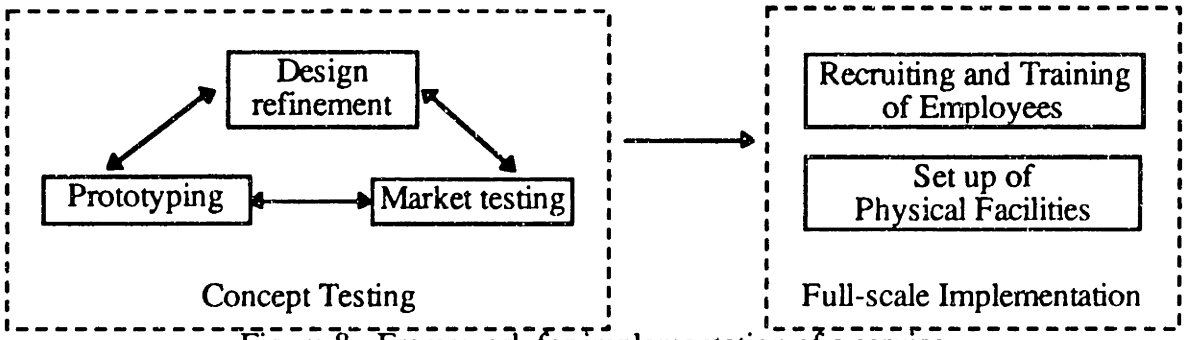

Figure 8 - Framework for implementation of a service

Although understanding or explicitly stating a framework for implementation is important, it is useless unless the designer knows how to get there. Thus, a plan or timetable is a critical aspect of service implementation. McNair and Leibfried(1992) lay out an implementation sequence which may be used for services. Having developed a design or "blueprint " for the service, the service designer then needs to let the rest of the organization know what it will look like and what their roles will be in the service. For this reason, the implementation sequence starts with communication.

Having educated the rest of the organization as to the plan for the service, the design team needs to develop an action plan, explicitly discussing the procedures and the implications of each step. As is made clear by Bitran and Pedrosa's framework, the action plan should start with a pilot test which will allow the design team to monitor problems in the service. Following the conclusion of the pilot test, the design team will then be able to develop plans for the full-scale implementation of the service. McNair and Leibfried stress that the action plan must include new "performance metrics" which allow the organization to assess the success of the new service design. These performance metrics will also provide a useful "base" for future service design efforts. Imai (1986) also touches on this issue with what he refers to as "check points" for management. Based on traditional SPC techniques, management check points are policy goals and measures which allow management to ensure that a deployment effort is within acceptable quality limits. By developing these points as a part of the concept development effort and incorporating their use into both the pilot and full-scale implementation plans, the service designers will be able to monitor the progress of their service.

Below, we present a sample service implementation plan:

1) **Communicate:** make sure that all of the parties impacted by the new service are aware of the service's goals, strengths and potential weaknesses. Moreover, this step may require an education effort to let the potential stakeholders know what is expected of them.

2) **Develop pilot implementation plan:** develop an action plan for implementation of the pilot plan with a timetable for reaching specific goals. The plan should also contain contingencies for returning to refining the design if the pilot experiment is unsuccessful. Finally, the plan should include the performance metrics which will be used to judge the service's progress.

3) **Roll out pilot implementation**

4) **Assess results using performance metrics:** evaluate the success of the new service relative to the service it replaces using the performance metrics. Based on the results of this step, the design team can determine whether to proceed to full-scale implementation or to return to the design refinement process.

5) **Develop full-scale implementation plan:** develop action plan for full scale implementation including a timetable, performance metrics and contingency plans.

6) **Roll out full-scale service**

7) **Reflect on the implementation process:** often when new products or services are implemented, those responsible realize that there are better ways to do it. This step stresses the importance of having the design team document these lessons and take action to ensure that future development projects incorporate them.

5.5.8 - Feedback, learning, and re-assessment

The author's son is a highly-energetic and inquisitive 15-month old. He is constantly tasting, poking and climbing - activities which have earned him many bruises. Yet each bruise teaches him a lesson; he seldom makes the same mistake twice. This is the essence of learning from experience. In contrast to this, it is quite common to see corporations and organizations making the same mistakes over and over again. Although many individuals within the organizations may have learned valuable lessons, the organization itself finds learning from experience more difficult.

Wheelwright and Clark (1992) state that the ability to sustain significant improvements in development over long periods of time rests on an organization's ability to learn from experience. While they acknowledge that most companies learn very little from their development efforts, they emphasize that those that do "understand the power in improvement have developed tools and methods to help people - individually and collectively - gain insight and understanding and focus energy and attention on the problem of learning." To this end, they present a framework for learning from development efforts. The five areas for focus which they identify provide the organization with a way to "remember" both what went wrong and what went right. This framework is presented in Table 5:

Areas of Focus	Types of Changes to Capture Learning	Examples
Procedures	Changing the specific, detailed sequence of activities or rules that developers follow.	Example: Service developers miss a critical customer need. Possible change: Development process mandates interviewing a higher minimum number of customers
Tools/Methods	Teaching engineers and developers new skills in using specific tools and methods	Example: The service is too expensive. Possible change: Service designers are given training in TQM and Concept Engineering.
Process	Changing the broad sequence of activities and phases that structure development	Example: Service does not mesh with the company's strategy. Possible change: Institute a strategy review with management before undertaking development projects.
Structure	Changing the formal organization, the locus of responsibility, the geographic location of development activities	Example: The service does not work with customers west of the Mississippi. Possible change: Put people on the design team from all geographic locations.
Principles	Adding to the set of ideas and values used to guide decisions in development	Example: The new service was extraordinarily successful. Possible change: All future services are developed using the same methodology and team structure.

Table 5 - Wheelwright and Clark's framework for organizational learning

This framework paves the way for what Iansiti (1993) calls the systemization of knowledge. By developing a culture of learning and creating a system for the accumulation of knowledge in both product and process, the firm will be able to achieve high productivity and short development lead times.

Chapter 6 - Results of product delivery service system development process

6.1 - Overview

In this chapter, we present the results of the ISG development project. While acknowledging that the study did not progress through the entire development process, we will discuss how a new product delivery service was conceived and implemented.

6.2 - Results of ISG product delivery service development process

As we stated in Chapter 1, at the time of this study there was considerable debate within Motorola as to what the relationship between ISG and MMG (producer of the other cable product) should be. Specifically, there was a desire by Motorola upper management to present "one face to the customer." This meant having only one sales representative and one order management system interfacing with each customer. It was believed that by doing this, the customer would only have to use one set of ordering procedures and would be able to meet all of his cable product needs through one interface.

Ultimately, the decision was made by Motorola that "one face to the customer" was the right way to go. In deciding this, Motorola also mandated that the client-server based order management system used by WDG (MMG and WDG shared facilities) would be the system used for all Cablecomm products. Thus, when customers ordered Cablecomm (ISG and MMG products), they would do so by placing an order with WDG's order entry group that would then be entered into WDG's order management system (discussed in the benchmarking study in chapter 4) which would then bill the customer. This changed the focus of the study being done by the author and a cross-functional team working to develop a new product delivery service concept at ISG for the new cable modem and its customers. Rather than completing the development process to develop an entirely new system, the challenge became one of how to best use WDG's system.

At this point, the quickest solution would have been to set up an electronic link to bring all cable modem purchase orders from WDG's system into ISG's order management system. However, it was clear that doing so would leave ISG with all of the original problems that our study had set out to address with the addition of the problem that they would also have to deal with an

additional information system. Specifically, we foresaw the following problems with this solution:

Original concerns with ISG system still exist:

- batch processes slowing transactions in the system
- manufacturing delay of 30 seconds per unit
- excess order tracking numbers degrading system performance
- shortage of MIS resources to fix the system
- barriers to efficient high-volume manufacturing and shipping

There would be two distinct order entry processes with:

- two distinct customer information databases to maintain (order data, financial data, ship-to location data, warrantee information, etc.)
- two distinct order entry processes with associated chances for erroneous data entry
- inability to coordinate initial order information and invoicing from WDG system to the shipping and automatic invoicing response from ISG system

Even slower customer response:

- double order entry system would mean ISG would have to wait to get order information from WDG producing an even slower delivery lead time than their current system

Although we adopted a solution before completing the full service development process, the background work done in preparation for concept development was still useful. By documenting specific customer requirements, developing assumptions about the nature of the ideal product delivery service, and benchmarking other systems within the corporation, we were able to develop a design for a new product delivery service using WDG's system. Because of this background work, we were able to implement a system that answered the major customer requirements that were identified in Chapter 2.

For review, these were:

- The ability to handle rapid (sometimes next-day) order delivery lead times
- The ability to efficiently handle customer-specific logo labels on each unit
- The ability to handle changes to order size and due-date on short notice

Reviewing our customer requirements and benchmark data, we were able to identify a number of areas in which we could use WDG's system to actually improve ISG's order management flow. Moreover, as our customer analysis had indicated that in the future the cable service providers would become more like CSG's customers, we were interested in using some of the

ideas we had learned from our benchmarking study. Because of these similarities, we believed that ISG would have to:

- manufacture generic modems to an aggregate forecast
- customize by adding a label as late in the process as possible
- ship to multiple locations for each customer
- respond quickly to changes in individual customer demand

Thus, we believed that the strategy of separating the order fulfillment process and the manufacturing process would be beneficial. Taking our knowledge of WDG's system gained through the benchmarking process, we put together a new system designed to receive, process and ship products on the same day from a finished goods inventory. This system is shown in Fig. 9 on the next page. In it, the customer's order stays entirely within the WDG order management system. The order is passed from the customer to the order entry group which processes the order and enters it into the system. From there, the order flows in real-time to the shipping queue. To ship the order, a person from ISG's production scheduling group looks at the order queue and prioritizes orders based on urgency. This person then issues a *ship-release* which allows the shipping personnel to see the order. After this, the shipper pulls the appropriate number of units from the shelf (where they are prepackaged but not sealed) applies the customer's logo to the front of each modem which is exposed, scans the bar-coded serial number, seals the package, prints out the shipping documents and hands over the order to the freight company.

Several points should be noted here. Although the order entry process takes place in Illinois, the ISG personnel are able to access and use the system in real-time in Massachusetts. As the system is client-server based, it is anticipated that users in Massachusetts will not see significant performance degradation. Moreover, this allows ISG to use its existing warehouse and shipping facilities. To ship cable modem orders, the shipping group simply required a remote system terminal and a hand-held bar-code scanner.

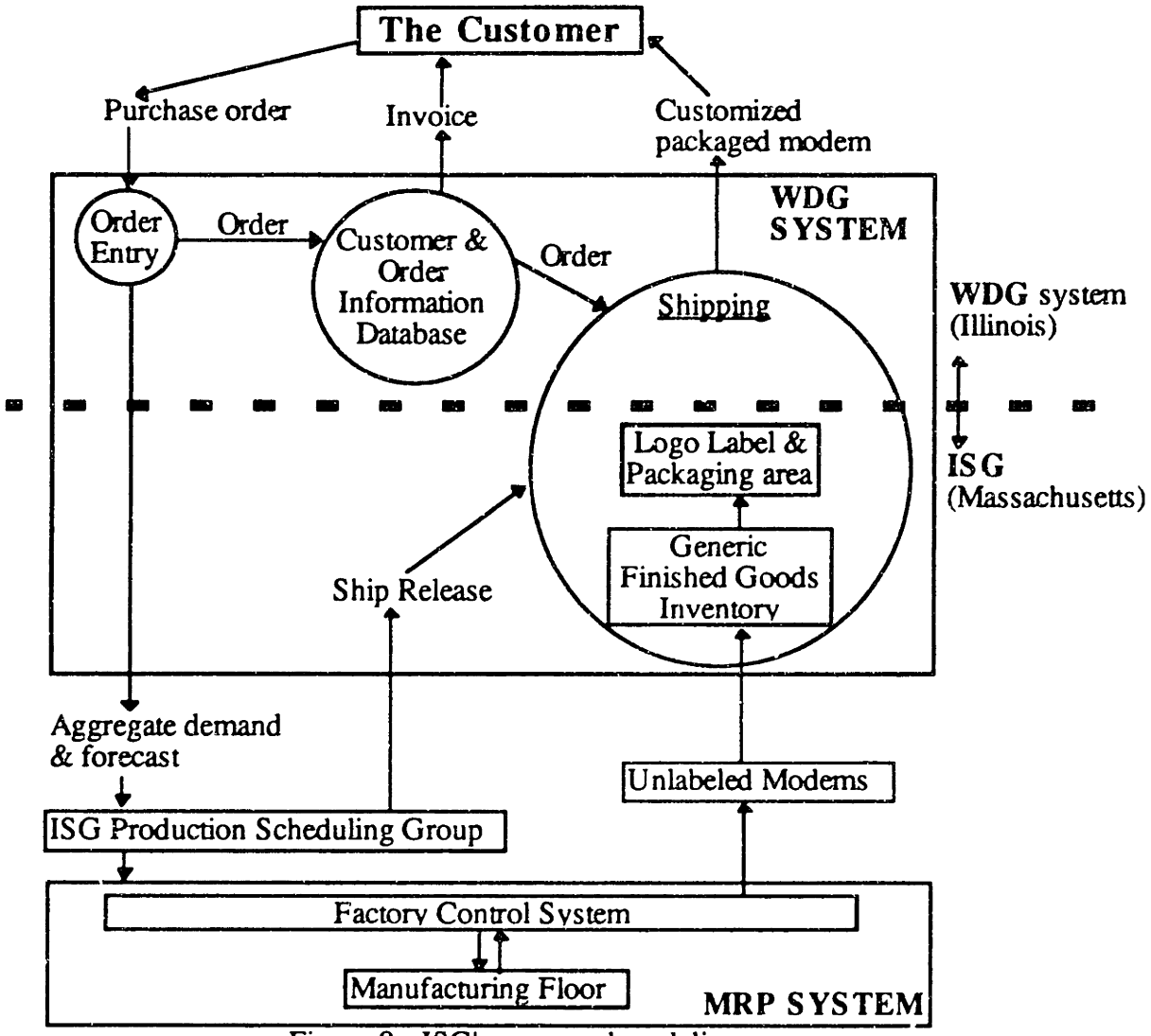

Figure 9 - ISG's new product delivery system

As may be seen in Fig. 9, this system allows ISG to realize several improvements over their original system. First, the original order management system has been removed from the manufacturing process, improving manufacturing throughput. Second, the factory is now able to produce generic units at a rate governed only by their manufacturing capacity (rather than information system capacity). Third, the production scheduling group can now treat the manufacturing floor as a captive supplier. As production does not have to be tied to individual orders, they are able to level-load the factory, build to a forecast, and achieve more efficient use of their capacity. Fourth, one person from the production scheduling group can now run the entire process after order entry. This person's responsibility becomes releasing orders to shipping in the WDG system, and scheduling periodic production runs in the ISG MRP system. Finally, the system gives the shipping area true "pick-and-ship" capability, improving delivery

lead time performance (to consistently under 24 hours if desired). In this system, the production scheduling group can adjust inventory levels to achieve satisfactory delivery lead times.

Another benefit of the VOC and benchmark studies was that we were able to identify and improve several weaknesses in WDG's system. For example, we discovered that the bar-code reading scheme they were using was rather slow. System engineers were able to propose a solution to this problem which improved bar-code reading performance to an acceptable level.

In summary, the system achieved "one face to the customer" while actually increasing ISG's capabilities. The benefits realized were:

- ability to ship orders within 24 hours in real-time system
- a single order management system focused on the customer
- increased capacity in the factory and ability to build to forecast
- development of "distribution center" capability
- reduction in number of people involved in the order fulfillment cycle
- adoption of a third-party system which can easily be updated and scaled for increased performance

Chapter 7 - Conclusion

In previous chapters, we have discussed the process and some of the considerations for developing a new customer service. We focused specifically on the requirements for developing a product delivery service system for a manufacturing organization using a study performed by the author at Motorola ISG as an example. Acknowledging that this study did not initially set out to design a product delivery service, we discussed the approach taken in the study and, where applicable, contrasted it with more appropriate approaches presented by the literature.

Clearly the study described in this thesis cannot be held up as a model service development process because we were obliged to move directly to a solution. However, as is made clear from the previous section, even following a partial process may produce better results than simply trying to "fix a problem." Thus, based on the experience gained through this study and additional research, we are able to make the following conclusions:

- Targeting the entire product delivery service system for improvement rather than individual functional problems is more likely to achieve customer satisfaction.
- Segmenting service customers allows the service designer to better understand the customer requirements for his design.
- While service development methodologies may be similar to product development methodologies, understanding the key differences between services and physical goods can make the service design process more effective.
- Developing a plan and following a methodology is vital for the success of a service development process.

Target the entire product delivery service system for improvement: Looking at the entire cycle that a customer's order travels - from cutting the order to receiving the shipment - gives managers a chance to see themselves through their customer's eyes. And by doing so, managers will find the greatest opportunities to improve overall operations and create new competitive advantages (Shapiro, Rangan and Sviokla, 1992).

The methodology for design of a customer service presented in this paper provides a multitude of opportunities for the manager of a manufacturing organization's product delivery service. At the very least, putting together a cross-functional team to talk with customers and to evaluate the company's existing practices will bring new visibility of the customer's requirements into the organization. However, if the effort is successful, the service designers can expect to develop a

new customer service which creates satisfied and loyal customers, produces a more efficient organization, and establishes a competitive advantage for the company. Furthermore, by operationalizing this methodology, and constantly improving it, the organization can expect to be able to sustain their competitive advantage.

Analyze segmentation of the service's customers: As described in Chapter 3, there are fairly serious penalties for the service provider that fails to correctly position its service. A large part of this process is the ability to accurately identify individual customer segments and their needs. In Chapter 3, we presented nine categories or service shaping "factors" which may be used to analyze customer segments. These were:

1. Does the customer uses a centralized or decentralized purchasing system?
2. Who is responsible for identifying product demand (the customer or the supplier)?
3. What is the customer's preferred method for communicating with the supplier?
4. Is the customer a distributor or end user of the product?
5. What are the customer's delivery lead time requirements and why?
6. Where is the service capacity constrained?
7. What is the customer's re-ordering frequency?
8. What aspects of the product delivery service are complex and why?
9. What are the consequences for customers if the service fails?

By asking each of these questions, the company will be able to better understand which customer segments it serves. The benefits of this are two-fold. First, the company will be able to evaluate the service requirements of their customer segments in terms of the type of information systems required, the production methods required, and the training required for their service personnel. Second the company will be able to assess whether they are really serving the customer segment that they want.

Understand the key differences between services and physical goods: In Chapter 5, we discussed some of the differences between services and physical goods. Some of these differences are:

- Services are intangible.
- Production, consumption, and delivery of services is immediate.
- The customer must participate in producing the service.
- The customer's impression of the service is often determined by the interface between him and the service provider and is influenced by "circumstantial evidence."
- The architecture of the service is difficult to identify.
- Service quality is very difficult to monitor and must thus be designed into the service.
- The designer must be aware of regulations on "fairness" and "social responsibility."

These differences oblige the service designer to look at those aspects of the service which will matter most to the customer. Often, the critical, customer-pleasing factors in the service will be incidental or non-obvious. Identifying these items before beginning the concept development stage of the service will help to ensure that the service truly produces customer satisfaction.

Develop a plan and follow a methodology: As the author learned (and has been stressed repeatedly in product development literature), having a development plan and methodology is critical for the success of a service development process. In the ISG study discussed in this thesis, the focus and goals of the project changed several times. Thus, earlier work continued to be useful, but it was not always perfectly suited to the purposes for which it was used. For example, initial customer interviews were done with the intention of setting up a Vendor Managed Inventory system rather than developing an entirely new product delivery service approach. This meant that many of the answers given by the customers were to questions not directly related to the ultimate project. Moreover, the team members working with the author changed several times. This resulted in a problem of constantly having to educate new people which slowed progress. Although these shortcomings may be attributed to the author's inexperience, they are important to note because they appear to be relatively common mistakes in industry.

As stated in Chapter 1, we believe that the true challenge for a manufacturing organization which ships products to customers (especially middlemen or distributors) lies in thinking of the order fulfillment process as a service system. Due to the way in which most service organizations evolve, the service itself is often created through an ad-hoc process rather than a formal design methodology. Because of this, many customer services are often misaligned and inefficient. At an even greater extreme, most manufacturing organizations do not even think of their delivery function as a customer service. Thus, the main vehicle for creating customer satisfaction is often running on "flat tires." However, by following the service delivery design methodology proposed in this thesis, the company will have in its hands the tools to produce customer satisfaction and a sustainable competitive advantage.

Glossary

Benchmarking The continuous process of measuring product, services and practices against the toughest competitors, or those companies (or organizations) recognized as industry leaders.
-David Kearns, Xerox Corporation

Cable Data Modem (CyberSURFR) The CyberSURFR connects IBM or Macintosh personal computers to a hybrid fiber/coax transmission system for very high speed communications. CyberSURFR is specifically designed for data communications for on-line services, Internet access, telecommuting, and other emerging services for home and business PC users. (From Motorola's WWW Product Information)

Cable Service Providers Providers of cable television (CATV) programming to the home.

Customer Service The supplying or supplier of utilities, commodities, or activities required or demanded by the public.

Design for Postponement The policy of delaying customization of a manufactured product until as late as possible. Thus generic products are built up to a certain level and then held awaiting specific customer orders. Following the customer order, the products are assembled in the way that the customer desires.

Electronic Data Interchange (EDI) The transmission of business documents, in standard formats, between computers. Organizations can transmit information either through point-to-point connections, between trading partners, or through an intermediary computer of a third-party service provider. The American National Standards Institute (ANSI) coordinates industry efforts to simplify and promote nationwide use of EDI by defining EDI document transmission and data format standards.

Global Enterprise Management System (GEM) The VAX -based order management system used at Motorola ISG. This system was custom-designed and developed for ISG by an outside contractor.

High-Mix/Low-Volume A manufacturing strategy which focuses on building a large variety of products (usually in configurations specified by the customer) in relatively small lot sizes (sometimes as small as one). Customer satisfaction is achieved through providing products which are closely fitted to individual customer requirements.

Low-Mix/High-Volume A manufacturing strategy which focuses on building a few standard products in very high volume and in large batch sizes. Customer satisfaction is achieved through providing products of relatively high quality and low price.

Order Management System The interaction between human operators and electronic information systems to manage the receipt, processing, fulfilling, and completion of purchase orders for goods produced by the company. In carrying out these functions, the system will most likely interact with other systems designed to: control manufacturing operations, control purchasing and tracking of materials, control financial data.

One face to the customer Motorola ISG's policy of having customers of multiple products interface with one sales representative, one ordering process, and one order management system.

Product Delivery Service The function of providing a product to a customer in a manner agreed to by both the supplier and the customer. This encompasses all of the functions necessary to determine the customer's need for the product, to determine the quantity required, to actually manufacture the product, to deliver the product to the customer and to collect payment for the product.

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APPENDIX A - KJ Diagram Analysis

The **KJ diagram** (shown in Fig. 2 on page 20) illustrates the relationship between the environment in which cable companies currently operate, their current business practices, their inexperience in dealing with new markets and products, and the responsibilities of vendors who supply the cable companies.

Three areas were judged to be of equally critical importance in determining the procurement needs of the cable companies: the fact that they appear unprepared to order products in markets in which they have no experience, that vendors must be reliable in meeting committed product delivery dates, and that vendors must take on an active role in meeting customer needs that the cable companies cannot support independently. These three areas were summarized as areas where the vendor (Motorola) would have to be proactive in identifying problems with: customer use of the product, consumer research, cable company inexperience, and areas in which the cable companies current business practices were leading to problems with delivery and warehousing of the product.

This diagram is a KJ diagram, an example of the KJ analysis method developed by Jiro Kawakita and applied to business situations by Shoji Shiba. It is a means of summarizing and characterizing large quantities of qualitative data in order to formulate hypotheses. It is used in situations where:

- The issues that surround a problem appear large and complex
- The information relevant to the problem appears in unorganized thoughts and ideas
- A breakthrough in traditional concepts is needed
- Team consensus is essential to problem solving
- Data is in non-numeric form and numeric or statistical techniques do not apply

During the KJ process, participants collect original ideas and assemble them in groups by affinity. These initial groups are titled and the process is repeated using the group titles as original data. Eventually, conclusions are discovered in the organized set of ideas. The KJ process follows the process described below:

1) **Agree on a topic or question for the KJ analysis.** In this example, the topic chosen was:

"What are the cable companies' key procurement requirements for Cable Modems?"

2) **Write and understand the data.** Based on interviews with, and visits to, local cable companies, facts, details and quotes were written on yellow "Post-It" labels. Each label contained only one complete thought or fact. These labels were then "scrubbed", and subjective and unclear descriptions and language were clarified or eliminated.

3) **Group similar data.** The team then worked together to group facts that intuition says are similar to each other. Note that groupings were made not by logical connections (i.e. put all labels about serial numbers together), but rather by the image the label invoked. Note that the labels on the top of each group summarize the labels below them. The large r boxes (with round edges) serve to link and summarize several smaller groups which evoke similar images.

4) **Title groups.** The groups of similar facts are then given titles that express the same meaning or image of the group of facts.

5) **Lay out groups and show relationship among groups.** The group hierarchies are laid out on the page to show clearly the internal structure of the groups and cause and effect relationships. The large arrows indicate cause and effect relationships.

6) **Vote on the most important low-level issues and draw conclusions.** Each team member is given three labels: red for most important, blue for second most important, and green for third most. Each team member places their labels to vote, and then based on the resulting ranking, an overall conclusion is drawn to finish the KJ analysis. In this case, the conclusion drawn was:

"Cable modem vendors must proactively identify and solve end user delivery problems resulting from the cable companies' inexperience in the new high-speed data market."

APPENDIX B - Cable Company Interview Guide

Questions for cable service provider interviews:

- What images come to mind when you think about a supplier or vendor of cable equipment (specifically the set-top boxes)?

- From your experience, what complaints, problems or weaknesses would you like to mention about suppliers?

- What features, services, or criteria do you think about when selecting a supplier or vendor?

- What new features, services, or practices might address your future needs from a supplier or vendor?

Using the following questions, attempt to gain a little more detailed descriptions of the customer's ordering, purchasing and stocking practices:

Purchasing Practices:

What is the difference between your best and worst suppliers?

What criteria do you use to choose a supplier? (Price, Deliver, reliability, features, other?)

What are some of the problems you've had in the past with suppliers?

What would a perfect supplier be/look like?

What is a typical order from you like?

Fax/Email/Fedex/EDI?
Lot size? (Min/typ/max)
Delivery Lead time
Delivery Method

How do you know when to order? (Plan, Forecast, Inventory Level?) How often?

How flexible are you when dealing with suppliers? Can you change freely?

Early vs. On Time?
Partial vs. Complete?
Supplier A vs. Supplier B

What metrics do you use to evaluate purchasing? (Cost Drivers?)

Do you have EDI capability? Any plans for it? What kind of ordering/Info System do you use?

How do you pay your invoices? How often?

How are order acknowledgments handled? Do you need one?

Is recycling a criteria?

Do you have a forecasting methodology?

How do you maintain your inventory? Min/Max? MRP or other automated system? Manual inventory? (If so, how often?)

Other comments?

Receiving Practices:

What would an ideal incoming order look like?

What kind of incoming inspection and/or audits do you do? (Do you need any kind of technical guide to assist in receiving and inspecting incoming shipments?

What is typical of packaging / pallet size / wrapping of shipments?

How big is an incoming order / shipment? Any size requirements for shipments? (Min / Max size)

How do you record/ process an incoming shipment? What system do you use to record it?

Type of equipment?
Bar Code?
What do you do with the data?
Do you ever share data w/ supplier?
Do you record when you use the equipment?

What do you do with Damaged incoming goods/shipments/packaging? What are your expectations / requirements for the supplier in this case?

Stocking Practices:

What would an ideal stocking method or process look like?

What problems have you had with your current process?

Do you have any secondary stocking locations? Where are they? Special requirements?

Do you have any environmental requirements / concerns (moisture, temp, etc.)

What is your typical shelf time for stock? (# inventory turns per year?)

Do you pull FIFO or randomly?

Do you have any type of preferred packaging? (strength, visibility?)

What is your preferred pallet size?

Shipping Practices:

How do you ship to your hubs /franchises /installers? (How many steps in the process are there?)

If products are damaged enroute? how are they handled?

Is recycleability of packaging / packing materials important?

Could you draw us a flow diagram from the receiving dock to the end user?

Returns Practices:

What is your current DOA rate? How do you handle DOAs?

How do you currently handle repairs?

Do you refurbish returned parts?

How do you handle warrantees? How many of your units are out of warrantee?

What is your commitment to the customer on repairs / defective equipment?

What are your expectations of the supplier?

Training and Service:

Do / will you need courses to teach your people how to repair systems?

Do you get repair kits from the supplier? Will you need them?

What are your current training practices?

What type of person do you look for in a service person? In a repair person?