MANAGEMENT OF TECHNOLOGY AND QUALITY IN ELECTRONIC CONSUMER SERVICE OPERATIONS: APPLICATIONS TO ELECTRONIC FOOD RETAILING

A THESIS
SUBMITTED TO THE FACULTY OF THE GRADUATE SCHOOL
OF THE UNIVERSITY OF MINNESOTA
BY

GREGORY RAYMOND HEIM

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY

KINGSHUK K. SINHA, ADVISER

JANUARY 2000

UMI Number: 9954766

Bell & Howell Information and Learning Company
300 North Zeeb Road
P.O. Box 1346
Ann Arbor, MI 48106-1346

UNIVERSITY OF MINNESOTA

This is to certify that I have examined this copy of a doctoral thesis by

Gregory Raymond Heim

and have found that it is complete and satisfactory in all respects,
and that any and all revisions required by the final
examining committee have been made.

Kingshuk K. Sinha

Name of Faculty Adviser

Signature of Faculty Adviser

December 31, 1999

Date

GRADUATE SCHOOL

ACKNOWLEDGEMENTS

I would like to thank everyone in the Operations and Management Science department who guided me through the doctoral program. Many different faculty members challenged me with class work and assistantships that led to my present skills and interests. My first research project advisers, David Kelton and Inder Khosla, helped me to learn much about research in simulation and scheduling. Roger Schroeder introduced me to the research of his World Class Manufacturing research group, which opened my eyes to many possibilities available in research in operations management.

Most of all, I would like to thank my adviser, Kingshuk K. Sinha. I never expected that my work with K.K. would turn into my most fruitful intellectual experience, and would renew my academic enthusiasm. K.K. showed me not only how to write grant applications and a dissertation, but also shared his vision of the responsibilities and actions of a good professor, researcher, teacher and adviser, for which I am extremely grateful.

In addition to K.K., I also would like to give special thanks to the other members of my dissertation committee, Roger Schroeder, John Anderson, and Jean Kinsey, whose comments and critiques helped enormously in writing this dissertation.

I also thank my student colleagues for their friendship and for years of encouragement: Kim, Joy, Catherine, David, Sarvanan, Manus, Tony, Rich, Harold, Sohel, Dinesh, Devesh, Debopam, Satish, Mikko, Oliver, Julie, Kristy, Mike, Adrian, William, and anyone else I may have missed. I also want to thank the Operations and

Management Science department staff, particularly Deb Brashear, who have provided advice and assistance over the years.

Finally, the most important supporters of my quest to obtain the doctoral degree have been my parents, Herbert and Carolyn Heim, and my brothers and sisters, Paula, Teresa, Bradley and Douglas, without whose support and understanding I would not have made it.

DEDICATION

Dedicated to my parents, Herbert R. Heim and Carolyn L. Heim.

For many years they have sacrificed personal resources and pleasures

in order to support the educational interests of their children.

Without their love and support, I never would have gone this far.

ABSTRACT

The emergence of electronic consumer services poses questions for managers and researchers about typical configurations of products and of process technologies that are used to design and deliver electronic services, as well as how these configurations relate to service performance. These questions lead to further questions of whether there is a fit between electronic service product configurations and process technology configurations, and how this fit relates to the effectiveness of delivery of electronic consumer services. The recent emergence of electronic services means that little is known about these questions, outside of practitioner literature evaluations of individual electronic services and individual process technologies. Based on these questions about emerging electronic consumer services, the research question underlying my dissertation is: *What are the dimensions of operations used to deliver electronic consumer service products, and how do these dimensions relate to the service quality and customer value delivered in electronic consumer services?*

The first stage of the dissertation develops a conceptual framework that serves as the foundation for the empirical analyses for the balance of the dissertation. The recent emergence of electronic services presents researchers with little prior academic literature upon which to perform subsequent research. Thus, prior to performing empirical research on service quality drivers, we enumerate the product and process dimensions of electronic service operations. The first stage develops a conceptual framework for electronic service operations, in the form of an electronic service product

typology and an electronic service process typology that are combined together to construct a product-process matrix for electronic consumer service operations. The product-process matrix facilitates the development of propositions related to the delivery of customer value. These propositions relate positions and paths of electronic service operations on the matrix to the delivery of customer value.

The second stage of the dissertation uses the conceptual product-process matrix as a framework to empirically examine the product and process typologies and the propositions about service quality and customer value. We use the product-process matrix as a framework to guide the collection of product and process data from electronic services. Using data from electronic food retailers, the second stage uses cluster analysis and related multivariate statistical classification methods to develop separate empirical taxonomies of electronic services using observed product and process technology variables, respectively. The electronic service product and process taxonomies provide empirical support for the product and process typologies. The taxonomies also serve as a framework for an empirical analysis of the product-process matrix for electronic services.

In the final stage of the dissertation, the configurations of electronic food retailers are used to analyze whether and how such configurations are related to service quality and customer value. We use the taxonomies to classify each electronic food retailing service into groups derived from the product configurations and process technology configurations. Since each service belongs to one group in the product taxonomy and to another group in the process taxonomy, the taxonomic groups provide each service with a position along each dimension of the product-process matrix that one can use as levels within statistical analyses. Using these positions, we explore whether the product and process configurations are independent of each other, and whether there exists a product-process matrix diagonal along which food retailers tend to position themselves. The results suggest that the stages of the product and process configurations exhibit a positive and significant correlation, indicating that there is a diagonal configuration within the product-process matrix along which food retailers tend to position themselves. The results also indicate that many food retailing services are positioned away from the matrix diagonal, which suggests that further analysis may help to explain the relationship between product-process matrix positions and service quality. Thus, using service quality data available for a subset of the electronic food retailing services in our sample, we explore the fit between the product and process configurations and service quality. The empirical analyses performed in this stage explore whether service quality levels are associated with the product and process configurations and their interactions, with distances of individual services from the ideal profiles of their product and process configurations, and with positions on or off of the product-process matrix diagonal. The results of these analyses suggest that service quality levels tend to improve as one moves down along the process configurations, and also tend to be higher along the product-process matrix diagonal.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1

Introduction

Electronic commerce used to be dominated by large companies that could afford to build the necessary computer infrastructure required to deliver electronic services. Early electronic services typically took the form of business-to-business applications of information technology that could integrate and improve the processes involved in purchasing and payment within a firm's supply chain. Common examples of services developed and delivered across these multi-company proprietary computer networks include electronic data interchange and electronic funds transfer. Recently, however, declining costs, ongoing advances and convergence of digital technologies have led to widespread penetration of electronic service delivery technologies into workplaces and homes (Bane, Bradley and Collis 1998). Hence, companies of all sizes can now electronically deliver services involving multiple forms of electronic media to individual customers anywhere and at any time (Collis, Bane and Bradley 1997). These newly emerging services and their underlying service operations are the subject of my dissertation.

The emergence of electronic services developed for individual consumers presents firms with unprecedented opportunities to create value for customers and also unlimited possibilities to fail. The novelty of this emerging class of technology intensive services has created the need for developing "a paradigm for the field of service operations management that allows us to capture the technological dimensions of 21st century services" (Chase 1996, p. 305). This research is a step toward addressing that need. The premise of the research is that understanding the complex and dynamic interrelationships between electronic service products and their underlying process technologies is key to managing electronic service operations effectively.

The potential for delivering value through electronic services poses questions for managers and researchers about typical configurations of products and of process technologies that are used to design and deliver electronic services, as well as how these configurations relate to service quality and customer value. These questions lead to further questions of whether there is a fit between electronic service product configurations and process configurations, and how this fit relates to the effectiveness of delivery of electronic services. Based on these questions about emerging electronic consumer services, the research question underlying my dissertation is: *What are the dimensions of operations used to deliver electronic consumer service products, and how do these dimensions relate to the service quality and customer value delivered in electronic consumer services?* Based on this research objective, the objectives of the study and the remaining chapters of the dissertation are as follows:

The *first* objective of this study is to understand the product dimensions in electronic services targeted at individual consumers, and the process dimensions used to deliver these electronic services. Chapter 2 develops a typology of electronic service products and a typology of electronic service processes, and combines them together to construct a conceptual framework in the form of a product-process matrix for electronic consumer service operations. Based on this conceptual framework, the chapter derives propositions for the delivery of customer value at positions and along paths within the product-process matrix.

The *second* objective of this study is to develop a framework in which to examine the relationship between the product and process typologies and electronic service quality. We accomplish this objective by developing taxonomies of electronic services derived from actual product and process technology data. Chapter 3 describes the research context for the empirical work in the dissertation, namely electronic food retailing services. We review the history of the food industry prior to the emergence of electronic consumer services, and characteristic aspects of food retailing, and use the discussion to motivate the usefulness of the retail food industry as a research context for electronic services. Chapter 4 uses cluster analysis to develop a taxonomy of electronic consumer services, using variables related to the dimensions of the electronic service product typology from Chapter 2. The taxonomy consists of groups of electronic food retailing services that represent frequently observed combinations of service product dimensions. Our results provide empirical support for the electronic service product typology, and illustrate several nuances exhibited by groups of services within the categories of the service product typology. Chapter 5 also uses cluster analysis to develop a taxonomy of electronic consumer service processes, using service process technology data from electronic food retailing services. The chapter also compares the cluster analysis taxonomy to an *a priori* taxonomy constructed from the basic electronic service process technologies. The results provide empirical support for the electronic service process typology, and illustrate nuances of the groups of services within each stage of the process typology. Taken together, the two taxonomies provide empirical support for the product-process matrix for electronic service operations.

The *third* objective of this study is to examine the relationship between the product and process configurations and service quality. Chapter 6 examines the fit between product configurations and process technology configurations within electronic services, and the relationship between these configurations and service quality. The objective of these tests is to determine whether the product and process technology configurations are related to service quality, and thus should be managed closely to deliver high service quality and in turn customer value in electronic services. Our results suggest that there is a fit between the product configurations and process configurations in electronic services. The results also suggest that the process configurations are associated with systematic and statistically significant differences in the levels of service quality in electronic services, and that positions further down the product-process matrix tend to exhibit higher levels of service quality. Finally, Chapter 7 presents contributions, limitations and future directions of this study.

CHAPTER 2

A Product-Process Matrix for Electronic Service Operations: Implications for the Delivery of Customer Value

2.1 Introduction

Electronic commerce – defined as the electronic exchange of information, goods, services, and payments – used to be the preserve of large companies that could afford to build or lease the necessary proprietary networks (Harrington and Reed, 1996).[1] Early applications of electronic commerce were largely limited to business-to-business services such as electronic data interchange and electronic funds transfer. These early applications typically required mainframe computer systems, complex and purpose-specific software, and massive systems integration. Declining costs, ongoing advances, and convergence of digital technologies have led to widespread penetration of such technologies into workplaces and homes (Bane, Bradley, and Collis 1998; *Time* July 20, 1998). Hence, it is becoming increasingly possible for firms to deliver services electronically to an individual customer anywhere and at any time (Collis, Bane, and Bradley 1997). This new and emerging class of service operations, namely electronic *business-to-customer* service operations, is the subject of this chapter.

While the emergence of electronic services presents firms with unprecedented opportunities to create value for customers, it also presents unlimited possibilities to fail (Biro, 1998; Hagel and Armstrong 1997; Harrington and Reed 1996; Yoffie 1997). The novelty of this emerging class of technology intensive services has created the need for developing "a paradigm for the field of service operations management that allows us to capture the technological dimensions of 21st century services" (Chase 1996, p. 305). This chapter is a step toward addressing that need. Our premise is that understanding the complex and dynamic interrelationships between electronic service products and their underlying process technologies is key to managing electronic service operations effectively. In this chapter, we report the development of a product-process matrix for electronic service operations. We demonstrate the application of the matrix by deriving propositions pertaining to the delivery of customer value through electronic services.

Our motivation for developing a product-process matrix for electronic service operations is to provide a conceptual framework for examining the different types of electronic service products and process technologies, the interrelationships between these products and processes, and their implications for the delivery of customer value. Conceptual frameworks, such as the product-process matrix, are fundamental to theory building (Doty and Glick 1994; Swamidass 1991). Product-process matrices have proven to be useful for both research and practice because of their descriptive and prescriptive abilities (Hayes and Wheelwright 1984; Kotha and Orne 1989). In the present context, the product-process matrix describes electronic service operations with reference to characteristics of electronic service products and electronic service process technologies. From a prescriptive standpoint, the matrix is the basis for deriving

[1] For a thorough discussion on electronic commerce, see Kalakota and Whinston (1996, 1997), and Tapscott(1996).

propositions intended to provide insights into how electronic service operations, depending on their position and paths on the matrix, will deliver customer value.

The remainder of the chapter is organized as follows. In section 2.2, we review the relevant literature to identify dimensions that differentiate between electronic service products and processes. Sections 2.3 and 2.4 report the development of two typologies, an electronic service product structure and an electronic service process structure, respectively. The product and process structures are the building blocks of the product-process matrix of electronic service operations. Section 2.5 presents the product-process matrix and propositions on delivering customer value through electronic services. Section 2.6 contains concluding remarks.

2.2 Electronic vs. Traditional Services: Some Background

The development of a product-process matrix requires the conceptualization of its two building blocks: the product structure and the process structure (Hayes and Wheelwright 1984). Thus, to develop a product-process matrix for electronic service operations, we must conceptualize the electronic service product structure and the electronic service process structure. Beyond a small number of articles and case studies, the literature on service management sheds little light on dimensions that illustrate the differences between electronic services. Advances in service technology have begun to motivate investigations into issues related to electronic service design, but this literature has tended to examine individual services rather than differentiate between groups of service operations. For example, Iansiti and MacCormack (1998) have examined the accelerated product and service design cycles in leading Internet firms, and case studies by Gerace et al. (1996) and Rangan and Bell (1998) have examined the electronic service design and delivery decisions made by Virtual Vineyards and Dell Computers, respectively. In the sub-sections to follow, we will identify dimensions of service products and processes, and then discuss the potential insights that can be gained from using these dimensions to differentiate between electronic services.

2.2.1 Service Product Dimensions

We first consider the usefulness of generic dimensions that differentiate services from goods. Service products possess characteristics of intangibility, heterogeneity, and inseparability of production and consumption. *Intangibility* occurs because services have no physical shape, which makes it difficult to count, measure, inventory, test, or fully describe the services. *Heterogeneity* results from variability in service system performance due to differences in delivery expectations and techniques of delivery. *Inseparability* of services describes the interface of sales, delivery and consumption. Goods are produced and inventoried for later sale and consumption, but services are characterized by simultaneous marketing, sale, delivery, and consumption.

Electronic services can include entirely new service transactions as well as elements of traditional services, thus they share many of the characteristics of traditional services. Electronic services are intangible because the service transactions and experiences delivered via electronic channels are difficult to measure, inventory, or describe fully. Service heterogeneity in electronic services stems from differences in provider technologies, service staff capabilities, and delivery expectations. Customers also contribute to electronic service heterogeneity because of their differing needs, self-service capabilities, willingness to interact, expectations and perceptions. Heterogeneity in electronic services also results from the performance of technology connecting the customer to the service delivery system. Finally, electronic services are inseparable because they have to be marketed, sold, delivered, and consumed simultaneously. Thus, since intangibility, heterogeneity, and inseparability appear to be generic properties of electronic services they do not differentiate well between such services.

While many dimensions have been proposed for traditional services, very little if any research has been conducted to identify dimensions that differentiate between electronic services. Cook, Goh, and Chung (1999) present a comprehensive review of the dimensions of traditional services. One dimension that might be adapted to electronic services is service quality. In examining traditional services, researchers created multidimensional constructs such as service quality (Parasuraman et al. 1985) and core and auxiliary elements of service quality (Lapierre 1996; Lovelock 1995) that could be used to describe and differentiate between traditional services. Electronic services also have core and auxiliary dimensions, which may occur as online offerings, such as multi-player gaming services, and offline offerings, as with electronic travel services that hand deliver paper tickets and itineraries. However, while existing constructs of core and auxiliary service quality differentiate between traditional person-to-person services, they do not necessarily distinguish between electronic services, or span previously unconsidered dimensions of electronic services.

2.2.2 Service Process Dimensions

A variety of dimensions can be found in the literature along which service processes have been characterized. Service processes include front office processes involving direct interaction with customers and back office processes with which customers have little contact. Chase (1978) characterized service operations according to their level of customer contact. Extending Chase (1978), Maister and Lovelock (1982) characterized service operations according to the extent of contact and extent of customization. Schmenner (1986) characterized services according to the degree of labor intensity, and degree of interaction and customization. Shostack (1987) characterized services according to dimensions that included degree of complexity of the service delivery structure and degree of divergence that is allowed during a service step. Haywood-Farmer (1988) extended this work to characterize services according to degree of contact and interaction, degree of labor intensity, and degree of labor customization. Goodwin and Radford (1993) presented a framework derived from customer scripts that characterizes services according to customer participation in the service delivery, and the provider's ability to control the customer's entry into the service delivery process. Kellogg and Nie (1995) differentiated between different stages of the service process using the construct of customer influence on the service process. Customer influence encompasses customer contact and interaction.

Electronic services differ in the extent to which customer contact, customization, interaction, and labor intensity can be used to differentiate between electronic service operations. Electronic service offerings are composed of online interactive service dimensions and offline non-interactive service dimensions. The online service dimensions involve continuous customer contact with the service system and offline elements involve little customer contact. As electronic services incorporate online elements, customer contact loses its power to differentiate because purely electronic services in any industry will have full customer contact. However, since customer contact can include varying levels of interaction, the level of *interaction* can differentiate between electronic services.

Similarly, the dimension of *customization* can be enriched to differentiate between electronic service operations. Electronic service customization takes place during online customer interactions and through offline back-office processes separated from the customer. *Online customization* can be accomplished by the service staff through the use of technologies such as videoconferencing systems, and by connecting customizable technologies directly to online service operations. *Offline customization* can be accomplished through many of the customizable tasks performed by service staff and technology, as in traditional back-office service operations. Note that in terms of competitive capabilities of operations, the process dimension of flexibility facilitates the delivery of interaction or customization.

2.3 Electronic Service Product Structure

Figure 2.1 is a 2X2 matrix that identifies electronic service products by their service content – either static or dynamic, and their target market segment – either unique or broad. Static content is simply downloaded to customers' service delivery technology without any assembly or modification. Dynamic content is created at the time it is requested based on the input or actions of customers and the state of the electronic service system at that time. We view the service products conceptualized in the electronic service product structure as a portfolio of goods and service attributes.

Figure 2.1: Electronic Service Product Structure Categories

	Electronic Service Content	
Market Segment	**Static**	**Dynamic**
Unique	***Niche Market*** One or a Few Services Low Demand Low Online Customization High Offline Customization No Joint Branding	***Customized Market*** Many Services High Demand High Online Customization Low Offline Customization High Joint Branding
Broad	***Market Extenders*** Several Services Low/Medium Demand Medium Online Customization Medium Offline Customization Low Joint Branding	***Mass Market*** Many Services Medium/High Demand Med./High Online Customization Low Offline Customization Medium Joint Branding

The resulting four cells of the 2X2 matrix correspond to *niche market*, *market extender*, *mass market*, and *customized market* service products. The dimensions along which electronic service products within each of the four cells of the matrix differ are scale and scope of the services, mix and content of online and offline customization, and the nature of joint branding.

2.3.1 Niche Market Electronic Services

Niche market electronic service products are typically targeted at a local or niche market where low demand exists for a small number of services. In niche market services, static online elements tend to be packaged with offline customization. From a service provider's perspective, customized online services are expensive to design and deliver, making them less likely to be offered in niche market services. While niche market services involve limited online dimensions, the customer may demand offline customization to enrich the service experience. For example, Eatwell Farm (http://www.eatwell.com/), a pick-up grocery service, packages fresh organic produce grown at the farm, based on customer orders received via the Internet. The online dimensions of service include ordering, culinary tips, and other free services and information for its customers about its current crops. After an order is placed, Eatwell Farm assembles the order in an offline fulfillment process, and the customer must then go to a neighborhood location to pick up the package of food. Similarly, SureSave (http://www.suresave.com/), a Hawaiian grocer, provides static pictures and directions for how customers can order customized deli trays. Electronic service providers also target market niches using customized offline services to design and produce products that meet individual customer needs, such as the personalized fortune cookies produced by Fancy Fortune Cookies (http://www.fortunecookiesonline.com/). They also use offline actions to modify the static online service experience over time as customers request enhancements.

2.3.2 Market Extender Electronic Services

Electronic service providers can grow by increasing the scope and online customizability of their services. Market extender electronic service products are broader than those in the niche market category. They are characterized by increased standardization of offline dimensions, and increased customization of online dimensions. For example, several medium sized regional electronic travel service providers use Internet Travel Network (http://www.itn.com/) capabilities to target wider market niches by combining online travel agent requests and customer self-designed travel packages with offline printing and delivery of tickets and associated materials by service staff or mail.

Online grocers also target these expanded niche markets. Examples of market extender electronic services include those provided by Hannaford's HomeRuns (http://www.homeruns.com/), a New England grocer, and Streamline (http://homer.natural.com/), a grocery delivery and household service provider in the Boston metropolitan area. These providers have targeted local and specialized national market niches, which have higher aggregate demand than niche market services. Virtual

Vineyards (http://www.virtualvin.com/), an electronic retailer of wines, entered the market with a broad offering of California wines targeted at a national market using static content containing product reviews and recommendations (Gerace et al. 1996). Virtual Vineyards' long term strategy was to transform its static content over time into a personalized, automated shopping system offering wines and complementary foods that would be chosen by the customer or suggested by customized online information resources.

2.3.3 Mass Market Electronic Services

Mass market electronic services can be targeted at a market with a broader cross-section of customers than can be targeted by market extender electronic services. As demand increases, customization of offline goods and services involved in electronic service products becomes increasingly difficult to perform. With a greater breadth of service offerings, customers need to have online customization that helps them search through the large variety of services and filters out irrelevant services. Large markets facilitate a breadth of services, but they also provide incentives for competitors to deliver similar services. Mass-market services, therefore, can become commodities. Providers of these services may attempt to differentiate themselves by joint branding of service portfolios that cannot be imitated. For example, Peapod (http://www.peapod.com/) offers mass-market online grocery services in many metropolitan markets. Because it serves large regional markets, Peapod and similar service providers can ally and jointly brand themselves with major grocery chains, and deliver customized electronic service elements via proprietary software. As they expand to additional metropolitan markets, service delivery systems of such providers must be increasingly customized to accommodate regional customer needs.

Travelocity (http://www.travelocity.com/), a provider of travel related services, has targeted markets with an increased breadth of customized travel service offerings. The customization is dynamic in that Travelocity can regularly update its customers about changes in the flight information and fares. Amazon.com (http://www.amazon.com/), a retailer of books and compact discs, has created customized online service experiences through automated search and suggestions systems for finding books, and capabilities allowing readers (i.e. customers) and authors to comment on books for sale.

Subspace (http://subspace.vie.com), a gaming service, has developed interactive multi-player games with a high level of customization that makes the gaming experience enjoyable. Many players (i.e. customers) can play an online game of Subspace simultaneously. Players can shoot down opposing players and send messages to each other while they play. Individual players can choose to play at one of several skill or speed levels to enhance their enjoyment.

2.3.4 Customized Market Electronic Services

Some customers' idiosyncratic needs can be satisfied via offline customization of niche market services, but other customers may have needs that are fulfilled only through online customization. Customized market electronic services can be targeted at such customers. Providers in this category can avoid being copied by offering uniquely customized joint services that build distinctiveness within the marketplace. For example, IndiSonic (http://www.indisonic.com/), a music retailer, builds customer relationships with many musical groups that cooperate with Indisonic to sell CDs and related goods. Alliances like Indisonic aggregate lesser known brands and remove supply chain intermediaries. This, in turn, allows them to deliver services to aggregated groups of customers having needs that are different from customers in the mass market. Autoweb Automotive Superstore's (http://www.autoweb.com) services are another example of customized market electronic services. Autoweb offers services branded by State Farm Insurance, NationsBank, Car and Driver Online, and BarnesandNoble.com. Autoweb makes it easy and convenient for customers to take care of all of their automotive needs in one online location. Finally, retailing services provided by Excite (http://www.excite.com/shopping/), Yahoo! (http://shopping.yahoo.com/), AOL (http:// www.aol.com/shopping/), and Amazon.com's Shop the Web (http://shoptheweb .amazon.com/) bring together goods and services of many different companies in highly customizable retailing environments that can integrate brands and services of many different electronic service providers.

2.4 Electronic Services Process Structure

We conceptualize the electronic services process structure, the second building block of the product process matrix, as four stages. The four stages are delineated according to the flexibility of electronic service process technology used by service providers to adapt to the dynamically complex and changing needs of customers.[2] More specifically, flexibility can be partitioned into dimensions of mix flexibility, volume flexibility (often referred to as scalability), and technology compatibility, each of which tends to increase as one moves down along the four process stages.

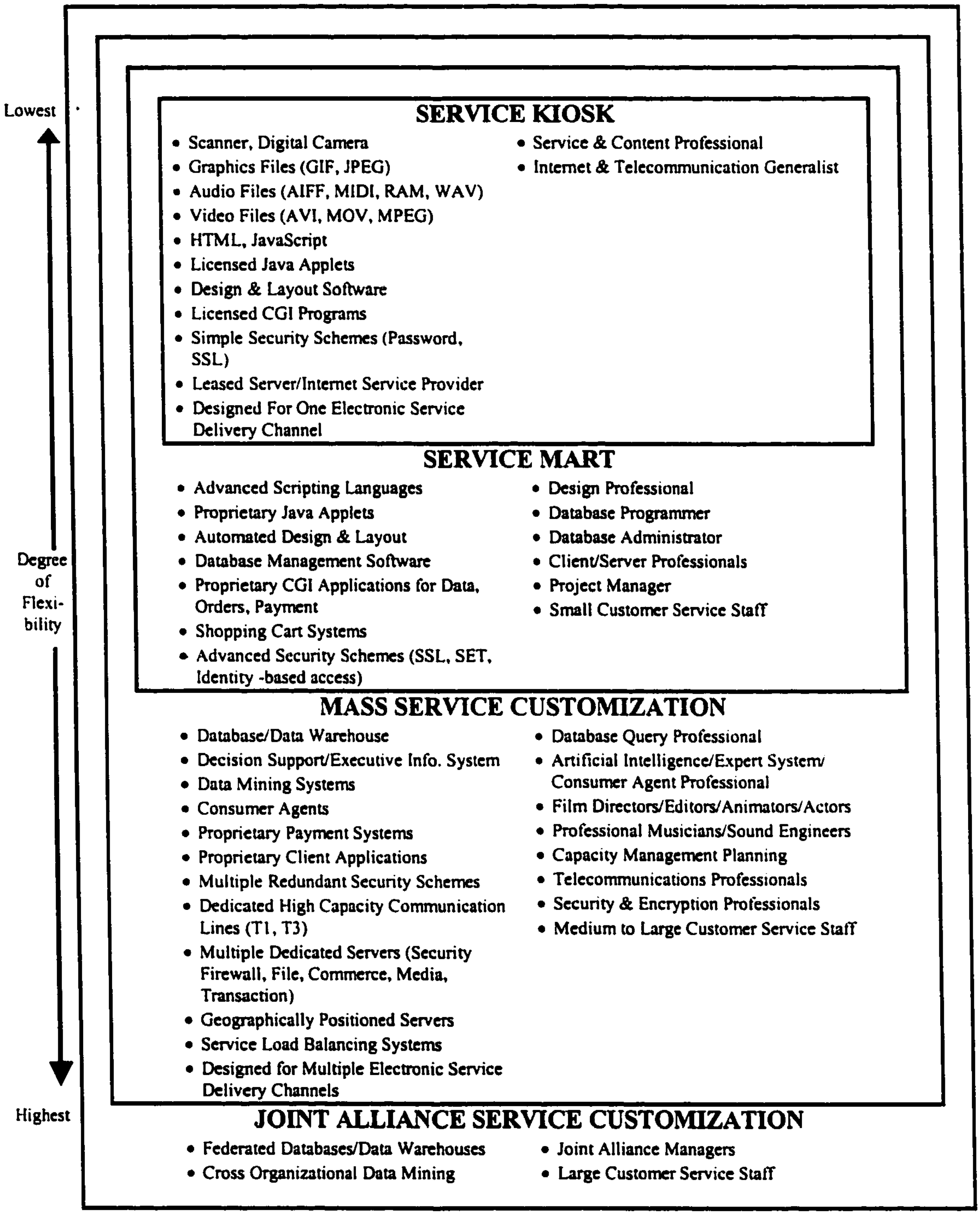
Figure 2.2 relates the four stages to typical technologies used in each stage, beginning with the least flexible technologies and ending with highly flexible technologies and infrastructure. As we indicate in Figure 2.2, earlier process stages are embedded within each subsequent stage. Technologies used in an earlier stage of the electronic service operations are often required for delivery in later stages. A glossary of electronic service process technology acronyms and terminology used in this chapter is presented in Appendix A.

The names of the four stages of the electronic service process structure are chosen to evoke relationships to traditional operations already found in the marketplace. *Service kiosk*, for example, evokes the notion of small stands set up in shopping malls or airports for individuals to deliver services. *Service mart* evokes the notion of a store that can deliver a relatively varied number of options to customers, but that is still limited in what it can deliver by the capacity of its technologies. *Mass service customization* evokes the notion of a provider who delivers a large number of services to meet

---

[2] Greenspun (1997) is an authoritative reference on decisions that need to be made when choosing technologies for electronic services. Yoffie (1997) provides a comprehensive review of the trends in electronic process technologies.

Figure 2.2: Stages in the Electronic Service Process Structure: Technologies and Technical Support Staff



dynamically changing customer preferences. Finally, *joint alliance service customization* evokes the notion of several service providers integrating their flexible process technologies.

2.4.1 Service Kiosk

The service kiosk uses inflexible but widely available technologies for delivery of electronic services. As shown in Figure 2.2, service kiosks typically deliver electronic services that use HTML, static image files, static sound files, and freely obtainable or licensed Java applets and CGI scripts. Service kiosks also choose not to operate their electronic service infrastructure, such as servers, security systems, and access to telecommunication infrastructure. Instead, they outsource the services that design and maintain those systems. Outsourced servers and infrastructure constrain the capabilities of the electronic services, which can limit the number and variety of services delivered online as well as the number of customers that can be served simultaneously.

Some providers use a service kiosk as their only form of operational process, while others use it as an inexpensive extension of existing physical operations. Service kiosks have been used by manufacturers, distributors, and traditional retailers of media, food products, and other customer goods to extend their reach to electronic delivery channels. These service kiosks serve as storefronts that allow customers to specify and order offline services. For example, font designer Chank Diesel uses ChankStore (http://www.chank.com/) to sell his fonts online, and to advertise and sell his offline custom font design services. ChankStore technologies include HTML and graphic files. The ChankStore outsources its server requirements to Internet service provider Bitstream Underground (http://www.bitstream.net/) and uses Digital River (http://www.digitalriver.com/) for secure payment transactions and order fulfillment.

Application of the service kiosk stage also can be found in the Raisin Rack Specialty Food Emporium (http://www.raisinrack.com/), a natural food store that sells produce, grains, herbs, and vitamins for a chain of three stores in Ohio. The Raisin Rack order form is an HTML form that e-mails a customer's information and order to Raisin Rack, and requests that customers call or fax their credit card payment information.

2.4.2 Service Mart

The service mart process builds on service kiosk technologies, adds more flexible technologies, and requires additional technical support staff. In service mart processes, static technologies used in the service kiosk can be created dynamically and linked together to deliver more highly customized services. For example, service providers can use CGI scripts and client side Java applets to increase the breadth and flexibility of service offerings, and also to differentiate their service offerings. In the most flexible service mart systems, small databases may be connected to the service process using CGI scripts or server side technologies such as Cold Fusion or Active Server Pages. These databases can be queried to dynamically build pages based on current information about products, and to collect customer data that can be used to customize current service delivery and to improve future services. At this process stage, server and telecommunication capacity needs to be increasingly robust to deliver reliable online services. Large unexpected variations in service demand are one of the most difficult technical challenges in electronic service design and must be managed through foresight of service design staff and the use of scalable technologies (Iansiti and MacCormack 1998). Increased scalability can be accomplished by using additional or faster processors, more server memory, more servers, and better management of server resources. However, technological limitations of CGI scripts, in particular, impose upper bounds on the volume flexibility of service mart systems. While service kiosk operations are designed to be self-standing and not require much interactive monitoring or maintenance by service staff, service mart operations require active involvement of a variety of technical support staff.

Application of the service mart stage can be found in Baltimore Coffee and Tea (http://www.baltcoffee.com/), which uses a CGI shopping cart system to sell more than 1000 varieties of coffee and tea. Their system lets customers choose whether to shop in a text or graphically rich shopping environment. During the checkout process, the CGI system collects shipping and payment information, and calculates a total order cost, all encrypted by SSL. Another example of an application of service mart can be found in the initial process design of Virtual Vineyards (http://www.virtualvin.com/), a retailer of wine and gourmet food selected and described by a group of food and wine connoisseurs. Virtual Vineyards used HTML forms delivered through Perl scripts and

CGI for merchandise orders (*PC Week* January 6, 1997), and supported encryption and security standards for processing online transactions.

2.4.3 Mass Service Customization

Mass service customization uses the most flexible electronic service technologies. This process stage requires the greatest breadth of technologies and technical support staff to deliver flexible services. As shown in Figure 2.2, technologies associated with the service mart at this stage are enhanced and adapted to the market requirements of mass service customization. To enhance service transactions, massive databases are built to collect customer data and are linked to data mining systems to learn about and enhance relationships with customers. At the mass service customization stage, electronic service delivery systems may handle millions of requests per hour, which necessitates scalable systems of multiple servers that can handle wildly varying aggregate customer demands without a noticeable decrease in the effectiveness of service delivery. Such server systems can be load balanced and distributed geographically to improve responsiveness. Backup systems of redundant hard disk arrays, servers, power generators, and digital infrastructure connections are also put in place in case primary systems fail. A security scheme involving several redundant security systems can be implemented to protect service technology and sensitive customer information during service transactions.

Application of mass service customization can be found in Travelocity (http://www.travelocity.com/) which, as noted earlier, is a provider of travel and related services. Travelocity offers reservations and ticketing on hundreds of airlines, continuously updated information on over 15,000 worldwide destinations, travel events, schedules, chat rooms, travel forums and a travel merchandise mall. Travelocity was built around the SABRE travel reservation system, initially developed by American Airlines. Travelocity uses HTML, JavaScript, CGI scripting, and secure channels for searching and booking. Travelocity uses its massive databases to proactively e-mail travel information to customers, and to maintain personal travel pages for customers. The extensive customer data collected through Travelocity has motivated The Sabre Group to build a data warehouse to explore and develop new services (*Computerworld* July 13, 1998, p. 6).

Other examples of application of the mass service customization stage can be found in Friend Finder. Friend Finder (htttp://www.friendfinder.com/) is a dating service that customizes itself according to customer interests and previous service evaluations. As a customer uses the service, the system attempts to update the customer's interests by examining the appeal of people with whom it matches them. Friend Finder also offers multiple levels of service options that have different prices, allowing customers to choose the flexibility and capabilities of their service delivery experience.

2.4.4 Joint Alliance Service Customization

Traditional joint branding alliances co-brand goods or services that are produced by one alliance partner. Alliances have become increasingly important within and across electronic service provider segments. The technological integration of several firms' electronic services creates significant challenges, but the potential gains from integration motivate these alliances and joint product development processes. The joint alliance service customization operation is characterized by its ability to deliver electronic services using technology separated by geographical distance and distributed across organizational boundaries. Firms pursuing joint alliance service customization employ the greatest breadth of technology and technical support staff. At this stage, most alliance partners have developed capabilities at the level of mass service customization. Joint alliances, therefore, involve integration of operations that allows the alliance organizations to deliver service packages and respond to individual customer preferences. Mass service customization technologies use flexible, reliable technologies that facilitate the integration of databases of different companies and facilitate decision-making using data from all organizations in the alliance. Technical support staff is also needed to manage organizational coordination, and customer service staff must be able to respond to customers of jointly delivered service portfolios.

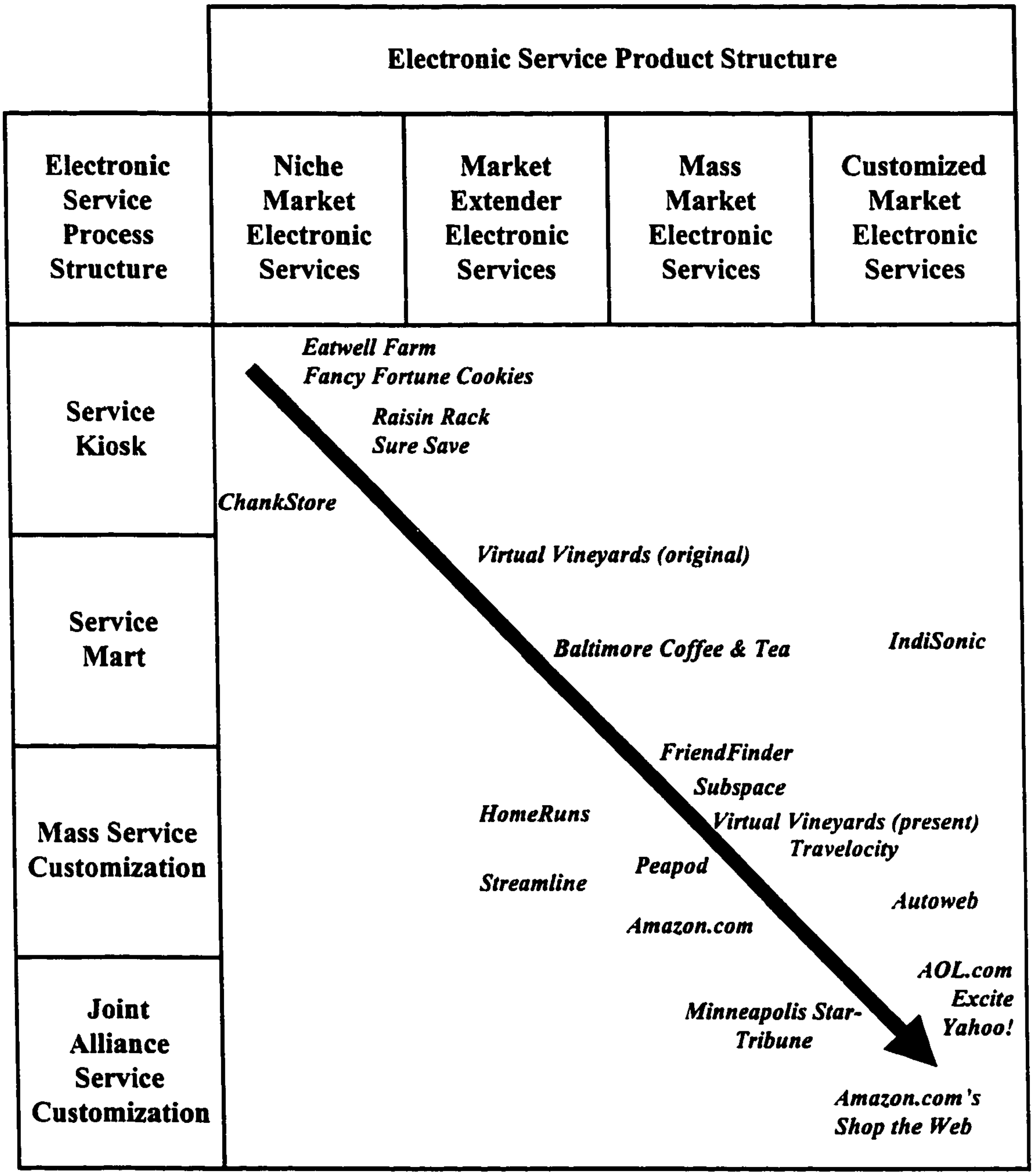
Application of joint alliance service customization can be found in the Autoweb Automotive Superstore (http://www.autoweb.com/), a jointly operated service that integrates the services of automotive service providers together in one place to provide one-stop shopping for automobiles, automotive insurance, and other related needs. Another example is the Minneapolis Star-Tribune (http://www.startribune.com/), which embeds the electronic personals ad service Personal Possibilities within its system, and integrates its database of newsprint personal ads together with Personal Possibilities. Finally, the AOL.COM (http://www.aol.com/shopping/) store and Amazon.com's Shop the Web (http://shoptheweb.amazon.com/) integrate product information together from hundreds of electronic retail services. In the case of AOL.COM, customers can use a personalized gift search system that lets them search across all of the products of participating services, based on self-reported personality profiles.

2.5 The Matrix

Figure 2.3 presents the product-process matrix for electronic service operations. The two sides of the matrix are the electronic service product structure and the electronic service process structure. For an illustration of a potential application of the matrix, we use the matrix to show the likely positions of a number of electronic service providers whose products and process technologies we cited as examples in the earlier two sections.

Service operations in the upper left-hand cells of the matrix are characterized by technologies with limited flexibility that make it difficult to change the online service dynamically. The increased scale of services makes offline customization less feasible as we move to the lower right area of the matrix. At the same time, service operations in this area are capable of using technology to interpret customer information and create a customized service experience. These service operations also expand to provide complementary services for larger groups of related customer needs. All of the service operations in the lower right corner can deliver the widest variety of service offerings

Figure 2.3: Product-Process Matrix for Electronic Services



for customers within the group of service markets in which the service providers operate individually.

The product-process matrix for electronic service operations in Figure 2.3 differs in a number of ways from the other product-process matrices in the literature. Most product-process matrices have founded their product structures on an assumption that as product volume increases product variety must decrease (Hayes and Wheelwright 1979; Kellogg and Nie 1995; Collier and Meyer 1998). Figure 2.3 is consistent with this assumption for physical service attributes, proposing that offline customization, which leads to variety of physical items and actions, will decrease as volume increases. In contrast, as volume increases along the electronic service product structure, a larger set of electronic service experience niches is targeted, and electronic service variety should increase due to capabilities of computer technology being used to satisfy this larger set of needs. Thus, we expect the customization of online service transactions to increase as services target additional niches, leading to both variety and volume for electronic service experiences. The Hayes and Wheelwright product structure also incorporated two tradeoffs: (i) flexibility versus dependability, which we view as solely a characteristic of the process structure, and (ii) quality versus cost, which we view as outcome variables resulting from the fit between the product and process structures. Overall, our product structure is somewhat more similar to the service product structure of Collier and Meyer (1998), if one were to reverse their structure. Our product structure also is conceptually related to the marketing web site design matrix of Palmer and Griffith (1998), who used a dichotomy between low and high information intensity, which intuitively relate to increasing use of static and dynamic content, to represent their marketing product structure.

Along the process structure, both the Hayes and Wheelwright product-process matrix and the product-process matrix for electronic service operations differ according to process flexibility. The Hayes and Wheelwright (1979) process structure also incorporated the same two tradeoffs found in their product structure: (i) flexibility versus dependability, and (ii) quality versus cost, indicating that their process structure was derived to match objectives of the marketing function, and only indirectly the objectives of the customer. Hayes and Wheelwright essentially assume that economies of scale motivate manufacturing to move to lower flexibility systems that facilitate low unit cost as they attempt to match themselves to high volume product demands. Economies of scale, low unit cost, and dependability seem theoretically possible in both low and high flexibility electronic service operations. Thus, the product-process matrix for electronic service operations assumes that flexibility dimensions will be used to differentiate between services operations based upon a movement from low flexibility to high flexibility. The concept of flexibility also incorporates elements of process structure complexity (Kotha and Orne 1989) into the process structure to represent the potential for mechanization, systemization and interconnection within the same firm and between electronic service operations of different firms. These elements make our process structure more similar to the reverse of the service product structure of Collier and Meyer (1998), since one might expect service flexibility to relate directly to the number of customer pathways in a service. Similarly, Palmer and Griffith (1998) constructed their marketing process structure from the dichotomy of don't sell versus sell, which should also tend to be positively related to service process flexibility.

2.5.1 Customer Value

Fundamental to managing a new and emerging class of operations, such as electronic service operations, is an understanding of how operations can enhance *customer value.* Perceived value of a good or a service is the construct that is most closely related to a customer's purchase decision. The delivery of customer value, therefore, will determine the rate and the extent to which customers of conventional services will switch to electronic services.

Perceived value is more individual and personal than perceived quality. According to Zeithaml (1988, p. 14), perceived value is the customer's "overall assessment of the utility of a product based on perceptions of what is received and what is given." Woodruff and Gardial (1996, p. 54) have defined customer value as the "customers' perception of what they want to have happen (i.e., the consequences) in a specific use situation, with the help of a product or service offering, in order to accomplish a desired purpose or goal."

Our review of the literature on electronic services suggests uncertainty typically associated with this class of services stems from lack of a clear understanding of their implications for customer value. Alba et al. (1997, p. 16) have observed that "the relative attractiveness of IHS [interactive home shopping] will be determined, as in the case of catalogs, by the customer's ability to predict the relative utility or satisfaction to be derived from a good presented electronically."[4] In a similar vein, Jeffrey P. Bezos, founder and chairman of Amazon.com has noted: "I hear a lot of people talking about business models, but I don't hear much about customer value" (*New York Times* January 18, 1999, p. C3).[3]

2.5.2 Propositions on Customer Value

We will now demonstrate the application of the product-process matrix to develop propositions on customer value through electronic service operations. The propositions relate positions and paths on the matrix to customer value. We also discuss the conceptual basis for each of the propositions.

Proposition 2.1. Electronic service operations that match service process technology to customer demand requirements should deliver higher customer value. Electronic service operations positioned toward the upper right hand corner of Figure 2.3 couple a market segment that wants a breadth of customized online services with service operations that use inflexible technologies. Service kiosk technology is limited in its ability to deliver customized online service offerings. Technical support staff in a service kiosk creates static content that can support repetitive transactions, but cannot support the scale and customization required to deliver a multitude of varying service transactions and experiences. Service providers using service kiosks to deliver customized, jointly

[3] On measurement of customer value, see Gale (1994); Woodruff and Gardial (1996); Parasuraman (1997); Sinha and DeSarbo (1998).

branded services will discover a mismatch between customer service expectations and experience.

Service operations positioned toward the lower left-hand corner of the matrix are more technologically feasible, but will deliver less value than service operations positioned along the diagonal. In low demand service markets, service operations employing jointly allied mass service customization have real and perceived costs above the level customers are willing to pay. Service operations positioned in the lower left-hand corner use technologies capable of delivering high online customization to target customers who desire high offline customization. The lower left-hand corner also creates perceived costs for customers, because the customer has to make a sacrifice in installing, learning, and operating special service technology. This corner, like the upper right corner, leads to a mismatch between service expectations and service delivered and motivates the following proposition:

Proposition 2.1 *Electronic service operations positioned along the matrix diagonal deliver greater customer value than service operations positioned in the upper right hand or lower left hand corners of the matrix.*

Proposition 2.2. As electronic service operations move toward mass service customization and joint alliance service customization, the increased flexibility of these systems facilitates scale, scope, online customization and integration with legacy service systems. Movement to these process structure stages involves an increased technological breadth and technically specialized support staff. Customers often can use these technologies to search and sort service information and customize service options. Service transaction data can also be collected and used to build business-to-customer relationships by personalizing immediate and subsequent service offerings and by drawing the customer back. Thorough personalization requires huge databases to collect customer data and tools such as data mining systems to gather and sort through this information. Consumer agents, expert systems, and statistical techniques can use the data to infer which type of services are of interest to a particular customer. These technologies require competent technical support staff that understands the technology and the service context to ensure that value is added to the service.

Electronic services delivered by alliances allow customers to purchase one or more alliance partners' services through integrated service processes. This model of service operations delivers value by giving customers enough flexibility to customize a package that contains several complementary service offerings. Such integration of service operations is likely to reduce customers' search costs. The larger variety of services may make customer purchasing information even more useful for suggesting and designing service packages that meet customer needs. Jointly operated services also facilitate joint branding, which can contribute to extrinsic attributes that drive perceived value, and can also benefit customers when services are new, experience-based, or used infrequently. These considerations lead to the following proposition:

Proposition 2.2 *Electronic service operations positioned toward the bottom of the matrix, i.e., those using mass service customization or joint alliance service customization, deliver greater customer value than* *service operations using service kiosk or service mart.*

Proposition 2.3. Electronic service operations deliver customer value when they become reasonable or preferred substitutes for conventional offline service delivery processes. Moving along the service product structure of the matrix, a tradeoff takes place between the value created by offline dimensions of conventional services and online dimensions of electronic services. The extent to which these service dimensions substitute for core and auxiliary attributes of traditional services will determine whether they provide value to a customer. Electronic service operations toward the right of the service product structure in Figure 2.3 target broad markets and cater to diverse customer preferences. Quick customization and response from online interactive media channels can create rich experiences that translate into lower search costs and enhanced customer value. The dynamic content of electronic service operations positioned toward the right of the matrix also reduces waiting time and allows customers to transact a service order quickly. Online customization also decreases the service heterogeneity that results from different service personnel and customer perceptions by letting customers control the service. We, therefore, state the following proposition:

Proposition 2.3 *Electronic service operations positioned toward the right of the matrix deliver greater customer value than service operations toward the left of the matrix when the value is derived mainly from online customization and brand alliances.*

Proposition 2.4. Conventional service operations use service personnel and technology for direct interaction with people, physical objects, and information. Electronic service operations toward the left of Figure 2.3 often involve elements of conventional services adapted to an electronic delivery channel. Small to medium sized retailers, for example, are not constrained by static content toward the left of the matrix because of their ability to combine customizable offline operations. These retailers typically use simple catalogs and order forms through which customers can order and pay for goods and services, and at the same time include written directions for how the service should be modified to suit their needs. The lower stages of the electronic service process structure, when targeted at the left of the service product structure, enhance the value of offline services and merchandise with pre-purchase sales experiences, post-sales consumption experiences, and the relationship with the customer, which leads to the following proposition:

Proposition 2.4 *Electronic service operations positioned toward the left of the matrix deliver greater customer value than service operations toward the right of the matrix when the value is derived mainly from offline dimensions of service offerings.*

2.6 Concluding Remarks

In this chapter, we developed a parsimonious conceptual framework in the form of a product-process matrix for examining the complex and dynamic interrelationships between electronic service products and processes, and their implications for the delivery of customer value. The primary contributions of this chapter to the literature on services are: (i) the two building blocks of the matrix – electronic product and process structures, (ii) the matrix itself, and (iii) the insights on delivery of customer value derived from the matrix. Typologies such as the electronic service product structure and the electronic service process structure, a conceptual framework such as the product-process matrix, and the propositions relating product-process interrelationships to customer value are amenable to cross-sectional and longitudinal empirical analyses (Safizadeh et al. 1996; Doty, Glick, and Huber 1993; Collier and Meyer 1998). This chapter, we believe, represents one of the very first theory development research initiatives on electronic service operations management.

From a practitioner standpoint, the product-process matrix has the potential to be useful both as a diagnostic tool and as a planning tool. As a diagnostic tool, the matrix can be useful to service providers for examining the causes of poor delivery of electronic services resulting from a mismatch between the electronic service products and process capabilities. As a planning tool, the matrix can be useful to service providers designing or re-designing electronic service operations by aiding in the choice of service products and appropriate process capabilities. Logical extensions to this chapter will be to conduct empirical analyses to (i) validate the categories of the electronic product structure and the stages of the electronic process structure, and in turn, develop taxonomies of electronic service products and processes, and (ii) investigate how the fit between categories of the product structure and stages of the process structure affects customer value.

CHAPTER 3

Research Setting – Electronic Food Retailing

3.1 Characteristics of a Useful Research Context

Electronic food retailing serves as the research context for analyzing the conceptual framework and testing the propositions presented in Chapter 2. Several factors support the choice of the food industry as an appropriate research context.

First, the research context should have sufficiently large aggregate revenue that motivates companies to switch consumers from one service channel to another. Emerging electronic services are not expected to increase total consumer expenditures (Peterson, Balasubramanian and Bronnenberg 1997). Instead, they will grow by convincing consumers to substitute consumption of electronic services for their previous mode of consumption of personal services. Without an existing, sufficiently high level of demand, there may exist too few services within one industry from which to collect data.

The research context also should span the breadth of the product typology presented in Chapter 2. An appropriate context should exhibit a wide variety of service products, with service product characteristics that represent the theoretical dimensions along which electronic services can be differentiated. The research context also should involve goods and services with complementary characteristics that motivate the joint branding of services.

Similarly, the research context should span the breadth of the process typology presented in Chapter 2. Electronic service operations are technological substitutes for traditional service operations. Thus, we would like to be able to characterize and measure the process technologies that are used in the electronic services. At the same time, electronic services are delivered via telecommunication infrastructures that substitute for each other, but that are complementary in the sense that the availability of one infrastructure tends to positively affect consumption across the other infrastructures (Peterson, Balasubramanian and Bronnenberg 1997). To the extent possible, we would like to understand and capture process elements that relate to this infrastructure. Finally, the ability to deliver many traditionally distinct services using similar electronic service technologies has created a blurring of industry and channel boundaries (Vepsäläinen and Saarinen 1998). The development of cross-industry electronic services by one traditional channel may affect the growth of all companies in that channel. Since this blurring of industry boundaries is recognized by our product and process typologies, we would like a research context that employs technologies that can be integrated, and possesses incentives for integrating the technologies across industry boundaries.

Finally, the research context should fulfill statistical requirements for an exploratory study. We would like to use a research context with a sufficiently large number of services so that our results can have sufficient degrees of freedom for hypothesis testing. We also would like the research context to exhibit sufficient organizational variety, product variety and process variety. In this way, we hope the findings might be generalized, to some extent, to industries outside of the research context.

In the following sections of this chapter we discuss each of these research objectives, as they relate to electronic food retailing. Section 3.2 discusses characteristics of demand and technology within the food industry that lead to various supplier incentives to develop electronic food retailing services. Section 3.3 discusses consumer objectives found in food retailing that help to fulfill our research objectives. Section 3.4 summarizes the reasons for using electronic food retailing as a research context.

3.2 Electronic Food Retailing: Substitution Incentives for Suppliers

The difference in consumer food expenditures between traditional grocery store and electronic food retailing segments presents a significant incentive for electronic food retailers to attempt to switch consumers from traditional to electronic food retailing. Food retailing makes up a significant proportion of consumer household expenditures. In consuming food at home and away from home in 1997, American consumers spent 10.9 percent of their disposable income on average on food (Donegan, 1998a). Overall, grocery sales in the United States in 1997 accounted for $436.3 billion in revenues (Donegan, 1998a). In contrast, electronic food retailing in 1998 was estimated to make up only $270 million in revenue (*Time*, 1998).

In addition to incentives provided by aggregate food expenditures, the retail food industry has undergone many changes that have affected traditional food stores, the food supply chain and consumers. These changes have provided several incentives for the introduction of electronic food retailing services. For existing retail stores, industry changes in scale and scope have negatively affected smaller grocers and lesser-known food brands. Grocers have tended to replace their traditional stores with bigger stores focused on large volume and low prices, and with specialized stores concentrating on market niches (Heikkilä et al. 1998, Kinsey and Senauer, 1996). Traditional grocery stores also have lost sales to specialized categories of stores such as merchandise discounters, category killers, and super center stores (Kinsey and Senauer, 1996). Overall, these competitive battles have been fought within a channel that has been decreasing in size over time. Stores that sell food items to be prepared at home have watched their relative proportion of total consumer food expenditures decline over time (Donegan, 1998a).

The food industry efforts to streamline food distribution throughout the food supply chain had additional negative effects on certain food segments. The streamlining initiative, called Efficient Consumer Response (ECR), changes the movement of food products in the retail food supply chain from a push system to a pull system in a manner similar to just-in-time (JIT) manufacturing. ECR uses barcodes to scan and collect consumer purchase data, which can be used in production planning, and in category management to rationalize the variety of products in a store. ECR information technology improves information flows between different supply chain parties and creates a smoother flow of products and paperless information within the food supply chain. ECR also refocuses supply chain performance from traditional volume measures to measures of customer satisfaction, cycle times, yield, reliability, and financial measures based on return on assets (Kinsey and Senauer, 1996). The cooperation between manufacturers and distributors adopting ECR has improved some areas of the food supply chain. However, ECR also increased consolidation and competition for shelf space, which in turn has led to a growing mistrust between manufacturers and distributors. Similar concentration changes in Finland led to wholesalers limiting the access of upstream producers to the consumer market (Heikkilä et al. 1998). Distrust and changes in food supply chain bargaining power create incentives for food manufacturers to shift their selling efforts to alternative trade channels outside of traditional grocery stores (Mathews, 1998).

Finally, changes in consumer food consumption preferences and practices have led to the substitution of prepared foods for groceries. Modern consumers increasingly want food in a ready-to-eat format, but also want it to be healthful, nutritious, and in great variety (Kinsey and Senauer, 1996). In practice, consumers do not seem to care whether they buy such foods in traditional grocery stores or via alternative channels, as alternative food retailing channel expenditures have recently grown much faster than traditional grocery service expenditures (Mathews, 1998). Consumers also have increased spending devoted to food prepared away from home (Donegan, 1998a). This movement of demand toward prepared foods has led traditional food retailers to broaden their operations, which in the past concentrated on food inventory management, to become purveyors of fully prepared meals called "home meal replacement" or "home ready meals" (Donegan, 1998b; Kinsey and Senauer, 1996). The declining revenues caused by this phenomenon may also move traditional grocers into electronic food retailing.

3.3 Electronic Food Retailing: Complementarity Incentives for Consumers

Food plays a variety of roles in individual and social life. These roles create complementary foods and service elements exploitable by food retailers to develop unique service operations. For example, Peter Granoff of Virtual Vineyards stated:

> "Wine and food ... are about farming, and they provide a bridge from those wild places to finer things, like art and culture. Then, of course, wine and food are about pleasure, so they appeal to the senses and the intellect. Additionally, the learning curve is steep in these fields. The more you learn, the more you need to know. Perhaps most importantly, though, wine and food are the vehicles for the coming together of family, friends, and loved ones." (Peter Granoff of Virtual Vineyards, in Gerace et al., 1996)

Food retailing services can attempt to satisfy consumers along many of these different objectives. The services can involve goods, services and service experiences, as well as information about the relationship of each of these items to sensual and intellectual characteristics of food preparation and consumption. The food goods can include perishables, semi-perishables, non-perishables and non-food goods, each of which in turn can be packaged along with other goods, services and service experiences inside and outside of the food industry to fulfill consumer objectives. Because of such a potentially broad offering of goods and service elements, the overall food retailing process can be more "bundle based" (Heikkilä et al. 1998) than for other types of retailing services typically involved in the sale of single goods having few immediate complementary elements.

The shopping process also can be designed to incorporate complementary elements. A simple conceptualization of the food retailing process involves search, purchase and customization processes for food items, however, grocery services have increasingly included complementary non-food services. Front office food retailing processes help the consumer choose and pay for a basket of food items, and back office service processes manufacture ready to eat and customized foods and assemble baskets of packaged foods chosen by the consumer. Traditional retailers have recognized synergies between food shopping and other tasks and have developed their operations beyond this simple concept by integrating complementary services such as photo development, dry cleaning and banking.

Electronic food retailing services can deliver service elements offered by grocery stores, as well as complementary service elements offered by electronic services in most any information intensive industries. When purchasing a food item for a meal experience planned at a certain time and place, the consumer is confronted with a complex, dynamically changing environment of product information and availability, which forces consumers continuously to reconsider the purchase opportunities. In contrast to the physical search processes in the traditional grocery store, electronic services can use information technology to help control the complexity of the consumer shopping experience at a time and place. Electronic food retailers can offer many potential service offerings, from purchase transactions and shipment processes, to offerings that fulfill consumer needs for the pleasure-seeking, sensuality, heritage, traditions, rituals, art, culture, and learning that often are associated with food (Gerace, et al., 1996), to complementary services such as banking and entertainment.

3.4 Electronic Food Retailing: Research Issues

The issues resulting from the supplier and consumer incentives discussed above make the retail food industry an appropriate context for examining the product-process matrix and for examining the positions and paths of the matrix to the quality of electronic services. The aggregate demand for food presents a sufficient incentive for established and entrepreneurial food retailers to introduce electronic food retailing services. The structural changes in the food industry have removed smaller food companies from the traditional supply chain and have led large-scale retailers to ignore smaller industry segments derived from non-mass market needs. The flexibility of electronic service technologies provides the potential for smaller retailers to reach customers having the demographics of ignored market segments, and to convince those customers to try their products or to consume their products once again.

The complementarity between food and other goods and services also lead us to expect a wide range of electronic food retailing services that will span the proposed product-process matrix. The changes in consumer needs and in supply chain relationships mentioned above have motivated food producers to employ electronic service technologies at the beginning and end of the retail food supply chain to improve services involving the delivery of food to consumers (Hemphill, 1996; Kinsey and Senauer, 1996). Farm-based food producers are using electronic commerce to circumvent the traditional food supply chain and to connect directly to consumers. At the consumer end of the food supply chain, new supply chain intermediaries have appeared between large food retailers and consumers to provide electronic food retailing services.

Finally, the electronic food industry satisfies several statistical objectives. The great number of small and large market segments have facilitated the emergence of a great number of electronic services from which data can be collected. In addition, since food retailing has elements that can be complemented by other food and non-food goods and services, one potentially can find and collect data from a set of service operations that span each of the categories in our product and process typologies. These two factors, large sample size and variability in the breadth of service offerings, make it likely that the findings from this one industry can be generalized to other electronic service contexts.

CHAPTER 4

A Taxonomy of Electronic Service Products: Empirical Analysis of Electronic Food Retailing

4.1 Introduction

This chapter relates empirically constructed configurations of electronic service product characteristics to a typology of electronic service products – one of the two building blocks of the product-process matrix for electronic services developed in Chapter 2. Conceptual typologies have often been used in the service management literature to build theory about organizational configurations (Cook, Goh and Chung, 1999). However, while typologies are useful for theory building as well as for description and prediction, they are ill suited for theory testing, being difficult tools to use empirically (Meyer, Tsui and Hinings, 1993). While typologies have helped to build understanding in many research areas, empirical analysis of typologies can improve their validity (Galbraith and Schendel, 1983).

Taxonomies developed empirically from actual data can provide insights that complement those incorporated into a typology. Taxonomy development can provide a basis for additional explanation, prediction, and theory testing (Miller 1981; Meyer, Tsui and Hinings 1993; Menor, Roth and Mason 1998). Taxonomies also can help one to identify groups of actual organizations that relate to ideal types in a conceptual typology, and to analyze whether and how these groups change over time relative to the ideal types. Perhaps most importantly, taxonomies can help to empirically analyze typologies for a specific industry. Thereafter, the taxonomy can be used as a framework for testing propositions derived from the underlying typology, leading to a better understanding for practitioners of the best practices within the industry.

In research contexts having many dimensions along which they may be characterized, as in electronic services, taxonomies are a useful tool for understanding characteristics shared by groups of organizations. Simple contingency models of service dimensions may not capture the full variety of service product attributes observable in electronic services. In contrast, the configurational approaches employed in taxonomic methods can incorporate complex groups of variables. Using these groups of variables, they often can produce simple yet understandable explanations of the underlying constructs. Taxonomic methods can use many dimensions to group organizational constructs of interest, including technologies, processes, practices and outcomes (Meyer, Tsui and Hinings, 1993). Further, taxonomies can be constructed at several levels of analysis, ranging from individuals within organizations, to organizations, to networks of organizations.

This study uses a cluster analysis of actual service product data from electronic food retailing services to develop a taxonomy of electronic service products. Actual service product data allows one to determine the existence of common product groups that actually appear within an industry, instead of product types that exist in a theoretical space. Further, actual data allows for the possibility that the product groups in an empirical taxonomy will closely match or illustrate mixtures or nuances of the types in a conceptual product typology. Since different nuances between service product configurations may lead to different service performance, an improvement in identification of common product configurations may lead to improved information and better management of electronic services.

The remainder of this chapter is organized as follows. Section 4.2 provides background for the construction of empirical taxonomies. Section 4.3 discusses the research design used for this study. Section 4.4 presents the results of this study. Section 4.5 discusses the results of this study, and Section 4.6 presents conclusions.

4.2 Background

Taxonomies have been developed to classify and explain complex organizational phenomena in many disciplines. Classification is a fundamental human process motivated by a desire for cognitive economy, predictive ability, and theory development (Milligan and Cooper 1987). Taxonomies have been found useful in a variety of contexts because they "provide parsimonious descriptions which are useful in discussion, research and pedagogy" (Miller and Roth, 1994, p. 286).

Taxonomies have been used in the operations management literature to classify and understand strategy and technology within manufacturing operations. For example, Bozarth and McDermott (1998) reviewed the use of taxonomies to analyze manufacturing strategy. Miller and Roth (1994) analyzed measures of competitive capabilities to develop manufacturing strategy groups. Boyer, Ward and Leong (1996) developed an empirical taxonomy based on existing conceptual typologies of advanced manufacturing techniques.

Taxonomies also have been employed to analyze service issues (Menor, Roth and Mason 1998; Cook, Goh and Chung 1999). Service marketing taxonomies include a classification framework for services (Silvestro, et al. 1992) and a taxonomy based on consumer perceptions of services (Bowen 1990). Service operations taxonomies include an inductive model of Menor, Roth and Mason (1998), who developed a taxonomy of agility in retail banks using measures of quality, flexibility and delivery. Finally, researchers have used taxonomic approaches to position services within product-process matrices (Collier and Meyer 1998).

Classification and strategic positioning of products and elements related to products also has been an important research area in the marketing literature. Taxonomies have been used to describe markets, market segments, cities, stores, magazines and customers. Researchers also have constructed measures to categorize individual products (Viswanathan and Childers 1999). Several reviews have discussed appropriate and inappropriate methodologies for constructing taxonomies (Punj and Stewart 1983; Stewart 1981; Milne 1994).

4.3 Research Design

Several decisions must be made when developing taxonomies. Three of the decisions are related to the process of choosing variables to use in the analysis: (i) how to select variables for an analysis, (ii) how to standardize the variables, and (iii) whether and how to transform the data when variables exhibit multicollinearity (Ketchen and Shook 1996).

4.3.1 The Empirical Context of the Research

The data for this study were collected from a sample of electronic food retailers on the World Wide Web. No directory of electronic food retailers existed prior to the study, thus the addresses of electronic food retailers used in the study were pooled from several sources. The first step in developing the directory of electronic retailers was to use Internet search engines to find addresses for electronic food retailing sites, and to collect addresses from link sites that maintain lists of electronic food retailing service addresses. Through this process, we identified a preliminary set of food-related sites on the World Wide Web. Each of the sites were visited and classified as being retailing sites, non-retailing sites, or non-operational sites. The addresses for non-retailing sites and non-operational sites were removed from the list of sites, leaving approximately 650 food retailing services. As additional food retailing services have appeared, they have been added to the address database, leading to a slightly larger candidate set of electronic food retailers. The sample was chosen in a random manner from this list of retailers. The food retailers in the sample were used to collect product variables relating to their electronic service operations. The data were collected in an ongoing manner beginning in late 1997. The overall sample consists of 255 electronic food retailers.

The use of a single industry sample provides several benefits. First, the sample is more likely to exclude potentially confounding factors related to industry characteristics. Second, the competitive environment within a single industry is likely to be similar, removing environment (in a single country) as a confounding factor. Third, since products and processes are more similar within an industry, variables can more easily be defined for a single industry, and can be defined in a more specific manner. Finally, the empirical findings of the study should be generalizable to electronic food retailers. In addition, since food retailers sell non-food items and offer electronic service attributes that are offered in many electronic service industries, we believe the findings will be generalizable to the vast majority of electronic retailers.

Selection of Variables and Data Collection

The choice of taxonomic variables is perhaps the most important decision that confronts all taxonomic studies (Ketchen and Shook, 1996). Bozarth and McDermott (1998) state that "the most important decision in developing a taxonomy centers around the choice of variables to use to classify organizations" (p. 431). The literature generally suggests that both "existing theory" and the "task at hand" should help to guide the choice of variables (Bozarth and McDermott, 1998).

The literature also indicates that taxonomies should not be constructed from sets of variables arbitrarily chosen for the convenience of the researcher. Ketchen and Shook (1996) differentiated between taxonomies that are developed inductively, deductively and cognitively, three strategies which imply theoretically ungrounded, theoretically grounded, and expert opinion approaches to choices of variables. Miller (1996) also criticized taxonomies developed from "arbitrary and narrow" sets of variables.

However, the inclusion of all collectable variables can potentially lead to problems of discerning which variables are significant differentiating factors of the taxonomy. For example, Ulrich and McKelvey (1990) used 78 variables to develop their taxonomy. Even when theory is used as a guide, several problems still may affect the process of choosing taxonomic variables. These problems include the validity of the literature used to choose variables, the possibility that the researcher may personally bias the choice of variables, the inclusion of irrelevant variables, the omission of variables of importance, and the inclusion of redundant or collinear variables (Ein-Dor and Segev, 1993).

The selection of variables for this study was guided both by existing theory and the research objectives of the study. More specifically, the typology of electronic service products from Chapter 2 guided the initial definition of variables. Variables were chosen in a manner that would provide for a theoretically supportable data set broad enough to make the exercise richly descriptive. Data were collected for a broad set of product variables and were not arbitrarily limited to a small number of variables. Given the exploratory nature of this study, every effort was made to include any reasonable variable that was encountered. When additional variables were included in the data set, each electronic service already in the data set was revisited and reexamined for those additional variables.

The electronic service product structure proposed in Chapter 2 was constructed from primary dimensions related to electronic service content and target market segment. Several secondary dimensions also were used to characterize electronic service products along the categories of the product structure. Tables 4.1 and 4.2 present the variables related to these primary and secondary dimensions of the service product structure. Table 4.1 shows that a number of count and interval variables, as well as a few dichotomous variables, are related to each of the product dimensions. In general, we expect increases in the count and interval variables to tend to relate to an increase in the corresponding conceptual product structure dimension.

Several variables also are available for examining the secondary dimensions of the electronic service product structure. Table 4.2 presents the dimensions *within* each of the four cells of the service product structure typology (Figure 2.1) and the variables conceptually related to these dimensions that were possible to collect from electronic food retailers. Table 4.2 indicates that these variables are mainly count and dichotomous variables.

The data were collected via direct observation of each electronic service and through collection of data from external sources. Electronic food retailing service sites on the World Wide Web were visited and data were collected at the point at which consumers interact with the service operations. During the visit, the hierarchical content structure of the service was mapped out, and relevant features were printed out for future reference. For each service, all observable content was downloaded and counted, transforming the content into a set of variables representing product and process choices actually implemented in the services. The researchers also collected supplemental information by visiting external information sources, such as the Internic

Table 4.1: Primary Product Dimensions and Related Variables

Product Dimension and Related Variables	Description
Service Content: Static	
Online periodical or magazine	Dichotomous (0/1)
Number of static pages or frame options	Count (0, 1, 2, ...)
KB HTML	Interval $(0, \infty)$
KB text files	Interval $(0, \infty)$
KB Adobe PDF files	Interval $(0, \infty)$
KB graphics	Interval $(0, \infty)$
Number of graphics files	Count (0, 1, 2, ...)
Number of audio files	Count (0, 1, 2, ...)
Number of video files	Count (0, 1, 2, ...)
Service Content: Dynamic	
Number of dynamically generated pages	Count (0, 1, 2, ...)
KB Cold Fusion	Interval $(0, \infty)$
KB Active Server Pages	Interval $(0, \infty)$
KB Cold Fusion or Active Server Pages	Interval $(0, \infty)$
Chat facility on site	Dichotomous (0/1)
Message board on site	Dichotomous (0/1)
Consumer agent on site	Dichotomous (0/1)
UPS/FEDEX tracking integrated into site	Dichotomous (0/1)
Site search system available	Dichotomous (0/1)
Site sort system available	Dichotomous (0/1)
Expert system available	Dichotomous (0/1)
Number of dynamic items	Count (0, 1, ... 7)
Target Market Segment: Unique vs. Broad	
Number of languages used	Count (0, 1, 2, ...)
Maximum distance willing to ship	Scale (1, 2, 3, 4, 5)
Number of goods offered	Count (0, 1, 2, ...)
Number of online services offered	Count (0, 1, 2, ...)
Number of offline services offered	Count (0, 1, 2, ...)
Number of payment options	Count (0, 1, 2, ...)
Number of shipping options	Count (0, 1, 2, ...)

(http://www.internic.net/) WHOIS resource, which provides physical addresses and technical information about Internet service providers and electronic service providers.

Table 4.2: Secondary Product Dimensions and Related Variables

Product Dimension and Related Variables	Description
Scale of Service	
Number of languages used	Count (0, 1, 2, ...)
Shipping targeted at local	Dichotomous (0/1)
Shipping targeted at multi-state region	Dichotomous (0/1)
Shipping targeted at nation	Dichotomous (0/1)
Shipping targeted at several nations	Dichotomous (0/1)
Shipping targeted at world	Dichotomous (0/1)
Shipping targeted at local or multi-state	Dichotomous (0/1)
Shipping targeted at one or more nations	Dichotomous (0/1)
Scope of Service	
Number of goods offered	Count (0, 1, 2, ...)
Service includes a membership club	Dichotomous (0/1)
Number of online service variations offered	Count (0, 1, 2, ...)
Number of offline service variations offered	Count (0, 1, 2, ...)
Number of payment options	Count (0, 1, 2, ...)
Number of shipping options	Count (0, 1, 2, ...)
Offline Customization	
Will ship as gift	Dichotomous (0/1)
Offer to customize goods or service offlline	Dichotomous (0/1)
Email updates and marketing offered	Dichotomous (0/1)
Periodic email newsletter offered	Dichotomous (0/1)
Collect consumer information	Dichotomous (0/1)
Online Customization	
Pages of consumer contributions to site	Count (0, 1, 2, ...)
Chat facility on site	Dichotomous (0/1)
Message board on site	Dichotomous (0/1)
Use consumer data to personalize online	Dichotomous (0/1)
Consumer agent on site	Dichotomous (0/1)
UPS/FEDEX tracking integrated into site	Dichotomous (0/1)
Site search system available	Dichotomous (0/1)
Site sort system available	Dichotomous (0/1)
Expert system available	Dichotomous (0/1)
Joint Branding	
Number of companies operating site	Count (0, 1, 2, ...)

Reliability of Measures

Reliability relates to the objective that, when measuring a theoretical construct, one would like the measure to report identical measurement values upon repeated measures of the same item. However, reliability is founded on the concept of a single true score underlying a measure (Bollen 1989), which implicitly is founded upon an assumption of a stable construct. This condition is reasonable for stable perceptual constructs, but may be violated by attributes in many operational contexts, since lower-level operations attributes can be changed minute-by-minute. Thus, actual data representing lower level operations attributes, including the data in this study, may represent only a single realization from a possible set of operational states. In similar research situations, such as cross-sectional studies incorporating dynamic financial data, researchers have assumed that single observations would possess reliability. Few statistical tests of reliability for such data have appeared in the literature. Since perceptual scale measurement items were not employed to collect data for this study, the extent to which subjective evaluations were made was only the identification of use, or lack of use, of a service product or service process attribute. As a result, tests of reliability for our data can not use reliability techniques developed in the literature for psychometric measurement models.

If reliability is in doubt for any data, one might approach reliability from a consistency or repeatability perspective (Bollen 1989). Using this approach, one can collect the same data multiple times to examine the inter-rater reliability of the collection process. However, in this study the cost of collecting replications of the data set would have been prohibitively expensive. Due to the cost and time of such replications, and the limited marginal improvement in information that such an exercise would provide for an exploratory study, the data were collected only once.

Validity of Measures

Validity relates to the objective that, in choosing measures of a construct, one would like measures to relate to the concept that they were intended to measure, and not to measure other constructs. Researchers have noted four types of validity: content validity, criterion validity, construct validity, and convergent and discriminant validity (Bollen 1989). *Content validity* of the data set was assured by basing the set of variables on information available from the information technology practitioner literature. The variables were derived from the product typology representing generic dimensions of electronic services, from knowledge of product attributes described in the practitioner literature, and from observation of product attributes that were not described in the literature but were observed in the process of collecting data. *Criterion validity* could not be evaluated since objective criterion measures were not available for each product attribute of each service in the sample. While *convergent and discriminant validity* is insightful to test when developing measures of perceptual phenomena meant to be uncorrelated, this form of validity does not seem to apply to direct counts of lower-level operations attributes which one might expect to be correlated. Finally, *construct validity* is indicated by statistically demonstrating theoretical associations between the constructs, which is the general objective of the empirical analysis in this study.

Characteristics of the Sample

The retailers in our sample come from a variety of positions from what is considered to be the traditional food supply chain. Table 4.3 summarizes the characteristics of the electronic services in our sample. Note that one company can position themselves in several supply chain positions. A number of the electronic food retailers also participate in catalog retailing. The smallest food retailer product offering consists of one product, while the largest offering consists of many thousands of goods. Finally, the primary food category is distributed across a number of categories, with the main categories being in beverages and coffee, meats, fresh produce, broad grocery services, candy and gift baskets.

4.3.2 Standardization and Transformation of Variables

Variables measured in different scales can affect cluster analysis results. Variables with larger ranges will tend to contribute more heavily to the distances calculated in performing cluster analysis. Thus, variables used to develop taxonomies should be transformed so individual variables do not adversely affect cluster results. Researchers have employed Z-score transformations (Cutcher-Gershenfeld 1995; Galbraith and Schendel 1983; Ulrich and McKelvey 1990) and have tranformed variables to identical intervals (MacDuffie 1995). With continuous variables distributed multivariate normal, researchers typically use Z-score standardization of the variables.

However, many researchers have applied Z-score transformations in situations where they make no sense, as when variables are nominal, scale variables or count variables. Johnson and Wichern (1992) discuss transformations that are appropriate in these situations.

Table 4.3: Characteristics of the Sample

	Number in Sample	Percent of Sample
Traditional Supply Chain Position		
Farmer/Fisherman	39	15.3%
Manufacturer	148	58.0%
Distributor	41	16.1%
Retailer	97	38.0%
Catalog Retailer		
Offers to send a catalog	58	22.7%
Number of Products Offered		
1-10	62	24.3%
11-50	82	32.2%
51-100	30	11.8%
101-250	34	13.3%
251-500	23	9.0%
501-1000	14	5.5%
1001-10,000	9	3.5%
10,000+	1	0.4%
Number of Offline Service Variations Offered		
0	158	62.0%
1-10	77	30.2%
11-20	12	4.7%
20+	8	3.1%
Number of Retailers Selling Online Services	7	2.7%
Primary Food Category		
Beverages (not Coffee)	35	
Coffee	23	
Meat/Seafood	35	
Fresh Produce/Vegetables	14	
Dairy	5	
Broad Grocery Services	6	
Dessert/Baked Goods	24	
Candy	20	
Gift Baskets	12	
Gourmet Food	27	
Ethnic Food	7	
Sauces/Hot Sauce	22	
Specialty/Other Foods	25	

Prior to choosing a standardization method, one should consider whether redundancy exists within the variables in a data set. If redundancy is present, the standardization of variables should be performed to facilitate subsequent transformations that remove the redundancy. In deductive taxonomic studies related to conceptual typologies, one would like to include variables related to each theoretical dimension of the typology, without having too many variables related to one dimension overweight the importance of that dimension in the statistical analysis. Redundancy also may exist within a set of variables used in an inductive study. In both cases, the redundancy can often be detected by analyzing the correlation between variables. When variables in a data set can be transformed to be approximately multivariate normal, researchers typically apply a two-step approach involving factor analysis to reduce a data set to a smaller set of orthogonal scale variables. Ketchen and Shook (1996) suggested using principal components factor analysis with a varimax rotation, and using the factor scores from this procedure in a subsequent cluster analysis. Other researchers have used principal components (Galbraith and Schendel 1983).

The literature does not suggest an appropriate methodology when a data set consists of a mixture of dichotomous, categorical, count and continuous variables. In this case, the product moment correlations used in typical factor analysis procedures must be substituted with polychoric, tetrachoric, polyserial and biserial correlation coefficients, which can then be used to calculate factors and factor scores for the set of variables. However, the restrictions placed upon the calculation of these correlation statistics tend to restrict the use of the dichotomous and count variables in our data set. Typically, researchers have taken the approach of limiting their study to a single type of data, or reducing mixed data sets to a single data type (Anderberg 1973). Thus, we limit our analysis to variables that can be transformed to approximate normality, and employ the two-step method suggested by Ketchen and Shook (1996) to remove multicollinearity in the data.

4.4 Empirical Analysis and Results

Researchers have proposed several criteria for constructing taxonomies. Bozarth and McDermott (1998) stated that taxonomies should not be affected by the techniques employed to develop the taxonomy or by the data used in developing the taxonomy. They also suggested that researchers should use multiple techniques in developing taxonomies to test the robustness of a solution. Further, robust taxonomies should facilitate both the understanding of existing types and the identification of omitted or unknown types (Ein-Dor and Segev, 1993), thus researchers should not need to include all possible cases when developing taxonomies. Taxonomies also should be cross-validated. The literature has typically suggested that researchers should validate taxonomies using holdout samples (Bozarth and McDermott 1998; Ein-Dor and Segev 1993). Ketchen and Shook (1996) described additional techniques that should and should not be used to examine reliability and validity of taxonomic solutions. Finally, taxonomies should help to answer the research question at hand, in a manner that provides an understandable interpretation of the phenomenon. Miller and Roth (1994) stated that "the most appropriate way to form strategic groups depends on what the researcher intends to accomplish." Taxonomic studies are often motivated by the objective of being able to identify a limited set of configurations that lead to a simple yet powerful explanation of differences in the population of interest. As the number of configurations decreases, it generally becomes easier to identify common themes that underlie successful and unsuccessful organizations (Miller and Friesen, 1977, 1978; Miller, 1981). However, a smaller number of clusters may also tend to exhibit larger within-cluster variation, leading to lower consistency within the clusters.

In this study, we follow the methodologies suggested by Ketchen and Shook (1996) for taxonomy development. In addition, where possible, we draw upon the methodological analysis of previous taxonomic studies of operations (e.g. Miller and Roth 1994; Menor, Roth and Mason 1998).

4.4.1 Variable Standardization

The count variables and non-negative continuous variables were transformed to remove a positive skew commonly observed in these data types. Johnson and Wichern (1992) suggest that individual transformations should be chosen for each variable in a data set. Since the count and continuous variables were skewed to the right, transformations were chosen that would compress the distributions of these variables toward zero. Johnson and Wichern (1992) suggest using the square root transformation in cases of count variables. Histograms of several variables also exhibited shapes typical of exponential distributions, thus logarithmic transformations also were examined.

After each transformation, the variables were examined for approximate univariate normality using histograms, and for the absence of nonlinear relationships between pairs of variables using scatterplots (Bollen, 1989). Histograms aid identification of outliers that can adversely affect parameter estimation (Bollen, 1989). Each variable also was examined for skewness and kurtosis using P-P and Q-Q plots. Variables that had insufficient variation across the sample were removed. The remaining variables were transformed using either a square root or natural logarithm transformation. Table 4.4 shows the primary conceptual dimensions from the product structure in Chapter 2, the theoretically related variables included in the study, and the transformations used for each variable.

Table 4.4: Electronic Service Product Variables: Transformations and Factor Loadings

Product Dimension and Related Variables	Description	Transformation	Factor Loading
Service Content: Static			
Number of static pages or static frame options	Count (0, 1, 2, ...)	ln(Y+1)	0.783
KB HTML	Interval (0, ∞)	ln(Y+1)	0.782
KB graphics	Interval (0, ∞)	ln(Y+1)	0.838
Number of graphics files	Count (0, 1, 2, ...)	ln(Y+1)	0.855
Service Content: Dynamic			
Number of dynamically generated pages	Count (0, 1, 2, ...)	ln(Y+1)	0.926
Number of dynamic service items	Count (0, 1, ... 7)	ln(Y+1)	0.926
Target Market Segment: Unique vs. Broad			
Number of goods offered	Count (0, 1, 2, ...)	ln(Y+1)	0.732
Number of offline services offered	Count (0, 1, 2, ...)	ln(Y+1)	0.371
Number of payment options	Count (0, 1, 2, ...)	SQRT(Y)	0.711
Number of shipping options	Count (0, 1, 2, ...)	SQRT(Y)	0.727

4.4.2 Multicollinearity Adjustment

Factor analysis was used to reduce the chosen variables to three factor score variables relating to the product typology dimensions. Common factor analysis programs typically assume that variables possess multivariate normality. When a sample includes non-normal variables, transformations of the variables can be chosen to make them more close to normal (Bollen, 1989). For our product variables, the variable transformations in Table 4.4 made the retained variables approximately normal, based on P-P and Q-Q plots. Thus, for the three sets of product variables, we used the exploratory factor analysis procedure in SPSS using a matrix of Pearson product moment correlations to develop factor score variables. The number of eigenvalues greater than one was used as the initial decision rule for selecting the number of factors to retain. The static content variables supported two separate factors, one general factor that explained most of the variation and a second factor that contrasted text and graphic content. The dynamic content and market segment variables indicated single factor solutions. Since SPSS concluded for each set of variables that a single factor explained a majority of variation in the data related to each concept, we used single factor solutions in each case. Table 4.4 presents the single factor solution loadings for each of the variables. The factor scores for the sets of variables related to static content, dynamic content and market share were retrieved and saved for subsequent use in the cluster analysis procedure.

4.4.3 Results of the Cluster Analysis

Hierarchical clustering methods were used to find a reasonable number of clusters. The results of the hierarchical clustering procedure were then used as the initial cluster centers for subsequent K-means cluster analyses. This two-stage procedure has been recommended in the literature since it tends to improve cluster analysis solutions

(Punj and Stewart, 1983; Ketchen and Shook, 1996), and has been used previously in the literature (Miller and Roth, 1994; Menor, Roth and Mason, 1998).

We used Ward's method for examining initial cluster solutions. Lehmann's rule (Miller and Roth 1994) suggests that the number of clusters should be between n/30 and n/60, where n is the number of observations. This rule suggests that our data set could support from four to eight clusters. Prior to the empirical analysis, a single outlier observation was removed from the data set because the number of goods it offers is over 100 times as much as the next largest food retailer in the sample. Since this service closely resembled the customized market service product stage, it was assigned its own cluster, leaving a maximum of seven clusters for the remainder of the data set. As the typology consists of four separate types, we examined the Ward's method solutions for three through seven clusters. Since the Ward's method cluster means were considerably different for the solutions with larger numbers of clusters, and the sizes of subsequent clusters remained fairly large, we chose the cluster solution having seven clusters. Table 4.5 presents the initial means from the Ward's method 7-cluster solution, as well as the relationship of these clusters to the clusters from 4-, 5- and 6-cluster solutions.

We then used the cluster means from the seven-cluster Ward's method solution as a starting point for a seven-cluster K-means cluster analysis. Table 4.6 presents the means of the factor score variables used to construct the clusters, and the resulting distances between the cluster centers. Interestingly, the cluster centers produced by Ward's method are quite similar to the centers from the K-means solution. The factor

Table 4.5: Comparison of Ward's Method Product Cluster Means for Factor Scores

Clusters = 7	Ward's Method Cluster Means						
Product Typology Dimension	1	2	3	4	5	6	7
Static Content	-0.88	-0.87	0.10	-0.29	0.95	1.93	-0.13
Dynamic Content	-0.59	-0.56	-0.15	-0.50	0.13	2.06	2.32
Market Segment	-1.53	-0.59	-0.44	0.32	0.93	1.43	1.13
Number in Cluster	36	41	47	57	38	23	12
Clusters = 6	Ward's Method Cluster Means						
Product Typology Dimension	1	2	3	4	5	6	7
Static Content	-0.87		0.10	-0.29	0.95	1.93	-0.13
Dynamic Content	-0.58		-0.15	-0.50	0.13	2.06	2.32
Market Segment	-1.02		-0.44	0.32	0.93	1.43	1.13
Number in Cluster	77		47	57	38	23	12
Clusters = 5	Ward's Method Cluster Means						
Product Typology Dimension	1	2	3	4	5	6	7
Static Content	-0.87		-0.11		0.95	1.93	-0.13
Dynamic Content	-0.58		-0.34		0.13	2.06	2.32
Market Segment	-1.02		-0.02		0.93	1.43	1.13
Number in Cluster	77		104		38	23	12
Clusters = 4	Ward's Method Cluster Means						
Product Typology Dimension	1	2	3	4	5	6	7
Static Content	-0.87		-0.11		0.95		1.22
Dynamic Content	-0.58		-0.34		0.13		2.15
Market Segment	-1.02		-0.02		0.93		1.33
Number in Cluster	77		104		38		35
Clusters	Ward's Method Clustering Pattern						
2	219						35
3	77		142				35
4	77		104		38		35
5	77		104		38	23	12
6	77		47	57	38	23	12
7	36	41	47	57	38	23	12

scores used in developing the clusters each have an approximate mean of zero and variance of one. Thus, clusters having negative factor score means tend to be related to low levels on the underlying variables, while clusters having positive factor score means tend to be related to high levels on the underlying variables.

Table 4.6 indicates that the three conceptual dimensions chosen to differentiate between electronic services do seem to lead to large differences between groups of electronic food retailing services. Table 4.6 also presents the F-statistics from a single-factor ANOVA for the factor score variables. Although the F-statistics should be viewed only as descriptive since they are a product of the K-means clustering procedure, the F-statistics related to the three product dimension variable cluster means indicate that there are differences between the clusters along each dimension.

Table 4.6: Comparison of Product Cluster Means for Continuous Variables

	Cluster Means							
Product Typology Dimension	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**F-Statistic (p-value)**
Static Content	-0.77	-1.05	0.10	-0.19	1.01	0.29	2.17	141.1 (0.000)
Dynamic Content	-0.59	-0.51	-0.18	-0.50	-0.15	2.08	1.93	180.2 (0.000)
Market Segment	-1.47	-0.41	-0.43	0.36	0.98	1.00	1.56	204.9 (0.000)
Number in Cluster	41	43	51	44	34	23	18	
Distance Between Cluster Centers								
Cluster 1		1.103	1.419	1.921	3.059	3.794	4.920	
Cluster 2			1.208	1.154	2.513	3.246	4.501	
Cluster 3				0.906	1.677	2.685	3.562	
Cluster 4					1.397	2.707	3.597	
Cluster 5						2.353	2.454	
Cluster 6							1.975	

We examined the reliability of our cluster solution by using the hold-one-out jackknife procedure available in the SPSS discriminant analysis procedure. Table 4.7 presents the results of this analysis, in which 97.6 percent of the items classified using cluster analysis remained in the same group using the discriminant analysis procedure. This finding provides empirical support to the K-means cluster analysis solution.

Table 4.7: Hold-One-Out Product Cluster Cross-Loadings

	Discriminant Analysis Solution							
Cluster Analysis Solution	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Total**
1	41							41
2	2	40	1					43
3		1	50					51
4			1	43				44
5					34			34
6						23		23
7						1	17	18
Total	43	41	52	43	34	24	17	254

The canonical variates from the discriminant analysis procedure, and the factor scores for each conceptual product structure dimension, also illustrate the differences between the product configurations. Figures 4.1 and 4.2 present plots of the product configurations based on the first two, and all three, canonical variates from the discriminant analysis, respectively. The plots show how the groups are differentiated along each of the three dimensions. Figures 4.3 through 4.5 plot the seven clusters along pairs of the factor score variables used to construct them. Together, these figures tend to indicate symmetric and non-overlapping clusters. Figure 4.5 indicates that clusters 1, 2 and 3 appear to be largely disjoint along the market segment and static content dimensions, while Figure 4.3 indicates a similar finding for clusters 5, 6 and 7 along the market segment and dynamic content dimensions. Finally, Figure 4.4 indicates that cluster 3 through 7 tend to differentiate themselves from cluster 1 and 2 along the dynamic content dimension.

Several additional methods were used to analyze the cluster solution. Not enough data were available to justify using half of the data set as a holdout sample to examine external validity. Cluster sizes in the K-means cluster analysis results are small enough that dividing the sample in half would potentially have led to problems with the identification of smaller clusters in both sub-samples. Instead of holdout samples, we performed single factor ANOVA and multiple comparison procedures on variables related to the primary and secondary level dimensions from the service product structure typology. Other studies have use similar validation procedures. For example, Miller and Roth (1994) used the Scheffé procedure to examine their clusters. Menor, Roth and Mason (1998) performed Tukey-Kramer pairwise comparisons for continuous variables, and multinomial tests of equivalence of frequencies for dichotomous variables.

We first analyze the variables related to the primary dimension factor scores. Table 4.8 presents a summary of the means of the original variables that were reduced to factor scores to construct the product taxonomy. Table 4.8 also presents F-statistics for a single factor ANOVA performed on the variable means of these clusters, using the transformed variables, as described in Table 4.4. Below each of the cluster means, we present Scheffe multiple comparison results, with identical integers representing the sets of clusters having insignificantly different means. Levene tests for homogeneity of

Figure 4.1: Plot of First Two Canonical Discriminant Analysis Functions

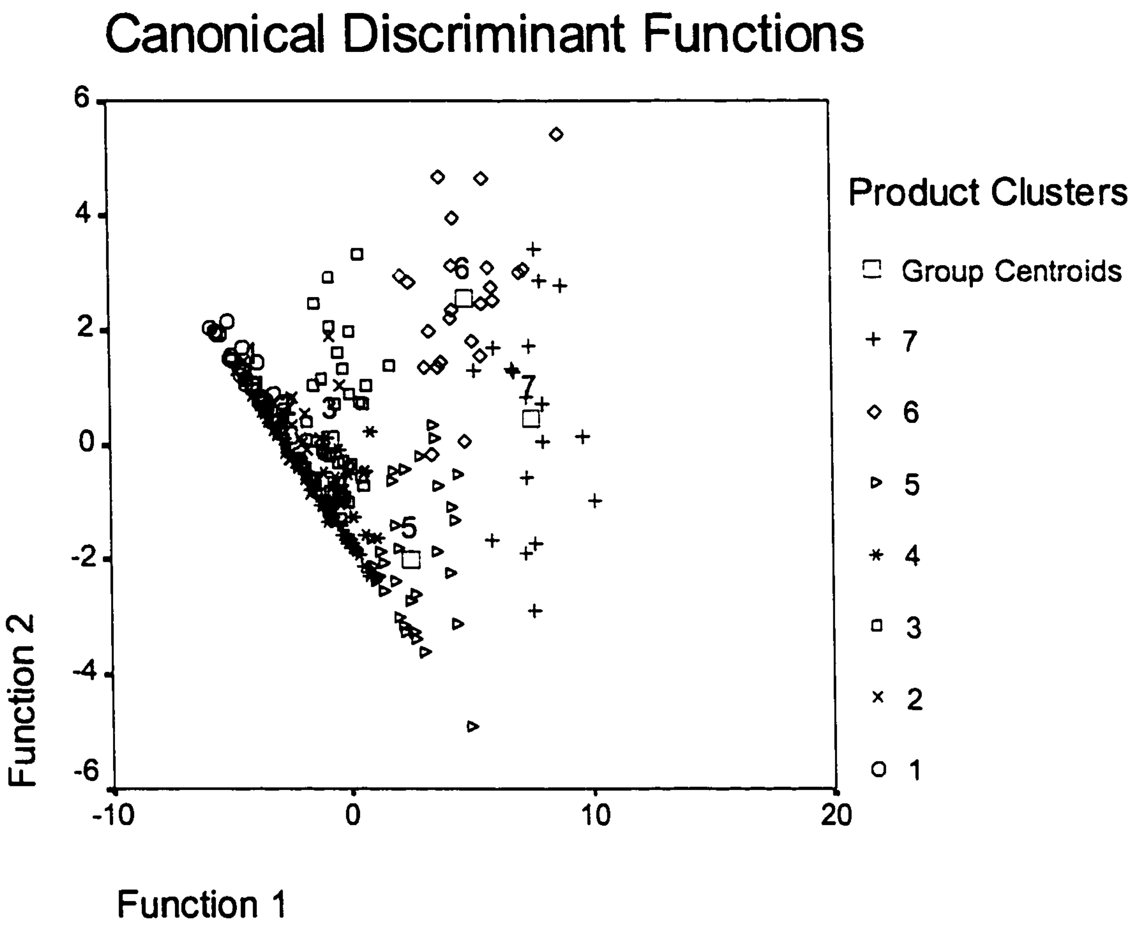


Figure 4.2: Three Dimensional Plot of Canonical Discriminant Functions

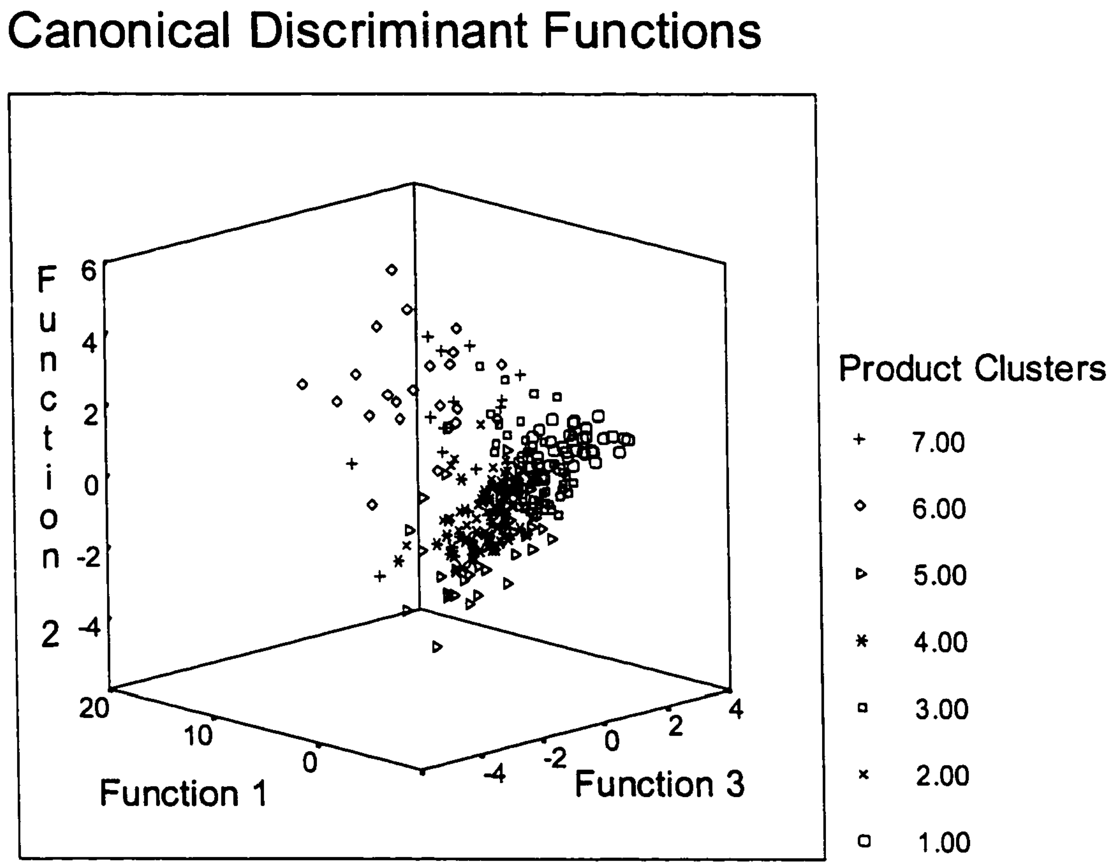


Figure 4.3: Plot of Static Content and Dynamic Content Factor Scores

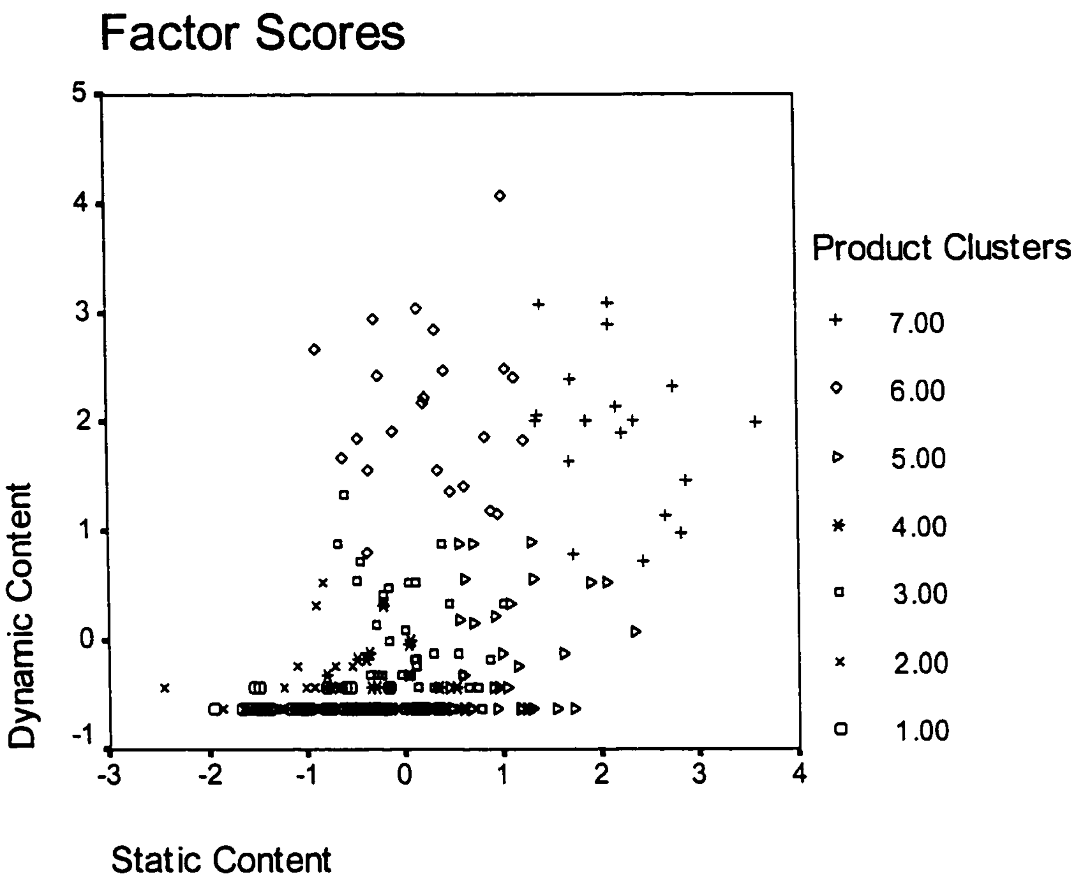


Figure 4.4: Plot of Dynamic Content and Market Segment Factor Scores

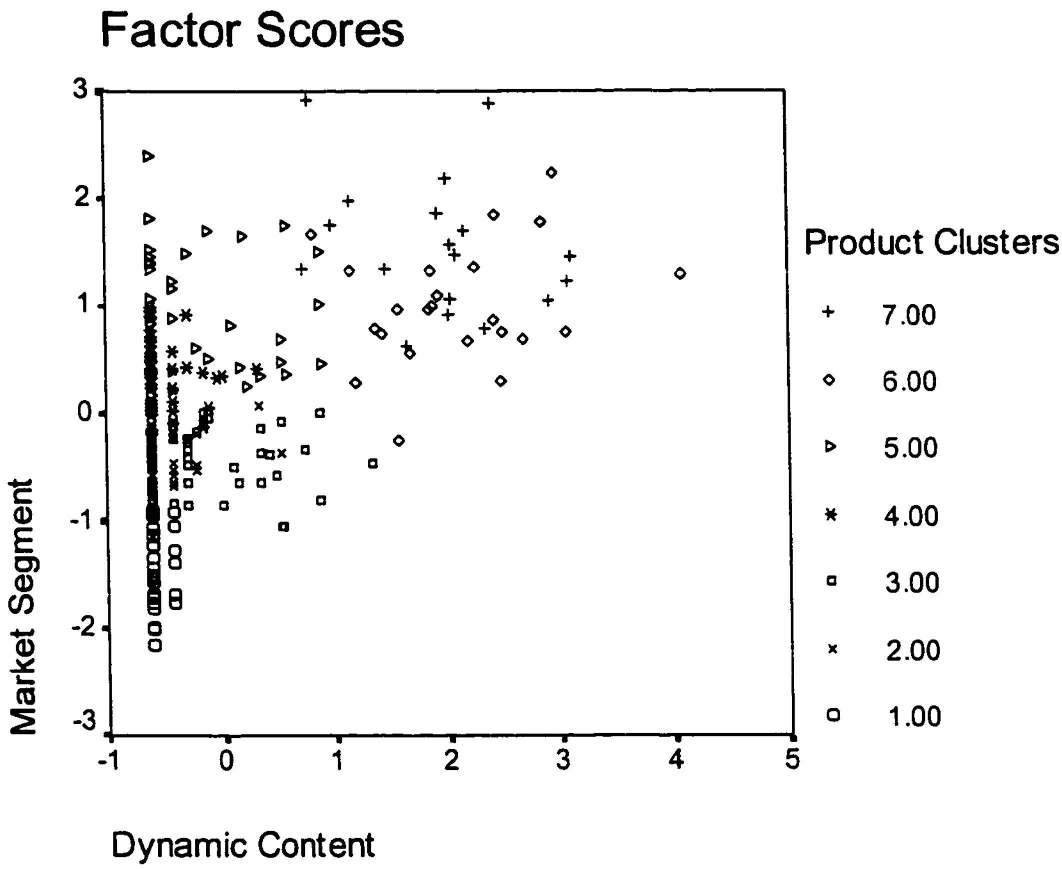
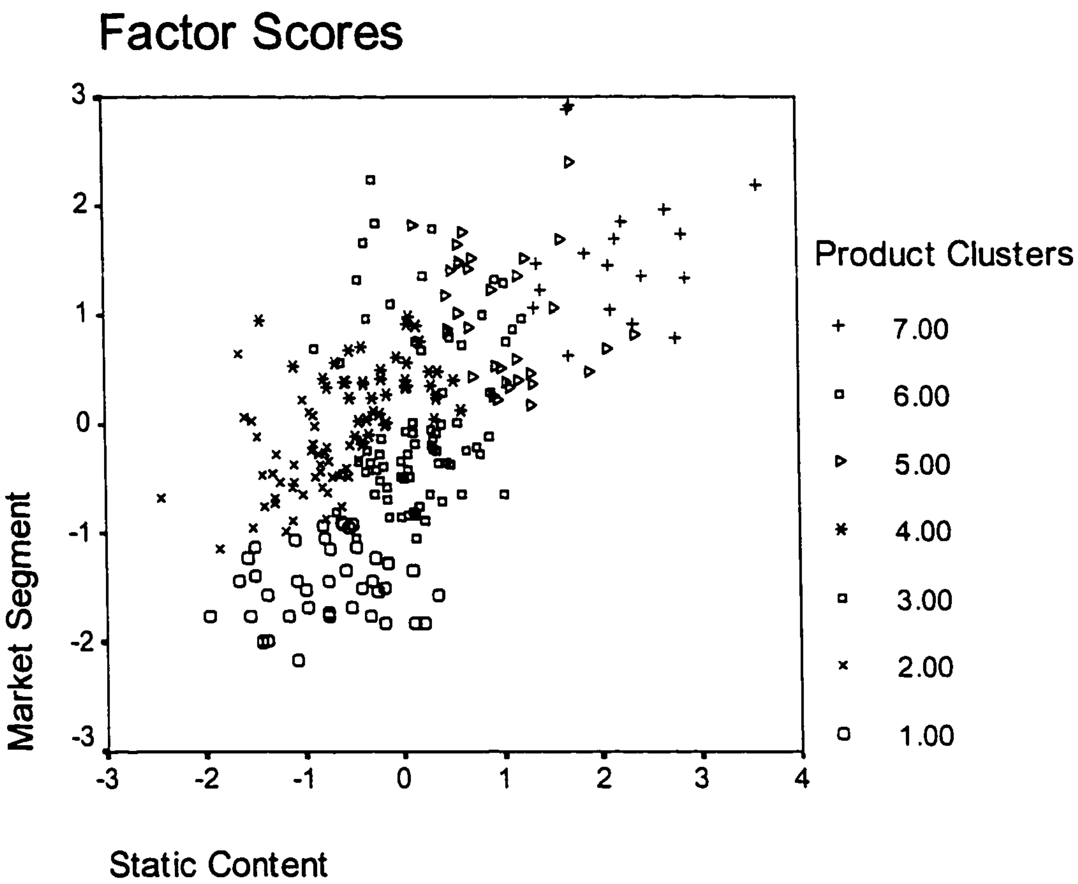


Figure 4.5: Plot of Static Content and Market Segment Factor Scores



variance also were performed for the original and transformed variables. Several of the tests rejected homogeneity of variance across the different levels, but residual plots indicated more similar within-cluster residual variance for the transformed variables, relative to the original variables. The different residual variances for the clusters may have been caused in some variables by a lack of variation in one or more of the clusters, and in others by the skewed nature of count data. Because non-constant variance can cause the significance levels calculated for F-tests to be incorrect, we also present nonparametric Kruskal-Wallis rank tests of the equivalence of means, which are interpreted in a manner similar to F-statistics. The numbers in parentheses below each of these statistics are the p-values for the test statistics, which indicate the proportion of times, across similar samples, that one might expect to observe statistics more extreme than those found here. Low values, for example, less than 0.05, 0.01 or 0.001, are commonly interpreted as providing evidence that might lead one to reject the null hypothesis of the test.

The results for the variables used to construct the factor score inputs for the cluster analysis tend to indicate significant differences between the product clusters. Table 4.8 shows that the F-tests and Kruskal-Wallis tests of identical cluster variable means tend to indicate statistically significant differences between the groups. Further, the Scheffé homogeneous subset multiple comparison procedure indicates similar patterns across the sets of dynamic content, static content, and market segment variables.

Table 4.8: Product Cluster Means: Cluster Analysis Variables

	Product Cluster Group								
Product Dimension	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**F (p-value)**	**K-W H (p-value)**
Number in Cluster	41	43	51	44	34	23	18		
Service Content: Static									
Number of static pages or frame options	6.80 1,2	4.93 1	13.31 1,2	12.18 1,2	46.50 2	17.35 1,2	138.28 3	24.437 (0.000)	119.087 (0.000)
KB HTML	21.93 1	23.13 1	90.63 1	58.43 1	372.07 1	85.06 1	2521.83 2	15.630 (0.000)	145.277 (0.000)
KB graphics	190.16 1	109.85 1	529.16 1	349.36 1	1356.09 1	3248.86 2	6983.26 3	33.860 (0.000)	164.628 (0.000)
Number of graphics files	12.1 1	9.1 1	35.1 1	23.9 1	109.6 1	943.0 1	536.0 1	2.935 (0.009)	190.814 (0.000)
Service Content: Dynamic									
Number of dynamically generated pages	0.15 1	1.05 1	7.88 1	1.48 1	19.06 1	513.61 1,2	233.50 2	4.897 (0.000)	131.652 (0.000)
Number of dynamic items	0.00 1	0.02 1	0.16 1	0.00 1	0.14 1	1.78 2	1.61 2	83.838 (0.000)	180.260 (0.000)
Target Market Segment: Unique vs. Broad									
Number of goods offered	11.5 1	46.3 1	63.4 1	108.5 1	328.3 1,2	514.7 2	653.1 2	8.452 (0.000)	144.397 (0.000)
Number of offline services offered	0.6 1	6.9 1	1.5 1	2.8 1	11.9 1	4.6 1	3.4 1	1.066 (0.384)	233.968 (0.001)
Number of payment options	0.4 1	2.7 2	2.4 2	3.8 3	4.0 3	4.1 3	4.6 3	49.444 (0.000)	130.527 (0.000)
Number of shipping options	1.0 1	1.3 1	1.2 1	2.0 1,2	2.8 2	2.9 2	4.2 3	22.648 (0.000)	106.048 (0.000)

We next analyze external service design variables to explore the taxonomy. Table 4.9 presents product cluster means of service product design variables that were not used to construct the product taxonomy. Table 4.9 also presents F-statistics for single factor ANOVA performed on the variable means of the clusters, and nonparametric Kruskal-Wallis rank test statistics. Several of the variables indicate statistical significance between the cluster means, particularly those related to the distance services will ship their goods, the amount of consumer contributions of information to the service, and the delivery of common types of dynamic service content (i.e. Active Server Pages, Cold Fusion). While the number of companies or brands appears to increase somewhat across the configurations, it appears only mildly significant at best. Finally, neither audio nor video content seems to be used much across the clusters, indicating that the food retailing services tend not to enhance store atmosphere through background music or film clips.

We also examine the product clusters using dichotomous variables not used in constructing the clusters. Table 4.10 presents service product attribute frequencies and Chi-square statistics for tests of independence of the taxonomy groups against the external variables for service attributes. Within each cell, the top number represents the number of services that offer the service attribute, while the bottom row contains the number of services that do not offer it. For many of the attributes, very few services at all offer them. In several tests of independence, this creates a problem since the expected counts in one or several of cells are below acceptable levels. However, several patterns are apparent within this table. First, the number of adopters of dynamic service elements that facilitate online service customization tends to increase as one moves to clusters 5 through 7. Second, clusters 1 to 4 tend to target local or national markets, while clusters 5 through 7 target worldwide markets. Finally, offline customization activities appear to increase in frequency toward the right of the taxonomy.

Table 4.9: Product Cluster Means: External Service Design Variables

	Product Cluster Group								
Product Dimension	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**F** (p-value)	**Kruskal-Wallis H** (p-value)
Number in Cluster	41	43	51	44	34	23	18		
Service Content: Static									
Number of audio files	0.10	0.05	0.27	0.07	0.18	0.00	0.61	2.587 (0.019)	10.565 (0.103)
Number of video files	0.00	0.00	0.02	0.45	0.00	0.00	0.00	1.150 (0.334)	6.442 (0.375)
Service Content: Dynamic									
KB Cold Fusion	0.00	0.00	6.67	0.00	10.41	2147.72	0.00	2.216 (0.051)	19.972 (0.003)
KB Active Server Pages	0.00	0.00	3.01	0.00	0.00	386.93	0.00	5.596 (0.000)	36.660 (0.000)
Pages of consumer contributions to site	0.00	0.00	0.27	0.05	1.74	0.30	61.61	4.210 (0.000)	43.373 (0.000)
Target Market Segment: Unique vs. Broad									
Maximum distance willing to ship	3.34	3.55	3.64	3.61	4.14	3.87	4.33	3.206 (0.005)	17.635 (0.007)
Number of languages used	1.02	1.00	1.00	1.00	1.06	1.00	1.50	2.114 (0.052)	8.662 (0.193)
Number of companies operating site	1.00	1.02	1.17	1.09	1.58	1.17	2.94	1.950 (0.073)	7.242 (0.299)

4.5 Discussion

In this section, we discuss the cluster analysis results and we assign a name to each of the cluster groups based on the characteristics of the electronic food retailers in each cluster. Each of the names relates to the names used in the conceptual typology of electronic service products.

Table 4.10: Product Cluster Frequencies: External Service Offering Variables

Product Dimension	Cluster Group 1	2	3	4	5	6	7	χ^2 (p-value)
Service Content: Static								
Online periodical or magazine	0 41	0 43	1 50 (2.0%)	0 44	2 32 (5.9%)	3 20 (13.0%)	8 10 (44.4%)	63.603[b] (0.000)
Service Content: Dynamic Online Customization								
Chat facility on site	0 41	0 43	1 50 (2.0%)	0 44	0 34	0 23	1 17 (5.6%)	7.606[b] (0.268)
Message board on site	0 41	1 42 (2.3%)	1 50 (2.0%)	0 44	2 32 (5.9%)	5 18 (21.7%)	5 13 (27.8%)	35.805[b] (0.000)
Site search system available	0 41	0 43	6 45 (11.8%)	0 44	3 31 (8.8%)	5 18 (21.7%)	3 15 (16.7%)	149.354[a] (0.000)
Site sort system available	0 41	0 43	0 51	0 44	0 34	4 19 (17.4%)	1 17 (5.6%)	33.827[b] (0.000)
Expert system available	0 41	0 43	0 51	0 44	0 34	4 19 (17.4%)	5 13 (27.8%)	51.661[b] (0.000)
Offline Customization								
Email updates and marketing offered	1 40 (2.4%)	3 40 (7.0%)	13 38 (25.5%)	11 33 (25.0%)	14 20 (41.2%)	11 12 (47.8%)	9 9 (50.0%)	36.253[a] (0.000)
Periodic email newsletter offered	0 41	0 43	1 50 (2.0%)	1 53 (1.9%)	1 33 (2.9%)	4 19 (17.3%)	9 9 (50.0%)	72.166[a] (0.000)
Will ship as gift	10 31 (24.4%)	26 17 (60.4%)	29 22 (56.9%)	34 10 (77.3%)	28 6 (82.4%)	20 3 (87.0%)	14 4 (77.8%)	43.996 (0.000)
Offer to customize goods or service offline	7 34 (17.1%)	17 26 (39.5%)	22 29 (43.1%)	27 17 (61.4%)	21 13 (61.7%)	10 13 (43.5%)	14 4 (77.8%)	29.600 (0.000)
Target Market Segment: Unique vs. Broad								
Shipping targeted at local	6 35 (14.6%)	2 41 (4.7%)	3 48 (5.9%)	8 36 (18.2%)	6 28 (17.6%)	1 22 (4.3%)	2 16 (11.1%)	8.564[a] (0.200)
Shipping targeted at multi-state region	0 41	2 41 (4.7%)	0 51	1 43 (2.3%)	1 33 (2.9%)	0 23	1 17 (5.6%)	5.301[b] (0.418)
Shipping targeted at nation	24 17 (58.5%)	25 18 (58.1%)	29 22 (43.1%)	30 14 (68.1%)	21 13 (61.8%)	18 5 (78.3%)	9 9 (50.0%)	5.380 (0.496)
Shipping targeted at several nations	2 39 (4.9%)	4 39 (9.3%)	4 47 (7.8%)	3 41 (6.8%)	2 32 (5.9%)	5 18 (21.7%)	5 13 (27.8%)	12.630[a] (0.049)
Shipping targeted at world	11 30 (26.8%)	12 31 (27.9%)	18 33 (35.3%)	12 32 (27.3%)	19 15 (55.9%)	11 12 (47.8%)	10 8 (55.6%)	14.256 (0.000)
Service includes a membership club	1 10 (9.1%)	9 34 (20.9%)	2 49 (3.9%)	4 40 (9.1%)	8 26 (23.5%)	11 12 (47.8%)	6 12 (33.3%)	36.017[a] (0.000)

a. One or more cells had expected counts below 5 but not below 1.

b. One or more cells had expected counts below 1.

In general, the service product variables used to construct the clusters vary systematically from left to right along the product taxonomy. Table 4.11 compares the clusters and the general patterns found among these variables to the product typology from Chapter 2, noting apparent differences between the two. The means of the *static content* variables (static pages, KB HTML, KB graphics, number of graphics) show a superficial attempt to create a retailing environment in the clusters that mainly implement static content, and a large effort in the clusters that mix static and dynamic content. The *dynamic content* variables (dynamically generated pages, dynamic service items) appear to indicate that food retailers do not wholly shift from static to dynamic content when the amount of static content gets large. Instead, some maintain high levels of static and dynamic content. The *target market* variables (distance willing to ship, goods offered, offline services offered, payment options, shipping options) also change as one moves from the static to dynamic service content packages. The leftmost cluster has a small number of goods they are willing to ship nationwide, but on average, they only accept one form of payment and only ship goods in one way. These limitations on shipping and payment options constrain the customer group they can reach, but may be unavoidable for small or rural retailers. Such services may not have sufficient customer volume to make expensive credit-processing services practical, and may find it difficult to gain access to many delivery services from rural locations. In contrast to niche market services, the right of the taxonomy exhibits content levels and types expected in a service offering targeted at a broader market. These services offer hundreds or thousands of products for delivery worldwide, and maintain the largest number of methods for payment and shipping. Descriptions of the characteristics exhibited within each cluster follow.

Table 4.11: Comparison of Product Taxonomy to Product Typology

Static Electronic Service Content					Dynamic Electronic Service Content		
Unique Market Segment			Broad Market Segment		Broad Market Segment		Unique Market Segment
Niche Market One/Few Services Low Demand Low Online Customization High Offline Customization No Joint Branding			**Market Extender** Several Services Low/Medium Demand Med. Online Customization Med. Offline Customization Low Joint Branding		**Mass Market** Many Services Medium/High Demand Med./High Online Cust. Low Offline Customization Medium Joint Branding		**Customized Market** Many Services High Demand High Online Cust. Low Offline Cust. High Joint Branding
Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6	Cluster 7	Cluster 8
One/Few Services Low Demand Low Online Customization Low Offline Customization No Joint Branding			Several Services Low/Medium Demand Med. Online Customization Med. Offline Customization Low Joint Branding		Many Services Medium/High Demand Med./High Online Cust. **High** Offline Customization **Low/Medium** Joint Branding		Many Services High Demand High Online Cust. Low Offline Cust. High Joint Branding

Cluster 1: Micro Segment Niche Service – The Micro Segment Niche Service configuration is characterized by low static content, low dynamic content, and a small target market. With six static pages and 12 graphic files on average, the service package that they offer consists of the lowest amount of static content for both text and graphics. The services use virtually no dynamic pages and employ none of the dynamic bells and whistles to make their online services entertaining or customizable. They offer 12 goods on average and few service variations, one-tenth of the average number of goods offered by the middle configurations, and one-sixtieth of the rightmost configurations. The Micro Segment Niche Services give customers few choices for payment or shipping.

They also appear not to care about binding the customer to the service, since they offer little that will draw customers back again and again based on the service environment. They are the least frequent to have membership clubs, typically do not use email to update customers about the service, and are not willing to customize goods and services offline or to send gift purchases for their customers.

Cluster 2: Enhanced Product Variety Niche Service – The Enhanced Product Variety Niche services are characterized by low static content, low dynamic content, and a slightly larger target market. Relative to the Micro Segment Niche Services, these services exhibit mainly an increase in the number of products they sell. They offer about four times the number of products offered in the Micro Segment Niche Service cluster, but similar to that cluster, they provide their customers with few options for payment or shipping. This cluster also tends not to offer any sort of membership club, but more frequently is willing to customize and to ship gifts.

Cluster 3: Medium Market Niche Service – The Medium Market Niche Services are characterized by average static content, low dynamic content, and a medium target market. On average, they use a mixture of 20 static and dynamic pages and 35 graphic files to sell 63 items and to offer a few offline service variations. However, they also tend to remove the limitations on shipping distances and payment methods somewhat, leading to a broader targeted market. Medium Market Niche Services exhibit a slightly increased distance to which they are willing to ship products, and an increase in the number of payment types they will accept. A few of these services also begin to attempt to attract customers through dynamic content and dynamic online service attributes such as message boards.

Cluster 4: Increased Options Market Extender – The Increased Options Market Extender services are characterized by above low static content, low dynamic content, and an above average target market. They employ a low amount of static content to sell over 100 goods, which is statistically closer to the Niche Services, but provide a number of shipment and payment options that differentiate them from the Niche Services. Some Increased Options Market Extender services are branded by several companies, which indicates that even simple text and graphic content can be used to deliver a multiple-brand service package.

Cluster 5: Broad Goods Selection Market Extender – The Broad Goods Selection Market Extender services are characterized by above average static content, average dynamic content, and a large target market. These services offer 328 products on average, and also the highest number of offline service variations. Even without a large amount of dynamic content, several of these services attempt to offer dynamic service attributes related to online service customization. They also seem to take a more coordinated approach to their services, offering membership clubs and email with higher frequency, customizing product items and shipping gifts.

Cluster 6: Efficient Content Mass Market Services – The Efficient Content Mass Market cluster is the first cluster to exhibit a high level of dynamic content, and illustrates the first of two mass market content strategies, characterized by high dynamic content and average static content. They sell fifty times as many goods (515 on average) as Cluster 1, and deliver their service attributes mainly through dynamic content. Some services within this cluster accomplish this through alternative content types oriented toward dynamic content, such as Cold Fusion and Active Server Pages content. The Efficient Content Mass Market cluster frequently offers a number of service attributes related to online and offline customization, tending to use message boards, site search systems and product information sort systems. They also attempt more frequently to create incentives for customers to return to the service, through membership clubs and email, customization of products, and shipping of gifts.

Cluster 7: High Content Mass Market Services – The High Content Mass Market services represent the second Mass Market content strategy, using high static content and high dynamic content. These services offer the broadest number of options in the sample. The services employ dynamic content at the heaviest level, use multiple languages most frequently, and are more frequently operated by several companies that have attached their brands to the services. They also allow consumers to contribute a significant amount of content to the service. As with the Efficient Content Mass Market Services, these services also frequently use elements related to online and offline customization, by customizing products and shipping gifts offline, and employing electronic message boards, search systems, and expert advice or suggestion systems. This cluster also more frequently exhibits service attributes designed to attract customers back to the service, such as email notification and online magazines related to the food they sell. The High Content Mass Market Service cluster also appears to represent a mixture of the services specified in the Mass Market and Customized Market types from the service product typology, as a slightly higher level of services are delivered under the brand names of two companies.

Cluster 8: Customized Market Service: This final configuration contains the single outlier service identified during the data collection process and removed from the sample prior to the empirical analysis. The service product delivered by this service includes over 800,000 food and non-food goods, and several-hundred service variations. The services are offered jointly by six different electronic services, one of which also was included in the sample as an individual food retailing service.

4.6 Conclusion

4.6.1 Summary

This chapter reports a study in which we empirically examined the first building block of the product-process matrix, namely the electronic service product structure. The electronic service product structure is characterized by the *content* of electronic services and the *market segment* targeted by the services. This product structure leads to expected differentiation of electronic service products along dimensions of scale and scope of the services, the mix and content of online and offline customization, and the nature of joint branding.

In this chapter, we discussed the development of a taxonomy of electronic service products related to the electronic service product structure. The empirical analysis was based on data collected on electronic service product dimensions from 254 electronic food retailers. We used cluster analysis to develop homogeneous groups of electronic services from data related to the product dimensions underlying our conceptual electronic service product typology. Our empirical analysis of the clusters revealed systematic, and often significant, differences among the groups and insightful information about the service products offered within each group.

4.6.2 Contributions

This study contributes to the literature in several ways. First, the study contributes to the literature on the product-process matrix by adopting a standard taxonomy development methodology to empirically examine the product structure of our proposed product-process matrix. While several product-process matrices have been proposed (Hayes and Wheelwright 1979; Kellogg and Nie 1995; Collier and Meyer 1998), few of the original authors empirically analyzed their models, and subsequent theory testing efforts (Safizadeh et al. 1996) have implicitly assumed them to be correct. Further, while some studies have employed subjective data to validate their frameworks (Collier and Meyer 1998), this is the first study that uses actual data from actual service operations to validate a conceptual framework in the form of a product-process matrix.

The findings of the study, based on attribute-level data instead of higher level abstractions, tend to provide evidence that supports our conceptual typology of dimensions that differentiate electronic services. The different configurations of electronic services tend to differ along the dimensions of dynamic content, static content and target market segment. Within the clusters defined by these dimensions, electronic food retailers tend to systematically differ according to service elements related to scale and scope of services, online and offline customization, and joint branding. However, since the product data is at the attribute level, the findings can be stated in even more specific terms. For example, while offline customization is the only customization available for the services toward the left of the taxonomy to perform, the frequency of offline customization tends to increase as one moves to more dynamic service clusters, instead of decreasing as we proposed in our conceptual typology. Such a finding illustrates how some dimensions may be supported, and others may not, when one views a conceptual framework such as a product-process matrix within a specific industry context.

4.6.3 Managerial Implications

The study also indicates several managerial implications. The findings of our study show that while conceptual models of service types can be insightful, empirical studies based on the conceptual types often can aid in the identification and understanding of various nuances contained within the original conceptual types. Managers may prefer simple conceptual models because of their economy of description and prediction. However, this study indicates that a full understanding of the nuances in product offerings across an industry context can be even better understood through a taxonomic study involving cross-sectional data analysis methods.

The study also suggests some practical implications in the area of food retailing through electronic services. It appears that, at the present time, even the food retailers that use the heaviest application of dynamic content do not implement many value-added service product attributes. The lack of these attributes indicates opportunities that food retailers can exploit to differentiate themselves.

4.6.4 Directions for Future Research

Limitations of the study include its exploratory nature. Since confirmatory methods have not been developed for testing typologies using actual operations data, this limitation perhaps cannot be avoided. Also, since the taxonomy was developed for electronic food retailing services, to some extent the results are contingent on the context. However, the technologies available for developing all electronic services are quite similar. For example, Amazon.com has used their book retailing services to begin selling food as well. Further, the data we use to represent electronic service products are fairly generic. Thus, we believe that the results can be generalized to other electronic service areas. Nevertheless, it would be insightful to perform similar research in other service contexts.

There are also several logical extensions to this research. First, one could expand the sample to include the whole population of food retailers to study how they change their product offerings over time using longitudinal data. Second, since food retailers seem to concentrate on online service elements that relate to their offline goods and services, one could collect data for additional service contexts to further examine the service typology. Service contexts that involve a large amount of online service elements for which consumers must pay, such as online personals services or online financial services, would help to round out the full breadth of potential online service elements. Third, since additional attributes are increasingly offered by electronic services, future studies might examine their effect within a cross-sectional, longitudinal study. Finally, as the validation of conceptual typologies will continue to be a persistent problem in many areas of the management literature, benefit might be gained from the development of a confirmatory method for typologies that can employ actual data collected from real-world products and processes.

CHAPTER 5

A Taxonomy of Electronic Service Processes: Empirical Analysis of Electronic Food Retailing

5.1 Introduction

This chapter relates empirically constructed configurations of electronic service processes to a typology of electronic service processes – the second of two building blocks of a product-process matrix for electronic services. Conceptual typologies have been used often in the service management literature to build theory about organizational configurations (Cook, Goh and Chung, 1999). However, while typologies are useful for theory building as well as for description and prediction, they are ill suited for theory testing, being difficult tools to use empirically (Meyer, Tsui and Hinings, 1993). While typologies have helped to build understanding in many research areas, empirical evidence supporting typologies can improve their validity (Galbraith and Schendel, 1983).

Models of traditional service processes developed for product-process matrices have been found useful for strategic service positioning (Kellogg and Nie 1995; Collier and Meyer 1998). These service process typologies have been derived from dimensions of customer influence (Kellogg and Nie 1995) and the number of customer pathways built into the service system design by managers (Collier and Meyer 1998). While a number of additional models have been proposed for strategic positioning of service processes, the empirical validation of service models is still in its infancy (Cook, Goh and Chung 1999).

Empirical taxonomies developed from actual data can provide insights that complement those incorporated into a typology. Taxonomy development can provide a basis for additional explanation, prediction, and theory testing (Miller 1981; Meyer, Tsui and Hinings 1993; Menor, Roth and Mason 1998). Taxonomies also can help one to identify groups of organizations that relate to ideal types in a conceptual typology, and to analyze whether and how these groups change over time relative to the ideal types. Perhaps most importantly, taxonomies can be used to empirically analyze typologies for a specific industry.

In research contexts having many dimensions along which they may be characterized, as in electronic services, taxonomies are a useful tool for understanding characteristics shared by groups of organizations. Simple contingency models of service dimensions may not capture the full variety of service product attributes observable in electronic services. In contrast, the configurational approaches employed in taxonomic methods can incorporate complex groups of variables. Using these groups of variables, they often can produce simple yet understandable explanations of the underlying constructs. Taxonomic methods can use many dimensions to group organizational constructs of interest, including technologies, processes, practices and outcomes (Meyer, Tsui and Hinings, 1993). Further, taxonomies can be constructed at several levels of analysis, ranging from networks of organizations, to organizations, to individuals within organizations.

In this study we develop a taxonomy of electronic service process technology using data from electronic food retailing services. Several studies have collected data to examine process typologies (Safizadeh, et al. 1996; Collier and Meyer 1998), but the data have taken the form of subjective classifications into descriptions of ideal process types (Safizadeh, et al. 1996) and perceptual scales (Collier and Meyer 1998). In contrast, actual service process data can be used to determine the existence of common groups that actually appear within an industry, instead of process types that exist in a conceptual or perceptual space. Actual data allow for the possibility that the process groups in an empirical taxonomy will closely match or illustrate various nuances of the types in our conceptual process typology. Since different nuances between subsets of a process type may lead to different service performance, an improvement in identification of common process configurations may lead to improved information and better management of electronic services.

The service process typology that we examine in this chapter was derived in Chapter 2 using the dimension of the flexibility of service processes to dynamically fulfill consumer needs. This higher-level abstraction of the flexibility concept was valuable for developing a conceptual service process typology, but needs to be translated into lower level flexibility dimensions that can be used as the foundation for constructing an empirical taxonomy. Since the service literature does not include comprehensive models of process flexibility for either traditional or electronic services, we developed a model of electronic service process flexibility dimensions and used the model to choose service process variables for this study.

The remainder of this chapter is organized as follows. Section 5.2 reviews the literature related to taxonomies of service processes, and dimensions of process flexibility that might be adapted to understand and position electronic services relative to one another. Section 5.3 presents the research design for this study. Section 5.4 presents the empirical results of this study and discusses the taxonomy of food retailing services developed in the study. Section 5.6 presents conclusions of this study.

5.2 Background

5.2.1 Taxonomic Methods

Taxonomies have been developed to classify and explain complex organizational phenomena in many disciplines. Classification is a fundamental human process motivated by a desire for cognitive economy, predictive ability, and theory development (Milligan and Cooper 1987). Yet, few operations management studies have used empirical methods to position operations within taxonomies derived from process characteristics. Perhaps the only empirical analysis of operations process design dimensions in a typology is that of Collier and Meyer (1998), who used perceptual scales to position industry-level service classes relative to one another according to the number of customer pathways built into the service system design by managers.

While the lack of extant literature related to taxonomic methods for operations has made the process of building taxonomies of actual operations systems challenging, it also presents research opportunities. Researchers must not only collect data, but must also develop a methodology for that data, since no cookbook of methodologies exists that details which procedures are best to use when data are of a certain type (Milligan and Cooper 1987). Statisticians typically have developed taxonomic methods for techniques such as cluster analysis based on assumptions that data of interest to practitioners would be distributed multivariate normal (Milligan and Cooper 1985). However, data about process technologies employed in operational settings are seldom available for empirical analysis in the form of continuous variables following normal distributions. Thus, researchers often have resorted to using subjective perceptual scales to represent the operations process (Collier and Meyer 1998) or the competitive capabilities of the output of the process (Menor, et al. 1998). Observations representing the use or non-use of technologies are often fairly easy to obtain. However, taxonomic grouping methods for dichotomous variables are generally much less developed, since Monte Carlo studies of grouping methods usually have involved tests of known configurations in continuous spaces (Milligan and Cooper 1985, 1987; Zimmerman, Jacobs and Farr 1982; Blashfield and Morey 1980; Hamer and Cunningham 1980).

The literature also lacks methods for statistically relating empirical taxonomies to the conceptual systems in the typologies upon which they can be based. Many of the studies that have developed taxonomies have used an inductive approach instead, using sets of variables as a theory-generating device, rather than for theory testing. While useful when there are no prior theories about a research context, deductive methods are preferable (Ketchen and Shook 1996). However, even in deductive studies that have chosen data and methods based on extant theories, the lack of specific statistical methods for relating conceptual models to empirical taxonomies hinders efforts to relate the empirical results to the underlying theories. Since the underlying theory for our taxonomy is based on service process flexibility, we next discuss a model of process flexibility for electronic services.

5.2.2 Service Process Flexibility

Although flexibility is the primary competitive capability underlying operational performance on the other competitive capabilities of cost, quality, and delivery, service process flexibility has not been examined in depth in the operations literature. Reviews of the service marketing and operations literature have found little mention of service flexibility (Goh, Cook and Chung 1999; Menor, et al. 1998). The advent of electronic business-to-business and business-to-consumer services, which have characteristics more typical of flexible manufacturing systems than of traditional person-to-person services, highlights this deficiency in the literature.

We organize our service process variables according to a model of service process flexibility dimensions for electronic services. The model of electronic service flexibility characterizes both online electronic and offline physical processes involved in the design and the delivery of electronic services. Table 5.1 presents the model of process flexibility dimensions, which were derived from manufacturing flexibility dimensions in the literature and from strategic uncertainties related to electronic service product attribute and process attribute states. Table 5.1 also differentiates between service flexibility dimensions related to individual electronic services and to networks of computer integrated electronic service operations. Since strategic uncertainty about process states at both of these service design levels can be hedged against by developing process flexibility, Table 5.1 subdivides electronic service process flexibility into dimensions of intra-service process flexibility and inter-service process flexibility.

5.3 Research Design

Similar to research in organizational performance, two approaches can be taken in positioning electronic service processes based on their process flexibility: a structural approach or a functional approach (Gresov and Drazin 1997). The structural perspective of process flexibility dimensions essentially assumes that flexibility is inherent to a technology, and does not vary across different implementations of that technology. This assumption largely eliminates the need for flexibility measures, since knowledge of the technology used by a company implies a level of flexibility. In contrast, the functional perspective of process flexibility assumes that flexibility is related to the implementation of technologies as artifacts within the process. Depending on the objective of the research, flexibility can be examined by understanding the configurations of these technologies at the attribute level, or by measuring flexibility at various levels of abstraction. If one is interested in viewing flexibility as a higher level

Table 5.1: Electronic Service Process Flexibility

Service Process Flexibility Dimension	Type of Uncertainty	Strategic Objective	Description
Product/Customer Interaction			
• Mix	Market acceptance of kinds of services	Diverse service line	The ability to change the range of electronic services offered within a given period of time.
• Security	Multiple security protocols	Service quality	A type of mix flexibility involving the ability to keep service transactions private between provider and customer.
• Human delivery	Failure of electronic service system, unanticipated electronic process requirements, idiosyncratic consumer needs	Service quality	The ability of human service delivery and customer service personnel to enhance electronic service offering.
• Modification	Specific service characteristics	Responsiveness to customer needs	The ability to make functional changes to the service.
• Quality	Different customer personalities, different customer willingness to pay	Service value	The ability to change planned electronic service quality levels.
• Order Process	Willingness of customer to interact, order and pay through a technology channel	Responsiveness to customer needs	The ability to change the range of methods used for ordering.
Intra-Service Process Flexibility			
• Design	Technological change, non-competitive processes	Service innovation	The ability to redesign the electronic service process.
• Volume	Aggregate service demand	Market share, customer service	The ability to change the level of aggregated electronic service output.
• Distribution	Unexpected server breakdown	Reliable service delivery, balanced capacity utilization, international competition	The ability to dynamically distribute electronic service delivery processes across a set of connected service delivery resources.
• Changeover	Length of service life cycle, "honeymoon" period	Service innovation	The ability to deal with additions to and subtractions from the mix over time.
• Channel	Unfulfilled customer need because of delivery technology	Service quality, delivery anywhere at any time	The ability to adapt and deliver electronic services to multiple electronic delivery channels.
• Electronic-to-Physical Integration	Customer perceived need for manufacturing involvement	Manufacturing competition on service, quick throughput and delivery	The ability to change electronic service processes based on current characteristics of physical processes. The ability to change physical processes based on current characteristics of electronic service processes.

Table 5.1: Electronic Service Process Flexibility (cont'd)

Service Process Flexibility Dimension	Type of Uncertainty	Strategic Objective	Description
Inter-Service Process Flexibility			
• Backward Integration	Network entry, network expulsion or exit	Flexibility responsiveness, flexibility range, flexibility mobility, customer service quality, enhanced revenue	The ability to manage and modify a partnership in one or several networks of service associates that sell other companies' services.
• Forward Integration	Network entry, network defection/expulsion and exit, network positioning and repositioning	Flexibility responsiveness, flexibility range, flexibility mobility, customer service quality, enhanced revenue, market share	The ability to manage a network of associated services that participate in the sale and delivery of your services.
• Full Integration	Network entry, network exit, network positioning and repositioning	Flexibility responsiveness, flexibility range, flexibility mobility, joint service and good development and delivery, efficient allocation of service production to network servers	The ability to integrate service delivery processes of different organizations' electronic service delivery systems.
System Dynamic			
• Flexibility Responsiveness	Changes in the level of uncertainties	Strategic adaptability	The ability to increase and decrease the above flexibility dimensions through a redesign of the service process.
• Flexibility Range	Entry by more flexible competitor	Strategic banking of flexibility	The ability to have a system with an envelope of capability or range of process states.
• Flexibility Mobility	Improved flexibility range of competitor	Strategic banking of flexibility	The ability to have low penalties for modifying the process within the flexibility range.
• Performance Measure Uniformity	Unknown cost function, imperfect accounting systems	Cost uniformity, price stability, price improvement, profit enhancement	The ability to have some performance measure stay the same within the flexibility range.

abstraction of specific attributes, it becomes important to have measures available for potential and realized service process flexibility. The development of these measures would facilitate measurement and research in various cases of process flexibility, for example, flexibility for dedicated processing or for random processing (Bernardo and Mohamed 1992).

As an exploratory study, the main objective of this study is not to develop measurement tools for high level abstractions of electronic service flexibility. The objective of this study is to examine flexibility at the attribute level. Thus, we employ a model of electronic service process flexibility dimensions mainly to choose between actual, observable process variables. In the present study, the empirical context is electronic food retailing. Using the chosen data, we first construct taxonomies using an algorithmic approach based on cluster analysis by analyzing a set of variables representing structural technologies and functional technology artifacts used to deliver electronic services. We next use a structural approach to position electronic services in an *a priori* manner according to their use of a small set of fundamental electronic process technologies represented in our service process typology. As a theoretical representation of our process typology, a structural framework can be used to examine how closely related the cluster analysis taxonomy is to our theoretical typology. When combined with information from relevant practitioner literature, such as the literature used to develop our process typology, the unordered configurations can be ordered into taxonomies. Estimates of the ordinal correlation between the two models can then be calculated to provide an estimate of the relationship of the cluster analysis taxonomy and the underlying service process typology.

5.3.1 The Empirical Context of the Research

The data for this study were collected from electronic food retailers on the World Wide Web. No directory of electronic food retailers existed prior to the study, thus the addresses of electronic food retailers used in the study were pooled from several sources. The first step in developing the directory of food retailers was to use Internet search engines to find addresses for electronic food retailing sites, and to collect addresses from link sites that maintain lists of electronic food retailing service addresses. Through this process, we identified a preliminary set of food-related sites on the World Wide Web. Each of the sites were visited and classified as being retailing sites, non-retailing sites, or non-operational sites. The addresses for non-retailing sites and non-operational sites were removed from the database, leaving approximately 650 food retailing services. As additional food retailing services have appeared, they have been added to the address database, leading to a slightly larger candidate set of electronic food retailers. The retailing firms in our sample were selected at random from the list of electronic food retailers. The retailers in the sample were used to collect data related to electronic service process attributes. The data were collected in an ongoing manner beginning in late 1997. The overall sample used in this exercise consists of 255 electronic food retailers.

The use of a single industry sample provides several benefits. First, the sample is more likely to exclude potentially confounding factors related to industry characteristics. Second, the competitive environment within a single industry is likely to be similar, removing environment as a confounding factor. Third, since products and processes are more similar within an industry, variables can more easily be defined for a single industry, and can be defined in a more specific manner. Finally, the single sample should provide internal generalizability of the findings for electronic food retailers. In addition, since food retailers sell non-food items and the electronic service technologies used to develop electronic services are similar across many electronic service industries, the sample is likely to provide findings that can be generalized to all electronic retailers, and to some extent to all electronic services.

Choice of Taxonomic Variables and Data Collection

Prior to any taxonomic analysis, a critical decision that must be made is a careful choice of variables to include in the analysis (Milligan and Cooper 1987). We make our choice of variables based on the set of conceptual flexibility dimensions presented in Table 5.1. Table 5.2 lists the flexibility dimensions from Table 5.1, and relates these dimensions to the process attribute data collected from electronic food retailing services. We use the dimensions to partition the data set into groups of process variables related to those dimensions, and we indicate the hypothesized relationship of each variable to the flexibility dimension. Variables in Table 5.2 were selected based on the process typology, the condition of being observable in food retailing services, and statistical considerations. Taxonomic variables were chosen in order to develop a theoretically supportable data set broad enough to make the exercise richly descriptive. The choice of variables was informed by existing theory. Using the process typology, a preliminary set of variables was specified. Data were collected for a broad set of process variables and were not arbitrarily limited to a small number of variables. Every effort was made to include any reasonable variable. When additional variables were included in the data set, each electronic service already in the data set was revisited and reexamined for those additional variables.

Table 5.2: Process Flexibility Dimensions and Electronic Service Process Variables

Flexibility Dimension and Related Variables	Variable Description	Hypothesized Relationship
	Intra-Service Flexibility Dimensions	
Volume Flexibility		
Uses ISP server	Dichotomous (0/1)	Unable to control capacity (-) Outsource to 24 hour capacity managers (+) Lease adequate capacity (+)
Uses own server	Dichotomous (0/1)	Control over capacity (+) Expensive to own capacity (-)
Product Flexibility: Order Process		
Order online	Dichotomous (0/1)	More options (+)
Order by mail	Dichotomous (0/1)	More options (+) Traditional order method (-)
Order by phone	Dichotomous (0/1)	More options (+) Traditional order method (-)
Order by fax	Dichotomous (0/1)	More options (+) Traditional order method (-)
Offline order form for mail/fax	Dichotomous (0/1)	More options (+) Traditional order method (-)
Number of electronic order/payment forms	Count (0, 1, 2, ...)	More options (+)
Electronic order form use mailto: or email	Dichotomous (0/1)	More flexible than nothing (+) Less flexible technology (-)
1-800 number available for customers	Dichotomous (0/1)	More options (+) Traditional order method (-)
Electronic order form uses CGI	Dichotomous (0/1)	More flexible technology (+)
Site uses a shopping cart system	Dichotomous (0/1)	Highly flexible technology (+)
Electronic order form uses Cold Fusion	Dichotomous (0/1)	Highly flexible technology (+)
Electronic order form uses Active Server Pages	Dichotomous (0/1)	Highly flexible technology (+)

Table 5.2: Process Flexibility Dimensions and Electronic Service Process Variables (cont'd)

Flexibility Dimension and Related Variables	Variable Description	Hypothesized Relationship
Changeover Flexibility		
Uses ISP server	Dichotomous (0/1)	Restricted access to server resources (-)
Uses own server	Dichotomous (0/1)	Full access to server resources (+)
Uses HTML files	Dichotomous (0/1)	Static files tough to edit (-)
Number of static HTML files	Count (0, 1, 2, ...)	Static files tough to edit (-)
Uses SHTML files	Dichotomous (0/1)	Static files tough to edit (-)
Number of SHTML files	Count (0, 1, 2, ...)	Static files tough to edit (-)
Uses CGI scripts	Dichotomous (0/1)	Programs easier to change (+) Programming languages cryptic (-)
Number of links calling CGI scripts	Count (0, 1, 2, ...)	Programs easier to change (+) Programming languages cryptic (-)
Uses Cold Fusion	Dichotomous (0/1)	Static files tough to edit (-) Database connectivity (+)
Number of Cold Fusion files	Count (0, 1, 2, ...)	Static files tough to edit (-) Database connectivity (+)
Uses Active Server Pages	Dichotomous (0/1)	Static files tough to edit (-) Database connectivity (+)
Number of Active Server Pages files	Count (0, 1, 2, ...)	Static files tough to edit (-) Database connectivity (+)
Uses online database queries	Dichotomous (0/1)	Database updating automatically changes service (+)
Site has on-the-fly calculation of total order costs	Dichotomous (0/1)	Adapts to product mix changes (+)
Mix Flexibility		
Number of graphic files	Count (0, 1, 2, ...)	More graphic variety (+)
Uses GIF files	Dichotomous (0/1)	More graphic variety (+)
Number of GIF files	Count (0, 1, 2, ...)	More graphic variety (+)
Uses JPG files	Dichotomous (0/1)	More graphic variety (+)
Number of JPG files	Count (0, 1, 2, ...)	More graphic variety (+)
Uses audio files	Dichotomous (0/1)	More musical variety (+)
Number of audio WAV files	Count (0, 1, 2, ...)	More musical variety (+)
Number of audio MID files	Count (0, 1, 2, ...)	More musical variety (+)
Number of RealNetworks audio files	Count (0, 1, 2, ...)	More musical variety (+)
Number of audio AU files	Count (0, 1, 2, ...)	More musical variety (+)
Number of audio AIFF files	Count (0, 1, 2, ...)	More musical variety (+)
Number of audio VMF files	Count (0, 1, 2, ...)	More musical variety (+)
Uses video files	Dichotomous (0/1)	More video variety (+)
Number of RealNetworks video files	Count (0, 1, 2, ...)	More video variety (+) Proprietary format requires special software (-)
Number of AVI video files	Count (0, 1, 2, ...)	More video variety (+) Proprietary format requires special software (-)
Number of Quicktime MOV video files	Count (0, 1, 2, ...)	More video variety (+) Proprietary format requires special software (-)
Number of brand name client programs used	Count (0, 1, 2, ...)	Extends range of service activities (+) Customer may know program (+) Customer must learn program (-)
Number of proprietary client programs used	Count (0, 1, 2, ...)	Extends range of service activities (+) Customer must learn program (-)

Table 5.2: Process Flexibility Dimensions and Electronic Service Process Variables (cont'd)

Flexibility Dimension and Related Variables	Variable Description	Hypothesized Relationship
Number of Java applets	Count (0, 1, 2, ...)	Programmable (+) Open platform (+)
Number of Static HTML files	Count (0, 1, 2, ...)	Greater textual content (+)
Number of Adobe Acrobat PDF files	Count (0, 1, 2, ...)	More service variety (+) Proprietary format requires special software (-)
Use client side JavaScript	Dichotomous (0/1)	Programmable (+) Doesn't work well on all platforms (+)
Uses client side Java	Dichotomous (0/1)	Programmable (+) Open platform (+)
Security Flexibility		
Order/Payment form uses SSL	Dichotomous (0/1)	Encrypted (+)
Order/Payment form uses digital certificate	Dichotomous (0/1)	Verifiable security (+) Electronic service can use ISP's digital certificate (-)
Site uses password/username, or customer registration	Dichotomous (0/1)	Higher security (+) Must provide electronic service with personal information (-)
Number of ordering methods	Count (0, 1, 2, ...)	Greater number of options for consumers (+)
Channel Flexibility		
Frames site	Dichotomous (0/1)	More consumer options (+)
Non-frames site	Dichotomous (0/1)	More consumer options (+)
Quality Flexibility		
Offers pay membership	Dichotomous (0/1)	Multiple segments targeted (+)
Offers membership	Dichotomous (0/1)	Multiple segments targeted (+)
Inter Service Flexibility Dimensions		
Backward Integration		
Participate in other firms' associate programs	Dichotomous (0/1)	Cross organizational integration (+)
Number of associate program products offered for sale	Count (0, 1, 2, ...)	Ability to manage higher level of integration (+)
Forward Integration		
Offer own associate program to other sites	Dichotomous (0/1)	Cross organizational integration (+)
Pay per click advertising program	Dichotomous (0/1)	Cross organizational integration (+)
Full Integration		
Alliance partner: multiple firms operating the site	Dichotomous (0/1)	Cross organizational integration (+)

Most of the electronic food retailer process attributes can be represented using nominal variables. Table 5.2 shows that data observable for electronic service process characteristics largely take the form of either dichotomous or count variables. Table 5.2

also indicates that the number of variables available in a dichotomous format is much larger than the number available in a count format. Further, several dimensions of electronic service flexibility can only be represented using dichotomous variables without further scale development for these dimensions. Because of these data considerations, we use only the dichotomous variables in the analysis leading to the construction of a process taxonomy. The analysis includes variables related to the following dimensions of electronic service process flexibility: volume flexibility, order process flexibility, changeover flexibility, mix flexibility, security flexibility, and integration flexibility.

The data were collected via direct observation of each electronic food retailing service and through collection of data from external sources. Electronic food retailing services on the World Wide Web were visited and data were collected at the point at which consumers interact with the service operations. For each service, all observable content was downloaded and counted, transforming the content into a set of variables representing product and process choices actually implemented in the services. The researchers also collected supplemental information by visiting external information sources, such as the Internic (http://www.internic.net/) WHOIS resource, which provides physical addresses and technical information about Internet service providers and electronic service providers.

Reliability of Measures

Reliability relates to the objective that, when measuring a theoretical construct, one would like the measure to report identical measurement values upon repeated measures of the same item. However, reliability is founded on the concept of a single true score underlying a measure (Bollen 1989), which implicitly is founded upon an assumption of a stable construct. This condition is reasonable for stable perceptual constructs, but may be violated by attributes in many operational contexts, since lower-level operations attributes can be changed minute-by-minute. Thus, actual data representing lower level operations attributes, including the data in this study, may represent only a single realization from a possible set of operational states. In similar research situations, such as cross-sectional studies incorporating dynamic financial data, researchers have assumed that single observations would possess reliability. Few statistical tests of reliability for such data have appeared in the literature. Since perceptual scale measurement items were not employed to collect data for this study, the extent to which subjective evaluations were made was only the identification of use, or lack of use, of a service product or service process attribute. As a result, tests of reliability for our data can not use reliability techniques developed in the literature for psychometric measurement models.

According to Bollen (1989), if reliability is in doubt for any data, one might approach reliability from a consistency or repeatability perspective. Using this approach, one can collect the same data multiple times to examine the inter-rater reliability of the collection process. However, in this study the cost of collecting replications of the data set would have been prohibitively expensive. Due to the cost and time of such replications, and the limited marginal improvement in information that such an exercise would provide for an exploratory study, the data were collected only once.

Validity of Measures

Validity relates to the objective that, in choosing measures of a construct, one would like measures to relate to the concept that they were intended to measure, and not to measure other constructs. Researchers have noted four types of validity: content validity, criterion validity, construct validity, and convergent and discriminant validity (Bollen 1989). *Content validity* of the data set was assured by basing the set of variables on information available from the information technology practitioner literature. The variables were derived from the electronic service process typology, from knowledge of process attributes described in the practitioner literature, and from observation of process attributes that were not described in the literature but were observed in the process of collecting data. *Criterion validity* could not be evaluated since objective criterion measures were not available for each process attribute of each service in the sample. While *convergent and discriminant validity* is insightful to test when developing measures of perceptual phenomena meant to be uncorrelated, this form of validity does not seem to apply to direct counts of lower-level operations attributes which one might expect to be correlated. Finally, *construct validity* is indicated by statistically demonstrating theoretical associations between the constructs, which is the general objective of the empirical analysis in this study.

5.4 Empirical Analysis and Results

The service process technology data limit the methodologies that can be used to develop configurations of services derived from process technology variables. Two possible methods are available for constructing process configurations. These methods include cluster analysis and *a priori* specification of configurations. In the *first approach*, several cluster analysis methodologies might be employed to study the process variables (SPSS 1998). Several data transformation and weighting schemes also have been developed specifically for dichotomous data sets. The *second approach* is based on theory and an understanding of the practitioner context. Prior to using these two approaches, we present an exploratory data analysis of the process variables to understand the frequency with which each technology is used, as well as the technology groups with which individual technologies are commonly implemented.

5.4.1 Exploratory Data Analysis

Variable Summary Statistics

In this section, we present summary statistics for the process variables analyzed in this study. Table 5.3 presents the list of variables, and lists frequency counts and percentages for the number of services in which the technologies were implemented. The frequencies in Table 5.3 and in subsequent analysis in Chapter 5 are based on 254 of the 255 observations in the sample, since one observation was identified as conceptually related to the joint alliance mass service customization type, and was empirically quite different from the remaining observations. Table 5.3 indicates that a number of technologies are either implemented by most of the services, or by very few of the services. We also sort Table 5.3 by the percentage of services implementing the technologies, within each of the conceptual dimensions of flexibility to which we propose they relate. Table 5.3 shows that the processes and process technologies represented in the sample are more frequently related to an inflexible electronic order process, and to decreased changeover flexibility. In contrast, variables related to high changeover, mix, volume, security, and integration flexibility seem to be less frequently implemented.

Process Technology Implementation Patterns

Using the same set of variables, we performed a multidimensional scaling (MDS) analysis to summarize the relationships between the variables, as a correlation table or factor analysis can do for continuous variables (Green and Carmone 1970). The results for the two-dimension MDS solution had a Stress score of 0.083, and an R-squared score of 0.98, indicating that the two-dimension solution was a fair to good representation of the underlying variables (Johnson and Wichern 1992). Since additional dimensions could show little improvement over the two-dimension solution, we present the two-dimension solution here.

Table 5.3: Summary Statistics: Service Process Variables Used In Analysis

Variable	Implemented Technology	Technology Not Implemented	% Implementing	Flexibility Dimension
Uses ISP server	248	6	97.6%	Volume Changeover
Uses own server	8	246	3.1%	Volume Changeover
Order/Payment form uses SSL	96	158	37.8%	Security
Order/Payment form uses digital certificate	91	163	35.8%	Security
Site uses password/username, or customer registration	30	224	11.8%	Security
Order by phone	231	23	90.9%	Order Process
1-800 number available for customers	183	71	72.0%	Order Process
Order by mail	162	92	63.8%	Order Process
Order online	179	75	70.5%	Order Process
Order by fax	158	96	62.2%	Order Process
Electronic order form uses CGI	149	105	58.7%	Order Process
Offline order form for mail/fax	71	183	28.0%	Order Process
Electronic order form use mailto: or email	60	194	23.6%	Order Process
Site uses a shopping cart system	70	184	27.5%	Order Process
Site has on-the-fly calculation of total order costs	63	191	24.8%	Order Process
Electronic order form uses Cold Fusion	10	244	3.9%	Order Process
Electronic order form uses Active Server Pages	7	247	2.8%	Order Process
Uses GIF files	248	6	97.6%	Mix
Uses JPG files	184	70	72.4%	Mix
Use client side JavaScript	48	206	18.9%	Mix
Uses audio files	23	231	9.1%	Mix
Uses client side Java	25	229	9.8%	Mix
Uses video files	3	251	1.2%	Mix
Alliance partner: multiple firms operating the site	14	240	5.5%	Integration
Participate in other firms' associate programs	8	246	3.1%	Integration
Offer own associate program to other sites	7	247	2.8%	Integration
Pay per click advertising program	2	252	0.8%	Integration
Uses HTML files	244	10	96.1%	Changeover
Uses CGI scripts	175	79	68.9%	Changeover
Uses online database queries	31	223	12.2%	Changeover
Uses SHTML files	11	243	4.3%	Changeover
Uses Cold Fusion	9	245	3.5%	Changeover
Uses Active Server Pages	5	249	2.0%	Changeover

Table 5.4 presents the ALSCAL results, sorted along the first dimension. The ordering of the data within these two dimensions seems to map onto our service process typology fairly well, indicating that our subjective association of items in the service process typology is supported by relationships between variables that are observed in actual practice. In particular, sorting along Dimension 1 seems to indicate that

Dimension 1 represents the general process flexibility dimensions upon which we based our service typology.

Table 5.4: Multidimensional Scaling (MDS) Results

Stimulus Number	Stimulus Name	Variable	Dimension 1	Dimension 2
1	TSD199	Uses ISP server	2.5978	-.1474
21	TSD118	Uses GIF files	2.5635	-.0820
14	TSD106	Uses HTML files	2.5602	-.3087
5	TSD155	Order by phone	2.3718	-.0555
22	TSD119	Uses JPG files	1.5461	.6162
16	TSD1845	Uses CGI scripts	1.5095	.2477
9	TSD188	1-800 number available for customers	1.5094	.6885
3	TSD153	Order online	1.4152	.5413
4	TSD154	Order by mail	1.2295	-.9439
6	TSD156	Order by fax	1.1921	-.5759
10	TSD163	Electronic order form uses CGI	1.0783	.1674
27	TSD164	Order/Payment form uses SSL	.0340	.5246
28	TSD165	Order/Payment form uses digital certificate	-.0101	.5168
11	TSD169	Site uses a shopping cart system	-.2927	.6617
7	TSD159	Offline order form for snail mail or FAX	-.3074	-.8972
8	TSD162	Electronic order form use mailto: or email	-.3363	-.8278
20	TSD171	Site has on-the-fly calculation of total order costs	-.3703	.6248
25	TSD131	Use client side JavaScript	-.7215	-.2323
29	TSD207	Site uses password/username, or customer registration	-.9827	.2529
19	TSD140	Uses online database queries	-1.0149	.2729
26	TSD132	Uses client side Java	-1.0383	-.2123
23	TSD126	Uses audio files	-1.0700	-.2714
33	TSD135	Alliance partner: multiple firms operating the site	-1.1326	-.0285
15	TSD107	Uses SHTML files	-1.1950	-.0833
30	TSD136	Participate in other firms' associate programs	-1.2082	-.0466
31	TSD137	Offer own associate program to other sites	-1.2241	-.0309
12	TSD167	Electronic order form uses Cold Fusion	-1.2260	-.0603
17	TSD109	Uses Cold Fusion	-1.2273	-.0177
2	TSD203	Uses own server	-1.2392	-.0538
24	TSD130	Uses video files	-1.2402	-.0886
32	TSD138	Pay per click advertising program	-1.2540	-.0531
13	TSD168	Electronic order form uses Active Server Pages	-1.2569	-.0425
18	TSD111	Uses Active Server Pages	-1.2598	-.0548

To further explore relationships between variables in the data set, we also performed a cluster analysis on the MDS dimension coordinates. Such a procedure can help to identify homogeneous or related subsets within the two-dimensional space constructed by MDS (Sireci and Geisinger 1992). Table 5.5 presents the MDS results sorted by the cluster numbers determined by a K-means cluster analysis. We specified six clusters in the K-means cluster analysis to allow for the possibility that the six different dimensions of flexibility represented in the data set might be represented in the grouping. It appears that the clusters represent at least four of the flexibility dimensions. Clusters 2, 3, 4 and 5 groups together different subsets of items related to levels of order process flexibility. Cluster 5 groups together the items related to security flexibility. Finally, Cluster 6 groups together items derived from mix flexibility and integration flexibility.

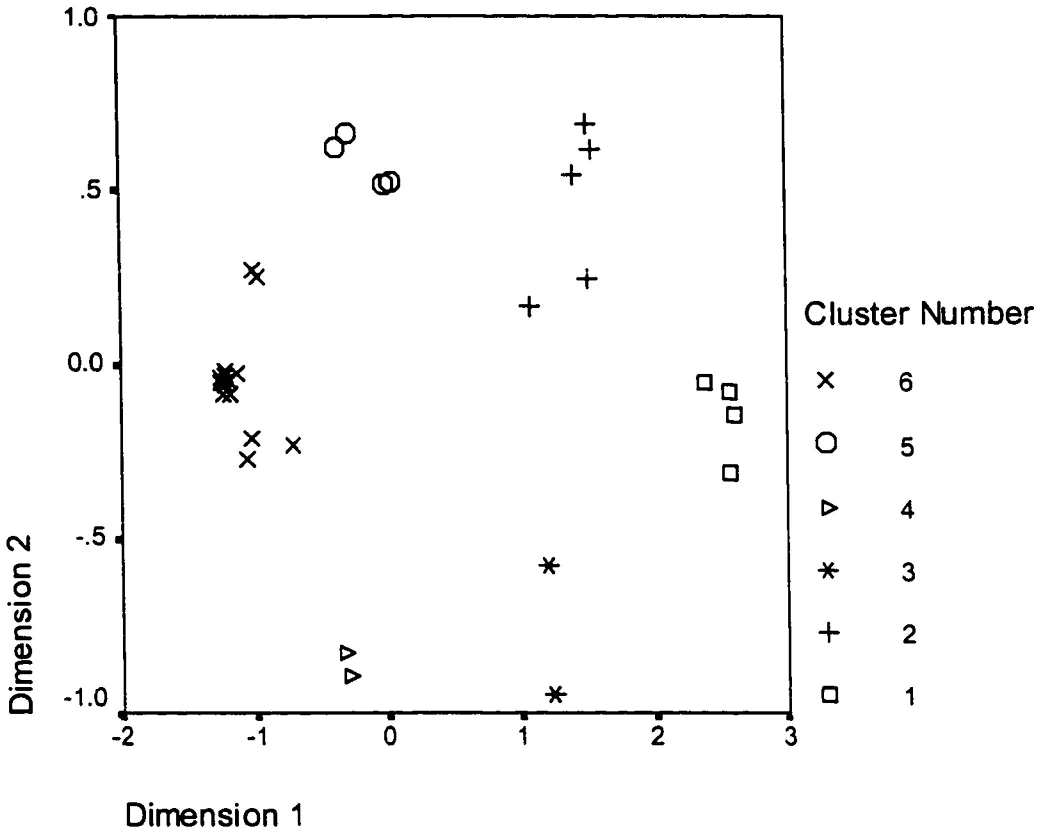
The clustering of the variables seems to be oriented around two dimensions of electronic service process flexibility. Figure 5.1 presents a scatter plot of the variables, using legends that correspond to the clusters listed in Table 5.5. Cluster 1 provides a useful baseline for interpreting the first MDS dimensions. Along Dimension 1, technologies are aligned from cluster 1, to clusters 2 and 3, to clusters 4 and 5, to cluster 6, in a manner that follows the service process typology proposed in Chapter 2. Thus, Dimension 1 appears to represent a general flexibility dimension for the technologies, or an implementation path that one follows in moving from initial electronic services to more flexible, dynamic electronic service processes. Along Dimension 2, Clusters 3 and 4 provide a useful baseline for describing the path through Clusters 1 and 6 to Clusters 2 and 5. Clusters 3 and 4 include mail, fax and unsecured e-mail ordering processes.

Clusters 1 and 6 include phone ordering, but mainly include static and dynamic content delivery processes. Finally, Clusters 2 and 5 are oriented toward encryption and online ordering procedures. Thus, Dimension 2 appears to represent the security and flexibility of the ordering process.

Table 5.5: K-Means Cluster Analysis of MDS Results

Stimulus Number	Stimulus Name	Variable	Dimension 1	Dimension 2	Cluster Number
1	TSD199	Uses ISP server	2.5978	-.1474	1
21	TSD118	Uses GIF files	2.5635	-.0820	1
14	TSD106	Uses HTML files	2.5602	-.3087	1
5	TSD155	Order by phone	2.3718	-.0555	1
22	TSD119	Uses JPG files	1.5461	.6162	2
16	TSD1845	Uses CGI scripts	1.5095	.2477	2
9	TSD188	1-800 number available for customers	1.5094	.6885	2
3	TSD153	Order online	1.4152	.5413	2
10	TSD163	Electronic order form uses CGI	1.0783	.1674	2
4	TSD154	Order by mail	1.2295	-.9439	3
6	TSD156	Order by fax	1.1921	-.5759	3
7	TSD159	Offline order form for snail mail or FAX	-.3074	-.8972	4
8	TSD162	Electronic order form use mailto: or email	-.3363	-.8278	4
27	TSD164	Order/Payment form uses SSL	.0340	.5246	5
28	TSD165	Order/Payment form uses digital certificate	-.0101	.5168	5
11	TSD169	Site uses a shopping cart system	-.2927	.6617	5
20	TSD171	Site has on-the-fly calculation of total order costs	-.3703	.6248	5
25	TSD131	Use client side JavaScript	-.7215	-.2323	6
29	TSD207	Site uses password/username, or customer registration	-.9827	.2529	6
19	TSD140	Uses online database queries	-1.0149	.2729	6
26	TSD132	Uses client side Java	-1.0383	-.2123	6
23	TSD126	Uses audio files	-1.0700	-.2714	6
33	TSD135	Alliance partner: multiple firms operating the site	-1.1326	-.0285	6
15	TSD107	Uses SHTML files	-1.1950	-.0833	6
30	TSD136	Participate in other firms' associate programs	-1.2082	-.0466	6
31	TSD137	Offer own associate program to other sites	-1.2241	-.0309	6
12	TSD167	Electronic order form uses Cold Fusion	-1.2260	-.0603	6
17	TSD109	Uses Cold Fusion	-1.2273	-.0177	6
2	TSD203	Uses own server	-1.2392	-.0538	6
24	TSD130	Uses video files	-1.2402	-.0886	6
32	TSD138	Pay per click advertising program	-1.2540	-.0531	6
13	TSD168	Electronic order form uses Active Server Pages	-1.2569	-.0425	6
18	TSD111	Uses Active Server Pages	-1.2598	-.0548	6

Figure 5.1: K-Means Cluster Analysis of Process Variables



5.4.2 Algorithmic Configurations: Cluster Analysis

We first used hierarchical cluster analysis to construct the taxonomy. Ward's method was used on squared Euclidean distances between the dichotomous data for individual food retailers because of its versatility and tendency to provide very good solutions (Anderberg 1973). Squared Euclidean distances were employed because of the simplicity of their interpretation, since they represent a count of the number of different process technology decisions between two electronic food retailers. Further, the properties of Ward's method cluster solutions for other similarity metrics are not known well (Anderberg 1973).

The literature presents few suggestions on how to choose between dichotomous variables for cluster analysis, how to standardize the variables, or whether it is good or bad to have redundancy or correlation between the variables in a data set. Intuitively, with dichotomous variables, the researcher is constructing an n-dimensional cube from a set of n variables. The cluster analysis algorithm essentially groups vertexes of the cube that are close together. While a small set of variables can lead to easy interpretation of cluster characteristics, it also may force the algorithm to place qualitatively different vertexes within the same cluster. In contrast, a larger number of variables hopefully will lead to larger expanses of empty vertexes that will separate the configurations, facilitating easy detection of related cases within the data set. Because of this, here we employ the same data set of 33 dichotomous variables to construct electronic service process configurations.

We constructed the clusters based on common practice from the literature. Lehmann's rule (Miller and Roth 1994) for the number of feasible clusters (n/30 to n/60, where n is the number of cases) suggests that the sample size can support between four and eight clusters. After removing the one outlier observation corresponding to the joint alliance mass service customization stage of the service process typology and assigning that outlier to its own configuration, we analyzed solutions for three through seven clusters based on the remaining 254 observations. Table 5.6 presents the relationship between the resulting cluster sizes, as one moves from a two-cluster solution to a seven-cluster solution. As Table 5.6 shows, cluster 3 is fairly stable, while clusters 1 and 2 are related, clusters 4 and 5 are related, and clusters 6 and 7 are related. At each step, the cluster analysis method does not appear to be pulling off individual outlier observations, but rather large subsets of larger clusters.

Table 5.6: Sizes of Clusters by Clustering Step: Ward's Method

	Cluster Sizes						
Process Taxonomy Development	1	2	3	4	5	6	7
Ward's 2	157						97
Ward's 3	78		79				97
Ward's 4	78		79		55		42
Ward's 5	78		79	32	23		42
Ward's 6	78		79	32	23	23	19
Ward's 7	45	33	79	32	23	23	19

We chose the seven-cluster solution for our subsequent discussion, rather than a lower number of clusters, since the cluster sizes that were being combined together by the Ward's method in the reduction from seven down to three clusters were quite large.

By studying a higher number of clusters, the clusters should tend to have increased internal consistency of the clusters, as they should consist of fairly large groups that exhibit large distances between the groups. The tradeoff in choosing a higher number of clusters is that we may be sub-dividing an ideal type into several sub-types, but we will avoid within-type variability that can occur from bundling together two consistent sub-types. Further, as we shall see, knowledge about the hierarchical clustering process can also help one choose an appropriate ordering for a taxonomy, since knowledge of the clusters that are grouped together at a later stage implies distances between those clusters.

Description of Cluster Results

To analyze the process configurations generated by the seven-cluster solution, we first examine frequencies of the implementation of various technologies within each configuration, using the variables used in constructing the configurations using cluster analysis. Table 5.7 presents the cluster means for the dichotomous variables used in the Ward's method solution. Each of the parameters represents the proportion within the cluster that has adopted each technology. Clusters 1 and 2 appear to concentrate on offline ordering processes. Clusters 3 through 7 concentrate on online ordering processes, commonly using shopping carts and dynamic processes to manage a customer order. Further, clusters 4 through 7 are the only clusters that broadly implement security features such as SSL encryption and passwords.

Table 5.7: Comparison of Ward's Method Process Cluster Frequencies

Process Typology Dimension	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6	Cluster 7	$\chi 2$ (p-value)
Cluster Size	45	33	79	32	23	23	19	
Volume Flexibility								
Uses ISP server	45 (100%)	33 (100%)	78 (98.7%)	31 (96.9%)	23 (100%)	23 (100%)	15 (78.9%)	32.270[b] (0.000)
Uses own server			2 (2.5%)	1 (3.1%)			5 (26.3%)	37.559[b] (0.000)
Product Flexibility:Order Process								
Order online		4 (12.1%)	78 (98.7%)	32 (100%)	23 (100%)	23 (100%)	19 (100%)	232.363 (0.000)
Order by mail	42 (93.3%)	7 (21.2%)	55 (69.6%)	28 (87.5%)	23 (100%)		7 (36.8%)	111.388 (0.000)
Order by phone	36 (80.0%)	32 (97.0%)	74 (93.7%)	30 (93.8%)	22 (95.7%)	19 (82.6%)	18 (94.7%)	11.910[a] (0.064)
Order by fax	21 (46.7%)	18 (54.5%)	54 (68.4%)	25 (78.1%)	22 (95.7%)	4 (17.4%)	14 (73.7%)	41.821 (0.000)
Offline order form for mail/fax	28 (62.2%)		16 (20.3%)	7 (21.9%)	15 (65.2%)	1 (4.3%)	4 (21.1%)	64.629 (0.000)
1-800 number available for customers	24 (53.3%)	23 (69.7%)	51 (64.6)	29 (90.6%)	21 (91.3%)	19 (82.6%)	16 (84.2%)	22.505 (0.001)
Electronic order form use mailto: or email			42 (53.2%)	16 (50.0%)	1 (4.3%)		1 (5.3%)	90.078[a] (0.000)
Electronic order form uses CGI		1 (3.0%)	72 (91.1%)	31 (96.9%)	18 (78.3%)	22 (95.7%)	5 (26.3%)	184.424 (0.000)
Site uses a shopping cart system	2 (4.4%)		9 (11.4%)	2 (6.3%)	23 (100%)	16 (69.6%)	19 (100%)	171.423 (0.000)
Electronic order form uses Cold Fusion		1 (3.0%)	1 (1.3%)				8 (42.1%)	79.790[b] (0.000)
Electronic order form uses Active Server Pages		1 (3.0%)			1 (4.3%)		5 (26.3%)	44.652[b] (0.035)
Changeover Flexibility								
Uses HTML files	45 (100%)	33 (100%)	79 (100%)	32 (100%)	23 (100%)	20 (87.0%)	12 (63.2%)	68.127[b] (0.005)
Uses SHTML files	2 (4.4%)	1 (3.0%)	3 (3.8%)		3 (13.0%)	1 (4.3%)	1 (5.3%)	5.893[b] (0.435)
Uses CGI scripts	10 (22.2%)	8 (24.2%)	75 (94.9%)	32 (100%)	21 (91.3%)	23 (100%)	6 (31.6%)	144.021 (0.000)
Uses Cold Fusion						1 (4.3%)	8 (42.1%)	90.498[b] (0.000)
Uses Active Server Pages		1 (3.0%)					4 (21.1%)	40.108[b] (0.000)
Uses online database queries			1 (1.3%)		9 (39.1%)	5 (21.7%)	16 (84.2%)	133.564[a] (0.000)
Site has on-the-fly calculation of total order costs			11 (13.9%)	4 (12.5%)	19 (82.6%)	13 (56.5%)	16 (84.2%)	122.903[a] (0.000)

Table 5.7: Comparison of Ward's Method Process Cluster Frequencies (cont'd)

Process Typology Dimension	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6	Cluster 7	$\chi2$ (p-value)
Mix Flexibility								
Uses GIF files	44 (97.8%)	31 (93.9%)	78 (98.7%)	30 (93.8%)	23 (100%)	23 (100%)	19 (100%)	6.042[b] (0.418)
Uses JPG files	31 (68.9%)	24 (72.7%)	50 (63.3%)	24 (75.0%)	21 (91.3%)	18 (78.3%)	16 (84.2%)	9.512[a] (0.147)
Uses audio files	6 (13.3%)	4 (12.1%)	7 (8.9%)	2 (6.3%)	3 (13.0%)	1 (4.3%)		4.641[a] (0.591)
Uses video files			2 (2.5%)	1 (3.1%)				3.980[b] (0.679)
Use client side JavaScript	7 (15.6%)	2 (6.1%)	10 (12.7%)	8 (25.0%)	14 (60.9%)	1 (4.3%)	6 (31.6%)	38.267[a] (0.000)
Uses client side Java	4 (8.9%)	2 (6.1%)	6 (7.6%)	2 (6.3%)	4 (17.4%)	2 (8.7%)	3 (15.8%)	3.319[a] (0.768)
Security Flexibility								
Order/Payment form uses SSL			2 (2.5%)	32 (100%)	23 (100%)	23 (100%)	17 (89.5%)	234.029 (0.000)
Order/Payment form uses digital certificate			1 (1.3%)	30 (93.8%)	23 (100%)	20 (87.0%)	17 (89.5%)	222.420 (0.000)
Site uses password/username, or customer registration			4 (5.1%)		12 (52.2%)	7 (30.4%)	7 (36.8%)	73.248[a] (0.000)
Backward Integration								
Participate in other firms' associate programs		1 (3.0%)		1 (3.1%)	3 (13.0%)	1 (4.3%)	2 (10.5%)	14.913[b] (0.505)
Forward Integration								
Offer own associate program to other sites					3 (13.0%)		4 (21.0%)	38.825[b] (0.000)
Pay per click advertising program						1 (4.3%)	1 (5.3%)	10.287[a] (0.113)
Full Integration								
Alliance partner: multiple firms operating the site			5 (6.7%)	2 (6.3%)	1 (4.3%)	2 (8.7%)	4 (21.0%)	14.003[a] (0.030)

a. One or more cells had expected counts below 5 but not below 1.
b. One or more cells had expected counts below 1.

We also analyze the technology implementation patterns across the process taxonomy using chi-squared statistics for contingency tables representing the association between each technology variable and the clusters. The numbers in parentheses below each of these statistics are the p-values for the test statistics, which indicate the proportion of times, across similar samples, that one might expect to observe statistics more extreme than those found here. Low values, for example, less than 0.05, 0.01 or 0.001, are commonly interpreted as providing evidence that might lead one to reject the null hypothesis of the test.

Since the clusters were constructed to minimize differences between implementation of process technologies within the groups, one might expect that many of the chi-squared statistics would exhibit significance. Table 5.7 indicates that movement toward higher indexed process configurations relates to more flexible process such as CGI, middleware such as Cold Fusion and Active Server Pages, online database queries, and security systems. Table 5.7 also indicates that the development of processes to manage affiliate or associate programs, and inter-service alliances, tends to be associated with the rightmost process configurations.

The evaluation of reliability for configurations derived from dichotomous data is not straightforward due to a lack of methodologies for analyzing dichotomous data. Employing the discriminant analysis jackknife procedure would violate the assumptions for the procedure, which would lead to uncertain results (Johnson and Wichern 1992). Thus, Table 5.8 examines the process taxonomy configurations using the means of the remaining process technology variables related to the process taxonomy. For each variable, single factor ANOVA as well as Levene tests for homogeneity of variance were performed. In each case the test rejected the homogeneity of variance for the variable across the different levels. The rejection of identical variance may result from several factors, including the data type, the skewed range of some variables, and the lack of variation in some variables within one or several clusters. Overall, the F-statistics tend to indicate at least one difference among pairs of cluster means. However, since the significance of the F-statistics in Table 5.8 is derived from the assumptions for ANOVA, the statistics should be interpreted cautiously. In cases such as Table 5.8, if one is not able to transform the data to obtain approximate normality of residuals, remedial techniques include the nonparametric rank F test (Neter, et al. 1996) and the Kruskal-Wallis test (Montgomery 1991). Where appropriate, we present results for the Kruskal-Wallis test, which for large values leads to rejection of the hypothesis that the means are identical for all clusters.

Several characteristics in Table 5.8 are of interest. First, the use of the standard technologies (HTML, GIF, JPG) increases fairly consistently as one moves across the taxonomy. However, most of the non-HTML content technologies, not including CGI, are implemented mainly in Cluster 7. Very few of the services appear to be differentiating themselves by enhancing their service mix, through the use of audio or video files. However, those that do seem to be positioned toward the left of the taxonomy, employing the less flexible content technologies, and enhancing them with audio and video.

Discussion

In this section, we characterize the taxonomy configurations related to the cluster analysis results presented above. Specifically, we relate the attributes of the configurations back to the conceptual process typology from Chapter 2 for electronic service processes. Thus, the names for each of the cluster groups are related to the names used in our conceptual typology of electronic service processes.

Table 5.8: Comparison of Process Cluster Means

	Process Cluster								
Process Dimension	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**F (p-value)**	**Kruskal-Wallis H (p-value)**
Cluster Size	45	33	79	32	23	23	19		
Product Flexibility: Order Process									
Number of electronic order/payment forms	0.00	0.09	1.90	13.19	1.74	1.43	2.00	1.239 (0.287)	190.500 (0.000)
Changeover Flexibility									
Number of static HTML files	17.5	7.9	16.7	33.0	107.7	42.5	22.5	6.838 (0.000)	19.159 (0.004)
Number of SHTML files	0.0	0.0	6.8	0.0	1.3	0.0	0.9	0.345 (0.912)	5.403 (0.493)
Number of Cold Fusion files	0.0	0.0	0.0	0.0	0.0	0.0	416.3	2.538 (0.021)	90.799 (0.000)
Number of Active Server Pages files	0.0	0.1	0.0	0.0	0.0	0.0	45.2	6.439 (0.000)	52.400 (0.000)
Mix Flexibility									
Number of GIF files	16.4	10.2	27.0	35.7	172.1	138.2	1015.7	2.478 (0.024)	79.852 (0.000)
Number of JPG files	8.8	7.5	20.6	17.7	89.5	46.8	107.3	4.911 (0.000)	36.011 (0.000)
Number of audio WAV files	0.0	0.1	0.1	0.0	0.2	0.0	0.0	1.025 (0.409)	7.073 (0.314)
Number of audio MID files	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.995 (0.429)	6.181 (0.403)
Number of RealNetworks audio files	0.0	0.0	0.0	0.0	0.3	0.0	0.0	1.610 (0.145)	5.181 (0.521)
Number of audio AU files	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.605 (0.726)	3.663 (0.722)
Number of audio AIFF files	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.119 (0.351)	6.697 (0.350)
Number of audio VMF files	0.0	0.1	0.0	0.0	0.0	0.0	0.0	1.119 (0.351)	6.697 (0.350)
Number of RealNetworks video files	0.0	0.0	0.0	0.1	0.0	0.0	0.0	1.161 (0.328)	6.938 (0.327)
Number of AVI video files	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.364 (0.901)	2.215 (0.899)
Number of Quicktime MOV video files	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.409 (0.873)	3.986 (0.682)
Number of brand name client programs used	0.0	0.0	0.1	0.0	0.1	0.0	0.0	1.064 (0.385)	5.854 (0.440)
Number of proprietary client programs used	0.0	0.0	0.0	0.0	0.2	0.0	0.1	1.641 (0.136)	10.237 (0.115)
Number of Java applets	0.2	0.1	0.2	0.1	0.2	0.1	0.2	0.212 (0.973)	2.641 (0.852)
Number of Adobe Acrobat PDF files	0.0	0.0	0.3	0.0	0.1	0.0	0.1	0.455 (0.841)	5.719 (0.455)
Number of popup windows	0.0	0.1	0.1	17.4	38.7	11.2	0.6	1.379 (0.224)	22.809 (0.001)

Cluster 1: Mail, Phone or Fax Us Service Kiosk – This Service Kiosk variant is characterized by its use of very few HTML and graphic files to list methods through which one can order food offline via mail, phone or fax. These services provide printable order forms and information about toll-free numbers, with the expectation that consumers will remember to call them at a later time. While this configuration infrequently employs CGI scripts, very few of these services allow customers to order online. Instead, they are forced to order by mail, fax, or most frequently, phone at their own cost.

Cluster 2: Please Call Us Service Kiosk – This variant of the Service Kiosk is quite similar to the observations found in Cluster 1. However, these electronic food retailers rely largely on phone or fax, and provide no forms that one can use to fax such an order. A small proportion of these services use a single page electronic order form to provide an addition means of ordering.

Cluster 3: Unsecure Order Form Service Mart – The Unsecure Order Form Service Mart is characterized by the shift to frequent use of processes involving CGI. These services also introduce electronic ordering into the service mix. About half of these services provide a simple order form that emails customer information to the food retailer, while the remaining order forms are commonly implemented through CGI scripts that parse the order form fields and examine whether they are correct. A small proportion of the food retailers implement unsecured shopping cart systems. Overall, these Service Mart systems do not indicate a concern for the security of their customers' payment information, as they seldom employ security technologies in their system.

Cluster 4: Secure Order Form Service Mart – This variant of the Service Mart process type is similar to Cluster 3, except that all of the services in this cluster use SSL encryption to protect consumer payment information.

Cluster 5: Secure Shopping Cart Service Mart – These services are characterized by being closer functionally to Mass Service Customization than to lower-tech Service Mart services in Cluster 3. This cluster exhibits process characteristics developed from mixtures of HTML files and templates, and CGI systems that manage the templates and query product databases. While the basic technology is CGI, this configuration uses the largest number of HTML files on average. Often, these CGI processes are used to insert customer ID numbers into static HTML files to track customers as they move through the service, and to link customers to their shopping basket. These services also use CGI processes to create password systems. This cluster also is the first configuration along the process taxonomy in which a majority of the services dynamically calculate the total order and shipping cost for customers. However, just in case the customer does not trust these order systems, almost all of these services still provide information on how to order through mail, phone and fax.

Cluster 6: Service Mart Mass Service Customization – This process configuration appears to be positioned in between the Service Mart and Mass Service Customization process types. While CGI is still frequently used to develop shopping cart systems, these services tend to remove mail and fax as alternative ordering channels. These services also frequently present an on-the-fly calculation of order costs to consumers. However, the services also frequently use no HTML, and the average number of HTML files used in retailing services starts to decrease in this configuration, indicating that the service process changes fully to a CGI program.

Cluster 7: Mass Service Customization – This cluster appears to relate most closely to the Mass Service Customization process stage from Chapter 2. The technologies used at this stage tend to be the most flexible, and this cluster exhibits a mixture of these various technologies. The use of HTML and CGI decrease in this configuration, with middleware such as Active Server Pages and Cold Fusion replacing CGI, and database systems serving as the basis for generating the shopping cart systems in the site. This cluster almost universally employs security procedures, and dynamically reports total order prices to the customer. Alliance partners are also frequently involved at this stage.

Cluster 8: Joint Alliance Service Customization – This cluster consists of the single outlier observation identified prior to the cluster analysis. This service is an alliance between six different electronic service companies. The parent service redirects the customer from one service to another within a frame of the parent service, using technologies that are similar to those employed in Cluster 7. Since this service operation is delivered by the operations technologies of all of the services in the joint alliance, this configuration is characterized by most of the most flexible electronic service technologies.

5.4.3 *A Priori* Configurations

We next consider the development of a process taxonomy derived from configurations constructed using theoretical priors about the flexibility of electronic service technologies related to the process typology. Table 5.9 presents a subset of the data related to these technologies. Table 5.9 presents the frequencies observed for each of the variables, based on the underlying dimensions of whether the sites use HTML, CGI, or database queries.

Table 5.9: Sample Statistics for Process Technology Use

			Alliance partners	**Uses SHTML**	**Uses Cold Fusion**	**Uses Active Server Pages**
Uses HTML 218	**Uses CGI 175**	**Uses Database 20**	3	3	2	0
		No Database 155	10	4	1	0
	No CGI 79	**Uses Database 11**	1	0	3	4
		No Database 68	0	4	4	1

Within the sample of 254 electronic food retailers, almost every company employs static HTML files. Those services that do not have chosen to use CGI or database-backed service delivery processes. The remaining process types of SHTML, Cold Fusion and Active Server Pages are employed infrequently. Because HTML, CGI and database-backed technologies tend to describe subsequent levels of technology choice along which electronic services typically differ (Greenspun 1997), the variables for CGI, database use, and multiple-company operations can reasonably represent a structural perspective of the service process typology. The three dichotomous variables for these process technologies can be represented as a three-dimensional cube, with different process technology configurations at each vertex. We divide this cube in half and present the number of services at each vertex in Table 5.10. Table 5.10 shows that only seven of the vertexes have services positioned on them, leading to seven *a priori* process configurations.

Table 5.10: Process Variable Clusters – *A Priori* Configurations

	Single Company		Joint Alliance	
	No Database	Database	No Database	Database
CGI	145	17	10	3
No CGI	68	10	0	1

Based on the capabilities of technologies in the *a priori* configurations, one can order the configurations based upon subjective evaluations of their flexibility to dynamically fulfill consumer needs. Table 5.11 summarizes the cell counts from Table 5.10, in order to directly relate the combinations of process technologies to the service process typology and orders the seven configurations based on the concept of service process flexibility incorporated into the service process typology. We use this same ordering in the descriptive tables for the *a priori* configurations presented below, as well as in a portion of the empirical analysis in Chapter 6.

Table 5.11: Summary of Electronic Service Configurations by Basic Processes

Characteristics of Configuration	Number in Configuration	Cluster Number
HTML	68	1
CGI	145	2
CGI, Joint Alliance	10	3
CGI, Database	17	4
Database	10	5
CGI, Database, Joint Alliance	3	6
Database, Joint Alliance	1	7

We present descriptive information about the *a priori* configurations in the next two tables. Table 5.12 presents the configuration means of count and continuous variables that were not used to construct the configurations. The table indicates that the means of the variables often are quite different across clusters. Further, many of the univariate ANOVA F-statistics for these means have p-values indicating that there is a statistical difference between the groups. However, as with Table 5.8, the inferences drawn from these statistics must be cautioned since the cluster groups exhibit different residual variances from cluster to cluster. Thus, as in Table 5.8, we present nonparametric Kruskal-Wallis rank tests of the cluster means, which tend to lead to similar conclusions. Table 5.12 shows that many of the clusters do not implement one or several process technologies at all. However, the variables related to HTML, GIF and JPG files vary systematically across the clusters, since they are employed in almost every cluster. These variables increase from Clusters 1 through 5, and are slightly lower in Clusters 6 and 7, as they employ other process technologies such as Active Server Pages and Cold Fusion.

Table 5.12: Comparison of Process Cluster Means – *A Priori* Configurations

Process Dimension	Process Cluster 1	2	3	4	5	6	7	F (p-value)	Kruskal-Wallis (p-value)
Number in cluster	68	145	10	17	10	3	1		
Product Flexibility: Order Process									
Number of electronic order/payment forms	0.18	4.12	2.20	1.35	1.30	5.67	2.00	0.232 (0.966)	110.404 (0.000)
Changeover Flexibility									
Number of static HTML files	10.13	29.83	45.10	87.59	2.80	65.00	126.00	3.733 (0.001)	34.333 (0.000)
Number of SHTML files	0.06	3.88	0.00	1.12	0.00	0.00	0.00	0.126 (0.993)	8.097 (0.231)
Number of Cold Fusion files	0.76	0.07	0.00	0.94	783.00	4.00	0.00	5.200 (0.000)	33.351 (0.000)
Number of Active Server Pages files	0.03	0.00	0.00	0.00	85.80	0.00	0.00	14.986 (0.000)	103.289 (0.000)
Mix Flexibility									
Number of GIF files	13.44	46.63	54.10	206.82	1831.7	103.33	425.00	4.741 (0.000)	58.051 (0.000)
Number of JPG files	7.29	20.27	20.5	193.71	67.10	136.33	0.00	12.731 (0.000)	36.963 (0.000)
Number of audio WAV files	0.03	0.04	0.00	0.29	0.00	0.00	0.00	1.378 (0.224)	7.454 (0.281)
Number of audio MID files	0.03	0.07	0.00	0.12	0.00	0.00	0.00	0.582 (0.745)	2.907 (0.820)
Number of RealNetworks audio files	0.00	0.00	0.00	0.41	0.00	0.00	0.00	3.245 (0.004)	27.993 (0.000)
Number of audio AU files	0.00	0.01	0.10	0.00	0.00	0.00	0.00	1.517 (0.186)	7.864 (0.248)
Number of audio AIFF files	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.450 (0.845)	2.735 (0.841)
Number of audio VMF files	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.123 (0.994)	0.752 (0.993)
Number of RealNetworks video files	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.123 (0.994)	0.752 (0.993)
Number of AVI video files	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.123 (0.994)	0.752 (0.993)
Number of Quicktime MOV video files	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.216 (0.971)	2.273 (0.893)
Number of brand name client programs used	0.00	0.03	0.10	0.17	0.00	0.00	0.00	1.227 (0.293)	5.508 (0.480)
Number of proprietary client programs used	0.00	0.00	0.00	0.42	0.00	0.00	0.00	4.239 (0.000)	27.993 (0.000)
Number of Java applets	0.07	0.16	0.00	0.42	0.10	0.67	0.00	1.272 (0.271)	15.079 (0.020)
Number of Adobe Acrobat PDF files	0.01	0.17	0.10	0.23	0.00	0.00	0.00	0.155 (0.988)	14.652 (0.000)
Number of popup windows	0.04	9.77	0.10	17.82	0.40	0.33	0.00	0.284 (0.944)	28.003 (0.000)

We also use the dichotomous variables to describe the *a priori* clusters. Table 5.13 presents the counts and percentages of services in each cluster that employ individual process technologies. The table also presents the Chi-square test statistics for a test of independence of dichotomous variables across the configurations of electronic food retailers. The configurations appear to exhibit systematic patterns in variables related to attributes of the process in each service. Technologies such as Java and JavaScript seem to be used toward the left of the taxonomy. Offline order processes (i.e.

Table 5.13: Comparison of Process Cluster Frequencies – *A Priori* Configurations

	Cluster Group							
Process Dimension	**1**	**2**	**3**	**4**	**5**	**6**	**7**	χ^2 **(p-value)**
Number in cluster	68	145	10	17	10	3	1	
Volume Flexibility								
Uses ISP server	68 (100%)	143 (99%)	10 (100%)	17 (100%)	9 (90%)	2 (67%)		100.554^b (0.000)
Uses own server		3 (2%)			2 (20%)	2 (67%)	1 (100%)	83.380^b (0.000)
Product Flexibility: Order Process								
Order by mail	45 (66%)	96 (66%)	7 (70%)	8 (47%)	3 (30%)	2 (66%)	1 (100%)	8.282^b (0.218)
Order by phone	68 (100%)	132 (91%)	10 (100%)	14 (82%)	9 (90%)	3 (100%)	1 (100%)	2.935^b (0.817)
Order by fax	36 (53%)	93 (65%)	7 (70%)	12 (71%)	7 (70%)	2 (67%)	1 (100%)	4.371^b (0.627)
Offline order form for mail/fax	23 (34%)	37 (26%)	4 (40%)	5 (29%)	1 (10%)		1 (100%)	7.671^b (0.263)
1-800 number available for customers	43 (63%)	107 (74%)	7 (70%)	14 (82%)	9 (90%)	3 (100%)	1 (100%)	5.790^b (0.447)
Order online	12 (18%)	126 (87%)	10 (100%)	17 (100%)	10 (100%)	3 (100%)	1 (100%)	127.166^b (0.000)
Electronic order form use mailto: or email	5 (7%)	50 (34%)	4 (40%)	1 (6%)				28.238^b (0.000)
Electronic order form uses CGI		123 (85%)	10 (100%)	14 (82%)		2 (67%)		164.105^b (0.000)
Site uses a shopping cart system	5 (7%)	31 (21%)	4 (40%)	17 (100%)	10 (100%)	3 (100%)	1 (100%)	98.061^b (0.000)
Electronic order form uses Cold Fusion	4 (6%)	1 (1%)		1 (6%)	3 (30%)	1 (33%)		30.160^b (0.000)
Electronic order form uses Active Server Pages	2 (3%)				5 (50%)			88.282^b (0.000)

Table 5.13: Comparison of Process Cluster Frequencies – *A Priori* Configurations (cont'd)

Process Dimension	1	2	3	4	5	6	7	χ^2 (p-value)
Number in cluster	68	145	10	17	10	3	1	
Changeover Flexibility								
Uses HTML files	68 (100%)	144 (99%)	9 (90%)	16 (94%)	3 (30%)	3 (100%)	1 (100%)	123.533[b] (0.000)
Uses SHTML files	4 (6%)	4 (3%)		3 (18%)				9.622[b] (0.141)
Uses Cold Fusion	3 (4%)	1 (1%)		1 (6%)	3 (30%)	1 (33%)		32.551[b] (0.000)
Uses Active Server Pages	1 (1%)				4 (40%)			78.574[b] (0.000)
Site has on-the-fly calculation of total order costs	2 (2%)	32 (22%)	2 (20%)	14 (82%)	9 (90%)	3 (100%)	1 (100%)	83.235[b] (0.000)
Mix Flexibility								
Uses GIF files	66 (97%)	142 (98%)	9 (90%)	17 (100%)	10 (100%)	3 (100%)	1 (100%)	3.432[b] (0.753)
Uses JPG files	48 (71%)	98 (68%)	10 (100%)	17 (100%)	10 (100%)	3 (100%)	1 (100%)	14.948[b] (0.126)
Uses audio files	5 (7%)	13 (9%)	1 (10%)	4 (24%)				5.970[b] (0.427)
Uses video files		3 (2%)						2.282[b] (0.892)
Use client side JavaScript	8 (12%)	23 (16%)	4 (40%)	10 (59%)	3 (30%)			25.452[b] (0.000)
Uses client side Java	3 (4%)	17 (12%)	1 (10%)	1 (6%)	1 (10%)	2 (67%)		14.165[b] (0.000)
Security Flexibility								
Order/Payment form uses SSL	3 (4%)	60 (41%)	5 (50%)	15 (88%)	9 (90%)	3 (100%)	1 (100%)	70.232[b] (0.000)
Order/Payment form uses digital certificate	3 (4%)	55 (38%)	5 (50%)	15 (88%)	9 (90%)	3 (100%)	1 (100%)	70.581[b] (0.000)
Site uses password/username, or customer registration	1 (1%)	13 (9%)	1 (10%)	8 (47%)	5 (50%)	2 (67%)		51.219[b] (0.000)
Participate in other firms' associate programs		5 (3%)		3 (18%)				14.747[b] (0.022)
Offer own associate program to other sites		2 (1%)		4 (24%)	1 (10%)			32.681[b] (0.000)
Pay per click advertising program		1 (1%)		1 (6%)				6.397[b] (0.380)

a. One or more cells had expected counts below 5 but not below 1.
b. One or more cells had expected counts below 1.

phone, fax, mail) are used fairly evenly by all configurations, but the use of other technologies related to electronic transactions increases as one moves to clusters 4 through 6.

Items such as online ordering, implementations of electronic shopping cart systems, dynamic calculation of order prices, and security procedures each increase as one moves from configuration to configuration. Finally, the clusters that are not involved in multiple-brand alliances tend to be the clusters that create associate programs or participate in other services' associate programs.

Comparison of the Two Approaches

We now compare the membership of the *a priori* configurations to the membership of the cluster analysis configurations. Table 5.14 shows that the cluster analysis configuration approach combines some *a priori* configurations, and divides others. Three clusters from the *a priori* configuration approach (5,6,7) are almost wholly grouped together within a single cluster (7) in the taxonomy constructed by cluster analysis. The cluster analysis approach also differentiates between different functional uses of CGI programs (e.g. no use, e-mail, order form, shopping cart) across the taxonomy. This differentiation is likely to lead to an improved framework for subsequent empirical analysis.

The statistical association between the two approaches appears to indicate a significant relationship. Nominal-by-nominal correlation statistics for the two sets of configurations range between 0.359 and 0.765, with each having a two-sided p-value of 0.000, indicating that one should tend to reject the absence of association between the two. This result provides empirical evidence that the configuration membership from the two approaches relate to each other in a fairly strong manner. If one orders the configurations developed through the two approaches based on practitioner information, one can use ordinal-by-ordinal correlation measures for the two approaches. The Spearman correlation between the two sets of ordered configurations in Table 5.14 is 0.710 with a p-value of 0.000, once again indicating a fairly strong relationship between the two approaches. Since the *a priori* process configurations relate directly to the proposed service process typology from Chapter 2, this statistic also provides empirical evidence that the ordered configurations constructed using cluster analysis relate fairly well to the conceptual electronic service process typology.

Table 5.14: Comparison of Cluster Analysis and *A Priori* Configurations

	Cluster Analysis Taxonomy							
***A Priori* Taxonomy**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Total**
1	35	25	4		1		3	68
2	10	8	69	30	12	16		145
3			5	2	1	2		10
4						5	3	17
5							9	10
6							3	3
7							1	1
Total	45	33	79	32	23	23	19	

5.5 Conclusion

5.5.1 Summary

This chapter reports results of an empirical analysis of the second building block of the product-process matrix, namely the electronic service process structure. Electronic service processes differ from each other according to their flexibility to dynamically fulfill consumer needs. Since service process flexibility has not been examined in the literature, we first developed a set of process flexibility dimensions for flexible service systems. We used these dimensions to frame our choice of variables for developing the electronic service process taxonomy. We then performed multidimensional scaling (MDS) procedures on our data set, and found that MDS positioned the variables consistent with our service process typology. The MDS solutions appeared to relate to several of our proposed flexibility dimensions. Next, we developed the taxonomy of electronic service processes. The empirical analysis used data collected on process dimensions from 254 electronic food retailers. We used both an *a priori* approach and a cluster analysis approach to develop homogeneous groups of electronic services from data related to electronic service processes. Our analysis revealed significant differences across the groups, and significant correlation between the *a priori* and cluster analysis configurations. As such, the empirical results tend to provide empirical support for the dimensions of our electronic service process structure.

5.5.2 Contributions

This study appears, to the best of our knowledge, to be the first study of its kind to empirically examine a process typology of dimensions that differentiate electronic services. We find empirical support that the different configurations of electronic services tend to differ along configurations of process attributes that we propose are related to several conceptual dimensions of service process flexibility. Within the clusters defined by these dimensions, electronic food retailers tend to systematically differ according to service process technologies that they implement.

Since no methodology has been suggested in the operations literature for validating conceptual typologies, and no measurement scales are available for measuring electronic service flexibility, the study also makes a methodological contribution. Specifically, the study develops a method for linking a conceptual typology to observed data using dichotomous observations. As no previous operations taxonomies employ dichotomous variables, this study is also the first to suggest how simple observations of technology type and technology use can be employed to position service operations relative to one another. Such a positioning method facilitates empirical description, prediction, and further theory development and testing.

5.5.3 Managerial Implications

From a managerial standpoint, the study provides several insights. First, the study indicates how important it is for managers to look below simple conceptual frameworks to understand the nuances of actual service operations within an industry. Managers often prefer simple conceptual models, such as the product-process matrix, because of their economy of description and prediction. However, our study shows that one can find different results depending on whether one takes a structural or functional view of the process. While a structural view is based in which technologies are used, the functional view is based in how the technologies are employed, which is important to understand to remain competitive. The two taxonomies that we construct indicate that there are several different nuances of operations processes that cannot be communicated within our conceptual typology, but that are further refinements of our four process structure types. Thus, the taxonomy helps to explain interesting variation within our conceptual framework. Managers can use this better explanation of the variation to understand their position relative to other electronic services.

Second, it seems that the clusters match our theoretical typology of service processes fairly well. This indicates that the model should be useful for communicating a basic understanding to employees of the relationship between the technologies they use and the flexibility of the electronic services they deliver.

Finally, this study presents a methodology that managers can employ to understand common operational types in an industry, as well as individual electronic services. Since electronic services can collect overwhelming amounts of data about the process technologies that consumers actually use within a single, highly customizable electronic service, this method may help managers to reveal the "virtual" types of operations that are being experienced by segments of customers.

5.5.4 Directions for Future Research

Limitations of the study include its exploratory nature. Since no confirmatory method exists to test typologies using actual data, this perhaps cannot be avoided. Further, since the taxonomy was developed in the area of electronic food retailing services, to some extent the results are contingent on the context. However, since the technologies used to develop and deliver services in many electronic service contexts are quite similar, the results are likely to be generalized to other electronic services. Nevertheless, it would be insightful to perform similar research in other electronic service contexts. Finally, since the literature on service flexibility includes neither models nor measures for traditional or electronic service processes, the view of service process flexibility upon which the study is based is somewhat new, and the measurement approach is the first of its kind.

There are also several logical extensions to this research. One could expand the sample to collect longitudinal data for the whole population of food retailers to study how they change their process technologies over time. One could also perform a cross-industry study to examine the process typology across retailing and non-retailing services. Since food retailers seem to concentrate on online service elements that relate to their offline goods and services, one could collect data for additional service contexts to further validate the service typology. Service contexts that involve a large amount of online service elements for which consumers must pay, such as online personal services or online financial services, would help to round out the full breadth of potential online service elements. Finally, future studies also should develop realized and potential flexibility measures for electronic services.

CHAPTER 6

Drivers of Service Quality and Customer Value in Electronic Food Retailing

6.1 Introduction

This chapter examines the use of the product-process matrix as the basis for theory development and testing in the context of electronic operations services. In this chapter, we study the relationship between electronic service product and process configurations and electronic service quality and customer value. We use membership in configurations of electronic services, constructed from data on actual electronic service product characteristics and service process technologies, to position electronic food retailers within a product-process matrix for electronic consumer services. The positions of the services are used to test hypotheses regarding fit between the product configurations and process technology configurations in electronic services, and the relationship between this fit and service quality and value. Finally, we examine whether service quality and value are associated with distances of individual service operations from the ideal profile within each configuration, positions on or off of the matrix diagonal, and positions along the matrix diagonal.

As the basis for a theory development, the product-process matrix can be shown to contain many possible propositions. Literature on fit and equifinality can be used to translate the constructs within a product-process matrix into propositions, and to relate the propositions to empirical analyses. As perspectives of fit relate isomorphically to statistical methods for testing them (Venkatraman 1989), the fit propositions can be tested using common statistical methodologies. Simple statistics, such as the correlation between product and process configurations, can indicate whether services have been designed with fit in mind, based on strategically chosen sets of product characteristics and process capabilities.

The product-process matrix can also be shown to represent lower-level service design attributes that are theoretically related to customer perceptions of service quality and customer value. Conceptual models of customer satisfaction, service quality and customer value have included both product attributes and process attributes as causal drivers of service perceptions (Zeithaml 1988, Bolton and Drew 1991). While the extant literature has viewed the product-process matrix as a driver of internal performance that implicitly leads to external performance (Hayes and Wheelwright 1979, Safizadeh et al. 1996), we use these conceptual service quality models as a basis for examining the relationship between the product-process matrix and service quality.

The remainder of the chapter is organized as follows. Section 6.2 reviews literature that links the product-process matrix to research on organizational fit, and to models of service quality drivers. Section 6.3 uses this literature to develop the research propositions tested in this study. Section 6.4 presents the research design for this study. Section 6.5 presents the empirical results and discusses the research findings. Finally, Section 6.6 discusses contributions and limitations.

6.2 Background

6.2.1 Fit, Equifinality, and the Product-Process Matrix

The concept of fit has motivated the construction of many organizational theories (Venkatraman 1989). Fit has been used broadly to allude to a relationship between two organizational constructs. Fit can be conceptualized in a number of ways. Venkatraman (1989) differentiated between six perspectives of fit, each of which relates isomorphically to specific statistical methods for theory testing. The six perspectives include three methods for specifying and testing bivariate fit, termed fit as moderation, fit as mediation, and fit as matching. The other three approaches to fit, fit as gestalts, fit as profile deviation, and fit as covariation, describe the specification and testing of fit between groups of variables.

Concepts of fit relate to two different approaches to conceptualize and empirically examine organizational design and its relationship to organizational performance. The research approaches are referred to as congruent propositions and contingent propositions (Drazin and Van de Ven 1985). Congruent propositions hypothesize a relationship between two or more organizational variables without relating those variables to performance. In contrast, contingent propositions relate organizational variables to organizational performance. Drazin and Van de Ven (1985) stated that all of the types of fit, whether congruent or contingency propositions, are useful since they can provide unique and complimentary information about a single data set.

The systems approach to contingency theory has given rise to the concept of equifinality (Drazin and Van de Ven 1985). Equifinality is essentially a proposition that identical organizational performance can be accomplished through a variety of organizational structures and operational processes (Gresov and Drazin 1997). Grezov and Drazin (1997) proposed four different organizational contexts in which organizational equifinality can appear, which they differentiate between according to their degree of conflict in an organization's functional demands, and the organizational latitude for its structural options. They call the four types configurational equifinality, tradeoff equifinality, suboptimal equifinality, and ideal profiles.[4] Each of these types is related to different research methodologies for studying organizations.

The importance of congruent and contingent propositions related to the product-process matrix has been acknowledged in the operations literature, but neither a systematic statement nor an empirical examination of the full breadth of potential propositions appears in the extant literature. In an empirical analysis of Hayes and Wheelwright's (1979) product-process matrix, Safizadeh et al. (1996) acknowledged the importance of contingency propositions, in particular equifinality, stating that: "Multiple process choices are possible, even within the same plant, to achieve the desired focus" (p. 1576). They also tested contingency propositions relating process

[4] Configurational equifinality results when organizations can use many structural options to fulfill many potential functional demands. Tradeoff equifinality results when there is one functional demand that can be fulfilled by many structural options. Suboptimal equifinality results when an organization faces many functional demands, but has few structural options to fulfill them. Finally, ideal profiles result when there is a dominant functional demand, and one or a limited few structural possibilities that fulfill the demand (Gresov and Drazin 1997).

type to perceived performance scales. In developing a matrix for traditional services, Kellogg and Nie (1995) developed but did not test several congruent propositions between organizational context and processes.

6.2.2 Electronic Service Quality and Service Quality Drivers

There are a number of models of price, customer satisfaction, quality and value developed for goods and services that help to frame a discussion about classes of service quality and value drivers. Two previous conceptual models incorporate a large set of potential items that explain the relationship of drivers to service quality and value. A model developed by Zeithaml (1988) concentrated on constructs mainly of interest to marketers, without considering the consumer process of forming perceptions. In contrast, a later model of Bolton and Drew (1991) incorporated the disconfirmation process for customer satisfaction, ignored extrinsic service attributes, but introduced engineering attributes and customer characteristics. Combining these two models together leads to a model of service perceptions in which product, process and customer attributes drive measures of service quality and value.

The service management literature also documents a variety of perspectives with regard to the definition and measurement of notions of perceived service quality and customer value. Service quality constructs and measures have been conceptualized in a variety of ways, including excellence, value as quality relative to price, value as consequences and attributes conditional upon goals, conformance to specifications, and meeting or exceeding consumer expectations (Gummeson 1992, Reeves and Bednar 1994, Woodruff and Gardial 1996, Woodruff 1997). However, the literature does not contain a comprehensive model of dimensions of consumer perceptions of service quality. Most models of service quality are oriented toward pure services that involve few or no facilitating goods. Very few researchers have attempted to extend these measures to retailing services that involve physical goods (Dabholkar, Thorpe and Rentz 1996).

The literature on dimensions of service quality and customer value of electronic services is just beginning to emerge. In one of the first studies for electronic shopping, Shim and Mahoney (1992) empirically differentiated between three types of dimensions of electronic shopping satisfaction: variety of offerings, easy shopping/quality, and shopping time required. They measured overall satisfaction of electronic shoppers for dimensions of shopping ease, delivery, credit, store reputation, ease of access, variety of stores, variety of selection, variety of style, advertisement, frequency of sale, ease of return, time spent on shopping, description of merchandise, and price. Several other practitioners also have discussed dimensions of value for electronic services (Hagel and Armstrong 1997, Biro 1998, Burke 1997).

More recently, Keeney (1999) developed a means-ends objectives network for the Internet commerce value proposition relating to "the net value of the benefits and cost of both a product and the processes of finding, ordering, and receiving it" (p. 533). In Keeney's view, to outperform conventional services, electronic services must design their businesses according to the values of their customers. Considering the values of customers during the design of services in turn should lead to services that have high service value. Keeney states that "the value proposition of a purchase can be significantly enhanced or worsened by the Internet" (p. 534). Further, "the value propositions of the Internet purchase and store purchase will partially depend on the book purchased as well as the method" (p. 534). Although Keeney's framework thoroughly describes the electronic service retailing process, it largely ignores services that are electronic but include no component for retailing goods, and only superficially considers the value from the item purchased.

6.3 Research Propositions

In this section we develop research propositions based on the literature on organizational fit to guide our empirical analysis of the product-process matrix for electronic services. Electronic services potentially face many functional demands from consumers. The product and process configurations from Chapters 4 and 5 also indicate that many structural options are available for managers of electronic services to fulfill those demands. Thus, we derive the propositions mainly from the configurational equifinality perspective of contingency proposition testing, in which one must empirically derive ideal profiles of configurations prior to testing their relationship to performance (Gresov and Drazin 1997).

6.3.1 Congruence Theory: Product and Process Configurations

We first examine the data for congruent fit to identify potential ideal profiles. The product-process matrix literature includes a congruence proposition that product configurations and process configurations will be associated. Hayes and Wheelwright (1979) referred to this congruence as a natural matching between a product structure and a process structure. Propositions related to diagonal positioning have been formulated and examined empirically in manufacturing and service matrixes (Safizedeh et al. 1996, Collier and Meyer 1998). In the case of electronic service operations, one also would expect that managers would implement electronic service process capabilities that are consistent with the electronic service products an organization intends to deliver to consumers.

Association Between Product and Process Configurations

We expect that electronic food retailers will tend to match their configurations of service product dimensions to their configurations of service process attributes. Since the literature seems to agree that some natural matching should appear between a product structure and a process structure, we expect there will be some relationship between the product and process configurations in our empirical taxonomies. Proposition 6.1 relates to the fit between product configurations and process configurations. We state the proposition for food retailing as follows:

> **Proposition 6.1**: Electronic food retailing services will tend to use product configurations and process configurations that are interrelated.

Existence of Product-Process Matrix Diagonal

Evidence of some relationship between the product and process configurations motivates a subsequent question of what form such a relationship takes. The product-process matrix diagonal is an obvious profile to examine, since we expect the flexibility dimension underlying the process structure should relate positively to increases in product volume, product breadth, and online customization along the product structure. Thus, Proposition 6.2 further examines the fit between product configurations and process configurations. We expect that food retailers will position themselves along the matrix diagonal because the product structure involved in retailing physical goods is likely to have synergy with the process structure as a food retailer increases the number of food items they offer to customers. Proposition 6.2 formally states that in food retailing there should be a relationship between product configurations and process configurations along the diagonal of the product-process matrix.

> **Proposition 6.2**: Electronic food retailing services will tend to position themselves along the matrix diagonal.

6.3.2 Contingency Theory: Drivers of Service Quality

The product-process matrix also can be used to generate contingency propositions that relate service quality and customer value to product configurations, process configurations, configuration interactions, and configuration consistency. The first three of these groups of propositions apply the configurational equifinality perspective of equifinality (Gresov and Drazin 1997), and assume that there exist theoretically specifiable or empirically identifiable structural or functional types that relate to performance. Propositions related to configuration consistency develop from the ideal profile perspective of equifinality (Gresov and Drazin 1997), and assume that cases having the ideal profile within a type should have higher performance.

Product-Process Fit and Service Quality

We first examine whether consumers perceive service quality to differ along the categories of product configurations and along the stages of process configurations. Since the product taxonomy is differentiated according to electronic service product design attributes leading to product breadth and online customization, we expect that consumers will perceive service quality to be different along the different product configurations. Since the process taxonomy represents different levels of process flexibility, and higher flexibility tends to prevent occurrences that decrease quality, we expect that the flexibility of the processes also will be related to the perception of service quality. Finally, the flexibility of service processes and the attributes of electronic service products may interact, and in turn affect service quality. Proposition 6.3 proposes a relationship between product configurations and electronic service quality, process configurations and electronic service quality, and product-process interactions and electronic service quality.

> **Proposition 6.3**: The service quality delivered by electronic food retailing services will improve as one moves from left to right along the categories of product configurations, and as one moves down the stages of process configurations in the product-process matrix. The service quality delivered by electronic food retailing will be highest along the diagonal of the matrix due to an interaction between the product categories and process stages.

Configuration Fit and Service Quality

The ideal profile perspective of equifinality suggests that positions away from the ideal profile of an ideal type should lead to lower organizational performance (Gresov and Drazin 1997)[5]. Thus, Proposition 6.4 proposes a contingency relationship between the ideal profiles within product and process configurations and service quality.

> **Proposition 6.4**: Electronic food retailers that use ideal profiles within the product and process configurations will have higher electronic service quality.

A product-process matrix also can be used to generate a large set of contingency propositions related to paths within the matrix and organizational performance. For example, Hayes and Wheelwright (1979) implied that equifinality existed along the diagonal of the product-process matrix. They indicated that movement away from the diagonal, without understanding the strategic implications of such a move, would lead to potential dissimilarity from competitors, opportunities for competitors to attack, and a task mismatch between marketing and operations. Empirical support for Proposition 6.2 also would suggest that the matrix diagonal might be an ideal profile in electronic food retailing. Movement away from the diagonal may lead to a similar mismatch for electronic food retailers between marketing and operations, and between operations capabilities and consumer needs. Thus, the following propositions are based on the

[5] *Ideal type* refers to a set of theoretically derived organizational formats. *Ideal profile* refers to the most effective set of organizational attributes among the range of attributes that may be implemented within an ideal type.

expectation that internal consistency between product outputs and operations processes will lead to high performance that is comparable across the matrix diagonal.

On-Diagonal vs. Off-Diagonal Service Quality

Proposition 6.2 suggested that electronic food retailers will position their services along the matrix diagonal. Such a set of matrix positions might be examined to determine whether they make up an ideal profile (Gresov and Drazin 1997). Proposition 6.5 views the matrix diagonal as an ideal profile, and relates the positions relative to the diagonal to performance. The extant literature suggests that positions off the diagonal should lead to lower performance. Thus, we examine whether there is a contingency relationship in electronic food retailing between positions on or off the matrix diagonal and service quality.

> **Proposition 6.5**: Electronic food retailing services positioned along the matrix diagonal should deliver greater electronic service quality than services positioned in the upper right hand or lower left hand corners of the matrix.

Configurational Equifinality

Configurational equifinality emerges when organizations "perform reasonably well" across design profiles within an ideal profile (Gresov and Drazin 1997). Proposition 6.5 provides general information about equifinality, since it examines whether configuration pairs along the matrix diagonal perform reasonably well, relative to off-diagonal positions. If the diagonal is significantly different from positions off of the diagonal, and each of the positions along the diagonal exhibits similar performance, then equifinality might reasonably be concluded. Thus, Proposition 6.6 further examines the proposition of equifinality for electronic food retailers along the matrix diagonal, by studying whether all of the positions along the matrix diagonal exhibit similar performance.

> **Proposition 6.6:** Electronic food retailing services positioned along the diagonal will deliver service quality that is not significantly different.

6.4 Research Design

6.4.1 Data and Data Collection

Independent Variables

The independent variables used in this study consist of the design attributes of the electronic service systems, which we have aggregated into product and process configurations. We use the configurations developed earlier for the electronic service product structure taxonomy (Chapter 4) and for the electronic service process structure taxonomy (Chapter 5). We create indicator variables representing configuration membership. The indicator variables are used to examine the interrelationship between product and process configurations, as well as the relationship of a configuration or an interaction between configurations to service quality.

Dependent Variable: Electronic Retailing Service Quality

The service quality data for electronic food retailers used in this study are publicly reported by BIZRATE (http://www.bizrate.com/). BIZRATE is a subsidiary of a marketing research company. BIZRATE independently measures service quality for electronic services using shoppers that rate each service on a list of over 40 service attributes. BIZRATE publicly reports their evaluations through a free electronic service, and also contracts with various companies to provide service quality data to individual customers through services such as America Online (AOL) and the Microsoft Network (MSN). The BIZRATE service quality data take the form of ten point single item scales. These data are available for 52 currently active food retailing services. Table 6.1 describes the dimensions represented in the BIZRATE data. The BIZRATE variables represent six of the fourteen dimensions of electronic shopping satisfaction proposed by Shim and Mahoney (1992), a number of Keeney's (1999) internet commerce customer value dimensions, and several of the retailing quality dimensions of Dabholkar, et al. (1996). Note that, as with these previous dimensions, the BIZRATE dimensions do not include pure service characteristics.

Table 6.1: Service Quality Dimensions (BIZRATE)

BIZRATE Service Quality Measures	Related Service Quality Concepts	Source
Individual Measures		
Electronic Service Measures		
Product Information	Description of Merchandise	Shim and Mahoney (1992)
Product Selection	Variety of Stores Variety of Selection	Shim and Mahoney (1992) Shim and Mahoney (1992)
Electronic Service Aesthetics	Appearance	Dabholkar, et al. (1996)
Electronic Service Navigation	Convenience Time Spent Purchasing Shopping Ease Time Spent on Shopping	Keeney (1999) Keeney (1999) Shim and Mahoney (1992) Shim and Mahoney (1992)
Customer Support	Problem Solving	Dabholkar, et al. (1996)
Fulfillment/Shipment/Return Measures		
Product In Stock		
Ease of Returns	Ease of Return	Shim and Mahoney (1992)
On-Time Delivery	Time to Receive Product Delivery	Keeney (1999) Shim and Mahoney (1992)
Customer Measures		
Price	Cost Price	Keeney (1999) Shim and Mahoney (1992)
Customer Loyalty		
Aggregated Measures		
Overall Quality		
Average of individual indexes		

Quality measurements generated by evaluation services such as BIZRATE have been used often in exploratory studies, both in the marketing and operations management literature. For example, MacDuffie (1995) used quality ratings from J. D. Powers assessments to represent the quality of automobile assembly. Thus, we consider the BIZRATE data to be sufficient for this exploratory study.

6.4.2 Statistical Methods

Congruent Propositions

One can test congruent propositions regarding the relationship between product and process configurations (Propositions 6.1 and 6.2) by viewing fit as covariation (Venkatraman 1989). The form of such a test will depend on whether one has nominal, dichotomous, ordinal or metric data available. In previous research (Safizadeh et al. 1996, Collier and Meyer 1998) significant Spearman correlation statistics for ordinal-by-ordinal data have been used to test for this type of fit, and to provide evidence supporting the validity of the product-process matrix as a conceptual framework. A number of symmetric and asymmetric correlation statistics are available for nominal-by-nominal and ordinal-by-ordinal data (SPSS 1998, Reynolds 1977). If one only is interested in a null hypothesis of independence between product and process configurations (Proposition 6.1), one might first test for the existence of this fit by using a contingency table to examine configurations.

Contingent Propositions

Once the membership of individual services in product and process configurations has been determined, correlation statistics, ANOVA and regression can be employed to analyze contingent propositions. The propositions of product-process fit (Proposition 6.3), on diagonal fit (Proposition 6.5), and configurational equifinality (Proposition 6.6) can be examined by viewing fit as moderation (Proposition 6.4) and fit as profile deviation (Proposition 6.5 and 6.6) (Venkatraman 1989), and using ordinal correlation statistics, ANOVA and nonparametric tests of equality of means. The proposition of internal consistency (Proposition 6.4) can be empirically studied by viewing fit as profile deviation (Venkatraman 1989) and measuring each organization's distance from its related ideal profile (Doty et al. 1993). Gresov and Drazin (1997) suggested using "creative variations" of distance measures to measure fit of theoretically or empirically derived configurations.

Two potential methodological problems exist for contingent propositions related to the product-process matrix. First, the congruent fit between product and process configurations may lead to correlation between observed variables that represent product types and process types in linear statistical methods. Based on the available cases and variables, the correlation could range from low to high.[6] One would expect a lower inter-correlation when using a structural representation of process types, whereas

[6] For example, if all or almost all cases fall on the product-process matrix diagonal, indicator variables for the product and process configurations would be exact or nearly linear combinations of each other, leading to high multi-collinearity. In this case, the test would have to be reduced to a test of different performance between product-process interactions only.

a functional representation of process types will represent service product attributes more closely, leading to potentially higher correlation. If correlation is observed between configurations, the correlation may lead to multicollinearity in the design matrix for a statistical technique, which may adversely affect parameter estimates. Second, no metric for configuration consistency has been proposed in the literature. Thus, there exists no prior guidance on how to represent the distance between an individual case and an ideal profile for a configuration. Further, no literature considers how to specify the ideal profile of a configuration (e.g. mean, median) within an empirical study.

6.5 Results and Discussion

6.5.1 Product-Process Fit

Independence Between Product and Process Configurations

Proposition 6.1 relates to the independence between product configurations and process configurations. We formulate Proposition 6.1 in terms of null and alternative hypotheses below.

> **$H1_0$**: Electronic service process technology choices are independent of electronic service product choices.
>
> **$H1_A$**: Electronic service process technology choices are not independent of electronic service product choices.

Rejection of the null hypothesis for this test provides evidence that product and process configurations are not independent of each other, and indicates that subsequent analyses should examine the nature of the relationship between the product and process configurations.

We first examine Proposition 6.1 using the product configurations and the *a priori* process configurations. Table 6.2 presents results for the case in which *a priori* process configurations were developed by partitioning the data set according to dichotomous variables representing the service process technology each service uses. The table presents tabular counts of services choosing individual product-process positions. The chi-square statistic for testing for independence between the row and column variables is 221.817 with a two-sided p-value of 0.000. This test statistic indicates that one should tend to reject the null hypothesis that product configurations are independent of process configurations. However, because several rows and columns of the table contain a low number of services, the expected cell counts within several cells of Table 6.2 are too low, which leads to the possibility that the significance level of the test of independence is incorrect.

In such cases, researchers commonly use theoretical priors to reduce the number of categories in the contingency table (SPSS 1998, p. 67). Based on the technological similarities between *a priori* process configurations presented in Table 5.11 (i.e. HTML, only CGI, Database), we reduced the counts for process configurations. Similarly, we reduced the number of product configurations based on similarities (i.e. Ward's method clustering patterns in Table 4.5) in the cluster analysis results for the product configurations. Table 6.3 presents results for the reduced number of configurations. The smaller number of product and process configurations leads to a Pearson chi-square statistic of 145.915 that has similar significance to the original categories, and reasonable expected cell counts. These findings tend to provide evidence that calls into question the null hypothesis of independence between product and process configurations, and tends to support Proposition 6.1.

Table 6.2: Test of Independence – *A Priori* Process Configurations

Process Configuration	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Total in Process Configuration**
1	25	16	13	8	5	1		68
2	16	26	34	33	24	4	8	145
3		1	3	3	1	2		10
4					3	7	7	17
5			1			9		10
6					1		2	3
7							1	1
Total in Product Configuration	41	43	51	44	34	23	18	254
Pearsons' $\chi 2$								221.817
Two-sided p-value								(0.000)
d.f.								36
Number (%) of cells with expected count below 5.0								36 (73.5%)
Number of cells with expected count below 1.0								18

We also analyze Proposition 6.1 using the process configurations constructed using a cluster analysis approach. Table 6.4 presents results based on the cluster analysis process configurations, showing that this test leads to a chi-square statistic of 220.937. The significance of the chi-square statistic suggests that one should tend to reject the hypothesis of no relationship between the two sets of classes. However, this conclusion once again must be tempered by the finding that a number of the expected cell counts violate the assumptions underlying this test.

Table 6.3: Reduced Table – *A Priori* Process Configurations

	Product Configuration				
Process Configuration	**1**	**2**	**3**	**4**	**Total in Process Configuration**
1	41	21	5	1	68
2	43	73	25	14	155
3		1	4	26	31
Total in Product Configuration	84	95	34	41	254
Pearsons' $\chi 2$					145.915
Two-sided p-value					(0.001)
d.f.					6
Number (%) of cells with expected count below 5.0					1 (8.3%)
Number of cells with expected count below 1.0					0

We once again use information about related clusters within the product and process taxonomies to reduce the number of classes in the test of independence. We employed information about the Ward's method clustering patterns from Table 4.5 and Table 5.6, respectively. The reduction from seven to four clusters was based on the pattern through which clusters were combined together by the Ward's method cluster analysis procedure to decrease the Ward's method solution from seven to four clusters. We present in Table 6.5 the reduction process for the cluster analysis configurations, since this reduction in the number of configurations will also serve as the basis for several analyses in following sections as well.

Table 6.4: Test of Independence – Cluster Analysis Process Configurations

	Product Configuration							
Process Configuration	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Total in Process Configuration**
1	14	12	7	6	6			45
2	18	5	6	3	1			33
3	7	17	24	18	10	2	1	79
4	2	6	2	13	8		1	32
5			1		6	9	7	23
6		3	7	4	2	2	5	23
7			4		1	10	4	19
Total in Product Configuration	41	43	51	44	34	23	18	254
Pearsons' $\chi 2$								220.937
Two-sided p-value								(0.000)
d.f.								36
Number (%) of cells with expected count below 5.0								29 (59.2%)
Number of cells with expected count below 1.0								0

Table 6.5: Configuration Reduction Process

	Product Configuration (Number in Seven Cluster Solution)							
Process Configuration	**1 (41)**	**2 (43)**	**3 (51)**	**4 (44)**	**5 (34)**	**6 (23)**	**7 (18)**	**Total in Reduced Process Configuration**
1 (45)	14	12	7	6	6			78
2 (33)	18	5	6	3	1			
3 (79)	7	17	24	18	10	2	1	79
4 (32)	2	6	2	13	8		1	55
5 (23)			1		6	9	7	
6 (23)		3	7	4	2	2	5	42
7 (19)			4		1	10	4	
Total in Reduced Product Configuration	84		95		34	41		254

The results for the reduced set of cluster analysis process configurations also indicate that one might tend to reject the independence between product and process configurations. Table 6.6 presents the reduced table for the cluster analysis process configurations. The chi-squared statistic for this test is 109.032 with a p-value of 0.000, which would lead one to reject the null hypothesis.

Table 6.6: Reduced Table – Cluster Analysis Process Configurations

	Product Configuration				
Process Configuration	**1**	**2**	**3**	**4**	**Total in Process Configuration**
1	49	22	7		78
2	24	42	10	3	79
3	8	16	14	17	55
4	3	15	3	21	42
Total in Product Configuration	84	95	34	41	254
Pearsons' $\chi 2$					109.032
Two-sided p-value					(0.000)
d.f.					9
Number (%) of cells with expected count below 5.0					0 (0.0%)
Number of cells with expected count below 1.0					0

In summary, the tests of independence reject the hypothesis of independence between product and process configurations. We view this information as supporting Proposition 6.1. In turn, this conclusion suggests that one might find it insightful to examine the type of relationship between the product and process configurations.

While the contingency table tests provide evidence that supports Proposition 6.1, we must state some caveats about these tests. While the statistical assumptions of the test are satisfied, at least when smaller numbers of product and process configurations are employed, the conceptual differences between the rows and the columns of this test are not entirely distinct. In service industries, a common viewpoint is that the product of the service is the process, which calls into question the use of such a test of independence. However, to the greatest extent possible, we attempted to construct the product and process configurations from non-overlapping sets of data. In essence, we used conceptually different variables and different data types to construct the taxonomies.

6.5.2 Congruence Theory: Product-Process Diagonal

Proposition 6.2 relates to a relationship along the product-process diagonal between product and process configurations. We formulate Proposition 6.2 in terms of the null and alternative hypotheses below.

> **$H2_0$**: Electronic service process technology choices and product choices do not follow the diagonal of the product-process matrix.
>
> **$H2_A$**: Electronic service process technology choices and product choices tend to follow the diagonal of the product-process matrix.

Rejection of the null hypothesis provides information that a diagonal exists in the matrix.

We examine Proposition 6.2 using nominal and ordinal correlation statistics between the product and process configurations. In the context of the product-process matrix, a positive correlation indicates that higher indexes for product configurations tend to relate to higher indexes for process technology configurations (Safizadeh et al. 1996, Collier and Meyer 1998). Table 6.7 presents correlation statistics for the relationship between product configurations and process configurations. The first row of Table 6.7 presents correlation statistics calculated for the *a priori* process configurations. The second row presents correlation statistics calculated using the process configurations constructed using cluster analysis. Table 6.7 presents correlation statistics available for both unordered categories (e.g. nominal-by-nominal) and ordered categories (e.g. ordinal-by-ordinal). Kendall's tau-b, Kendall's tau-c, Goodman and Kruskal's gamma, Spearman's rho, and Somers' d are measures of correlation that are appropriate for table variables having ordered categories (SPSS 1998, Reynolds 1977).

The correlation coefficients for both of the process configuration scenarios suggest that the product and process configurations exhibit a positive correlation significantly different from zero. In the case of our ordering of the product and *a priori* process configurations based on the underlying product and process typologies, the symmetric and asymmetric ordinal-by-ordinal correlation statistics range from 0.388 to 0.641. When we employed the algorithmic cluster analysis process configurations, we found significant ordinal-by-ordinal correlation statistics between 0.449 and 0.569. Thus, in both cases we find statistically significant associations between the product configurations and process configurations.

Overall, the nominal and ordinal correlation statistics indicate that the product and process configurations are positively related. This provides empirical support for the existence of a diagonal, and that product choices typically follow processes along the diagonal.[7]

The fact that the correlation statistics are not close to 1.0 indicates that a good number of electronic food retailers are positioned away from the matrix diagonal. This finding is illustrated further by the positions of services in Tables 6.2 and 6.4. The

[7] Interestingly, the correlation statistics we find are comparable in magnitude to those found in previous studies of the product-process matrix (Safizadeh et al. 1996, Collier and Meyer 1998).

finding suggests that further examination of these off-diagonal positions would be worthwhile, particularly their relationship to external service performance measures.

Table 6.7: Correlation Between Product and Process Configurations

Product-Process Configuration Methodology	Symmetric Correlations	Asymmetric Correlation Product Configurations Dependent	Asymmetric Correlation Process Configurations Dependent
***A Priori* Process Configurations**			
Nominal-by-Nominal			
Phi	0.935 (0.000)		
Cramer's V	0.382 (0.000)		
Contingency coefficient	0.683 (0.000)		
Lambda	0.141 (0.001)	0.148 (0.000)	0.128 (0.055)
Goodman &Kruskal's tau		0.108 (0.000)	0.159 (0.000)
Uncertainty coefficient	0.206 (0.000)	0.168 (0.000)	0.269 (0.000)
Ordinal-by-Ordinal			
Kendall's tau-b	0.470 (0.000)		
Kendall's tau-c	0.388 (0.000)		
Goodman & Kruskal's gamma	0.641 (0.000)		
Spearman's rho	0.547 (0.000)		
Somers' d	0.463 (0.000)	0.560 (0.000)	0.394 (0.000)
Cluster Analysis Configurations			
Nominal-by-Nominal			
Phi	0.933 (0.000)		
Cramer's V	0.381 (0.000)		
Contingency coefficient	0.682 (0.000)		
Lambda	0.183 (0.000)	0.217 (0.000)	0.143 (0.000)
Goodman &Kruskal's tau		0.127 (0.000)	0.128 (0.000)
Uncertainty coefficient	0.220 (0.000)	0.216 (0.000)	0.224 (0.000)
Ordinal-by-Ordinal			
Kendall's tau-b	0.464 (0.000)		
Kendall's tau-c	0.449 (0.000)		
Goodman & Kruskal's gamma	0.546 (0.000)		
Spearman's rho	0.569 (0.000)		
Somers' d	0.464 (0.000)	0.471 (0.000)	0.456 (0.000)

6.5.3 Service Quality Drivers: Product Configurations and Process Configurations

We formulate Proposition 6.3 in terms of the null and alternative hypotheses below. Rejection of the null hypotheses provides empirical evidence that a relationship exists between electronic service quality and product choices (H3), process choices (H4), and interactions between product and process choices (H5).

H3$_0$: Service quality performance for food retailers is the same across product taxonomy configurations.

H3$_A$: Service quality performance for food retailers is not the same across product taxonomy configurations. Service quality improves from left to right along the categories of product configurations.

H4$_0$: Service quality performance for food retailers is the same across process taxonomy configurations.

H4$_A$: Service quality performance for food retailers is not the same across process taxonomy configurations. Service quality improves from top to bottom along the stages of process configurations.

H5$_0$: Interactions between product configurations and process technology configurations will not affect service quality performance.

H5$_A$: Interactions between product configurations and process technology configurations affect service quality performance.

We examine the above hypotheses using single-factor and two-factor analysis of variance (ANOVA) approaches, as well as ordinal correlation statistics between the service quality indexes and the product and process configuration indexes. We use a single factor ANOVA model to analyze mean service quality within the set of seven product and process configurations, and use the two-factor ANOVA model to analyze the reduced set of four product and process configurations. The equation for the single-factor ANOVA model we estimate is as follows:

Equation 6.1:

$$y_{ik} = \mu. + \alpha_i + \varepsilon_{ik}$$

The equation for the two-factor ANOVA model we estimate is as follows:

Equation 6.2:

$$y_{ijk} = \mu_{..} + \alpha_i + \beta_j + (\alpha\beta)_{ij} + \varepsilon_{ijk}$$

In equations 6.1 and 6.2, y_{ijk} represents observations for each of the service quality indexes, $\mu_{..}$ represents the overall mean service quality, α_i represents service quality differences between the overall mean and the mean service quality for the i^{th} product configuration, β_j represents service quality differences between the overall mean and the mean service quality for the j^{th} process configuration, and $(\alpha\beta)_{ij}$ represents service quality differences between the overall mean and the mean service quality for the ij^{th} product-process configuration interaction. The SPSS GLM procedure was used to estimate equation 6.1 using Type IV sums of squares which are suggested when the design matrix includes cells with missing observations.

Service Quality Indexes

Factor analysis and reliability tests were employed to reduce service quality measures from BIZRATE (http://www.bizrate.com/) into several index variables representing service quality in electronic services. Four service quality index variables were constructed by averaging several related BIZRATE quality variables. Table 6.8 presents the quality indexes used in this study, the related BIZRATE measures from which they were constructed, and the general service quality concept they represent. The variables Shopping Ease and Appearance and Electronic Service Quality were constructed from measures related to electronic attributes of the service. The variable Product Offering relates to product attributes of the items for sale. Conceptually, the Electronic Service Quality index is closer to an overall measure of service quality perceptions, since it incorporates the electronic dimensions from both Shopping Ease and Appearance, and Product Offering. Finally, the variable Product Fulfillment relates to measures of the services' fulfillment process. Appendix D presents the methodology used to construct each quality index.

The quality indexes constructed for this study are mainly available for services positioned in the first three product types and second two process types from the conceptual product-process matrix proposed in Chapter 2. Figure 6.1 pictorially presents the positions of the available observations within the product-process matrix from Chapter 2. Table 6.9 presents the positions of available observations within the product-process matrix constructed from our product and process configurations. Initial scatter plots of the service quality indexes against the product and process configurations indicated systematic patterns between the configurations and service quality. These patterns were particularly evident for the Shopping Ease and Appearance, Electronic Service, and Product Offering quality indexes.

Table 6.8: Variable Construction – Service Quality and Customer Value

Research Study Index	BIZRATE Quality Indexes	Service Quality Concept Represented
Shopping Ease and Appearance	Web Site Aesthetics Web Site Navigation Customer Support	Quality of appearance and ease of shopping delivered by retailing system operations
Electronic Service Quality	Web Site Aesthetics Web Site Navigation Customer Support Product Selection Product Information	Quality of information and experience delivered by retailing system operations
Product Fulfillment	On Time Delivery Product in Stock	Quality of offline service process fulfillment operations
Product Offering	Product Selection Product Information Ease of Returns Price	Customer value of the product offering

Table 6.9: Product-Process Combinations

	Product Configuration								
Process Configuration	1	2	3	4	5	6	7	Total in Process Configuration	Reduced Process Configuration
1									1 0
2									
3		1	1	3	1	1	1	8	2 8
4		1	1	1	1		1	5	3 22
5			1		3	8	5	17	
6			3	1	1	2	4	11	4 22
7			1			7	3	11	
Total in Product Configuration		2	7	5	6	18	14	52	
Reduced Product Configuration	1		2		3	4			
Number	2		12		6	32			

Figure 6.1: Position of Service Quality Observations Within Product-Process Matrix

Electronic Service Process Structure	Electronic Service Product Structure: Niche Market Electronic Services	Market Extender Electronic Services	Mass Market Electronic Services	Customized Market Electronic Services
Service Kiosk				
Service Mart	5	9	16	
Mass Service Customization	4	2	16	
Joint Alliance Service Customization				1

We first analyze Proposition 6.3 using single-factor ANOVA on the service quality indexes. The first analysis employs the full set of seven product configurations and seven process configurations developed through cluster analysis.[8] We present configuration means, F statistics and non-parametric Kruskal-Wallis statistics for the means, and Spearman correlation statistics between each configuration ordering and each quality index. The numbers in parentheses below each of these statistics are the p-values for the test statistics, which indicate the proportion of times, across similar samples, that we might expect to observe statistics more extreme than those found here. Low values of the p-values (for example, less than 0.05, 0.01, or 0.001) are interpreted as providing evidence that might lead one to reject the null hypothesis of the test. Table 6.10 presents the results of this analysis for the product configurations, while Table 6.11 presents the results for process configurations. Table 6.10 indicates that only the Product Offering quality index appears to change moderately across the product configurations. While the F-tests and non-parametric Kruskal-Wallis (K-W) statistics indicate that the differences between the Product Offering means are only marginally significant, Spearman's rho indicates that the quality indexes and configurations tend to increase together, particularly for Product Offering, as one moves from left to right along the product configurations. This finding is intuitively reasonable, since one might expect perceptions of product breadth and information to relate to the product typology, which was constructed from similar dimensions. Table 6.11 indicates significant and systematic increases in the Shopping Ease and Appearance, Electronic Service Quality

[8] We use only the cluster analysis process configurations to examine proposition 6.3 through 6.6.

and Product Offering indexes along the process configurations. Spearman's rho indicates a positive correlation between the process configurations and service quality index levels. These results tend to provide weak empirical support for the product configuration hypothesis (H3) and somewhat stronger support for the process configuration hypothesis (H4) of Proposition 6.3.

Table 6.10: ANOVA on Product Configurations

		Product Configurations									
Quality Index	**Average Quality Index**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**F (p)**	**K-W (p)**	**rho (p)**
Cluster Size		41	43	51	44	34	23	18			
Number of Observations		0	2	7	5	6	18	14			
Shopping Ease and Appearance	6.52		6.50	6.05	6.20	6.20	6.81	6.64	0.836 (0.531)	3.563 (0.614)	0.190 (0.177)
Electronic Service Quality	6.63		6.30	6.20	6.20	6.27	6.81	6.97	1.454 (0.223)	5.874 (0.319)	0.325 (0.019)
Fulfillment Quality	7.00		6.50	6.36	7.10	7.08	7.03	7.29	1.045 (0.403)	3.422 (0.635)	0.240 (0.087)
Product Offering	6.27		5.25	6.18	5.70	5.87	6.36	6.75	2.020 (0.093)	8.689 (0.122)	0.364 (0.008)

Table 6.11: ANOVA on Process Configurations

		Process Configurations									
Quality Index	**Average Quality Index**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**F (p)**	**K-W (p)**	**rho (p)**
Cluster Size		45	33	79	32	23	23	19			
Number of Observations		0	0	8	5	17	11	11			
Shopping Ease and Appearance	6.52			5.67	6.07	6.45	6.75	7.21	3.556 (0.013)	13.627 (0.009)	0.516 (0.000)
Electronic Service Quality	6.63			5.90	6.08	6.62	6.96	7.09	3.584 (0.012)	13.046 (0.011)	0.491 (0.000)
Fulfillment Quality	7.00			6.88	6.10	7.26	7.36	6.72	2.371 (0.066)	5.225 (0.265)	0.031 (0.830)
Product Offering	6.27			5.44	5.85	6.36	6.75	6.48	3.198 (0.021)	11.829 (0.019)	0.395 (0.004)

We next analyze the quality indexes using ANOVA on the reduced set of product and process configurations. Table 6.12 presents the number of observations available for the quality variables. Table 6.13 presents the results of this analysis for the product configurations, while Table 6.14 presents the results for process configurations. Table 6.13 indicates that, once again, Product Offering is the quality index that varies most significantly along the product configurations, increasing as one moves toward the right of the product taxonomy. Similarly, Table 6.14 indicates that the Shopping Ease and Appearance, Electronic Service Quality and Product Offering indexes vary systematically along the process structure. Once again, these results tend to provide weak support for the product configuration hypothesis (H3) of Proposition 6.3 and somewhat stronger empirical support for the process configuration hypothesis (H4) of Proposition 6.3.

Table 6.12: Product-Process Positions: Reduced Number of Configurations

	Product Configuration				
Process Configuration	**1**	**2**	**3**	**4**	**Total in Process Configuration**
1					
2	1	4	1	2	8
3	1	3	4	14	22
4		5	1	16	22
Total in Product Configuration	2	12	6	32	52

Finally, we analyze the relationship between the service quality indexes and product-process configuration interactions related to fit derived from moderation between the product and process configurations (H5). We used the SPSS general linear model (GLM) procedure to obtain these parameter estimates used to examine Proposition 6.3. The results are presented in Table 6.15.

Table 6.13: ANOVA on Product Configurations

		Product Configuration						
Quality Index	**Average Quality Index**	**1**	**2**	**3**	**4**	**F (p-value)**	**Kruskal-Wallis (p-value)**	**Spearman's rho (p-value)**
Cluster Size		84	95	34	41			
Number of Observations		2	12	6	32			
Shopping Ease and Appearance	6.52	6.50	6.11	6.17	6.52	1.351 (0.531)	3.303 (0.347)	0.247 (0.078)
Electronic Service Quality	6.63	6.30	6.20	6.27	6.88	2.420 (0.078)	5.451 (0.142)	0.322 (0.020)
Fulfillment Quality	7.00	6.50	6.67	7.08	7.14	0.933 (0.432)	2.573 (0.462)	0.211 (0.133)
Product Offering	6.27	5.25	5.98	5.88	6.53	2.574 (0.065)	6.877 (0.076)	0.336 (0.015)

Table 6.14: ANOVA on Process Configurations

		Process Configuration						
Quality Index	**Average Quality Index**	**1**	**2**	**3**	**4**	**F (p-value)**	**Kruskal-Wallis (p-value)**	**Spearman's rho (p-value)**
Cluster Size		78	79	55	42			
Number of Observations		0	8	22	22			
Shopping Ease and Appearance	6.52		5.67	6.36	6.98	6.178 (0.004)	12.543 (0.002)	0.496 (0.000)
Electronic Service Quality	6.63		5.90	6.50	7.02	6.238 (0.004)	12.582 (0.002)	0.495 (0.000)
Fulfillment Quality	7.00		6.88	7.00	7.04	0.092 (0.912)	0.292 (0.864)	0.022 (0.875)
Product Offering	6.27		5.44	6.25	6.61	5.441 (0.007)	10.940 (0.004)	0.419 (0.002)

In three of the regressions presented in Table 6.15, Levene's test for constant variance indicated non-constant error variance along the configurations. When we attempted to adjust for this using weighted least squares procedures, we found that the majority of treatments had similar squared residual scatter plots, and that a few observations associated with the lowest fitted values for the dependent service quality variables had slightly lower residuals. While we attempted to estimate variance functions for the equations, the variance functions derived from residual estimates were insignificant, and subsequent weighted least squares accomplished little to correct the regression estimates. While one might have removed the observations having lower variance, we believe it is of greater importance in an exploratory study to retain the additional information provided by these observations. Thus, we present ordinary least squares results for the full set of observations in Table 6.15.

The parameter estimates from the analysis, presented in Table 6.15, tend to provide only minor support for the proposition that quality increases as one moves from left to right along the product structure of the matrix (H3). However, Table 6.15 once again indicates stronger support for the proposition (H4) that service quality improves as one moves from top to bottom along the process structure of the matrix. The results also indicate a few significant and close-to-significant interaction effects for the quality indexes, suggesting only marginal empirical evidence for the product-process interaction hypothesis (H5) when examined using a fit as moderation approach.

Table 6.15: ANOVA on Product and Process Configurations

Variable	Measures of Service Quality/Customer Value: Shopping Ease and Appearance	Electronic Service Quality	Product Fulfillment	Product Offering
Constant	7.250 (0.000)	7.250 (0.000)	7.000 (0.000)	6.703 (0.000)
Product Configuration				
1	-0.095 (0.920)	-0.643 (0.434)	-2.286* (0.022)	-1.464 (0.121)
2	-1.117* (0.021)	-0.930* (0.026)	0.200 (0.676)	-0.403 (0.384)
3	-0.250 (0.790)	-0.250 (0.759)	0.000 (0.999)	0.047 (0.960)
4	0	0	0	0
Process Configuration				
2	-2.417*** (0.001)	-1.650** (0.008)	0.250 (0.721)	-1.078 (0.116)
3	-0.821* (0.018)	-0.607* (0.041)	0.286 (0.405)	-0.239 (0.470)
4	0	0	0	0
Product X Process Interactions				
1X2	1.929 (0.192)	1.643 (0.200)	3.036* (0.048)	1.339 (0.356)
1X3	0	0	0	0
2X2	2.450** (0.010)	1.480 (0.068)	-1.075 (0.256)	0.278 (0.759)
2X3	0.688 (0.929)	0.354 (0.584)	-1.319 (0.089)	0.022 (0.976)
2X4	0	0	0	0
3X2	-0.250 (0.864)	-0.550 (0.664)	-0.250 (0.867)	-0.922 (0.523)
3X3	0.238 (0.824)	0.057 (0.951)	-0.161 (0.884)	-0.574 (0.589)
3X4	0	0	0	0
4X2	0	0	0	0
4X3	0	0	0	0
4X4	0	0	0	0
Levene's Test of Equality of Error Variances: F (p)	2.835 (0.009)	3.264 (0.003)	1.650 (0.127)	2.853 (0.009)
R^2	0.390	0.366	0.224	0.268
Adjusted R^2	0.241	0.212	0.034	0.090
N	52	52	52	52
F (p-value)				
Product	1.778 (0.545)	1.208 (0.586)	2.651 (0.391)	1.462 (0.613)
Process	8.706 (0.009)**	5.419 (0.019)*	0.215 (0.883)	5.084 (0.052)
Product X Process	8.335 (0.095)	4.021 (0.282)	7.601 (0.142)	1.335 (0.890)
Sums of Squares	Type IV	Type IV	Type IV	Type IV

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

6.5.4 Performance Relative to Ideal Profiles

Proposition 6.4 proposes that a relationship exists between service quality and each service's deviation from the ideal profiles within the product and process configurations to which they belong. We examine the proposition using distances within the configurations derived from our cluster analysis solutions. In order to perform this empirical analysis, we assume that there exists a set of ideal configuration profiles from which individual service of the same type might differ. We base these ideal profiles on the centroid means of our product and process configurations. In both the product and process cases, we employ a squared Euclidean distance metric. In the case of the product configurations, we use the distance from the observed cluster centroids, which are based on the factor scores for static content, dynamic content, and market segments. Since the *a priori* process configurations are constructed so that they will be fully consistent, we only examine the cluster analysis process configurations using their cluster centroid means. The null and alternative hypotheses related to Proposition 6.4 are as follows:

> **H6$_0$**: Service quality performance of electronic food retailers is not affected by position relative to the ideal profile within the configuration to which it belongs.
>
> **H6$_A$**: Service quality performance of ideal profile electronic food retailers will not be the same as of food retailers positioned at a distance from a configuration center.

We examine these hypotheses using simple linear regression on squared Euclidean distances from configuration centers. The distance of each retailer to the ideal type of its related product configuration were obtained from the SPSS K-means cluster analysis performed in Chapter 4, and computed from the process configuration centers obtained in Chapter 5. The equation for the simple linear regressions used to analyze Proposition 6.4 is as follows:

Equation 6.3

$$y_i = \alpha + \beta_1 x_{1i} + \varepsilon_i$$

In equation 6.3, y_i represents observations for each service quality index, x_{1i} represents the distances from product and process configuration centers, and ε_i represents a normally distributed random error term.

Overall, we find no evidence of configuration fit resulting from profile deviation among the data for electronic food retailers. Table 6.16 presents linear regressions of the configuration distances on the service quality indexes. The regressions for product and process configuration distances indicate the absence of a significant relationship between configuration distance and the service quality indexes. Thus, we find no evidence to support Proposition 6.4. This finding may result for several reasons. Since the previous findings indicated that Product Offering increases slightly along the product configurations, and the Shopping Ease and Appearance and Electronic Service Quality indexes tend to increase with the process configurations, the differences in the quality indexes on the lower and upper sides of a configuration may average to zero. The sample size available for this empirical analysis also may not provide enough observations of the performance distribution within each configuration to observe a significant pattern.

Table 6.16: Regression on Configuration Distances

Variable	Shopping Ease and Appearance		Electronic Service Quality		Product Fulfillment		Product Offering	
Constant	6.146 (0.000)	6.438 (0.000)	6.212 (0.000)	6.568 (0.000)	6.604 (0.000)	7.093 (0.000)	5.792 (0.000)	6.326 (0.000)
Product Configuration Distance	0.406 (0.232)		0.454 (0.113)		0.430 (0.162)		0.528 (0.081)	
Process Configuration Distance		0.029 (0.781)		0.022 (0.800)		-0.032 (0.726)		-0.016 (0.859)
R^2	0.028	0.002	0.049	0.001	0.039	0.002	0.060	0.001
Adjusted R^2	0.009	-0.018	0.030	-0.019	0.020	-0.017	0.041	-0.019
N	52	52	52	52	52	52	52	52
F (p-value)	1.466 (0.232)	0.078 (0.781)	2.600 (0.113)	0.065 (0.800)	2.018 (0.162)	0.124 (0.726)	3.167 (0.081)	0.032 (0.859)

6.5.5 On-Diagonal vs. Off-Diagonal Service Quality

Proposition 6.5 examines whether product-process matrix positions on the diagonal as a whole are related to better organizational performance. We formulate Proposition 6.5 in terms of null and alternative hypotheses below.

$H7_0$: Service quality performance of food retailers positioned on the diagonal will be the same as of food retailers positioned off the diagonal.

$H7_A$: Service quality performance of food retailers positioned on the diagonal will not be the same as of food retailers positioned off the diagonal.

Rejection of the null hypothesis indicates that a relationship exists between the fit between product and process configurations and service quality, and a positive and significant difference between the two positions provides initial evidence that the matrix diagonal might be an ideal profile for electronic food retailers.

We examine Proposition 6.5 using single-factor ANOVA. Similar to the method of Safizadeh, et al. (1996), we assign observations positioned in on-diagonal positions in our reduced set of configurations (i.e. (2,2), (3,3), (4,4)) to one group, and the remaining observations to another group. The single-factor ANOVA model for this test is as follows:

Equation 6.4:

$$y_i = \mu. + \alpha_i + \varepsilon_i$$

In equation 6.4, y_i represents the observations for service quality indexes, $\mu.$ represents the overall mean, and α_i represents service quality differences between the overall mean and the on- or off-diagonal position.

We find a statistically significant relationship between on and off diagonal positions for the Shopping Ease and Appearance and the Electronic Service Quality indexes. Table 6.17 indicates that estimates of these two quality indexes on the diagonal are significantly different from estimates for off-diagonal positions. The F-test and the Mann-Whitney U statistic for two independent samples both indicate similar levels of significance for the difference between the two groups. Further, the Spearman correlation indicates that movement from off-diagonal to on-diagonal positions is positively correlated with the Shopping Ease and Appearance and Electronic Service Quality indexes. We view these findings as evidence that supports Proposition 6.5.

Table 6.17: ANOVA on On-Diagonal and Off-Diagonal Configurations

Quality Index	Average Quality Index	Off Diagonal	On Diagonal	F (p-value)	Mann-Whitney U (p-value)	Spearman's rho (p-value)
Cluster Size		28	24			
Shopping Ease and Appearance	6.52	6.17	6.93	7.911 (0.007)	194.000 (0.009)	0.368 (0.007)
Electronic Service Quality	6.63	6.37	6.93	5.688 (0.021)	214.500 (0.025)	0.314 (0.024)
Fulfillment Quality	7.00	7.07	6.91	0.342 (0.561)	296.000 (0.433)	-0.110 (0.439)
Product Offering	6.27	6.20	6.37	0.464 (0.499)	304.000 (0.555)	0.083 (0.560)

6.5.6 Configurational Equifinality

The empirical analysis of Proposition 6.5 provided preliminary indication of configurational equifinality, since it indicated that services along the diagonal seem to perform reasonably well relative to services positioned off of the matrix diagonal. Thus, the following empirical analysis further explores whether service quality levels are identical along positions on the product-process matrix diagonal. We formulate Proposition 6.6, which proposes a test of equifinality within the group of food retailers along the matrix diagonal, in terms of the null and alternative hypotheses below.

> **$H8_0$**: Service quality performance of food retailers positioned on the diagonal will be similar.
>
> **$H8_A$**: Service quality performance of food retailers positioned on the diagonal will differ according to their position along the diagonal.

Rejection of the null hypothesis indicates that service quality is significantly different across the positions along the matrix diagonal, indicating that the proposition of configurational equifinality across the whole matrix diagonal should be revised or rejected. Essentially, equifinality serves as the null hypothesis of the test. The proposition of interest is typically formulated as the alternative hypothesis, in order to reject the null hypothesis in favor of the alternative hypothesis only under rare conditions. However, we feel this formulation is reasonable, since more risk might result from assuming that service quality along the diagonal is different in a specific manner, than in assuming that service quality is similar along all subsections of the diagonal.

We used single-factor ANOVA to analyze the positions of services identified as on the diagonal in the test of Proposition 6.5. Using the full sample of food retailing observations to improve the error variance estimates, we examine whether companies within different product-process combinations along the diagonal exhibit different levels of service quality. The single-factor ANOVA model for this test is presented in equation 6.5:

Equation 6.5:

$$y_i = \mu. + \alpha_i + \varepsilon_i$$

In equation 6.5, y_i represents the observations for service quality indexes, $\mu.$ represents an the overall mean service quality, and α_i represents the differences between the overall mean and positions of interest on the diagonal (i.e. off diagonal, on diagonal positions (2,2), (3,3) and (4,4)).

We find some evidence of an increasing pattern along the product-process matrix, particularly for the Shopping Ease and Appearance and the Electronic Service Quality indexes. Table 6.18 presents results of our empirical analysis of diagonal positions. We include the off-diagonal positions in the tests to serve as a baseline for the levels along the diagonal, and to increase the sample size for the tests. Table 6.18 shows that the F-statistics and Kruskal-Wallis statistics for the Shopping Ease and Appearance, Electronic Service Quality, and Product Offering quality indexes indicate differences in the mean quality levels of at least one pair of configurations. Overall, the service quality levels along the product-process matrix diagonal tend to increase as one moves down the diagonal. This pattern is particularly evident for Shopping Ease and Appearance and for Electronic Service Quality. Spearman correlation statistics also indicate a positive correlation between lower right positions on the diagonal and these service quality indexes. However, Table 6.18 also shows that the mean quality for diagonal position (2,2) is below the average off-diagonal quality level, indicating that superior performance is more characteristic of positions further down the diagonal. Overall, Table 6.18 provides exploratory evidence that tends to indicate that one should reject equifinality along the entire product-process matrix diagonal. We view these findings as evidence that appears to reject Proposition 6.6.

Table 6.18: ANOVA on Off-Diagonal Configuration and On-Diagonal Positions

		Configuration Position						
Quality Index	**Average Quality Index**	**Off Diagonal**	**2**	**3**	**4**	**F (p-value)**	**Kruskal-Wallis (p-value)**	**Spearman's rho (p-value)**
Cluster Size		28	4	4	16			
Shopping Ease and Appearance	6.52	6.17	6.17	6.41	7.25	4.715 (0.006)	12.804 (0.005)	0.451 (0.001)
Electronic Service Quality	6.63	6.37	6.15	6.45	7.25	4.702 (0.006)	12.815 (0.005)	0.413 (0.002)
Fulfillment Quality	7.00	7.07	6.37	7.13	7.00	0.647 (0.589)	2.298 (0.513)	-0.060 (0.672)
Product Offering	6.27	6.20	5.50	6.70	6.28	2.455 (0.074)	7.921 (0.048)	0.190 (0.177)

6.6 Conclusion

6.6.1 Summary

Effective management of the design and delivery of electronic services can be enhanced by understanding the relationship between service product configurations offered to customers, service process configurations used to deliver services, and dimensions of service quality or value. Theoretical frameworks in the form of product-process matrixes implicitly incorporate several propositions about these relationships that are amenable to empirical analysis.

The purpose of this study was to conduct a comprehensive empirical analysis of a product-process matrix developed for electronic consumer services. We studied the electronic service product-process matrix using data from electronic food retailing services. We used the literature on fit and equifinality to specify the propositions embedded within all product-process matrixes. We empirically examined the propositions using a data set for electronic food retailers. First, we examined the association between product and process configurations by formulating congruent and contingent propositions of fit between product and process configurations, and service quality. Second, we examined the independence between the product and process configurations, and explored the presence of a matrix diagonal along which one would expect electronic food retailing services would tend to be positioned. Third, we next examined the association between product and process configurations and service quality. Finally, we examined the association between service quality and the deviations of each service from its ideal profile within the corresponding product and process configurations.

We obtained evidence against the independence of product and process configurations, and obtained positive and significant correlation coefficients between product and process configurations. This finding suggests electronic food retailers do tend to position themselves along a diagonal in the matrix. We also found systematic relationships between electronic service product quality and the service product configurations, and between electronic service quality and the service process configurations. The results of our empirical analysis suggest performance differences for on and off diagonal positions, as well as a tendency for electronic service quality to improve as services are positioned further down the diagonal. We infer from the results that configurational equifinality is not apparent in this context. While we expected that configurational fit might lead to higher service quality, our empirical analysis found little relationship between within-configuration distances and service quality indexes. In summary, the ordering and characteristics of the product and process configurations map directly to our underlying conceptual product-process matrix. Overall, the findings provide empirical support for the product-process matrix and the related propositions.

6.6.2 Contributions

This study contributes to the literature in several ways. First, the study empirically analyzed the operational context of electronic consumer services. Specifically, we examined the relationship between product and process configurations, and tested the relationship of product-process positions to electronic service quality. More generally, the study advances the operations strategy literature on the construction and validation of product-process matrices as mechanisms for theory generation and theory testing.

The study also moves research in this area of the literature beyond descriptive methods to examine results of service product and process choices. The study performs empirical analysis of the product-process matrix, and links operations to quality measures that can be theoretically related to service design attributes. Further, the study serves as a basis for future data collection and research, by having the potential to examine the evolution of electronic service product and process choices over time, and to examine additional industries to perform a cross-industry evaluation.

Finally, the study operationalizes several propositions that have been alluded to or discussed in the literature, but have not been examined empirically. These propositions relate to the effect that the concept of ideal type has on the performance of an individual service of that type having characteristics that differ from the ideal profile for that type.

6.6.3 Managerial Implications

The results of the study provide general insights which managers can use when designing or redesigning electronic services. The findings show that, typically, managers of electronic services are using product offerings that fit with process technology configurations. The findings also show that there appears to be systematic changes in service quality levels as one moves across the product structure of the matrix, and down the process structure of the matrix. Overall, product configurations with more product variety and higher online customization are associated with higher perceptions of product offering quality. Further, electronic service operations that use more flexible technologies tend to be associated with higher perceptions of electronic service quality.

The results also suggest that the product-process matrix may be a more useful conceptual framework when it is examined within the context of an individual industry, rather than as a conceptual framework that applies across many industries. Interestingly, this finding suggests what practitioners often suggest: that more research on best practices would be quite useful to the business community. Rigorous studies of product-process matrixes at the attribute level in specific industries could accomplish such goals.

Finally, while the empirical methods in this study have been used to analyze cross-sectional data from a sample of food retailers, the overall methodology is directly applicable to the analysis of service operations within a single electronic service firm. Further, the methodology should become more useful as electronic services are built from increasingly customizable components. As increased operations flexibility in electronic services facilitates the customization of electronic service environments by customers, it will become increasingly difficult to understand which operations components are being used and how they relate to customer perceptions service quality and value. Configurational research methodologies can be applied to these operations to understand the common operational configurations, and to relate those configurations to service quality.

6.6.4 Directions for Future Research

Since the study is the first of its type to examine the product-process matrix empirically, there are several potential directions for future research. This type of research should be applied to other product-process matrixes to additional industry contexts to further develop methods for analyzing configurations of products and processes. Different industry contexts could uncover different data types that will require additional methods to be developed. The research also indicates the tradeoffs that take place in basing empirical research in a typology versus a taxonomy. When one assumes that ideal types within a conceptual framework such as a product-process matrix are true, one might use the framework structure to sample efficiently. For example, with the product-process matrix, one might sample in a manner that will make the characteristics of the sample along the product structure orthogonal to the sample along the process structure. This leads to the possibility of better parameter estimates, at the risk that the researcher may be studying a world that exists only in the theoretical framework. In contrast, a taxonomic approach can ground an empirical study in the real world, and can aid in specifying classes of product configurations and process configurations. The cost of grounding a theoretical model in reality prior to testing hypotheses may mean the loss of a simple statistical methodology. Finally, the organizational performance literature, upon which several of our propositions are founded, clearly is not as adaptable as it should be for specific operations phenomena.

The shortcomings of research in this area suggest several directions for future research. Since most other product-process matrixes have not been empirically examined to illustrate their descriptive and prescriptive abilities, researchers could start doing such research in a variety of industry contexts. More taxonomic research would be helpful to better understand modern operations, as well as to further develop taxonomic methods for the study of operations management. Such research could have practical benefits for practitioners in industry, as well as help to provide information about actual operations for teaching pedagogy. Further, since the organizational performance literature related to conceptual gestalts in operations clearly lacks specificity regarding the process of generating configurational theory and its relationship to hypothesis testing of specific propositions, work in this area also would be valuable.

Researchers also should develop enhanced models of theoretical service quality dimensions for electronic services, and related service quality measures. In reviewing the literature for this study, we found little insight about the nature of service quality in modern service contexts, including electronic services. The few extant studies of electronic services are helpful, but more research is needed to fully understand electronic service design attributes and their relationship to electronic service quality. The development of a validated set of service quality dimensions related to lower-level attributes of electronic service operations would greatly aid future research, as well as practice, in electronic services industries.

CHAPTER 7

Concluding Remarks

7.1 Summary

This dissertation developed a product-process matrix for electronic consumer services. The dissertation examined the product and process structures of the matrix empirically, and employed configurations derived from actual product and process attributes to analyze the association between the product and process configurations. The dissertation also examined the association between service quality and the product and process configurations. The findings of the dissertation have several implications that we discuss in the sections below.

7.2 Product-Process Matrix

Central contributions of this dissertation to the operations literature are the electronic service product and process structures, the product-process matrix, and the insights on delivery of service quality and customer value derived from the matrix. Typologies such as the electronic service product structure and the electronic service process structure, a conceptual framework such as the product-process matrix, and the propositions relating product-process interrelationships to customer value are useful for description and subjective prediction. They also can be empirically tested via cross-sectional or longitudinal analyses (see for example, Safizadeh, et al., 1996; Doty, Glick, and Huber, 1993). The only other model of product-process interaction in electronic commerce appears to be the model developed by Palmer and Griffith (1998) for electronic marketing, thus this paper represents one of the first theory development research initiatives on design and delivery of electronic consumer services.

From a practitioner standpoint, the product-process matrix has the potential for application both as a diagnostic and a planning tool. As a diagnostic tool, the matrix can be used by service providers to examine the causes of poor delivery of electronic services due to mismatches between the electronic service products and the process technology capabilities. As a planning tool, the matrix can guide service providers considering the introduction of new categories of electronic service products in determining new and appropriate process technology.

The logical extension of the development of a product-process matrix is to empirically examine its product and process structures, and investigate the relationship between performance and the fit between the product and process structures. To the best of our knowledge, research oriented toward operationalizing a product-process matrix has not appeared previously in the operations literature. The product and process structures of previous product-process matrixes have never been empirically examined to provide evidence that either supports them or calls them into question. Thus, although complex theoretical frameworks have been broadly employed in descriptive research and widely taught in the operations literature, very few of these frameworks have had any empirical analysis of their validity.

7.3 Product Taxonomy

The dissertation used actual data related to electronic service product dimensions to examine the product typology empirically. Chapter 4 reviewed literature on methodologies for taxonomy development from the management literature. In the case of actual electronic service product data, product variables were found to be available in several data types. Since sufficient variables were available that represented each of the conceptual product typology dimensions and that could be transformed to approximate normality, we applied a standard two-step taxonomy methodology recommended and commonly used in the literature.

Using this approach, the dissertation developed configurations of electronic food retailing services. After examining and transforming individual variables, factor analysis was employed to reduce multicollinearity in the data representing each conceptual dimension. Cluster analysis was then used to develop the product taxonomy configurations, which were subsequently examined with a combination of methods suggested and typically employed in the literature. Based on the findings, we believe that the product taxonomy configurations were significantly different, and represented largely different conceptual groups.

7.4 Process Taxonomy

The dissertation then used actual data related to electronic service process dimensions to examine the conceptual process typology empirically. Chapter 5 found little prior work in the literature on the empirical development of service process taxonomies. Chapter 5 also found little prior literature on electronic service process flexibility. Thus, based on the manufacturing flexibility literature, we developed a conceptual framework for service process flexibility in electronic services. We used this model of process flexibility as the background for our choice of process variables, and our examination of the service process data collected from electronic food retailers.

The dissertation then empirically developed process configurations. Since structural and functional approaches can be followed in choosing process variables for a taxonomy, we used both *a priori* and cluster analysis approaches to develop a process taxonomy. The taxonomies were shown to possess systematic differences along a number of variables used to construct the taxonomy, and among a set of external variable representing the extent of use of several process technologies. The cluster analysis approach also was shown to provide greater descriptiveness of the functional processes employed in the services. Further, since the *a priori* approach relates directly to the process typology, we used it to examine the association between the algorithmic cluster analysis taxonomy and the conceptual process typology.

7.5 Empirical Analysis of the Product-Process Matrix

The remainder of the dissertation examined congruent and contingent propositions related to the product typology, the process typology, their interaction within the product-process matrix, and their relationship to service quality. Chapter 6 reviewed the strategic management literature on fit in congruent and contingent propositions, and suggested a set of propositions to be tested in the context of a product-process matrix. Given the data available for these exploratory tests, we determined the feasibility of each test, and performed the tests considered appropriate.

The dissertation first examined hypotheses related to the interaction between the product and process taxonomy configurations. The *first* proposition examined whether product configurations and process configurations were independent of each other, finding that independence could be rejected. The *second* proposition relates to the existence of a product-process matrix diagonal along which one might expect food retailers would position themselves. We calculated nominal and ordinal correlation coefficients for index variables related to unordered and ordered configurations. The correlation coefficients for ordered configurations indicated that there is a positive and significant association between the product taxonomy configurations and process taxonomy configurations. These results suggest that there is a diagonal configuration within the product-process matrix along which food retailers tend to position themselves, implying a fit between product and process configurations. However, the results also suggested that many food retailers positioned their services away from a matrix diagonal, which suggested that further tests would have the potential to explain the relationship between product-process matrix positions and service quality.

The final section of the dissertation explored contingency propositions related to the relationship between product-process matrix positions and service quality and customer value. The *third* proposition examined the relationship between service quality and the product and process configurations. The results of this exercise showed that service quality perceptions related to product information and variety varied moderately with the configurations of service product attributes. The results also indicated that configurations of service process technologies were more strongly associated with perceptions of shopping ease and appearance and electronic service quality. The *fourth* proposition examined the relationship of service positions within each configuration and service quality. This analysis showed that services that are a large distance away from the ideal profile of a configuration were not significantly associated with higher or lower service quality levels. The *fifth* proposition examined the effect on service quality of being positioned on the matrix diagonal. This analysis illustrated the extent to which matching product configurations with process configurations leads to higher service quality. The results indicated that service quality perceptions tend to be higher for food retailers positioned along the product-process matrix diagonal. The *sixth* proposition examined the hypothesis of equifinality across the product-process positions on the matrix diagonal. This analysis provided information about quality differences along the matrix diagonal, which indicated that service quality was significantly higher only along the bottom positions of the matrix diagonal.

The empirical analysis in Chapter 6 also provided empirical support for several of the propositions formulated in Chapter 2. Since service quality perceptions should relate positively to customer value, the empirical analysis for Propositions 6.5 and 6.6 provides preliminary empirical support for Proposition 2.1, which related customer value to the fit between the product structure and the process structure along the product-process matrix diagonal. The empirical results for Proposition 6.3 also provided preliminary empirical support for Proposition 2.2, which related customer value to the service processes along the service process structure. However, little empirical support was found for Propositions 2.3 and 2.4, which related customer value to positions along the product structure. Since Propositions 2.3 and 2.4 proposed that customer value along the product structure would depend on consumer needs, one might expect perceptions to be averaged out across the product structure, and that measures of service quality perceptions would exhibit no statistical differences. Since the cross-sectional nature of the data used in this study cannot incorporate individual consumer needs, empirical analysis of Propositions 2.3 and 2.4 will need to be examined within the service operations of an individual electronic service.

7.6 Limitations of the Study

The main limitation of this study is that the domain of electronic services is still evolving. Hence, our examples and illustrations of the product-process matrix are to some extent founded on the characteristics and trends of electronic service products and process technologies evident today. Electronic service processes and products may change over time, as new technologies are introduced and as companies further enhance their electronic service offering. However, this argument might be made for most research contexts through which one might examine a product-process matrix, as technologies are seldom static over the long run, and product offerings are constantly modified to meet changing needs of consumers. To the extent possible, we have utilized research methods that can be adapted easily to data representing new service product and process attributes as they appear.

The research also is limited to some degree by the research context of electronic food retailing. Although we have made what we believe is a convincing case for the potential to generalize our findings from electronic food retailing services to generic electronic services, inevitably the findings will be contingent to some degree on the research context. One limitation in electronic food retailing data is the lack of implementation of a number of possible service offerings and process technologies. Interestingly, Palmer and Griffith (1998) also found that a cross-industry sample of 250 Fortune 500 companies had implemented very few of the product and process attributes that they might have chosen to offer on their web site, so our finding seems to be consistent with findings across industries. However, even this finding is important, since it suggests that there remains much room in electronic services in which to develop a distinctive competence in electronic food retailing.

7.7 Directions for Future Research

This dissertation also suggested a number of areas that future researchers could explore in their studies of electronic services. We discuss each below.

7.7.1 Research Methodology and Data Collection

This research could be examined in a number of electronic service contexts. First, one could expand the sample to examine a population of electronic services over time using longitudinal data. Second, one could collect data for service contexts outside of electronic food retailing to further examine the service typologies empirically. Finally, since we have shown that taxonomic methods can be used to analyze product-process matrixes, it would be interesting to see similar studies of manufacturing and service characteristics for related product-process matrixes.

7.7.2 Service Process Flexibility

Chapter 5 employed the literature on manufacturing process flexibility to develop a model of process flexibility dimensions for electronic service processes. The extant literature appears to have few discussions about process flexibility for traditional or electronic services. Thus, additional research needs to be done to conceptualize and unify the literature on traditional manufacturing and service flexibility and electronic service process flexibility. A logical extension of this research would be to develop measures of service process flexibility.

7.7.3 Service Quality and Customer Value Measurement

Very few models or conceptual frameworks have been developed for examining the drivers and consequences of service quality and customer value in electronic consumer services. Keeney's (1999) model appears to be the only work that specifies a means-ends framework for electronic retailing. Additional research needs to be done to conceptualize customer value, service quality and consumer satisfaction in the context of business-to-business and business-to-consumer electronic services, for both generic and industry-specific contexts. Such work could consist of further conceptual models of consumer value in specific electronic service contexts, as well as validated measures of electronic services that can be used to measure service performance in electronic services.

APPENDIX A

Electronic Service Technology Terminology

A.1 Introduction

Electronic services are developed from a variety of back office and front office information technologies. While some of these technologies are well-known and represented by simple names, many of the technologies are less-known and commonly referred to only by acronyms. Thus, in this Appendix we provide a guide to these terms and acronyms. The following section contains an abbreviated description of electronic service process technology terminology. For more detailed information, see the Techweb Technology Encyclopedia (http://www.techweb.com/encyclopedia/).

A.2 Electronic Service Terminology

Active Server Pages: An alternative to CGI scripts. Active Server Page web pages include programming code used to interact with databases and programs on a server.

AIFF: Audio Interchange File Format. A digital audio file format from Apple®.

AVI: Audio Video Interleaved. A digital multimedia video file format from Microsoft®.

Client Application: A computer program used to deliver electronic service content to a computer or other service delivery device owned by a customer.

Cold Fusion: An alternative to CGI scripts. Cold Fusion web pages use the Cold Fusion Markup Language to interact with databases.

Common Gateway Interface (CGI): A WWW-to-server interface that receives requests from a WWW server to execute programs stored on a server computer. The Common Gateway Interface executes these programs, and returns the program output to the WWW server, which in turn sends the output to the customer's service delivery device.

Typically, CGI programs are written in scripting languages such as PERL, or are executable programs written in C or C++.

Consumer Agent: A computer program or system that can help customers accomplish some task, such as purchasing a product, based on decision criteria provided by the customer to the agent, such as a desired price range. For a futuristic example, see Alba et al. (1997).

Data Mining System: A system that facilitates either manual or automated examination of databases of customer information to discover patterns and relationships between variables.

Data Warehouse: A massive database that supports organizational decision making. Data warehouses integrate organizational data, such as operational data or a customer's purchasing history, into a single database management system.

Encryption: A security procedure that uses cryptography to encode electronic service content into a collection of computer bits that appear to be random, making them virtually impossible for anyone other than the service provider and customer to decode. Encryption is used in electronic services to protect customer credit card numbers and other sensitive data.

Federated Databases: A system of independently managed, heterogeneous database systems that facilitate controlled sharing of data.

GIF: Graphics Interchange Format. A digital graphics file format developed by CompuServe®. GIF files can display one graphic, or several graphics presented in a repeatable sequence.

HTML: HyperText Markup Language. A presentation language used to define the page layout of digital documents on an electronic service delivery device.

Identity-based Access: A security scheme that uses an identifier to manage customer access to electronic services. Common schemes involve Internet Protocol (IP) address numbers, and cookie text strings placed on a customer's computer. Future electronic services may use identifiers such as digital fingerprints or smart cards.

Internet Service Provider: A company that resells digital telecommunication line capacity, leases server computer disk space, and leases digital technologies that can be used to develop and deliver electronic services. The companies also perform contract work to develop and manage electronic service operations.

Java® Applet: A computer program module, written in the computer language Java. Java was designed so that Java programs could theoretically run on any device capable of digital processing, including personal computers. Java applets are shipped as object code from a server to a customer's service delivery device, upon which they are run by a Java virtual machine programmed to run applets on that device.

JavaScript™: A scripting language embedded inside HTML that can be used to enhance electronic services and to control electronic service delivery devices, such as windows in a World Wide Web browser.

JPEG, JPG: Joint Photographic Experts Group. A compressed digital graphic file format.

Load Balancing System: A capacity management system that dynamically allocates electronic service processing to individual servers based on their current workloads.

MIDI: Musical Instrument Digital Interface. A digital audio file format.

MOV: The QuickTime® digital multimedia video file format, developed by Apple®.

MPEG: Moving Pictures Experts Group. A compressed digital video file format.

Password: A security scheme in which customers input a username and a password to access electronic services.

RA, RAM: RealAudio™ and RealVideo™ digital audio and video file formats playable by Progressive Networks®, Inc. programs. These file formats facilitate transfers of static audio and video files as well as streams of dynamically generated audio and video.

Scripting Language: Computer languages used to define the layout and timing of audio and visual elements of electronic services.

Security Scheme: A collection of security systems that limit access to electronic services to paying customers, and forbid access to those who want to play with or damage the server computers used in the service operations.

Server: Software installed on a computer that receives service requests sent across a telecommunication network from a customer service delivery device. Servers fulfill these requests by sending documents, querying databases, or executing programs.

SET: Secure Electronic Transaction. A secure credit card payment protocol developed by MasterCard® and Visa®.

Shopping Cart System: A computer program used by electronic retailers. The shopping cart system manages the list of products selected by each customer through the point of a successful payment transaction. Shopping cart systems also often facilitate the management of product information and prices presented to the customer.

SSL: Secure Sockets Layer. A security protocol developed by Netscape® Communications Corporation.

T1, T3: Point-to-point dedicated telecommunications lines. T1 communication lines operate at a capacity of 1.544 megabits per second. T3 lines operate at a capacity of 44.736 megabits per second.

WAV: A digital audio file format developed for Microsoft Windows®.

APPENDIX B

Database of Variables for Electronic Food Retailing Services

B.1 Introduction

Appendix B summarizes the database of variables for product and process attributes of electronic food retailing sites on the World Wide Web. The organization of Appendix B is as follows. Section B.2 presents the list of variables contained in the database of variables from electronic food retailing services, and describes the method through which the data were identified and collected.

B.2 Database Description and Identification of Data Items

Sections B.2.1 to B.2.6 categorize the variables representing electronic food retailing products and processes by whether they are contact information (B.2.1), meta-data variables (B.2.2), organization type classification variables (B.2.3), product-related variables (B.2.4), process-related variables (B.2.5), or BIZRATE service quality data (B.3.6). Information about the data type of each variable and a description of each variable are presented within each section.

B.2.1 Contact Information

Information about the physical location of the business and about the designers and Internet service providers used by the service.

A08: Name of Business – Determined from site information
A09: Street Address – Determined from site information
A10: Street Address2 – Determined from site information
A11: City – Determined from site information
A12: State – Determined from site information
A13: ZIP – Determined from site information
A14: Country Of Business – Determined from site information

A15A: Toll Free Phone – Determined from site information
A15B: Local Phone – Determined from site information
A15C: Toll Free FAX – Determined from site information
A15D: FAX – Determined from site information
A17: URL – Determined from site information
A18: E-Mail – Determined from site information
A19: ISP – Determined from site information, stated in content or within hypertext documents, obtained from Internic WHOIS
A20: ISP URL – Determined from site information, stated in content or within hypertext documents, obtained from Internic WHOIS
A25: Author/Designer – Determined from site information, stated in content or within hypertext documents
A26: Author E-mail – Determined from site information, stated in content or within hypertext documents

B.2.2 Metadata

Metadata is information about an electronic service company stored in files that make up an electronic service site. Metadata is typically stored by creators of a service system to facilitate classification of the service in online search services, and by technologies used to create the building blocks of the service process.

A21: Description – Contained in hypertext
A22: Classification – Contained in hypertext
A23: Keywords – Contained in hypertext
A24: Generator – Contained in hypertext

B.2.3 Type of Organization

Organization type variables represent a classification of the service operators into one or more positions of the traditional manufacturing and consumer service supply chain.

Each of the variables is dichotomous (Y/N).

CONFD173: Farm, CoOp, Group of Farmers, Fisherman – Determined from site information
CONFD174: Manufacturer, Food Processor, Baker – Determined from site information
CONFD175: Distributor, Reseller, Importer, Jobber, Broker – Determined from site information
CONFD177: Retailer or Restaurant – Determined from site information
CONFD176: Mail Order Company, Catalog Retailer – Determined from site information

B.2.4 Product Variables

Product variables represent information about elements of the service that are oriented toward the consumer's experience within the service, including product variety, online and offline customization of services, brand alliances, and ease of product searching. Digital content variables relate to the extent of use of static or dynamic content in the service experience.

Variables beginning with the prefix PX are *continuous* and *count* (0, 1, 2, ...) variables. Variables beginning with the prefix PD are *dichotomous* (Y/N) variables. Variables beginning with the prefix EP are extra variables retained to describe the service, or containing information upon which other variables were based.

PX27: Number of Companies Operating Site – Determined from site information related to which company/companies are fulfilling the orders from the site. An absence of such information was coded as 1.
PD73: e-mail Updates and Marketing Offered – Determined from content on site.
PD74: Periodic e-mail Newsletter Offered – Determined from content on site.
PD75: Online Periodical or Online Magazine – Determined from content on site.
PX76: Pages of Consumer Contributions – Counted from the content on the site.
PD78: Chat Facility on Site – Determined from content on site.
PD79: Message Board on Site – Determined from content on site.
PD80: Use Consumer Data to Customize – Y if site queries customer to input name or characteristics and modifies the service based on the input
PD81: Consumer Agent Available – Y if site has a system that can serve as a shopping agent for the customer based on customer input. Determined from content on site.
PX82: SiteLevels – Estimated based on mapping site as a hypertext stack
PX83: Main Pages – Counted from site, more than 1 if multiple addresses are maintained as front pages
PX84: Main Frame Page Options – Counted from site
PX85: Static 2nd Level Pages – Counted from site
PX86: 2nd Level Frames – Counted from site
PX87: 2nd Level Frame Page Options – Counted from site
PX88: Static 3rd Level Pages – Counted from site
PX89: 3rd Level Frames – Counted from site
PX90: 3rd Level Frame Page Options – Counted from site
PX91: Static 4th Level Pages – Counted from site
PX92: 4th Level Frames – Counted from site
PX93: 4th Level Frame Page Options – Counted from site
PX8393: Number of Static Pages or Frame Options – Calculated from variables PX83 through PX93
PX94: Dynamically Generated Pages – Counted from pages on site. A page is denoted as dynamically generated if the text content is the result of a link with arguments, or if the page changes from visit to visit.
PX28: Number of Languages Translated – Determined from content on site.
PX104: KB Static Text – Determined by downloading all .TXT files used in the site and adding up the size of all of these files.
PX105: KB HTML – Determined by downloading all .HTML files used in the site and adding up the size of all of these files.
PX108: KB of COLD FUSION Files – Determined by downloading all .CFM files used or generated by the site and adding up the size of all of these files.
PX110: KB of ACTIVE SERVER PAGE Files – Determined by downloading all .ASP files used or generated by the site and adding up the size of all of these files.
PX112: KB PDF – Determined by downloading all .PDF files used in the site and adding up the size of all of these files.
PX114: Total KB Graphics – Determined by downloading all graphic (.GIF, .JPG, .TIFF, etc.) files used in the site and adding up the size of all of these files.
PX115: Total Static Content KB – Sum of PX114, PX105 and PX104.
PX 117: Total # Banner Graphics – Counted from each page of the service.
PX 126: Total Audio Files – Counted from site.
PX 130: Total Video Files – Counted from site.
PD32: Membership Club? – Determined from content on site. Membership clubs can either be free or pay.

PX 34: Number of Goods Offered (SKU) – Determined from a count of the site. Duplicate counts of SKUs were prevented by matching the counts with graphics on the site, and by matching dynamically generated page content to previously visited pages saved to files.

PX 35: Number of Service Variations Offered – Determined from a count of the site. Service variations were considered to be any offline action, either free or costing money, which was specified as a service option for customers.

PX 35B: Number of Service Variations for Online Services – Determined from a count of the site. Online service variations range from electronic services that require a membership fee to access, to online services related to maintaining online content for customers such as ads or HTML pages.

PX 36: Ship As Gift – Determined from order page or information page on the site.

PD365: UPS or FedEx Tracking Integrated into Site – Determined from site.

PD37: Will Customize Goods/Services Offline – Determined from order page or information page on the site. Based on whether customer is given the option of asking for specific actions to be performed to their food product or to the packaging and shipping of the food product.

PX 221: Number of Payment Options – Counted from all of the payment options listed on the site.

PD56: Quality Certified? – Determined based on whether the service includes a banner or link to a third-party quality certification service on the Internet.

PD57: Quality Guarantee – Determined from order page or information page on the site.

PD60: Use Image Maps – Determined from hypertext content.

PD61: Site Search System Available (e.g. Search for Term) – Determined from site.

PD62: Site Sort Capabilities Available (e.g. Sort by Price, Name) – Determined from site.

PD63: Expert System - Online and Dynamic (e.g. Recipe Calculator, etc.) – Determined from site. Expert systems were considered to be any automated decision making system using inputted customer information and outputting some suggestion, information or decision related to the service context.

PD887: Store Saves Customer Order History (Customer Can View Order History) – Determined from site information that states that customers can create accounts that will store their order history with the service over time.

PD886: Store Offers Free Post Card Service – Determined by whether the service uses an insourced or outsourced post card service.

PD885: Gift Reminder - Birthday or Holiday – Determined by whether the service includes a facility for managing names, addresses and dates related to gift-giving occasions.

PD884: Address Book – Determined by whether the service includes a facility for managing names and addresses.

PD883: Shopping List Maintained Across Separate Visits (Persistent Across Time) – Determined by whether the service can retain a shopping visit across separate consumer visits.

PD882: Multiple Personalized Shopping Lists For Each Customer – Determined by whether a consumer can generate multiple shopping lists within the service.

PX66: Number of Shipping Options – Counted from the shipping options listed on the site.

PD68: Shipping Targeted At Local (Courier Delivery or Consumer Pickup) – Determined from order page or information page on the site.

PD69: Shipping Targeted At Multi-State Region – Determined from order page or information page on the site.

PD70: Shipping Targeted At Nation – Determined from order page or information page on the site.

PD71: Shipping Targeted At Several Nations – Determined from order page or information page on the site.

PD72: Shipping Targeted At World – Determined from order page or information page on the site.

PD6872: Maximum Distance Willing to Ship – Constructed from variables PD68-PD72. 1 = Local, 2 = Multi-State Region, 3 = Nation, 4 = Several Nations, 5 = World.

PD99: Nutritional Information Page – Determined from content on site. Y if nutritional information is listed for goods offered in service.

PD100: Recipe Page or System – Determined from content on site. Y if recipes appear somewhere on the service.

PX101: Number of Recipes – A count of the number of recipes presented on the site.

PD1015: Recipes are Directly Linked to the Order System – Determined by whether ingredients in recipes are linked through hypertext order links to an order page.

PD77: Consumers Can Add Service Content Used to Enhance Service – Determined by whether the service includes a dynamic system through which consumers can add content to a service, or the service requests for comments or contributes from consumers that will be posted if appropriate.

PD33: If Has Membership Club, Does Club Cost Money? – Determined based on whether a price is listed for a membership club.

PD881: Service Lists In-Stock Inventory Level – Determined by whether the service lists the current inventory level for individual goods SKUs.

PD880: Service Offers Back-In-Stock Notification Service – Determined by whether the service will contact customers when items that have gone out of stock are back in stock.

EPD59: Quality Assurance Participation (Name of Certifier) – Information about third-party quality certification service used by the service.

EPA29: Main Goods Category – Approximate goods category in which the service appears to offer a majority of products.

EPA30: Goods Offered – General description of goods offered through service.

EPA38: Services Offered – General description of services offered through service.

PD39: Pay By Check/Money Order – Determined from order page or information page on the site.

PX40: Checks: Number of Currencies Accepted – Determined from order page or information page on the site.

PD395: Pay C.O.D. – Determined from order page or information page on the site.

PD396: Pay Gift Certificate – Determined from order page or information page on the site.

PD41: Pay Electronic Cash (e.g. CyberCash) – Determined from order page or information page on the site.

PD42: Pay From User's Account– Determined from order page or information page on the site.

PD43: Pay By AMEX – Determined from order page or information page on the site.

PD435: Pay By Optima– Determined from order page or information page on the site.

PD44: Pay By DISC– Determined from order page or information page on the site.

PD45: Pay By MC– Determined from order page or information page on the site.

PD46: Pay By VISA– Determined from order page or information page on the site.

PD47: Pay By Diners Club– Determined from order page or information page on the site.

PD48: Pay By Carte Blanche– Determined from order page or information page on the site.

PD49: Pay By JCB– Determined from order page or information page on the site.

PD50: Pay By Eurocard– Determined from order page or information page on the site.

EPA65: Ship Product By– A list of shipping methods offered to the customer. Determined from order page or information page on the site.

EPA67: Shipping Area– A list of the distances to which the service will ship. Determined from order page or information page on the site.

EPD95: External Links In Content – Determined from whether the service includes a hypertext link that directs the customer outside of the site.

PD96: Index Of Related Companies – Determined from whether the service includes a page of hypertext links to companies in a related food industry.

PD97: LinkPage – Determined from whether a page on the service is designated as a page of hypertext links to other electronic service destinations.

PD98: FreeStuff/Contests – Determined by whether the service states that they have free items or contests.

PD985: Free Games – Determined by whether the service offers some interactive elements that serve as games for customers (i.e. Java applet games for kids to play)

EPC02: Static Or Dynamic – Subjective characterization of the content on the site (STATIC, MIXED, DYNAMIC)

PD64: Site Map Available – Determined from whether the service includes a map to the site in the content on the site.

PX367: Number of Associate Program SKUs (Goods or Services) Offered – A direct count of the number of goods or service SKUs offered to customers that will be delivered by another company through an affiliate or associate service.

B.2.5 Process Variables

Process variables represent information about the process technologies and technology support staff used to deliver electronic food retailing services. Process dimensions variables represent the use of individual technologies, or of common functional implementations of technology types, which can include elements developed within a single firm's electronic service or through an integration of several companies' technology processes.

Variables beginning with the prefix SX are *continuous* and *count* (0, 1, 2, ...) variables. Variables beginning with the prefix SD are *dichotomous* (Y/N) variables. Variables beginning with the prefix ES are extra variables retained to describe the service, or containing information upon which other variables were based.

SD135: Alliance Partner: Is More Than One Firm Operating the Site – Determined from whether the service is coordinated with a number of firms, whether through fulfillment of products, maintenance of individual order forms for several companies, or maintenance of content and services on site.

SD136: Participate in Other Firms' Associate Programs? – Determined by whether a service states that they participate in an affiliate or associate program, and list one or more products for sale through their affiliation with that service.

SD137: Offer Own Associate Program to Other Sites? – Determined by whether a service lists an associate program that they offer to other electronic services.

SD138: Pay Per Click Advertising Program – Determined by whether a service list an advertising program in which other electronic services or sites can participate.

SD139: Collect Consumer Information? – Determined by whether the service requests some type of consumer information on some page of the serivce (e.g. for sending a catalog, sending email, etc.)

SX103: Total # Graphic Files – A count of the total number of graphic files downloaded through the service.

SX106: # Static HTML Files – A count of the total number of HTML files downloaded through the service.

SD106: Uses HTML Files – Y if SX106 > 0

SX107: # Static SHTML Files – A count of the total number of SHTML files downloaded through the service.

SD107: Uses SHTML Files – Y if SX107 > 0

SX109: # CFM FILES – A count of the total number of Cold Fusion pages downloaded through the service.

SD109: Uses Cold Fusion – Y if SX109 > 0

SX111: # ASP Files – A count of the total number of Active Server Pages downloaded through the service.

SD111: Uses Active Server Pages – Y if SX111 > 0

SX113: # PDF Files – A count of the total number of Adobe Acrobat PDF files downloaded through the service.

SX118: GIF Files – A count of the number of GIF graphic files downloaded through the service.

SX119: JPG Files – A count of the number of JPG graphic files downloaded through the service.

SX120: Audio: WAV Files – A count of the number of WAV audio files downloaded through the service.

SX121: Audio: MID Files– A count of the number of MIDI audio files downloaded through the service.

SX122: Audio: RA, RAM Files– A count of the number of Real Audio audio files downloaded through the service.

SX123: Audio: AU Files– A count of the number of AU audio files downloaded through the service.

SX124: Audio: AIFF Files – A count of the number of AIFF audio files downloaded through the service.

SX125: Audio: VMF Files – A count of the number of vocaltec media format VMF audio files downloaded through the service.

SX127: Video: RAM Files – A count of the number of WAV audio files downloaded through the service.

SX128: Video: AVI Files – A count of the number of AVI video files downloaded through the service.

SX129: Video: QuickTime MOV Files – A count of the number of MOV video files downloaded through the service.

SD1010:Uses Cascading Style Sheets (CSS) – Determined from hypertext on site.

SD131: Use JavaScript – Determined from hypertext on site and attributes of site pages.

SD132: Use JAVA – Determined from attributes of service, browser window notification that JAVA applets are being loaded, and page information provided by browser.

SD133: Use Shockwave – Determined from service content

SD134: Live Video – Determined from service content.

SX142: Number of Popup Windows – A count of the number of pages that a opened by the service into new windows or into smaller pop-up windows.

SX147: Number of Brand Name Client Programs Used – Determined by whether a client program, developed by a company other than the present service, must be downloaded and installed prior to participating in the service.

SX148: Number of Proprietary Client Programs – Determined by whether the site offers its own programs to the customer (e.g. Screensavers, Browser Extensions).

SD149: Frames Site Available – Determined by whether the site uses hypertext frames.

SD150: Non Frames Site Available – Determined by whether the site does not use hypertext frames.

SX151: # JAVA Applets – A count of the number of different Java applets employed throughout the site.

SD153: Order Online – Determined by whether customers can order online through an order form designated for order and payment processes.

SD154: Order By Mail – Determined by whether an address is stated and directions are given for ordering via mail.

SD155: Order By Phone – Determined by whether a phone number is included and directions are given for ordering by phone.

SD156: Order By Fax – Determined by whether a Fax number is included and directions are given for ordering by Fax.

SD159: Offline Order Form For Snail Mail or Fax – Determined by whether the service includes a page that customers can print out and use to mail or fax an order to the service.

SX161: Number of Electronic Order/Payment Forms – A count of the number of separate order forms. Multiple order forms are used for product groups, or separate companies on the same site, and different levels of security (non-SSL vs. SSL).

SD162: Electronic Order/Payment Form Uses mailto:/E-mail – Determined by whether the process (ACTION) used in an order page is a HTML mailto: method and includes the email address to which the order is sent.

SD163: Electronic Order/Payment Form Uses CGI – Determined by whether the process (ACTION) used in an order page is an address of a CGI program.

SD164: Order/Payment Form Uses SSL – Determined from browser page information.

SD165: Electronic Order/Payment Form Uses Digital Certificate – Determined from browser page information. This variable may differ from SD145 due to an expired digital certificate.

SD167: Order/Payment Form Uses Cold Fusion File (.CFM) – Determined from the file extension of the order page.

SD168: Order/Payment Form Uses Active Server Pages (.ASP) – Determined from the file extension of the order page.

SD169: Uses Shopping Cart – Determined by whether the system includes a processes that manage a list of items for each customer that the customer wants to purchase.

SD171: Site Has On-The-Fly Calculation of Total Order Costs – Determined by whether shipping costs are added in to an order sub-total to present the customer with a grand total for the order.

SD1845:Uses CGI Scripts – Determined from the URLs of pages and from the ACTION field of HTML forms.

SD188: Customer Service Phone # (1-800, 1-888) – Determined by whether a toll free number is listed on the service.

SD198: Site is Hosted on a Virtual Mall – Determined by whether the service is contained within an ISP that manages their site specifically for bringing together many retailers.

SD199: Use ISP Server – Determined from site information, site URL, and from Internic WHOIS service.

SD203: Uses Own Server – Determined from site information, site URL, and from Internic WHOIS service.

SD207: Password and Username/Customer Registration – Determined by whether the service includes a system for logging in or registering customers.

SD141: Some Pages Pop Up New Browsers – Determined from whether the service loads some pages in pop-up windows.

SD160: Electronic Order Form – Determined by whether the service uses an electronic order form.

SD170: Uses Brand Name Shopping Cart Service or System – Determined by whether the service uses a shopping cart that was developed by a firm that attaches a brand name to it.

SD1701:Soft Cart Shopping Cart System – Determined by whether the SoftCart.exe program is employed in the site.

SD1702:YAHOO Store – Determined by whether the retailers is located on the YAHOO retailing (e.g. the URL of the store is http://store.yahoo.com/companyname)

SD172: iCat DBMS Catalog System – Determined by whether the retailer uses the iCat shopping cart system.

SD1703:WebOrder Catalog System – Determined by whether the retailer uses the WebOrder shopping cart system.

SD146: Use Counter – Determined from whether a count of the number of customers that have visited the site is presented to customers.

SD166: Digital Certificate is Owned by This Company – Determined by whether page information from the browser states that the purchaser of the digital certificate

SD140: Online DBMS – Determined by information supplied by the service, ascertaining whether the site uses online queries based on product group category numbers and product id numbers, and whether researcher modification of the numbers for these pages bring up database error codes or different tables generated from a database.

SD157: Service Employees Personally Call Customer In Response To Order to Get Payment Information – Determined from order page or information page on the site.

SD158: Customer Must Call to Leave Credit Card Number/Verify Order – Determined from order page or information page on the site.

SD206: Uses Licensed External Branded Service Technology – Determined from URL of service attribute offered within the service.

B.2.6 Service Quality Variables

Y210: BIZRATEOverallSQ – Transcribed from www.bizrate.com
Y211: BIZRATEPrice – Transcribed from www.bizrate.com
Y212: BIZRATEProductInformation – Transcribed from www.bizrate.com
Y213: BIZRATEProductSelection – Transcribed from www.bizrate.com
Y214: BIZRATEWebsiteAesthetics – Transcribed from www.bizrate.com
Y215: BIZRATEWebsiteNavigation – Transcribed from www.bizrate.com
Y216: BIZRATEProductInStock – Transcribed from www.bizrate.com
Y217: BIZRATEEaseOfReturns – Transcribed from www.bizrate.com
Y218: BIZRATEOnTimeDelivery – Transcribed from www.bizrate.com
Y219: BIZRATECustomerSupport – Transcribed from www.bizrate.com
Y220: BIZRATECustomerLoyalty – Transcribed from www.bizrate.com

APPENDIX C

Equations of Variables Constructed From The Database

C.1 Variable Equations

Variables constructed from the variables in the database are as follows.

Number of Dynamic Service Attributes

This variable represents the fundamental dynamic service product attributes and consumer interaction experiences that are frequently made available to consumers in electronic retailing services. The variable was constructed to create a variable that would represent potentially non-text dynamic service attributes.

PX61_365 = PD61 + PD62 + PD63+ PD78 + PD79 + PD80 + PD365

PD61: Site Search System Available (e.g. Search for Term)
PD62: Site Sort Capabilities Available (e.g. Sort by Price, Name)
PD63: Expert System - Online and Dynamic (e.g. Recipe Calculator, etc.)
PD78: Chat Facility on Site – Determined from content on site.
PD79: Message Board on Site – Determined from content on site.
PD365: UPS or FedEx Tracking Integrated into Site – Determined from site.

APPENDIX D

Measures of Service Quality and Customer Value: Analysis of BIZRATE Service Quality Variables

D.1 Introduction

In order to examine contingency theories about consumer value at positions within the product-process matrix, one must choose or construct appropriate variables that relate to service value. BIZRATE (http://www.bizrate.com/) tabulates several individual service quality variables for a range of electronic services. We use these variables to construct indexes related to inter-correlated groups of service quality dimensions.

The remainder of Appendix D is organized as follows. Section D.2 provides background on data reduction of this type in empirical studies. Section D.3 presents the research design. Section D.4 presents the results of this data reduction exercise. Section D.5 discusses the service quality concept represented by the indexes constructed in this exercise.

D.2 Background

D.2.1 Measures of Electronic Service Quality: BIZRATE

BIZRATE measures service quality along the dimensions of web site aesthetics, web site navigation, customer support, on time delivery, product in stock, ease of returns, product selection, product information, price, customer loyalty, and an aggregate average of all of the items. The BIZRATE variables relate fairly well to

Keeney's (1999) framework on value. In particular, Keeney's dimensions of Time to Receive Product, Convenience, Time Spent, Shopping Enjoyment, Product Quality, and Cost are represented in the BIZRATE scales.

D.3 Research Design

D.3.1 Data

The data set used in the analysis of BIZRATE service quality for electronic food retailers consists of 61 observations collected by BIZRATE. BIZRATE generated the data through an internal evaluation process carried out by expert shoppers employed by BIZRATE. The methodology BIZRATE uses to collect the data is available on their site (http://www.bizrate.com/).

D.3.2 Statistical Method

We use exploratory factor analysis and reliability analysis to examine the BIZRATE data. Because we have 61 observations, our data set can satisfy the Lawley and Maxwell rule for factor analysis that the sample should contain at least 51 more cases than the number of variables being considered in the factor analysis (Dixon 1992). Based on an exploratory factor analysis, we choose a reasonable number of dimensions and their related variables. We then perform a reliability analysis on the additive indexes constructed from the individual index variables.

D.4 Results

D.4.1 Exploratory Factor Analysis

Table D.1 presents Pearson correlation statistics for the BIZRATE service quality variables. Each of these variables is developed from a ten-point scale based on ratings given by a number of expert shoppers. A first observation is that the variable Customer Loyalty is significantly correlated with all other variables. Customer loyalty has been used in the marketing literature not as a dimension of service quality but as a consequence of service quality, meaning that one should expect the positive relationship found in the BIZRATE data. The second observation is that the variables Product In Stock and On Time Delivery are correlated strongly with each other, but with no other variables, indicating that they probably form a unique dimension of variation within the data. Third, one notices that the variables Product Selection, Product Information, Electronic Service Aesthetics, Electronic Service Navigation, and Customer Support seem to form a highly inter-correlated subset of the data. Finally, one sees that Price, Product Selection, Product Information and Ease of Returns seem to form a moderately inter-correlated subset of the data set. Price seems to have very few significant correlations with other variables that tend to relate to electronic attributes of the service.

Table D.2 presents factor loadings from an exploratory factor analysis of the whole set of service quality variables. The first factor includes variables that relate to the electronic service characteristics. The second factor seems to relate to variables that measure the fulfillment process. Variables that load heavily on the third factor relate to dimensions of the product offering that is being sold through the electronic service. Customer loyalty, which is a consequence of service quality rather than a dimension of service quality, loads relatively highly on each of the factors, indicating that customer intentions to use the service again is correlated with each of the three factors.

Table D.1: Pearson Product-Moment Correlations

	Price	Prod Info	Prod Selec	Aesth	Navig	In Stock	Ease Retrn	On Time	Cust Supp	Cust Loyal
Price	1.000									
Prod Info	0.263*	1.000								
Prod Selec	0.370**	0.477**	1.000							
Aesth	0.150	0.335**	0.579**	1.000						
Navig	0.169	0.542**	0.388**	0.626**	1.000					
In Stock	0.185	0.167	-0.006	0.099	0.127	1.000				
Ease Retrn	0.101	0.319*	0.280*	0.188	0.346**	-0.064	1.000			
On Time	0.202	0.197	0.108	-0.019	0.071	0.540**	0.115	1.000		
Cust Supp	0.288*	0.359**	0.243	0.467**	0.510**	0.261*	0.113	0.240	1.000	
Cust Loyal	0.433**	0.648**	0.569**	0.549**	0.684**	0.370**	0.574**	0.492**	0.571**	1.000

* Significant at the 0.05 level (two-tailed test)
** Significant at the 0.01 level (two-tailed test)

Table D.2: Factor Loadings of Service Quality Variables

	Factor 1 Electronic Service	Factor 2 Fulfillment	Factor 3 Information/ Returns	Communalities
Web Site Aesthetics (y214)	0.872	a	a	0.772
Web Site Navigation (y215)	0.777	a	0.298	0.696
Customer Support (y219)	0.711	0.363	a	0.641
Product Selection (y213)	0.576	a	0.470	0.552
On Time Delivery (y218)	a	0.856	0.200	0.777
Product In Stock (y216)	0.117	0.839	-0.159	0.743
Price (y211)	0.258	0.372	0.249	0.267
Ease of Returns (y217)	a	a	0.883	0.784
Product Information (y212)	0.492	0.217	0.509	0.548
Customer Loyalty (y220)	0.655	0.557	0.405	0.938
Eigenvalues	4.102	1.586	1.030	
Cum. % Variance Explained	41.016	56.878	67.182	

[a] Factor loading below 0.10 in absolute value
Total sample size = 61
Method: Principal component factor analysis, Varimax rotation

Since Customer Loyalty has been conceptualized as a consequence of service quality rather than a dimension of service quality, it is not wholly reasonable to include it in this analysis of service quality dimensions. However, the information Customer Loyalty provides in Table D.2 indicates that it is evenly related to three dimensions of variation, and that most (93.8%) of the variation in Customer Loyalty can be explained by the remaining variables. Removal of items having large factor loadings on several factors can improve the distinction between factors (Gupta and Somers 1992). Thus, we performed subsequent factor analyses with the service quality data set, but without including the Customer Loyalty variable.

Several factor analyses were run. Based on the number of eigenvalues greater than one, principal components factor analysis suggested a two-factor solution. However, the two-factor solution explained only 53.5 percent of the variation in the variables. The three-factor solution explained 64.5 percent, a four-factor solution explained 74.8 percent, a five-factor solution explained 82.2 percent, and subsequent solutions explained 88.8, 94.0, 97.7 and 100.0 percent of the variation. Based on this finding, additional factor analyses were run for three and four factor solutions, using principal components analysis with Varimax, Quartimax and Equimax orthogonal rotations. Overall, the solutions showed that Product Information and Product Selection tend to have high factor loadings on the first and third factors in a three-factor solution. When a four-factor solution was chosen, these same variables each loaded significantly on one of the third and fourth factors. Further, in the four-factor solution Price began to load with very high factor loadings on the fourth factor, indicating that Price has a largely unique dimension of variation. Based on the series of factor analysis, the finding that three factors correlated with customer loyalty, and the objective of finding parsimonious groups of variables that could be related to value, we chose a three-factor solution. Table D.3 presents the three-factor principal component factor analysis using the reduced data set.

Table D.3: Factor Loadings of Service Quality Variables

	Factor 1 Electronic Service	Factor 2 Fulfillment Process	Factor 3 Product Offering	Communalities
Web Site Aesthetics (y214)	0.861	a	0.163	0.774
Web Site Navigation (y215)	0.783	a	0.311	0.711
Customer Support (y219)	0.729	0.348	a	0.653
On Time Delivery (y218)	a	0.844	0.190	0.752
Product In Stock (y216)	0.160	0.839	-0.143	0.750
Ease of Returns (y217)	a	a	0.796	0.637
Product Selection (y213)	0.478	a	0.611	0.601
Product Information (y212)	0.448	0.204	0.573	0.571
Price (y211)	0.142	0.385	0.434	0.357
Eigenvalues	3.241	1.571	0.995	
Cum. % Variance Explained	36.0	53.5	64.5	

[a] Factor loading below 0.10 in absolute value
Total sample size = 61
Method: Principal component factor analysis, Varimax rotation

Based on the results in Table D.3, we examined four indexes for electronic service quality and value related to the three factors. The first variable, called Shopping Ease and Appearance, was constructed as the average of Web Site Aesthetics, Web Site Navigation and Customer Support. The second variable, called Electronic Service Quality, was constructed as the average of Web Site Aesthetics, Web Site Navigation, Customer Support, Product Selection and Product Information. The third variable, called Product Fulfillment, is constructed as the average of On Time Delivery and Product In Stock. The final variable, called Product Offering, is constructed as the average of Ease of Returns, Product Selection, Product Information, and Price. Table D.4 presents a reliability analysis for indexes constructed from these groups of variables.

Table D.4: Reliability Analysis of Service Quality Scales

	Shopping Ease and Appearance	**Electronic Service Quality**	**Product Fulfillment**	**Product Offering**
Web Site Aesthetics (y214)	0.6529	0.7290		
Web Site Navigation (y215)	0.6353	0.7196		
Customer Support (y219)	0.7567	0.7822		
On Time Delivery (y218)			N.A.	
Product In Stock (y216)			N.A.	
Ease of Returns (y217)				0.6203
Product Selection (y213)		0.7692		0.4243
Product Information (y212)		0.7685		0.3777
Price (y211)				0.5410
Scale Mean	19.3770	32.9508	14.0492	25.1148
Scale Std. Dev.	3.3023	4.7308	1.7647	3.8691
Alpha	0.7597	0.7931	0.6208	0.5540
Standardized Item Alpha	0.7748	0.8052	0.7012	0.6335
Tukey estimate of power to achieve additivity	4.8127	4.8330	109.7729	4.8214
Hotelling's T-squared F (p-value)	11.5170 5.66 (0.006)	40.2104 9.55 (0.000)	0.1249 0.125 (0.725)	68.5361 22.1 (0.000)
N	61	61	61	61

Table D.4 shows the Cronbach's alpha coefficients for these scales tend to be above 0.60. Based on statistical properties exhibited in Table D.4 and the extant literature, it would seem that one should not use a simple average of all of the BIZRATE variables. The BIZRATE Overall Service Quality variable, which is a simple average of all the other variables, is also problematic since it averages one variable that is driven by service quality (Customer Loyalty) and nine service quality dimension variables. The combined scales derived from our factor analysis and reliability analysis seem to have a parsimonious, interpretable structure conforming largely to statistical requirements for scale construction. Thus, we use the combined scale variables in place of the BIZRATE Overall Service Quality variable to measure value in the context of electronic food retailing.

D.5 Discussion

D.5.1 Shopping Ease and Appearance

The Shopping Ease and Appearance index contain the BIZRATE indexes Web Site Aesthetics, Web Site Navigation, and Customer Support. These variables are each related to the information and digital content in an electronic service. Thus, Shopping Ease and Appearance represents customer perceptions of electronic elements of the service.

D.5.2 Electronic Service Quality

The Electronic Service Quality index contains the indexes Web Site Aesthetics, Web Site Navigation, Customer Support, Product Selection and Product Information. These variables are each related to the information and digital content in an electronic service. Thus, while similar to the Shopping Appearance and Ease index, Electronic Service Quality represents a higher level abstraction of customer perceptions of the electronic elements of the service.

D.5.3 Product Fulfillment

The Product Fulfillment index contains the indexes On Time Delivery and Product In Stock. Both of these measures are conceptually related to service activities that take place after the consumer disconnects from the electronic service process. Thus, the Product Fulfillment index represents the customer perception of the back office fulfillment process of the service.

D.5.4 Product Offering

The Product Offering index contains the indexes Ease of Returns, Product Selection, Product Information, and Price. Each of these items is largely related to the characteristics of products that are offered through the service, thus the Product Offering index is likely to represent the customer satisfaction with the overall product offering. As price also is included in this scale, the Product Offering index is conceptually related to the concept of service value.

REFERENCES

Alba, J., J. Lynch, B. Weitz, C. Janiszewski, R. Lutz, A. Sawyer, and S. Wood, 1997. "Interactive Home Shopping and the Retail Industry," Commentary Report No. 97-105, Marketing Science Institute.

Anderberg, Michael R., 1973. Cluster Analysis for Applications, Academic Press: New York, NY.

Bane, P. W., S. B. Bradley, and D. J. Collis, 1998. "The Converging World of Telecommunication, Computing, and Entertainment," in Sense and Respond, S. P. Bradley and R. L. Nolan, eds., Harvard Business School Press: Boston, MA, p. 31-62.

Bernardo, John J., and Zubair Mohamed, 1992. "The Measurement and Use of Operational Flexibility in the Loading of Flexible Manufacturing Systems," European Journal of Operational Research, Vol. 60, No. 2, p. 144-155.

Biro, K., 1998. "Delivering Customer Value Through the World Wide Web," in Sense and Respond, S. P. Bradley and R. L. Nolan, eds., Harvard Business School Press: Boston, MA, p. 107-122.

Blashfield, Roger K., and Leslie C. Morey, 1980. "A Comparison of Four Clustering Methods Using MMPI Monte Carlo Data," Applied Psychological Measurement, Vol. 4, No. 1 (Winter), p. 57-64.

Bollen, Kenneth A., 1989. Structural Equations with Latent Variables, John Wiley and Sons: New York, NY.

Bolton, Ruth N., and James H. Drew, 1991. "A Multistage Model of Customers' Assessments of Service Quality and Value," Journal of Consumer Research, Vol. 17 (March), p. 375-384.

Bowen, J., 1990. "Development of a Taxonomy of Services to Gain Strategic Insights," Journal of the Academy of Marketing Science, Vol. 18, No. 1, p. 43-49.

Boyer, Kenneth K., Ward, Peter T., and G. Keong Leong, 1996. "Approaches to the Factory of the Future: An Empirical Taxonomy," Journal of Operations Management, Vol. 14, No. 4, p. 297-313.

Bozarth, Cecil, and Chris McDermott, 1998. "Configurations in Manufacturing Strategy: A Review and Directions for Future Research," Journal of Operation Management, Vol. 16, No. 4, p. 427-439.

Burke, Raymond R., 1997. "Do You See What I See? The Future of Virtual Shopping," Journal of the Academy of Marketing Science, Vol. 25, No. 4, p. 352-360.

Chase, R. B., 1978. "Where does the Customer Fit in a Service Operation?," Harvard Business Review, Vol. 56 (November-December), p. 137-42.

Chase, R. B., 1996. "The Mall is my Factory: Reflections of a Service Junkie," Production and Operations Management, Vol. 5, No. 4 (Winter), p. 298-308.

Collier, D. A. and S. M. Meyer, 1998. "A Service Positioning Matrix," International Journal of Operations and Productions Management, Vol. 18, No. 12, p. 1223-1244.

Collis, D. J., P. W. Bane, and S. P. Bradley (1997), "Winners and Losers: Industry Structure in the Converging World of Telecommunications, Computing, and Entertainment," in Competing in the Age of Digital Convergence, D. B. Yoffie, ed. Boston: Harvard Business School Press, p. 159-200.

Computerworld, 1998. July 13, p. 6.

Cook, D. P., C. H. Goh and C. H. Chung, 1999. Service Typologies: A State of the Art Survey," Production and Operations Management, Vol. 8, No. 3, p. 318-338.

Cutcher-Gershenfeld, Joel, 1991. "The Impact of Economic Performance of a Transformation in Workplace Relations," Industrial and Labor Relations Review, Vol. 44, No. 2, January, p. 241-260.

Dabholkar, P. A., D. I. Thorpe, and J. O. Rentz, 1996. "A Measure of Service Quality for Retail Stores: Scale Development and Validation," Journal of the Academy of Marketing Science, Vol. 24, No. 1, p. 3-16.

Dixon, J. Robb, 1992. "Measuring Manufacturing Flexibility: An Empirical Investigation," European Journal of Operational Research, Vol. 60, No. 2, p. 131-143.

Donegan, P., 1998a. "The way it was," Progressive Grocer, 65th Annual Report of the Grocery Industry, April Supplement, p. 8-10.

Donegan, P., 1998b. "Labor pains intensify," Progressive Grocer, 65th Annual Report of the Grocery Industry, April Supplement, p. 12-17.

Doty, D. H., and W. H. Glick, 1994. "Typologies as a Unique Form of Theory Building: Toward Improved Understanding and Modeling," Academy of Management Review, Vol. 19, No. 2, p. 230-251.

Doty, D. H., W. H. Glick, and G. P. Huber (1993), "Fit, Equifinality, and Organizational Effectiveness: A Test of Two Configurational Theories," Academy of Management Journal, Vol. 36, No. 6, p. 1196-1250.

Drazin, Robert, and Andrew H. Van de Ven, 1985. "Alternative Forms of Fit in Contingency Theory," Administrative Science Quarterly, Vol. 30, No. 4, p. 514-539.

Ein-Dor, Phillip, and Eli Segev, 1993. "A Classification of Information Systems: Analysis and Interpretation," Information Systems Research, Vol. 4, No. 2, p. 166-204.

Galbraith, Craig, and Dan Schendel, 1983. "An Empirical Analysis of Strategy Types," Strategic Management Journal, Vol. 4, No. 2, p. 153-173.

Gale, B. T., 1994. Managing Customer Value, The Free Press: New York, NY.

Gerace, T. A., L. R. Klein, J. F. Rayport, and A. J. Silk, 1996. "Virtual Vineyards," Case 9-396-264, Harvard Business School Publishing: Boston, MA.

Goodwin, C., and R. Radford, 1993. "Models of Service Delivery: An Integrative Perspective," in Advances in Services Marketing and Management, Vol. 2, T. A. Swartz, D. E. Bowen, and S. W. Brown, eds., JAI Press: Greenwich, CT, p. 231-252.

Green, Paul E., and Frank J. Carmone, 1970. Multidimensional Scaling and Related Techniques in Marketing Analysis, Allyn and Bacon: Boston, MA.

Greenspun, P., 1997. Database Backed Web Sites, MacMillan: New York, NY, (http://photo.net/wtr/thebook/).

Gresov, Christopher, and Robert Drazin, 1997. "Equifinality: Functional Equivalence in Organization Design," Academy of Management Review, Vol. 22, No. 2, p. 403-428.

Gummeson, Evert, 1992. "Quality Dimensions: What to Measure in Service Organizations," in Advances in Services Marketing and Management, Vol. 1, T. A. Swartz, D. E. Bowen, and S. W. Brown, eds., JAI Press Inc.: Greenwich, CT, p. 177-205.

Gupta, Y. P., and T. M. Somers, 1992. "The Measurement of Manufacturing Flexibility," European Journal of Operational Research, Vol. 60, No. 2, p. 166-182.

Hagel, J., III, and A. G. Armstrong, 1997. Net Gain: Expanding Markets Through Virtual Communities, Harvard Business School Press: Boston, MA.

Hamer, Robert M., and J. W. Cunningham, 1981. "Cluster Analyzing Profile Data Confounded With Interrater Differences: A Comparison Of Profile Association Measures," Applied Psychological Measurement, Vol. 5, No. 1 (Winter), p. 63-72.

Harrington, L., and G. Reed, 1996. "Electronic Commerce (Finally) Comes of Age," The McKinsey Quarterly, No. 2, p. 68-77.

Hayes, R. H., and S. G. Wheelwright, 1979. "Link Manufacturing Process and Product Life Cycles," Harvard Business Review, Vol. 57 (January-February), p. 133-140.

Hayes, R. H., and S. G. Wheelwright, 1984. Restoring Our Competitive Edge: Competing Through Manufacturing, John Wiley & Sons: New York, NY.

Haywood-Farmer, J., 1988. "A Conceptual Model of Service Quality," International Journal of Operations and Production Management, Vol. 8, No. 6, p. 19-29.

Heikkilä, Jukka, Jukka Kallio, Timo Saarinen, and Virpi Kristiina Tuunainen, 1998. "Analysis of Expectations on Electronic Grocery Shopping for Potential Customer Segments," Working Paper, Helsinki School of Economics, Electronic Commerce Institute.

Hemphill, R. D., 1996. "Internet & the food industry: Today and tomorrow," in: A Strategic Guide to Understanding and Managing Technology, Food Marketing Institute: Washington, DC, p. 57-64.

Iansiti, M., and A. MacCormack, 1998. "Product Development on the Internet," In Sense and Respond, S. P. Bradley and R. L. Nolan, eds., Harvard Business School Press: Boston, MA, p. 175-200.

Johnson, Richard A., and Dean W. Wichern, 1992. Applied Multivariate Statistical Analysis, Third Edition, Prentice Hall, Inc.: Englewood Cliffs, NJ.

Kalakota, R., and A. B. Whinston, 1996. Frontiers of Electronic Commerce, Addison-Wesley: Reading, MA.

Kalakota, R., and A. B. Whinston, 1997. *Electronic Commerce: A Manager's Guide*, Addison-Wesley: Reading, MA.

Keeney, Ralph L., 1999. "The Value of Internet Commerce to the Customer," Management Science, Vol. 45, No. 4, p. 533-542.

Kellogg D. L., and W. Nie, 1995. "A Framework for Strategic Service Management," Journal of Operations Management, Vol. 13, No. 4, p. 323-37.

Ketchen, David J., and Christopher L. Shook, 1996. "The Application of Cluster Analysis in Strategic Management Research: An Analysis and Critique," Strategic Management Journal, Vol. 17, No. 6, p. 441-458.

Kinsey, J., and B. Senauer, 1996. "Food Marketing in an Electronic Age: Implications for Agricultural Producers," Working Paper 96-2, The Retail Food Industry Center, University of Minnesota.

Kotha, S., and D. Orne, 1989. "Generic Manufacturing Strategies: A Conceptual Synthesis," Strategic Management Journal, Vol. 10, No. 3, p. 211-231.

Lapierre, J., 1996. "Service Quality: The Construct, its Dimensionality and its Measurement," in Advances In Services Marketing And Management, Vol. 5, T.A. Swartz, D.E. Bowen, and S.W. Brown, eds., JAI Press: Greenwich, CT, p. 45-70.

Lovelock, C.H., 1995. "Technology: Servant or Master in the Delivery of Services?," in Advances in Services Marketing and Management, Vol. 4, T.A. Swartz, D.E. Bowen, and S.W. Brown, eds., JAI Press: Greenwich, CT, p. 63-90.

MacDuffie, John-Paul, 1995. "Human Resource Bundles and Manufacturing Performance: Organizational Logic and Flexible Production Systems in the World Auto Industry," Industrial and Labor Relations Review, Vol. 48, No. 2 (January), p. 197-221.

Maister, D. H., and C. H. Lovelock, 1982. "Managing Facilitator Services," Sloan Management Review, Vol. 23, No. 4 (Summer), p. 19-31.

Mathews, R., 1998. "A Fragile Peace," Progressive Grocer, Vol. 77 (April supplement), p. 26-28.

Menor, Larry J., Aleda V. Roth and Charlotte H. Mason, 1998. "Agility in Retail Service Management: A Numerical Taxonomy," Working Paper, Kenan-Flagler Business School, University of North Carolina at Chapel Hill.

Meyer, Alan D., Tsui, Anne S., and C. R. Hinings, 1993. "Configurational Approaches to Organizational Analysis," Academy of Management Journal, Vol. 36, No. 6, p. 1175-1195.

Miller, Danny, 1981. "Toward a New Contingency Approach: The Search for Organizational Gestalts," Journal of Management Studies, Vol. 18, No. 1, p. 1-26.

Miller, Danny, and Peter H. Friesen, 1977. "Strategy-Making in Context: Ten Empirical Archetypes," Journal of Management Studies, Vol. 14, No. 3, p. 253-280.

Miller, Danny, and Peter H. Friesen, 1978. "Archetypes of Strategy Formulation," Management Science, Vol. 24, No. 9 (May), p. 921-933.

Miller, D., 1996. "Configurations Revisited," Strategic Management Journal, Vol. 17, No. 7, p. 505-512.

Miller, Jeffrey G., and Aleda V. Roth, 1994. "A Taxonomy of Manufacturing Strategies," Management Science, Vol. 40, No. 3, p. 285-304.

Milligan, Glenn W., and Martha C. Cooper, 1985. "An Examination of Procedures for Determining the Number of Clusters in a Data Set," Psychometrika, Vol. 50, No. 2, p. 159-179.

Milligan, G. W., and M. C. Cooper, 1987. "Methodology Review: Clustering Methods," Applied Psychological Measurement, Vol. 11, No. 4, p. 329-354.

Milne, George R., 1994. "A Magazine Taxonomy Based on Customer Overlap," Journal of the Academy of Marketing Science, Vol. 22, No. 2, p. 170-179.

Montgomery, Douglas C., 1991. Design and Analysis of Experiments, Third Edition, John Wiley and Sons: New York, NY.

Neter, John, Kutner, Michael H., Nachtsheim, Christopher J., and William Wasserman, 1996. Applied Linear Statistical Models, Third Edition, Richard D. Irwin, Inc.: Chicago, IL.

New York Times, 1999. January 19, p. C3.

PC Week, 1997. "10 Who Dared to be Different," 6 January, p. 21-30.

Palmer, J. W., and D. A. Griffith, 1998. "An Emerging Model of Web Site Design for Marketing," Communications of the ACM, Vol. 41, No. 3, p. 45-51.

Parasuraman, A., 1997. "Reflections on Gaining Competitive Advantage Through Customer Value," Journal of the Academy of Marketing Science, Vol. 25, No. 2, p. 154-161.

Parasuraman, A., V.A. Zeithaml, and L.L. Berry, 1985. "A Conceptual Model of Service Quality and its Implications for Future Research," Journal of Marketing, Vol. 49, No. 4 (Fall), p. 41-50.

Peterson, Robert A., Balasubramanian, Sridhar, and Bart J. Bronnenberg, 1997. "Exploring the Implications of the Internet for Consumer Marketing," Journal of the Academy of Marketing Science, Vol. 25, No. 4, p. 329-346.

Punj, Girish, and David W. Stewart, 1983. "Cluster Analysis in Marketing Research: Review and Suggestions for Application," Journal of Marketing Research, Vol. 20, No. 2 (May), p. 134-148.

Rangan, V. K., and M. Bell, 1998. "Dell Online," Case 9-598-116. Harvard Business School Publishing: Boston, MA.

Reeves, Carol A., and David A. Bednar, 1994. "Defining Quality: Alternatives and Implications," Academy of Management Review, Vol. 19, No. 3, p. 419-445.

Reynolds, Henry T., 1977. The Analysis of Cross-Classification, The Free Press: New York, NY.

Safizadeh, M. H., L. P. Ritzman, D. Sharma, and C. Wood, 1996. "An Empirical Analysis of the Product-Process Matrix," Management Science, Vol. 12, No. 11 (November), p. 1576-1591.

Schmenner, R. W., 1986. "How Can Service Businesses Survive and Prosper?," Sloan Management Review, Vol. 27, No. 3, p. 21-32.

Shim, S., and M. Mahoney, 1992. "Differentiation of Satisfied Users and Dissatisfied Users of In-Home Electronic Shopping Mode: An Exploratory Study," Journal of Consumer Satisfaction, Dissatisfaction and Complaining Behavior, Vol. 5, p. 192-200.

Shostack, G. L., 1987. "Service Positioning Through Structural Change," Journal of Marketing, Vol. 51, No. 1 (January), p. 34-43.

Silvestro, Rhian, Lin Fitzgerald, Robert Johnston, and Christopher Voss, 1992. "Towards a Classification of Service Processes," International Journal of Service Industry Management, Vol. 3, No. 3, p. 62-75.

Sinha, I., and W. S. DeSarbo, 1998. "An Integrated Approach Toward the Spatial Modeling of Perceived Customer Value," Journal of Marketing Research, Vol. 35, No. 2 (May), p. 236-49.

Sireci, Stephen G., and Kurt F. Geisinger, 1992. "Analyzing Test Content Using Cluster Analysis and Multidimensional Scaling," Applied Psychological Measurement, Vol. 16, No. 1 (March), p. 17-31.

SPSS® Base 8.0 Applications Guide, 1998. SPSS, Inc.: Chicago, IL.

Stewart, David W., 1981. "The Application and Misapplication of Factor Analysis in Marketing Research," Journal of Marketing Research, Vol. 18, No. 1 (February), p. 51-62.

Swamidass, P. M., 1991. "Empirical Science: New Frontier in Operations Management Research," Academy of Management Review, Vol. 16, No. 4, p. 793-814.

Tapscott, D., 1996. The Digital Economy: Promise and Peril in the Age of Networked Intelligence, McGraw-Hill: New York, NY.

Time, 1998. "Click till you drop," July 20, p. 34-41.

Ulrich, Dave, and Bill McKelvey, 1990. "General Organizational Classification: An Empirical Test Using the United States and Japanese Electronics Industries," Organization Science, Vol. 1, No. 1, p. 99-118.

Venkatraman, N., 1989. "The Concept of Fit in Strategy Research: Toward Verbal and Statistical Correspondence," Academy of Management Review, Vol. 14, No. 3, p. 423-444.

Vepsäläinen, Ari P. J., and Timo O. Saarinen, 1998. "Channel Separation for Electronic Commerce," Proceedings of NOFOMA '98, p. 1-14.

Viswanathan, Madhubalan, and Terry L. Childers, 1999. "Understanding How Product Attributes Influence Product Categorization: Development and Validation of Fuzzy Set-Based Measures of Gradedness in Product Categories," Journal of Marketing Research, Vol. 36, No. 1 (February), p. 75-94.

Woodruff, Robert B., 1997. "Customer Value: The Next Source for Competitive Advantage," Journal of the Academy of Marketing Science, Vol. 25, No. 2, p. 139-153.

Woodruff, R. B., and S. F. Gardial, 1996. Know Your Customer, Blackwell: Cambridge, MA.

Yoffie, D. B., 1997. "Introduction: CHESS and Competing in the Age of Digital Convergence," in Competing in the Age of Digital Convergence, D. B. Yoffie, ed., Harvard Business School Press: Boston, MA, p. 1-35.

Zeithaml, V. A., 1988. "Consumer Perceptions of Price, Quality and Value: A Means-End Model and Synthesis of Evidence," Journal of Marketing, Vol. 52, No. 3 (July), p. 2-22.

Zimmerman, Ray, Rick Jacobs, and James Farr, 1982. "A Comparison of the Accuracy of Four Methods of Clustering Jobs," Applied Psychological Measurement, Vol. 6, No. 3 (Summer), p. 353-366.