Dimensions of flexibility in apparel production

Heidi Patricia Scheller

Iowa State University

Follow this and additional works at: https://lib.dr.iastate.edu/rtd

Part of the Business Administration, Management, and Operations Commons, Industrial Engineering Commons, and the Operational Research Commons

Recommended Citation

https://lib.dr.iastate.edu/rtd/10719

This Dissertation is brought to you for free and open access by the Iowa State University Capstones, Theses and Dissertations at Iowa State University Digital Repository. It has been accepted for inclusion in Retrospective Theses and Dissertations by an authorized administrator of Iowa State University Digital Repository. For more information, please contact digirep@iastate.edu.
INFORMATION TO USERS

This manuscript has been reproduced from the microfilm master. UMI films the text directly from the original or copy submitted. Thus, some thesis and dissertation copies are in typewriter face, while others may be from any type of computer printer.

The quality of this reproduction is dependent upon the quality of the copy submitted. Broken or indistinct print, colored or poor quality illustrations and photographs, print bleedthrough, substandard margins, and improper alignment can adversely affect reproduction.

In the unlikely event that the author did not send UMI a complete manuscript and there are missing pages, these will be noted. Also, if unauthorized copyright material had to be removed, a note will indicate the deletion.

Oversize materials (e.g., maps, drawings, charts) are reproduced by sectioning the original, beginning at the upper left-hand corner and continuing from left to right in equal sections with small overlaps. Each original is also photographed in one exposure and is included in reduced form at the back of the book.

Photographs included in the original manuscript have been reproduced xerographically in this copy. Higher quality 6" x 9" black and white photographic prints are available for any photographs or illustrations appearing in this copy for an additional charge. Contact UMI directly to order.
Dimensions of flexibility in apparel production

by

Heidi Patricia Scheller

A Dissertation Submitted to the
Graduate Faculty in Partial Fulfillment of the
Requirements for the Degree of
DOCTOR OF PHILOSOPHY

Department: Textiles and Clothing
Major: Textiles and Clothing

Approved:

Signature was redacted for privacy.
In Charge of Major Work

Signature was redacted for privacy.
For the Major Department

Signature was redacted for privacy.
For the Graduate College

Iowa State University
Ames, Iowa
1995

Copyright © Heidi Patricia Scheller, 1995. All rights reserved.
TABLE OF CONTENTS

INTRODUCTION

Transitions in the Structure & Dynamics of the Domestic Apparel Industry
- Retail changes
- Consumer demand
- Import penetration
- Technological changes in apparel production

Purpose

Conceptual Framework
- Research Questions

Objectives

Definitions of Terms

Organization of the Dissertation

REVIEW OF LITERATURE

Ideology of Flexibility
- Definitions of flexibility
  - Flexibility as strategy
  - Flexibility as adaptive response
- Dimensions of flexibility
  - Specific dimensions of flexibility
  - Static and dynamic flexibility
  - Flexibility as dynamic efficiency
  - Complexity of flexibility
- Management systems
  - Mechanistic management systems
    - Cognitive structures of managers
  - Organic management systems
  - Organizations as cultures
    - Implications of corporate cultural control
- Ideological development of the apparel industry
- Ideology and manufacturing
- Taylorism and production ideologies
- Patriarchy and production ideologies

Perspectives of flexibility: Options, economic, & manufacturing theories
- Theoretical framework of flexibility in production
- Options theories
  - Exploration vs. exploitation
  - Flexibility as decisions
  - Economic theories
- General model of a manufacturing system
- Behavioral theory of the apparel firm
Internal barriers 135
  Structural barriers 135
  Functional barriers 137
  Cognitive barriers 137
  Resistance to change 138
External barriers 139
  Costs of flexibility 139
  Inflexibility of technology 140
  Sourcing and vendor relationship barriers 141
  Labor union barriers 143

Meanings: Perspectives of Flexibility 144
  Flexibility as a set of abilities 144
  Perceptions of flexibility as they related to profit 145
  Perceptions of flexibility as they related to productivity 146
  Flexibility as a solution to quality failure 148
  Flexibility as a renovated conception of the value of time 150
  Summary of perspectives of flexibility 151

Mechanisms: A Theory of Transitional Capacity of Apparel Producers 151
  The process of earning transitional capacity 153
    Recognition of demand variation 153
    Identification of adaptive variants 154
    Developments of mechanisms to assess risk & determine the value
    of variants 154
    Cultivation of measuring techniques that support adaptive variants 154
    Earning transitional capacity through intensive knowledge
    acquisition 155
  Summary of theory of transitional capacity of apparel producers 155

Contribution of the Literature 156
  The deGroote framework 156
  Ideology 157
  Behavioral and technological forms 158
  Barriers to flexibility 159
  Paradigm shift in apparel production 159

SUMMARY 160
  Conclusion 160
  Limitations 162
  Recommendations for Further Research 162
  Summary 163

REFERENCES 166
ACKNOWLEDGMENTS 181
APPENDIX A: DATA COLLECTION INSTRUMENTS 182
APPENDIX B: INTRODUCTORY LETTER 187
APPENDIX C: THEME DEVELOPMENT 189
APPENDIX D: HUMAN SUBJECTS REVIEW 202
INTRODUCTION

Time and product variety are the central dimensions that promote the emergence of flexibility in the apparel production sector of the United States. As a critical source of comparative advantage, the dimension of product cycle time is driving the apparel industry's initiative for change (Bailey, 1993). Production flexibility, with faster response to apparel market preferences, is now the strategic aim of the industry (Miller & Blais, 1993; Schoer & Ziemke, 1994; Tucker & D'Andrea, 1992). Extending from product development to retail sales, U.S. apparel firms are adopting technologies and systems that meet requirements for reduced cycle times and increased product variety (Lin, Kincade, & Warfield, 1994). These efforts to become more sensitive to the influential needs of consumers are being coordinated among suppliers, producers, and retailers (Hunter, King, Nuttle, & Wilson, 1993). Within and across firms, the apparel production sector is undergoing a structural and dynamic transition (Bailey, 1993; Sieling & Curtain, 1988).

Transitions in the Structure and Dynamics of the Domestic Apparel Industry

Four major developments are influencing the U.S. apparel industry's transition toward flexibility. Each of these developments were addressed in a variety of presentations by industry experts at the 1994 International Apparel Research Conference (International Apparel Research Committee Proceedings, 1994). Further support for their salience is apparent in the apparel trade press, business periodicals, and academic literature.

The first development involves the recent consolidation of the retail sector and the emergence of alternative methods of retailing. Second, there are changes in consumer demand and the structure of markets. The third development is the intense competition from lower-wage foreign producers. Last, is the availability of computerized technologies for most aspects of apparel production. All four developments are interrelated, and share the common premise that the apparel supply system is changing to one where goods are being
pulled out of the system by consumers, rather than being pushed out of the system by manufacturers and retailers (International Apparel Research Committee Proceedings, 1994).

**Retail changes**

Consolidation of the traditional American retailing sector during the past several years continues to intensify. Concentrated power among fewer retail firms has resulted from mergers and closings of many large department stores (Agins, 1994; Friedman, 1988). Discount retailers, such as manufacturer's outlet stores, category specialists, and discount store chains, have increased their market shares in apparel at the expense of department and specialty stores (Germeroth-Hodges, 1993). These newer retail formats have lower cost operating structures, due in part, to less expensive real estate and lack of commitment to full assortments (Kaufman, Smith, & Ortmeyster, 1994; Morganowsky, 1993). Retailers with distinctive marketing competencies are seeking fresh images using exclusive apparel products that serve to differentiate themselves from other retailers in the minds of consumers (Conant, Smart, & Solano-Mendez, 1993). Establishment of private label apparel lines by retailers has been an effective technique that provides growth opportunities for producers who are willing to work directly with the retailers (Germeroth-Hodges, 1993). Specialized tasks of product conceptualization and development formerly done by apparel manufacturers is now also in the domain of retailers who want greater merchandise control and better margins (Gaskill, 1992).

The balance of power to determine merchandise, timing, and pricing is shifting away from manufacturers and toward retailers (Agins, 1994). In a study that examined the exchange relationships between apparel manufacturers and retailers, ZuHone and Morganosky (1995) found imbalances in various dimensions of power dependencies between the two. Retailers perceived that they were losing control over the determination of markdown prices, markdown timing, and merchandise placement in their stores. Manufacturers perceived that they were gaining power in these areas as well as that related to advertising content and
media selection. Both retailers and manufacturers believed that retailers will have greater overall power in the future.

Relationships between retailers and their vendors have both behavioral and economic implications (Skinner, Gassenheimer, & Scott, 1992) requiring dramatic adjustments in how apparel goods are supplied to retailers (Agins, 1994). Verticalization in the industry has both textile and apparel firms integrating forward into production, sourcing and retailing. At the same time, store and catalog retailers are integrating backward into production and supply sourcing (Bernard, 1987; Jacobs, 1994). Even though single brand and single product apparel companies have performed well financially in the past, fashion trends, such as those toward casual clothing in the workplace, are encouraging producers to assure their retail customers a varied product mix with expanded distribution channels (Jacobs, 1994).

Brand-named marketers, such as Liz Claiborne and The Gap, have established decentralized production networks throughout many newly industrialized countries. For example, in 1990, Levi Strauss, a sportswear manufacturer with $4.2 billion in sales, was producing, in part, through a network of 600 worldwide contractors (Bonacich & Waller, 1994). Through buyer-driven commodity chains, marketers, retailers, and trading companies are able to merge research, design, sales, and marketing with the low-cost production capabilities of a dense overseas contracting network. Such contracting relieves the buyers from owning factories and from carrying the financial obligations of production labor (Appelbaum & Gereffi, 1994).

Contractual flexibility within buyer-driven commodity chains brings a source of value to the consumer because worldwide apparel production capacity is utilized more efficiently to meet the needs of all markets (Appelbaum & Gereffi, 1994). Production is continuously shifted to countries and firms offering the most appropriate skills, equipment, capacities, and costs (Bonacich, Cheng, Chinchilla, Hamilton, & Ong, 1994). Increasingly liberal import restrictions, where combined with advances in telecommunications and transportation, have
reduced the need for producer proximity to the market (Alcorta, 1994).

The widespread and increasing use of computers in the apparel industry is a major technological change that has supported contracting activities. With bar coded merchandise, data obtained at the point-of-sale provides useful information for the merchandising and operational aspects of retailing (Friedman, 1988). Partnerships among suppliers, producers, and retailers supported by electronic data interchange (EDI) are becoming more common. By creating a technological form of vertically integrated structure, partnerships are an innovative method for apparel firms to meet consumer needs (Blackburn 1991).

At the core of Quick Response (QR) is an electronic infrastructure linking retailers, manufacturers, and their suppliers. Information that originates from the consumer's purchase behavior is expanded with supplier data, and flows up through the supply chain, allowing preferred merchandise to be produced and delivered rapidly (Black, 1994). Historically, apparel producers have offered goods to the marketplace through a process where designers and product developers tried to create what consumers would want. The traditional retail pattern of preordering most apparel merchandise resulted in season-end residual inventories as well as stockouts of popular merchandise within the season. Quick Response was conceptualized as a method to decrease apparel production time allowing for in-season readjustment of merchandise orders according to what consumers were buying (Hunter, King, Nuttle, & Wilson, 1993). The dynamic difference with QR networks is that consumers now pull apparel goods through the production chain with their buying behavior (Hunter, 1990). Effective for basic apparel goods, QR replenishment systems are not well established for fashion goods, but are being used more frequently by fashion oriented apparel companies (Tucker & Corey, 1993). Also, this innovative technology has not been widely adopted by small and medium sized producers due, in part, to the large capital expenditures required (Agins, 1994; Tucker & D'Andrea, 1992).
**Consumer demand**

Consumers are demanding a wider range of apparel products within narrower time frames (Lin, et al., 1994). Regional and seasonal variations in consumer apparel preferences are requiring a wider variety of apparel products to be delivered continuously (Bernard, 1987; Jacobs, 1994). Quality and pricing in apparel products are becoming more important to American consumers (Jacobs, 1994; Scheller, 1993; Tucker & D'Andrea, 1992). Imbalances in supply and demand became an issue in the last decade. During the 1980s, soft goods shipments to retailers grew at an annual rate of 13%, while consumer purchase growth of these goods remained at 7%. Excess retail inventories in the stagnating apparel market forced retailers to leverage producers into reducing margins for price-conscious consumers (Jacobs, 1994).

**Import penetration**

Survey data on manufacturing industries collected by the U.S. Department of Commerce offer an overview of the size and scope of the apparel production sector. In 1992, there were 23,048 establishments in the U.S. producing apparel and other textile products (SIC 23). Those firms employed 985,600 people with an annual payroll of over $15.3 billion. Production workers alone accounted for 824,000 of the sector's employees, with average earnings of $13,809 per production worker (U. S. Department of Commerce, in press). Wages for apparel production workers in many offshore firms are dramatically lower; however, other costs associated with offshore sourcing are not reflected in the offshore labor cost data.

Because countries have varying wage and benefit requirements as well as different data collection techniques, simple comparisons of worldwide wage differentials are not always meaningful. Nevertheless, hourly wages in the Caribbean region for apparel production workers in 1992 ranged from a low of $.41 in Haiti, to a high of $5.50 in the U.S. Virgin Islands. These offshore figures are in U.S. dollars and reflect fringe benefits and required
so charges. Such dramatic differences in wages have encouraged offshore sourcing. For example, Mexican operator wages and benefits averaged between $1.01 and $1.15 per hour (Cedrone, 1993, November). With a 44 hour week and 50 weeks of work, $1.15 per hour would produce an annual wage cost of $2,530 per worker.

Despite decades of protectionist legislation, the penetration of foreign apparel products into the U.S. continues to expand (Yang, 1994). Retailers and manufacturers are increasing their global sourcing in both amounts and locations, resulting in higher import penetration of apparel goods into the U.S. market (Handfield, 1994; Yang, 1994). In 1992, China became the largest foreign apparel supplier to the U.S. market, with imports also growing rapidly from other areas in Asia and Canada (Tucker & D'Andrea, 1992). An increasing portion of apparel imports enters the United States under the Harmonized Tariff Schedule of the United States (HTSUS), provision 9802 program (formerly 807). Garments assembled abroad from U.S. components under the 9802 program accounted for nearly 14% of apparel imports in 1992. Mexican and Caribbean producers have assembled the most HTSUS 9802 imports. Garment production has become an important part of the growth in the Mexican maquila sector (Chinchilla & Hamilton, 1994).

Pressures from quotas on Asian goods along with the tariff advantages of the HTSUS 9802 program are strong incentives for U.S. manufacturers and retailers to source products from Caribbean and Central American countries (Cedrone, 1994, March). It is expected that apparel trade will be affected by the provisions of the North American Free Trade Agreement (NAFTA) among the United States, Canada, and Mexico (Glasmeier, Campbell, & Henton, 1993; Tucker & D'Andrea, 1992).

In an environment of competition from imports, apparel retailers and producers have adopted a variety of techniques to maintain profitability. Sub-contracting and joint ventures of apparel assembly operations in low-wage countries, such as those of the Caribbean, have allowed for reduced shipping costs and lower prices for consumers while maintaining the
viability of many support jobs in the U.S. (Balkwell & Dickerson, 1994). In a dramatic position shift, a recent agreement between the Amalgamated Clothing and Textiles Worker's Union (ACTWU) and the Clothing Manufacturer's Association of the United States (CMA) allows CMA producers to make 10% of their garments in non-union shops. It is expected that these producers will source offshore for their non-union production. Represented by the ACTWU are about 36,000 workers in several hundred CMA member firms. This agreement also requires producers to abide by International Labor Organization standards that provide for decent working conditions in the production of non-union garments (Abend, 1994).

Technological changes in apparel production

Apparel producers are also responding to these environmental transitions through changes in the dynamics of their internal operations. Technology is increasing both the capital intensity and the efficiency of the industry (Bailey, 1993; Lin, et al., 1994). Since World War II, the strategic intention of the American apparel producers has been to increase productivity through incremental improvements in the traditional progressive bundle system. This was accomplished by maximizing the output of individual sewing operators (Bailey, 1993; Hill, 1992a; Hoffman & Rush, 1988). Domestic apparel manufacturing has its historic anchor in the progressive bundle system, which is characterized by mass production of high volume styles with long lead times. In this system, finished garments emerge from a process that coordinates skilled sewers who perform single operations on each garment. Large bundles of garment parts move sequentially through production plants as operators are paid a productivity incentive through a piece-rate plan. Because this process depends on specialized operations, labor-based product costing, and fewer retail selling seasons, it was and continues to be perceived as a profitable system for the markets and industrial structure of the 20th century (Bailey, 1993).

However, recent developments in maintaining profitability through the systematic reduction of production cycle time are qualitatively different than the incremental
improvements in productivity that have predominated in the apparel industry during this century (Hoffman & Rush, 1988). With the progressive bundle system, profits and market share were earned by economies of scale through large volume orders and low style variation (Cokins, 1994; Lin, et al., 1994). Now that materials and overhead exceed labor in the cost content of garments, high inventories of work in process with long production schedules have become too expensive for manufacturers to financially tolerate and inconsistent with the needs of the market (Awasthi, 1994; Brimson, 1991). Because smaller production volumes and increased style variation can reduce productivity and increase costs, producers are making more dramatic changes in alternative sewing systems and technology adoption (Lin, et al., 1994; Sieling & Curtain, 1988).

Cost reductions through changes in the organization of apparel production are being approached from a variety of strategic options (Bailey, 1993). In order to serve niche markets and more frequent retail selling seasons, producers are establishing modular manufacturing systems and unit production systems. Although descriptions of these systems are covered in the Review of Literature, a brief introduction to them is offered here. In modular production, focused teams of operators (ranging from 5-17 members) sew and finish smaller runs in less time than is required in the progressive bundle system (Carrere & Little, 1989). Unit production systems provide a computer-integrated overhead transport technology to move apparel parts among sewing operators. Finished garments are produced faster with dramatically less inventory, while current production data are continuously available. In addition, cross-training of operators for more than one skilled job allows both of these systems to accommodate shorter runs of a wider variety of products. Combinations of these systems with sub-assembly of small parts in progressive bundle lines provide another means to faster, lower cost production (Hill, 1992a; Schoer & Ziemke, 1994).

Diffusion of organizational innovation with flexible apparel production systems is thought to be low, with about 90% of manufacturers still using the progressive bundle system (Hill,
A recent study of Alabama apparel producers found 77% using bundle systems, and a few using a combination of systems (Lin, et al., 1994). Technical innovation, however, is diffusing throughout the industry, with specialized equipment for operations such as collar attachment or pocket setting (Schroer & Ziemke, 1994). Many firms have invested in computerized design, cutting, embroidery, sewing, information, labeling, packaging, and tracking equipment (Cedrone, 1994, June; Tucker & D'Andrea, 1992). Electronic data interchange (EDI) is becoming a requirement for producers that are supplying large retailers (Agins, 1994). Because new technology is costly, larger manufacturers with greater capital resources have led the industry in its adoption (Tucker & D'Andrea, 1992). In some firms, organizational innovation is being coupled with technical innovation.

Mass production in U.S. manufacturing industries after World War II thrived in environments of low uncertainty by adopting mechanistic, bureaucratic structures (Nemetz & Frye, 1988). Underlying the foundations of industrialism has been the view of a factory as a mere collection of individual machines and operations. Emerging now is the world view of manufacturing as a part of an integrated system that converts materials into economic satisfactions (Drucker, 1990; Slaughter, 1994). In the systems view, the factory is not a place, but a stage in a process that integrates people, materials, machines, and time (Drucker, 1990). New organizational forms have evolved to become more responsive and flexible to accelerating changes in customer preferences, technology, and competitive forces (Webster, 1992).

The focus of this study was on the structural and dynamic transitions that apparel producers were undergoing as they accommodated their customers' demands. Changes in retailing, consumer demand, global production, and technology were requiring responsiveness from producers that depended on fundamental reform. Reform that was behavioral, technological, and structural required an understanding of the dynamics of transition to sustainability (Slaughter, 1994).
Purpose

The purpose of this study was to inductively describe strategic apparel production behaviors, values, and ideologies that intended to reduce cycle time, increase the range of apparel products in the marketplace, and respond to environmental uncertainties. Because domination of the productivity paradigm that has supported the progressive bundle system and its concomitant piece-rate incentive scheme has been challenged, the fundamental assumptions and values within the cultural sphere of the apparel industry were examined. Furthermore, the study described the premises of the apparel production culture through the perceptions of managers and consultants. By analyzing the ways that managers and consultants thought about flexibility, the study focused on how the referent firms were becoming flexible.

Flexibility in apparel production is a salient concept in the apparel trade press; however, flexibility as a multidimensional construct has neither been fully defined, described, nor developed in the apparel research literature. The review of manufacturing literature more broadly indicates that flexibility is a latent variable representing suites of many other variables. Attempts have been made to isolate and measure amounts of flexibility within other types of manufacturing firms. Apparel is a complex, continuously changing set of soft goods products manufactured in a wide range of firms. Consequently, within specific apparel firms, quantitative measurements of flexibility may not be as valuable to the audience of this research, namely, other apparel firms and the academic community, as would qualitative descriptions of flexibility dimensions and techniques. deGroote (1994) asserts that it is unnecessary to obtain specific measures of flexibility in order to gain insight into its nature. Application of deGroote's theoretical framework of technologies, diversity, and performance criteria in a study such as this one demonstrates that flexibility can be defined and analyzed on the basis of ordinal properties only.

In order to address the issues of how apparel managers can create useful flexibilities that
will improve the performance of their firms, this study described and compared the
dimensions of flexibility within and among a variety of apparel production systems. The
study was conceptually grounded in previous research. Various dimensions of flexibility
reported in the management literature served as points of departure for issues and
relationships of flexibility that were unique to apparel production systems. Through in-
dept, exploratory interviews with apparel production managers and consultants who advise
the apparel industry, major and minor themes related to flexibility were described. Results
are useful to guide further flexibility research, to assist in the development of instruments that
can assess flexibility, and to guide apparel production managers in flexibility related
decisions. Knowledge gained from this study may also help apparel managers and
researchers to document the value of production flexibility, to discover elements of flexibility
in reorientation of production processes, and to develop manufacturing strategies that are
essentially flexible.

Conceptual Framework

The conceptual framework for this study is grounded in three major constructs. Support
for the salience of these constructs is found throughout the academic literature on
manufacturing flexibility, the apparel trade press, and written materials from major apparel
trade organizations. Interpretations of flexibility identified within the broad range of
manufacturing literature served as points of departure for the framework. As conceptual
categories, these constructs inductively emerged through preliminary interviews of apparel
production managers and consultants. Coupled with visits to apparel production plants and
two nationally recognized apparel production research and demonstration sites, attendance at
industry seminars on flexible apparel manufacturing provided further clarification for the
validity of these constructs.

The following five research questions guided the study and were developed from the three
constructs that include the ideology of flexibility, the behavioral and technological forms of
flexibility, and the barriers to flexibility. Issues related to these constructs affect producers as they strategically adopt flexible techniques and philosophies. The relational framework among these constructs had not been identified *a priori*, leaving open the possibility of other emergent themes. Final interview instruments were developed from the research questions with the goal of allowing relationships between and among constructs to emerge in the data.

**Research questions**

<table>
<thead>
<tr>
<th>Construct</th>
<th>Research Question</th>
</tr>
</thead>
</table>
| **Ideology** | How do apparel producers perceive the concept of flexibility in production?  
How does the concept of flexibility relate to the dominant apparel production ideologies of quality, productivity, and profit? |
| **Forms** | What are apparel producers doing (behaviorally, technologically, and structurally) to support their perceptions of flexibility? |
| **Barriers** | What are the barriers to the implementation of flexible production philosophies and techniques?  
What knowledge do apparel producers need to overcome their resistance to change? |

**Objectives**

1. Inductively describe dimensions of apparel production flexibility, including, but not limited to market and industry forces that are contributing to the need for increased production flexibility, and issues related to labor, management, materials, quality, productivity, profit, and growth within a variety of apparel production systems.

2. Define the concept of flexibility in apparel production by characterizing the meaning and significance of flexibility to apparel managers and consultants.

3. Develop constructs and model(s) that will support a grounded theory of flexibility transition within apparel production firms.
Definitions of Terms

The following terms are operationally defined for the purpose of this study. All of the terms are found in the literature, and most of them are used in the everyday language of apparel producers.

**Apparel producer:** Organization or individual that plans and executes the conversion of resources into garments. Apparel producers may include manufacturers and contractors who make clothing. Due to the increase in vertical integration, definitional ambiguity about apparel manufacturing has developed. For example, some apparel manufacturers produce their own goods, contract for goods from other producers, sell their goods to other retailers, and operate their own retail stores. Throughout the Review of Literature, the use of the terms contractor, producer, or manufacturer depended on the author's reference.

**Benchmarking:** A term used to describe organizational goal setting that is based on the best practices in a particular industry. Companies that use benchmarking strategy search for the knowledge and techniques of successful competitors so that they can implement exceptional practices to improve their own performance.

**Bottleneck:** A resource within an apparel production system with a capacity that is less than the demand being placed on it (Vonderembse & White, 1991). In a manufacturing process, a bottleneck is the station with the highest mean operation time. Utilizations of other stations are calculated based on the 100% utilization of the bottleneck (Aly & Subramaniam, 1993). In an apparel production system, a particular operation or machine is a bottleneck when its capacity is too low to keep up with the flow of products that have to pass through it. Generally, it is the capacity of a bottleneck that determines the capacity of an entire plant. For example, a finishing department that has a maximum daily capacity of 5,000 garments determines the total daily capacity of the plant. Despite the plant's ability to sew 6,000 garments per day, the finishing department acts as a capacity constraint on the plant. Sewn products will pile up behind such a bottleneck, until more finishing capacity is added to
reduce it, or the flow of garments to the finishing department is controlled elsewhere in the process.

**Cycle time**: The relative amount of time required to design, develop, produce, transport, and sell a garment at retail. Practically, the cycle time is equal to or more than the sum of all the task times (Vonderembse & White, 1991).

**Electronic data interchange (EDI)**: An information system shared by retailers and their vendors for conducting business transactions electronically (Lewison, 1994).

**Forms of flexibility**: Behavioral activities, equipment, and techniques that are supported by an ideological strategy of responding to the needs of the market.

**Ideology**: A specific form of practical social consciousness that is materially anchored and sustained. Ideological forms of social consciousness manifest themselves as sets of values and strategies that influence social control. The productive and distributive practices of a society lie within an ideological framework of social structure (Mészáros, 1989).

**Kanban**: A manufacturing system that uses cards to indicate when more materials are needed in the production system, in order to keep a controlled level of inventory in production. Kanban is a Japanese word meaning "visible record" (Vonderembse & White, 1991).

**Lead time**: The amount of time that producers or suppliers (sellers) have from notification of an order to the actual production of the order or reception of the order by the buyer.

**Production flexibility**: The capacity of a production system to adapt to changes in the environment and changes in process requirements (Swamidass, 1988). As a global measure of the opportunity within a manufacturing system to add value to its products, flexibility permits a firm to cope with environmental uncertainty by allowing it to switch products, volumes, and parts quickly, thereby maximizing its responsiveness to market demands (Gupta & Somers, 1992). The definition of production flexibility is further developed in the Review of Literature.
Quick Response (QR): A program initiated among apparel industry members to coordinate suppliers, producers, and retailers to reduce the amount of time apparel products require from inception to final consumer sale. At the core of the apparel industry's "Quick Response" (QR) initiative is an electronic infrastructure linking retailers, manufacturers, and their suppliers with information that originates from the consumer's purchase behavior, is expanded with supplier data, and flows through the supply complex allowing preferred merchandise to be produced and delivered rapidly (Blackburn, 1991; Hunter, 1990).

Garments carry bar coded tags that are scanned at the point of sale. These data are gathered and used analytically to determine the rates and amounts of products being sold. Information from the point of sale is transmitted electronically back to producers and suppliers in order to expedite replacement inventory.

Stock keeping unit (SKU): One garment of a particular combination of style, size, and color. A category of merchandise for which separate records for stock and sales are maintained (Lewison, 1994).

Technology: "...practical implementations of intelligence" (Ferre, 1988, pp. 26). The term "implementations" implies that technologies are concretely embodied in artifacts, implements, or social organization. Technologies are practical in that they are not ends in themselves. The technology of a society reflects the knowledge of what the society's members know how to do (Ferre, 1988).

Throughput: A steady-state average output of a production system (Hopp & Simon, 1993). Some authors refer to throughput as the revenue gained from the output of a production system (Seidmann & Tenenbaum, 1994). In this study, throughput refers to the value or quantity of physical goods produced, while throughput rate refers to the time it takes to produce the goods.

Work in process: The amount of inventory that the producer has partially completed. Work in process refers to materials that are committed to production, such as cut goods or partially
sewn goods (Vonderembse & White, 1991).

Organization of the Dissertation

The dissertation is arranged as follows. Chapter two covers the review of literature according to the three constructs of the study, including a summary of the literature's contribution to the study. The third chapter describes research methods, including sampling procedure, data collection, and data analysis. It also introduces support for the qualitative methods and emergent design. Results are developed in the fourth chapter as analysis of the original data. An examination of the issues surrounding the research questions and their foundational constructs is made. Further conceptual analysis based on emergent themes provides a relational model grounded in the data. The fifth chapter summarizes the study as it traces the implications of the work. Limitations of the investigation evolve into recommendations for further research. References are listed in alphabetical order at the end, while the appendices contain data collection instruments and coding guides.
Despite the recent development of a substantial body of academic literature on flexibility in manufacturing industries, academic studies of flexibility specific to apparel and related soft goods production are still limited. Organizational and technological innovations in apparel production have been dominant issues in the apparel trade press. Through anecdotal accounts of successful firms, as well as advice from industry consultants, the trade press has attempted to educate industry managers about production flexibility. Apparel research facilities that are funded by educational institutions, government, and private industry are progressive in their technical studies of flexible improvements in production processes. Consequently, their research offers some quantitative evidence of the benefits of flexibility. All of these sources contribute to the growing body of knowledge on flexibility in apparel production.

Three bodies of literature are examined here. They can be categorized as: 1) generic manufacturing studies on strategic flexibility; 2) apparel trade press articles; and 3) technical research papers on apparel production. These categories of literature are cross-reviewed according to the three constructs of this study: the ideology of flexibility, the behavioral and technological forms of flexibility, and the barriers to flexibility. Constructs are reviewed as they relate to flexibility in manufacturing in general, and apparel production firms specifically.

Within and across these bodies of literature, there are subtle but comprehensive issues of corporate culture, shifting strategic paradigms, and conflicting related ideologies. The three principal bodies of literature outlined above are founded theoretically in a range of scholarly literature that addresses these issues. In order to gather and interpret the range of flexibility literature into a meaningful synthesis for this study, contemporary management literature on these comprehensive issues is reviewed within specific sections where its theoretical support
is most influential.

Because a large body of highly technical literature on hard goods flexible manufacturing systems, robotics, and microprocessor controlled production operations exists in a variety of engineering and production journals, their contribution to this study and to this review of literature was considered but omitted. These works address what is specifically known as flexible manufacturing systems (FMS), characterized by a group of flexible machine tools connected to a material handling system (Gunasekaran, Martikainen, & Yli-Olli, 1993). FMS production systems differ from labor intensive manufacturing systems, such as those of apparel, in that there are not operators for every machine, and set-up and operations are performed by robots or by the machines themselves. The key differences are in automated material handling and multi-skilled labor that supervises equipment rather than performs individual operations (Gunasekaran, et al., 1993; Kaighobadi & Venkatesh, 1994; Mair, 1994). With the exception of a few FMS works that have direct implications for this study, that body of literature is not reviewed here. Its technical concentration and hard goods orientation are not related to the essential human themes and the soft goods focus of this study.

The review of literature is divided into sections according to the three research constructs. Because definitional ambiguity about apparel manufacturing has developed, the use of the terms contractor, producer, or manufacturer depends on the author’s reference throughout the review. The literature is then summarized for its contribution to the study.

**Ideology of Flexibility**

Literature encompassing the construct of flexibility as an ideology focuses on a recent range of work in operations management, strategic management, economics, and organizational theory. The research agenda on the ideology of flexibility covers three broad categories in the business literature: quantitative measurements and predictive models of
flexibility, taxonomies of flexibility forms, and financial valuation of flexibility (Sethi & Sethi, 1990). In addition to its definitions and dimensions, the ideology of flexibility includes its role in the firm and industry culture, its theoretical perspectives, and its competition with other dominant ideologies, such as productivity, quality, and profit. Strategic management literature offers theoretical support for flexibility from several perspectives: organizational theories, options theories, and economic theories. These avenues of literature are traced from the practical to the theoretical, and begin with a variety of definitions and dimensions of flexibility.

**Definitions of flexibility**

**Flexibility as strategy** The concept of flexibility is captured within a larger construct of strategy. Strategy is defined as "...actions or patterns of actions intended for the attainment of goals." (Swamidass & Newell, 1987, pp. 509). The hierarchical view of strategy refers to three levels: 1) corporate strategy addresses the selected industries, product markets, and resource allocation; 2) business strategy lies within a multi-business corporation and is designed to maximize each firm's ability to compete with its distinctive competencies; and 3) manufacturing strategy involves a functional area of the firm that maximizes its competencies while capturing corporate and business level missions (Hofer & Schendel, 1978; Swamidass & Newell, 1987). Effectively using manufacturing strengths to achieve business goals and to contribute to long-term growth is the expected outcome of manufacturing strategy (Wheelwright & Clark, 1992). Flexibility is now being recognized as one of the most significant dimensions of manufacturing strategy (de Groote, 1994).

In their review of empirical manufacturing strategy studies, Minor, Hensley, and Wood (1994) found that manufacturing strategy is most effective when it is coordinated with and supported by business level strategy. A longitudinal study of three firms' manufacturing strategies found two significant reasons for strategically adopting a flexible manufacturing system. The first reason was that the distinction of the firm's image in the eyes of its
customers was important. The second reason was the need to increase manufacturing capacity (Meredith & Vineyard, 1993).

The scope of flexibility is very broad. Total flexibility has been defined as "... a global measure of the opportunity of a manufacturing system to add value to its products." (Gupta & Somers, 1992, p. 168). Faced with growing imports, American industries are creating more flexible production processes as competitive strategy. Increased adaptability allows them to offer a wide range of products to meet the needs of specific market niches while being geographically closer to their markets than foreign producers (Gerwin, 1993). Flexible production capacity may be held in reserve, as in the case of military apparel contractors or seasonal market demands. Surge capacity, for example, is maintained for national emergencies when contractors must dramatically increase production (Defense Logistics Agency, 1992; Gerwin, 1993).

Most research on flexibility in manufacturing has applied to operational decisions related to production planning, scheduling, control, and investment in advanced manufacturing technology. Ownership of strategic options is a recurring concept in flexibility research. Flexibility permits a firm to cope with environmental uncertainty by allowing it to switch products, volumes, and parts quickly, thereby maximizing its responsiveness to market demands (deGroote, 1994).

Gerwin (1993) proposed a strategic model that holds environmental uncertainty as one of five variables (see Figure 1.). The other variables include manufacturing strategy, methods for delivering flexibility, required manufacturing flexibility, and performance measurement. Paths of the Gerwin model reveal the generic strategy of adaptation as the firm's behavior moves defensively from uncertainty into strategy, on to flexibility and beyond. Implicit in the framework is an expanded definition of flexibility as an investment that creates options for a manufacturing firm to use either defensively or offensively.
Flexibility as adaptive response Because definitions are dependent on context and purpose (Ferre, 1988), researchers have conceptualized production flexibility as an adaptive response to environmental uncertainty (Gerwin, 1993; Gupta & Goyal, 1989). Manufacturing flexibility refers to the capacity of a production system to adapt to changes in the environment and changes in process requirements (Swamidass, 1988). Flexibility has also been defined "... as a hedge against the diversity of the environment." (de Groote, 1994, p. 933).

Environmental uncertainty is itself a complex construct comprised of the firm's internal disturbances and external forces. Internal variations include problems such as equipment breakdowns, supply shortages, variable task times, and queuing delays. External forces are the current and potential probabilities that variations may exist in levels of demand, prices, product mix, and availability of materials. External uncertainty can arise from the actions of competitors, government regulations, consumer preferences, and technological innovations (Sethi & Sethi, 1990).

A recent paper by Nayyar and Bantel (1994) extends the importance of decision speed and
develops it with the concept of competitive variety. This distinctive competence is referred to as competitive agility. Firms that face multiple environmental conditions find competitive value in rapid decision-making as well as implementation speeds, thereby making them more "agile". Because uncertainties may be current or potential, they exist for levels of product demand, prices, product variety, or availability of resources. Technological advances and actions of competitors are also uncertainties that carry unknown probabilities (Sethi & Sethi, 1990). The time required to decide what to do is as essential an element of flexibility as is the time required to do it (Nayyar & Bantel, 1994). Issues of organizational structure, communications, and functional specialization also arise from the speed/variety imperatives.

**Dimensions of flexibility**

Dimensions of flexibility in manufacturing have been identified through literature reviews as well as through empirical studies. As a way of conceptualizing different types of flexibility, dimensions can be very specific, or very general. This section covers literature on the specific dimensions of flexibility, such as product mix flexibility. Globally, other ways to think about dimensions of flexibility include static and dynamic flexibilities, flexibility as dynamic efficiency, and the complexity of flexibility. These general conceptualizations follow the specific dimensions of flexibility.

**Specific dimensions of flexibility** Flexibility dimensions add definitional clarification and are especially relevant to apparel production. These behavioral dimensions are responses to specific strategic objectives that are in turn based on types of uncertainty. The purpose of Table 1 is to show the wide variety of flexibility dimensions that have been developed in the literature. The chronological order of their appearances in publications is indicated. Some authors have gathered dimensions from across other studies. Redundancy of dimensions is evident. For example, the concept of volume flexibility is present in four of the models, but it is definitionally the same as the output flexibility concept studied by Fiegenbaum and Karnani (1991). As the dimensions of flexibility were refined over time, Gerwin (1993)
Table 1. Dimensions of flexibility identified in the literature

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Action flexibility</td>
<td>Output flexibility</td>
</tr>
<tr>
<td>Adaptation flexibility</td>
<td>Gupta &amp; Somers (1992)</td>
</tr>
<tr>
<td>Application flexibility</td>
<td>Expansion/market flexibility</td>
</tr>
<tr>
<td>Assembly system flexibility</td>
<td>Material handling flexibility</td>
</tr>
<tr>
<td>Demand flexibility</td>
<td>Routing flexibility</td>
</tr>
<tr>
<td>Design flexibility</td>
<td>Machine flexibility</td>
</tr>
<tr>
<td>Dispatch flexibility</td>
<td>Market flexibility</td>
</tr>
<tr>
<td>Job flexibility</td>
<td>Product/production flexibility</td>
</tr>
<tr>
<td>Machine flexibility</td>
<td>Process flexibility</td>
</tr>
<tr>
<td>Machining flexibility</td>
<td>Programming flexibility</td>
</tr>
<tr>
<td>Material flexibility</td>
<td>Volume flexibility</td>
</tr>
<tr>
<td>Mix flexibility</td>
<td>Gerwin (1993)</td>
</tr>
<tr>
<td>Modification flexibility</td>
<td>Mix (product variety) flexibility</td>
</tr>
<tr>
<td>Process flexibility</td>
<td>Changeover flexibility</td>
</tr>
<tr>
<td>Program flexibility</td>
<td>Modification flexibility</td>
</tr>
<tr>
<td>Product flexibility</td>
<td>Volume flexibility</td>
</tr>
<tr>
<td>Production flexibility</td>
<td>Rerouting flexibility</td>
</tr>
<tr>
<td>Routing flexibility</td>
<td></td>
</tr>
<tr>
<td>State flexibility</td>
<td>Material flexibility</td>
</tr>
<tr>
<td>Volume flexibility</td>
<td></td>
</tr>
</tbody>
</table>

grouped them into more abstract and inclusive concepts. Within Gerwin's concept of mix flexibility are captured many of Swamidass' (1988) terms that had appeared in operations management literature. Gerwin's (1993) model of the dimensions of flexibility offers the most concise and holistic framework.

Sethi and Sethi's (1990) flexibility constructs were built from literature that had accumulated over twenty years and were developed to encompass most of the definitional and conceptual ambiguity in the literature. Examples of these constructs include machine flexibility that describes the variety of operations machines can perform within cost and
setup constraints, *expansion flexibility* as the effort needed to increase capacity, and *market flexibility* that depends on the ease with which a production system can adapt to a changing environment.

Gupta and Somers' (1992) dimensions are empirically derived and accommodate the redundancy among studies. The value of their work lies in the development of the instrument itself. A comprehensive instrument was constructed from the accumulated literature on manufacturing flexibility, tested, and analyzed with multivariate methods. The reliability of this 21-item instrument is high enough to indicate that the items perform well in capturing the constructs of flexibility.

The conceptual model of flexibility proposed by Gerwin (1993) includes six dimensions of manufacturing flexibility: mix, changeover, modification, volume, rerouting, and material. These dimensions apply at levels within the activity process, such as at the machine level, the cellular level, the plant level, and the multi-plant level (Swamidass, 1988). Furthermore, each dimension of flexibility possesses a scope of range and time (Slack, 1988). Production systems are more flexible if they can manufacture a wider range of goods or a greater range of volumes. The amount of time it takes a firm to produce goods or to change production within its range is also critical to flexibility (Gerwin, 1993).

*Mix flexibility* refers to the strategic objective of product diversity, as it encompasses the range of product line and variations within those product lines. The temporal aspect of mix flexibility involves speed of setups to produce the increased range of products and their variants. *Changeover flexibility* is essentially product innovation through the firm's ability to change products as the markets determine product life cycles. The range aspect of changeover involves the number of major design changes, while the temporal aspect refers to the period of time from design to production startup. *Modification flexibility* refers to responsiveness to customer requirements through accommodation of minor design changes in products, by number and by rate. *Volume flexibility* involves increases or decreases in
production volume levels throughout the range of products and time obligations. *Rerouting flexibility* focuses on process flow and machine downtime with consideration of the number of options for rerouting and amount of time rerouting requires. Last, *material flexibility* is the ability of a manufacturer to accommodate variations in materials in terms of number of variations and how much time is required to deal with them (Gerwin, 1993).

**Static and dynamic flexibility** The United States is experiencing a fundamental change in its industrial sector. Reorganization of traditional production with a focus on manufacturing skills will determine the transition (Cohen & Zysman, 1987). Cohen and Zysman (1987, pp. 88) define a transition as "... a period of uncertain and unstable parameters linking two phases with stable parameters..." Manufacturing flexibility is the "slogan of that transition" (Cohen & Zysman, 1987, pp. 130). Within that transition is a distinction between static and dynamic flexibility. The distinction between the two forms of flexibility is critical, not the differences in techniques used to achieve the flexibilities (Cohen & Zysman, 1987).

*Static flexibility* is the ability of a producer to adjust its operations to changing conditions in the market, such as rising or falling demand or the mix of products (Cohen & Zysman, 1987). This adjustment occurs within fixed product types and production structure. Static flexibility implies the firm's ability to change its strategic direction, level of production, product line composition, labor variables, wages, work organization, or many other things (Cohen & Zysman, 1987). Static flexibility forms include many of the dimensions of flexibility identified by previously reviewed authors within specific contexts. Techniques to achieve static flexibility may be technological, political, or organizational. Examples include adopting new machinery, renegotiating with unions to reduce job categories, or develop a network of subcontractors (Cohen & Zysman, 1987).

In contrast, *dynamic flexibility* goes beyond static flexibility in that it becomes the long term capacity to develop production innovation that steadily improves productivity. Many
strategic decisions that seem flexible do not fall into the definition of dynamic flexibility. For example, offshore sourcing is very common in the apparel industry, as manufacturers seek lower wage production (Mytelka, 1991). However, moving production offshore rather than developing the skills of domestic workers to steadily improve the production process would not be considered a dynamic flexible strategy according to the definitions of Cohen and Zysman (1987). Their persuasive rhetoric cautions U.S. manufacturers:

A strategy of trying to hold onto the high value-added activities while subcontracting production to foreign producers who have a manufacturing edge defines the fast track to disaster. Over time, American firms will not be able to control what they cannot produce. The only viable strategy for American firms is to combine advanced technology with high-skilled labor and innovative management to create high-wage, high-productivity, flexible production capabilities. (Cohen & Zysman, 1987, pp. 261)

Let us summarize our position as a simple proposition. Lose control of the manufacturing or production process of your product and you risk losing control of both the technology and the final markets. (Cohen & Zysman, 1987, pp. 129)

The basis of competitive advantage in apparel and footwear in the past depended heavily on inexpensive labor (Cohen & Zysman, 1987). When U.S. companies have been threatened by competitors producing low cost goods with inexpensive foreign labor, they have sometimes been able to transform a labor-intensive process into one that is more technology and capital intensive (Cohen & Zysman, 1987). Competition under mass production systems focused on price. However, competition under "flexibilism" focuses on customization, quality, and price (Goss & Knudsen, 1994).

Dynamic flexibility requires changing production capacities and technologies over the long-term. However, innovative transitions must also be efficient, in order to improve performance. What internal capacities firms have that allow them to efficiently change is considered in the next section.
**Flexibility as dynamic efficiency**  

The dramatic changes in technology and markets that have occurred in manufacturing industries can cause abrupt and irreversible shifts in the market positions of individual firms. Established positions in traditional markets do not ensure for a firm the capacity to change. Skills required for success in one set of technologies may not be useful in a new set of technologies. Because static efficiency is the ability to profit from stable conditions, the apparel production sector in the U.S. benefited for years from static efficiency. On the other hand, dynamic efficiency is the capacity to adapt to changing circumstances (Cohen & Zysman, 1987). A number of research centers representing the apparel industry are focusing their work on the development of adaptable capacity in order to achieve dynamic efficiency.

A research program sponsored by the Defense Logistics Agency to improve apparel production technology is addressing the industry's need for dynamic efficiency. Technology is being developed to advance the industry from the production of ready-to-wear garments sized according to standard anthropometric data, to the production of made-to-measure garments that use body scanning technology for individual consumers. This program also seeks to advance production from traditional methods to computer integrated manufacturing that use product representation standards in communicating requirements. Ultimately, the program's goal is to move the industry toward integrated enterprises where all aspects of apparel product life cycle are coordinated through a framework of standards, practices, and supporting technology (Defense Logistics Agency, 1992; Moncarz & Lee, 1993).

**Complexity of flexibility**  

Operationalizing flexibility has been difficult because the domain of flexibility has not been established. Some measures based on the characteristics of manufacturing processes have not captured the complexity of flexibility (Slack, 1988). Gerwin (1993) asserts that applied investigations of flexibility will be hampered without valid and reliable measures, and that operationalizing flexibility is the most important research priority. Quantitative investigations have suffered from industry specificity,
restrictive assumptions, and significant limitations.

Dixon (1991) addressed the multidimensional concept of flexibility in the textile industry. By developing a measure that supported the inclusion of firm size, structure, and technology, he proposed a general model of flexibility. Another instrument for measuring and analyzing manufacturing flexibility was developed by Gupta and Somers (1992). In a survey of senior executives of manufacturing firms, 21 items representing nine principal components were identified as valid and reliable measures of flexibility. As a framework for development and testing of hypothetical flexibility relationships, this model is the most comprehensive.

In another review of literature on flexible manufacturing systems, the complexity of interrelationships between flexibility dimensions and various characteristics of production systems is salient (Gunasekaran, et al., 1993). Swamidass & Newell (1987) concluded from an empirical study of 35 manufacturers that regardless of the production process used, the greater the flexibility of that process, the better the firm's growth performance. Furthermore, the study concluded that the role of manufacturing managers in strategic decision making was a function of environmental uncertainty. Firms whose manufacturing managers were highly involved strategically, performed better.

A proposed path analytic model that emphasized the sequential, non-linear relationships among four constructs was deduced from manufacturing literature and tested. These constructs included: 1) manufacturing flexibility; 2) perceived environmental uncertainty; 3) economic performance; and 4) the role of managers in strategic decision making. The authors recognized that these four constructs represented an underlying structure of many other variables such as industry type, process, size, structure, and technology (Swamidass & Newell, 1987, pp. 513).
Management systems

Strategy and environmental adaptation are major themes in the ideology of flexibility. In order to better understand the ideology of flexibility within the context of manufacturing firms, it is useful to address the ways that people think about manufacturing firms, and how these firms have developed over time. The next section covers literature related to metaphorical perceptions of manufacturing firms. They include mechanistic management systems, organic management systems, and organizations as cultural systems. This literature serves as a frame of reference for the ideological development of the apparel industry. Additionally, the metaphorical descriptions of organizations lend some understanding to the subsequent theories of production flexibility.

Mechanistic management systems

As organizations are forced to adapt to technical and commercial changes, the mechanistic management systems that were appropriate for the stable conditions of the past evolve toward an "organic" form of organization (Burns & Stalker, 1961). Mechanistic systems are characterized by the following: 1) hierarchical structure of authority, communication, and control, with exclusive knowledge anchored at the top of the hierarchy for centralized decision making; 2) differentiation of specialized tasks into functional roles with precise definitions of the rights, obligations, and technical methods that are attached to those functional roles; 3) working behavior governed by decisions that are communicated vertically from superiors to subordinates, with required loyalty and obedience; and 4) a greater respect for the prestige and importance of local, internal knowledge, skills, and experience than for general knowledge and education (Burns & Stalker, 1961).

The mechanistic form is essentially a framework of two principles: definition and dependence. All behavior is conceived and carried out according to the structure of the organization. Individuals work for the organization and struggle to carry out their assigned tasks within and across the functional barriers. Tasks and jobs are neatly defined so that individuals know what they do not have to know or do, as much as they know what their
precise duties are. The more job definition is developed by management, the more omniscient managers seem. No one is overburdened with undelegated responsibility, so that all separate functions are connected to defined roles that extend through the hierarchy of superiors and subordinates (Burns & Stalker, 1961). Mass production manufacturers have thrived in environments of low uncertainty by assuming bureaucratic, mechanistic structures (Nemetz & Frye, 1988).

A recent case study of an American tailored apparel producer detailed these mechanistic characteristics and the internal conflicts that environmental changes were inducing. Major retail customers insisted on production quality. Despite a newly professed managerial commitment to both product and production quality, retained beliefs of maximizing output at individual operations remained the dominant imperative. Bureaucratic structures could not be overcome by operators and supervisors who were struggling to control variation both within the process and within the materials. Consequently, high quality failure characterized the outcome of a new quality commitment (Scheller, 1993).

After studying the construction industry, Stinchcombe (1959) asserted that under conditions of economic uncertainty and technological variability, craft administration is a more rational form of production than a bureaucratic form because it requires less capital, thereby reducing overhead. Craft production is the type of administration that dominates industries producing individual products through specialized knowledge. On the other hand, bureaucratic administrative forms in manufacturing are characterized by mass production, with a routinization of both the work and the product. In traditional trades, individual craftsmen were guided in their production decisions by a collective cultural knowledge—a combination of ideology and behavioral techniques. However, in mass production, jobs have been fragmented and specialized so that individual workers do not have a wide enough knowledge base to make decisions. Instead, many decisions are made bureaucratically through collective knowledge in the form of procedures or regulations. Kusterer (1978)
found in his studies of factory workers that limited craft production forms existed within bureaucratic factories. Management directives may have specified production goals and deadlines, but the procedures for accomplishing the production were left up to the workers. In another example, new employees were trained by existing employees, but management did not specify how that training had to be done. It is evident in these cases that micromanagement of tasks by bureaucratic directives is not functionally practical, and that craft forms within bureaucracies may be valuable.

**Cognitive structures of managers** Manufacturing firms in the U.S. are still dominated by a scientific management tradition that influences the design of production activities. This notion holds people within the organization as being unpredictable creators of mistakes. The workforce was considered a source of problems, not as a source for problem solving. Given the inherent instability in factory production, the traditional managerial response has been to integrate people out of the production process by breaking down the system into the smallest possible parts and creating a bureaucracy to manage the parts (Alic, 1993).

Larger firms in the apparel industry have been characterized by hierarchical leadership structures. Leaders in such structures acquire dominating positions that can suppress the flow of ideas. One of the reasons that teamwork structures are replacing hierarchical structures in manufacturing industries is that managers see the need for an increase in the involvement of more people within the organization (Mueller, 1994). Senior managers play an integrative role in the management team. In a study that linked dimensions of the scope of firms with the cognitive complexity of their senior managers, Calori, Johnson, and Sarnin (1994), showed the importance of a two-fold analysis. Chief executive officers (CEOs) of multinational firms were found to have complex understandings of the structures of their industries. Different from the dimension of the geographic scope of their industries, was the understanding of the dynamics of their industries, especially through links with foreign parent companies. The study demonstrated that senior managers have cognitive complexity
that parallels the complexity of the business environments their firms operate within.

Ganz (1981) asserts that the processes of creation, diffusion, and utilization of knowledge within an organization depend upon the extent to which the organization's structure is subject to reform. Social change and technical change are integrated in complex ways within organizations (Ganz, 1981). With higher levels of automation, fewer people who are more skilled are required in the workforce, in order to solve complex problems in the factory (Alic, 1993). Manufacturing firms that have adopted teamwork structures to better utilize knowledge have been forced to accommodate their new objectives through their existing structural and historical constraints (Mueller, 1994).

**Organic management systems** In contrast to the mechanistic form, organic forms are working organizations where individuals work with the organization to serve the general aim of the firm. As polar opposites of mechanistic structures, organic forms of organizations are able to adapt to changing conditions because of their inherent characteristics: 1) a network structure of control, authority, and lateral communication with pockets of specialized knowledge and expertise that contribute to the common goals and team commitments; 2) continuous adjustment and redefinition of individual tasks through consultations with other people and communication that consists of information and advice rather than directives and decisions; 3) technical or commercial knowledge located anywhere in the network; and 4) creation of value through affiliations and technical expertise that are external to the organization (Burns & Stalker, 1961).

Even though organic systems are not hierarchical, they remain stratified. Authority is owned by those who demonstrate expertise and capability, while the location of authority is settled by consensus. Individuals within organic organizational structures have heavier demands placed on them because their jobs are not self-contained and precisely defined. They have to continuously participate with others through appropriate language and activities that are meaningful to everyone. Furthermore, there is less definition in status roles and
modes of communication. The greater the extent and rate of change the organization is experiencing, the more the activities of members become determined by the real tasks and needs of the firm, rather than by routines and instructional policies (Burns & Stalker, 1961). Studies done by Woodward (1965) showed that mass production firms manufactured large volumes of standardized products in highly mechanistic, organizational structures, and that organizational structure was more organic for firms that produced a wider range of goods.

Shepard (1956) addressed the radical differences between "Scientific Management" and the emerging forms of industrial organizations that made more optimal use of human resources:

The central emphases in this development are as follows:
1. Wide participation in decision-making, rather than centralized decision-making.
2. The face-to-face group, rather than the individual, as the basic unit of organization.
3. Mutual confidence, rather than authority, the integrative force in organization.
4. The supervisor as the agent for maintaining intragroup and intergroup communication, rather than as the agent of higher authority.
5. Growth of members of the organization to greater responsibility, rather than external control of the member's performance or their tasks. (Shepard, 1956, pp. 125)

Nearly forty years later, these are the essential changes that have been taking place in American manufacturing organizations. Because these two forms of organizational systems represent a polarity, many intermediate stages between them are represented in organizations. The relationship between the mechanistic form and the organic form is elastic so that firms can operate with management systems that have elements of both forms for varying environmental conditions (Burns & Stalker, 1961).

Organizations as cultures Smircich (1983a) shows how current themes in organization and management research were derived from anthropological concepts of culture, as well as from concepts in organizational theory. Smircich examined five viable modes of organizational research that portray culture. Culture is represented as either a dependent
variable, an independent variable, or as a root metaphor for conceptualizing the organization. The latter promotes a view of organizations as "...expressive forms, manifestations of human consciousness" (Smircich, 1983a, pp. 347). Culture as a root metaphor extends the instrumental view of organizations as mechanistic entities comprised of functional specializations. The root metaphor view also extends beyond the adaptive view that represents organizations as organisms with adaptive capabilities. The research agenda supported by culture as a root metaphor conceives organizations in terms of their expressive, ideational, and symbolic aspects, not in solely economic or material terms (Smircich, 1983b).

Viewing apparel production organizations as knowledge systems necessitates the assumption that thought is related to behavior. If organizations rest in a system of meaning, then they do not depend on bureaucratic rules and structures (Morgan, 1986). Many organizational problems are embedded in the thinking of their members. A close relationship between thoughts and actions allows for the creation of new ways of organizing (Morgan, 1986). Although the focus in the culture metaphor is on language, symbols, rituals, and so forth, these are not perceived as cultural artifacts. Instead, they are perceived as "...generative processes that yield and shape meanings and that are fundamental to the very existence of organization" (Smircich, 1983a, pp. 353).

Schein (1985) outlined common meanings of organizational culture found in the literature. These meanings that guide organizations focus on observed behaviors, norms, dominant values, philosophies, rules, and the organizations' interpersonal climate. As reflections of organizational culture, these meanings do not define culture. Instead, Schein defines organizational culture as:

...a pattern of basic assumptions-invented, discovered, or developed by a given group as it learns to cope with its problems of external adaptation and internal integration-that has worked well enough to be considered valid, and therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems. (Schein, 1985, pp. 8)

One of the strengths of viewing the organization as a cultural or multicultural system is
that it reveals the shared interpretive schemes that create and recreate meanings. This ability supports the creation of organized action and change by influencing the language, norms, ceremonies, and other social practices that transmit ideology. Ideologies, beliefs, and values guide action. In the past, managers have seen themselves performing rational duties of designing organizational structures and job descriptions. Through the coordination of business activities in functional departments and development of schemes to motivate employees, managers have operated through patterns of authority in established hierarchies. The advent of corporate cultural control as a managerial duty allows managers to see themselves as symbolic actors who have the roles of fostering desirable patterns of meaning in their organizations. That culture can be manipulated in an instrumental way reflects a mechanistic pattern of thinking about organizations (Morgan, 1986).

In an analysis of organizational culture, Baligh (1994) proposed a theory on the goodness and badness of "fit" between structural components and cultural components. Organizational cultures that value groups over individuals, and believe that cooperation is more efficient in achieving organizational goals, have different structures for effective performance than competitive, individualistic cultures. Cultures that promote teamwork and cooperative harmony have a high level of participation by members in making comprehensive decision rules. Furthermore, these cultures reward individuals based on group performance.

In a broad review of corporate culture literature, Willmott (1993) asserts that the phenomenon of corporate "culturism" (the perception of managerial cultural control in an organization) relates historically to the adoption of more flexible forms of business. Popular philosophies such as Total Quality Management (TQM) have been addressed in management literature for many years. Common to these programs is the expansion of the autonomy of workers that forces them to commit to "... a monolithic structure of feeling and thought" (Willmott, 1993, pp. 517). Employees within strong corporate cultures are encouraged to devote themselves to the values and ideologies of the firm, and to assess their worth to the
firm accordingly. Willmott asserts that the crafting of corporate culture extends the self-
direction and self-control of Theory Y (McGregor, 1960) to produce a distinctive philosophy
and form of management control. By seeking to construct consensus within the firm,
corporations manage the process through which employees acquire values.

**Implications of corporate culture control.** Willmott (1993) argues that the implications
of corporate cultural control are profound. Employees are selected through specific hiring
practices and promoted through the perceived acceptance of the firm's core values. Mere
compliance is insufficient, because corporations expect more than operant conditioning of
behavior. The homogenization of values and norms within the organization denies the
development of conditions in which critical reflection is fostered. By eliminating pluralism
and the associated conflict of values its diversity brings, a monocultural environment is
created. Suppressing the indeterminacy and ambivalence of individuals robs them of the
ability to question or think critically about the organization. Therefore, the normative
framework of the organization creates a firm that is lacking in the capacity for internal
change. Even when employees avoid deep identification with corporate values by behaving
with calculated compliance, they remain unable to alter the managerial control that extends
into the affective domain of workers (Willmott, 1993). The cultural metaphor of
organizations thus exposes a reinterpretation of traditional managerial processes and
behavioral concepts (Morgan, 1986).

**Ideological development of the apparel industry**

As the mass production system of apparel manufacturing developed, a conventional
wisdom about how the system best functioned, using machines and labor, developed along
with it. Studying the relationships between the conventional wisdom of apparel managers
and operators and the paradigm shift toward more flexible forms of production raises some
theoretical issues. The following section describes literature related to the ideological
development of the apparel industry through the cognitive structures of managers.
Ideology and manufacturing  Ideology is described by Mészáros (1989) as a specific form of practical social consciousness that is materially anchored and sustained. Various ideological forms of social consciousness manifest themselves as rival sets of strategies and values that may result in social control. Any society's productive and distributive practices lie within a regulatory framework of social structure. Because of the antagonistic nature of social structure, ideologies are conflictual. The radical questions that social conflicts invite challenge the continual imposition of formerly viable modes of production and distribution. Therefore, the changing character of society's productive and distributive practices follows the course of historical development (Mészáros, 1989). The development of a specific type of mentality over time is an inherent part of any social system (Auerbach, 1988).

North Americans value probabilistic thinking with trial and error learning. Analysis is oriented toward problem solving, with a tendency to discover simple causes, preferably those that are economic or technical. Technical decision makers use information as an abstract commodity that parallels money. The group decision maker sacrifices the powerful influence of information to the demanding social network of the group. These problem solving approaches are contained within the concepts of time and future states, so that action is designed to affect the future (Stewart, 1983). Innovations arise from the interaction of three factors: market demands, needs of buyers and sellers in the market, and technical advances (Cohen & Zysman, 1987).

Apparel production can be viewed as a transformation process—raw materials are transformed into finished garments in economical periods of time. In cultures where material goods are highly valued, people will seek transformation processes that produce the greatest output in the least amount of time. These cultures perceive of time as "monochronic" (Baligh, 1994, pp. 22), or one-dimensional. This perception of time encourages them to maintain high levels of control over transformation processes. Baligh believes that there is a cultural tendency to protect processes, even when they are inefficient. In his words..."If the
transformation process itself is also highly valued in a culture, then people in the culture may not seek to change the process even if they also value more output to less" (Baligh, 1994, pp. 22).

Over the past century, American apparel producers have primarily used one type of transformation process-the bundle system. Despite changing environmental conditions and strong industry initiatives toward more flexible systems over the past decade, approximately 90% of American apparel firms continue to produce with a bundle system and piece-rate compensation (Hill, 1992a). Because adoption of flexible technologies among apparel producers has been so limited in comparison to other manufacturing industries, the value that apparel producers place on the transformation process itself may be an important issue.

Value in the traditional progressive bundle system has been supported by a product costing technique that allocated overhead costs to each garment according to the amount of labor time in the garment. Time efficiencies within the transformation process operations were thought to reflect lower product costs and consequently, greater profit margins. Costs were believed to be "managed" by reducing the amount of labor time. These costing beliefs have been valued by managers and incorporated into the training and rewards that operators received. However, newer cost accounting techniques that assess resource management instead of cost management reveal that the allocation of overhead to labor time offers a distorted view of actual product costs. Even so, in the traditional assembly line method, performance measures were and continue to be part of the belief system about how garments are best manufactured (Gardiner, Blackstone, & Gardiner, 1994; Scheller, 1993).

**Taylorism and production ideologies** The historical development of the U.S. apparel industry through the twentieth century has its ideological roots in the influences of Taylorism and practices of early assembly line manufacturers. In the early twentieth century, Frederick Taylor (1992) believed that the elements of scientific management had evolved through industrial practices of deliberate increases in output per worker. To Taylor, scientific
management was a complete mental revolution that required a long period of time to develop in a manufacturing organization.

Taylor's four principles of scientific management are as follows. The first principle involved the gathering of all the knowledge that was in the heads of the workers, recording and tabulating it, and reducing it to rules, laws and mathematical formulas. This mass of traditional knowledge that the workers had was reflected in their behavior on the job, and it was believed that it could be captured by motion and time studies, which were thought to be truly scientific. The second principle involved the careful and "scientific" selection of workers by studying them, profiling them, and choosing those with the most productive characteristics. The third principle focused on training workers to understand the science of production and offer them intangibles such as better treatment or opportunities to express their needs freely, as well as higher pay, in trade for their work motivation and increased output. The fourth principle represented a division of work that divided all tasks into those of management and production. Formerly, many managerial duties were performed by workers. Taylor thought that teamwork and cooperative democracy among managers and workers would create a mutual interdependence that would prevent labor strikes, as long as management shared the profits from increased productivity with the workers (Taylor, 1992).

Critics of Taylor's theory thought the scientific management system would make workers into machines and rob them of initiative (Braverman, 1974). In response to criticism, Taylor defended his principles with the metaphor of the surgeon. The modern (1916) surgeon was compared to a finer mechanic, combining manual dexterity with a great knowledge of implements, materials, and techniques. Surgeons in training were taught the current state of the art, learned to master it, but were also encouraged to push the field further by showing initiative and developing new techniques. This form of training workers by teaching them to build on their knowledge was central to Taylor's theory. All workers could propose process improvements; those proposals would be tested, and the workers would be rewarded if their
ideas were successful. Finally, Taylor believed that progress in manufacturing came through workers, and that the four principles of scientific management actually created worker initiative (Taylor, 1992). Much of Taylor's philosophy mirrors that of G. Edward Deming. Later in the twentieth century, Deming promoted the use of statistical process control and ongoing process improvement through worker contributions as the most effective methods for reducing variation in manufacturing processes (Evans & Lindsay, 1989).

Many writers of manufacturing studies refer to the ills of the modern factory as being caused by Taylorism. Review of Taylor's speeches and writings reveal that his theories promoted productive manufacturing organizations that were positivistic in their use of experimental methods and data collection, but more naturalistic in their training, communications, and democratic forms. Taylor's principles of organizing work for better productivity encouraged the development of new technologies. In other words, Frederick Taylor did not promote the mechanistic, bureaucratic structures that many U.S. manufacturing organizations have evolved into. Models of bureaucratic behavior feature the use of general and impersonal rules, ineffective organizational learning, decreased visibility of powerful managers, high levels of interpersonal tension and conflicts, as well as intense supervision as a function of authoritarianism (March & Simon, 1992).

According to Burns and Stalker (1961), there is no optimal type of management system. Rather, systems develop appropriately according to their specific sets of conditions. Bureaucratic structures have been effective under certain conditions. For example, a productivity transformation that perpetuated the viability of a bureaucratic structure occurred in the British shoe industry nearly forty years ago. Shoe companies were concerned with maximizing return on their invested capital by attempting to make more shoes per employee and per square foot of factory space. Although shoes had been made by a craft type of production, they were produced faster by dramatically reducing the labor content in each pair. For example, in 1957, Clark's factory made women's fashion shoes in Plymouth,
England. At that time, the average length of time it took to manufacture a pair of women’s fashion shoes was 19 days. Within a year, Clark’s had reduced the production time to three days. Each job was broken down into the smallest possible self-contained operation. Specialized tasks proved to be advantageous to efficient production (Hudson, 1978).

Bureaucratic forms also have disadvantages. Reeves’ (1970) descriptive study of a British clothing factory found fragmented bureaucratic control that resulted in conflicts between time in production and quality objectives. Control mechanisms that governed the rate of production conflicted with those governing the sequence of production. The monitoring of the production process was found to be much less effective than the monitoring of the production output. Production quantity imperatives reigned over quality imperatives because of the importance of meeting deliveries on time.

Patriarchy and production ideologies Batch production firms differ from firms with unit production or continuous flow processes in their product standardization, organizational structures and behavior (Reeves, 1970; Woodward, 1970). Apparel production is a form of batch production and it remains dominated by female operators pushing fabric through sewing machines. Apparel firms continue to have mass production characteristics such as separation between managers and operators, gender role typing, and patriarchal structures (Bailey, 1993; Scheller, 1993).

Patriarchal theory represented society and organizations within it as an enlargement of the family form. The father, or patriarch, was thought to be the authority and protector of the family, so that members of the family naturally submitted to his power. Rights and status were bestowed within the family, while inheritance and descent passed exclusively through men. This perceived structure extended into politics, businesses and other institutions. Its principles are being challenged by contemporary theorists (Coward, 1983).

The apparel industry’s success emerged from the production of mass-produced garments for a large domestic market using a largely female, low-wage workforce and strong
patriarchal structure. Managers in the apparel industry believed that efficiency in production came from engineering the process and controlling sewing operators' time by breaking down jobs into minute tasks that took only seconds to perform. Styles changed slowly for many commodity type articles, such as jeans, underwear, and men's shirts. The design of factories reflected the mass production method, with most plants dedicated to producing only one type of product (Bailey, 1993; Schoer & Ziemke, 1994).

Competitive advantages, such as those of economies of scale in manufacturing, that are suddenly lost in particular industries can render the accumulated mastery of manufacturing techniques obsolete (Cohen & Zysman, 1987). Now that changes in the markets are reducing the demand for mass-produced garments in large volumes, apparel producers are faced with fundamental changes in their organizations that are essentially ideological. The mechanistic bureaucracies do not easily accommodate changing conditions, so innovative apparel organizations are transforming their organizational structures, behaviors, and ideologies (Bailey, 1993; Burns & Stalker, 1961; Schoer & Ziemke, 1994).

Because combinations of mechanistic and organic forms can exist within the same organization, the perception of manufacturing organizations as either mechanistic, organic, or cultural systems may be too simplistic. The cultural system is inherent in both mechanistic and organic types of organizations. The literature devotes enough explanation of the metaphorical views of organizations that support an understanding of flexibility as an ability to change in form, ideology, and behavior. The next section assesses the theoretical models of flexibility that approach these types of changes.

**Perspectives of production flexibility: Options, economic, and manufacturing theories**

Because flexibility is an emerging phenomenon in research literature, only a few theories related to flexibility in manufacturing have been developed. The following section describes a useful framework for production flexibility constructs, wherein, no particular organizational form is assumed. Related works in options theories, economic theories, and manufacturing
models lend some theoretical support to flexibility. No theories of transition or of flexibility within apparel production firms were found in the literature.

Theoretical framework of flexibility in production deGroote (1994) proposed a useful theoretical framework of flexibility in production processes. Three concepts were derived from generic properties shared by the models of flexibility proposed in the literature: flexibility as a property of technologies, diversity, and performance criteria. The first concept is that of flexibility. As a hedge against uncertainty, flexibility is considered a property of technologies. Technology is defined in this framework as "... any aspect of a firm's production resources, control procedures, and overall strategy" (deGroote, 1994, pp. 934). Flexibilities are compared by strategists and by those managing production between sets of technologies.

The second concept is that of diversity. Diversity is a property of environments in which technologies are operated. In this sense, diversity refers to general notions of variety, complexity, or variability. Diversity may refer to variability in market conditions. This could include variation from seasonal or fashionable apparel production or variable raw material prices. Flexibility and diversity are two complementary properties. Therefore, the more diverse the environment, the more flexibility is required to cope with that environment.

The third concept is a performance criterion for evaluation of differing technologies in different environments. A given technology would be considered more flexible than another if an increase in environmental diversity produced a more desirable change in performance than would have been produced with a different technology under the same conditions (deGroote, 1994). For example, in apparel manufacturing, unit production is considered more flexible than a progressive bundle system, because it reduces cycle time and the amount of capital tied up in materials inventory. Cycle times are so much shorter that the performance criteria of cash flow and profitability are more desirable.

In review, the essential elements of deGroote's (1994) framework are flexibilities as
technologies, diversity as a property of environments, and performance criteria for the
evaluation of technologies in a variety of environments. The distinction between the two
complementary properties of flexibility and diversity is the inherent principle of the
framework.

By characterizing flexibility in this way, deGroote developed three strategic properties
related to distinct optimization problems. The first problem is that of allocation of
environments to technologies, as illustrated by a multi-product apparel producer that allocates
different parts of its product line to different plants or different sub-contractors. Apparel
products are variable components of demand, and they have to be allocated to appropriate
technologies (i.e.; plants with necessary capacities, certain types of equipment, sub­
contractors, operators with specific skills, etc.). Given this problem of allocating two
different environments to two different technologies, the overall performance of the system is
better if the more diverse environment (e.g., apparel product line) is allocated to the more
flexible technology.

The second problem reflects the design of optimal technology for a given environment.
As an operations strategy, the theory proposes that an increase in the diversity of the
environment (e.g.; increased variation in demands made by retail customers on apparel
producers) makes it more desirable to choose a more flexible technology. An example may
be that of a large discount retailer requiring an apparel producer to install an EDI system for
communications and inventory control. The producer is concomitantly facing demands by
other retail customers to install similar systems. Therefore, it is in the producer's best interest
to select an EDI system that is flexible and capable enough to accommodate all of its retail
customers, rather than separate systems that are dedicated to single customers.

The third strategic property of this framework is related to the influential force that the
firm exerts on the environments in which its technologies operate. As a problem in
managing the interface between the firm's strategy and its operations, options are created.
For example, a change in the delivery strategy of an apparel producer that guarantees 24 hour turn around on an order to its retail customers would have a major impact on the performance capabilities of various technological choices in production. In this scenario, the firm may have to dramatically change its information, production, and delivery structures (i.e.; its technologies) to more flexible forms. Thus, an increase in the flexibility of these technologies makes them more attractive to operate in more diverse environments. Consequently, the firm can seek more diversity in its environment (e.g., more variability in its product line or more customers) because it has established more flexible technologies (deGroeote, 1994). Some firms have failed in this regard. Studies have demonstrated that flexible manufacturing systems within U.S. firms are underutilized because the subsequent strategic opportunities flexibility offers are not realized.

Performance criteria of particular flexible technologies depend on the relevant notions of environmental diversity and appropriate evaluation techniques (deGroote, 1994). Traditional cost accounting and capital budgeting methods have failed to capture many of the benefits of flexibility. Such intangible benefits include increased employee morale, better quality, reduced work-in-process inventories, reduced floor space, faster response to market demand shifts, and longer use of equipment over generations of product changes (Laengle, Griffen, & Griffen, 1994).

**Options theories** These theories are categorized as options theories because they involve choices between a variety of options. Options theories presented here include the decisions between exploration and exploitation, decisions among sets of flexibilities, decisions that are economically based, decisions within queuing networks, and decisions that are behaviorally based.

**Exploration vs. exploitation.** The attention and resources of organizations are divided between two kinds of activities: exploration and exploitation. Exploration is the search for and pursuit of new knowledge, while exploitation is the use and development of knowledge.
the organization already has (March, 1991). The basic challenge of a firm is to maintain a balance between exploration and exploitation. Sufficient exploitation is necessary to insure the firm current viability; on the other hand, sufficient exploration is needed to insure future viability (Levinthal & March, 1993).

**Flexibility as decisions.** Jones and Ostroy (1984) have developed a sequential decision model that suggests the following: The more variable a decision maker's beliefs about the future, the more flexible position the decision maker will choose. Decisions between short-term investments that leave future options open and long-term investments that hinder those options are dependent on the amount of variability the decision maker's beliefs about the future have. The less confident decision maker is faced with more uncertainty, and greater risk in future commitment. Investment in capital resources, such as plant capacity, is a decision that could deliver more flexibility for future production. However, if the investment in plant capacity is made under the conditions of uncertainty (more variability of beliefs about the future), then the decision toward such an illiquid capital investment may be one that surrenders cash to inflexibility.

A strategic options "bundle" framework has been proposed as a set of feasible choices a firm can make in its response to uncertainties (Sanchez, 1993). Consisting of product options, timing options, and implementation options, this set of choices can define any type of flexibility a firm could select. The framework captures choices the firm makes about which products it should develop, produce and market. Also, when the firm should develop, produce and market its product is integrated with how the firm chooses to organize or implement its development, production, distribution, and marketing of those selected products. For example, firms choose between assets and technologies that impact their operational flexibilities (Sanchez, 1993).

**Economic theories** Most models intended to assess the economic benefits of flexibility are limited by their simplified assumptions. Laengle, et al. (1994), however, have proposed a
theoretical model to determine the optimal capacity level for a combination of dedicated and flexible manufacturing systems using varied and realistic assumptions. Because large apparel manufacturers today have both dedicated and flexible plants, this model is worth exploring. Assuming combinations of product demand over a fixed time horizon, their model demonstrates the economic value of expansion and product flexibility. The net present value and profits for some combinations of production systems, or for a totally flexible production system, are higher than for a dedicated, single product system (despite the higher cost of flexibility).

The historical development of flexibility is presented by Sethi and Sethi (1990) through economic, organizational, and manufacturing contexts that span about 70 years. Economic works based on decision theories and the costs of flexibility have evolved into the measurement and value of flexibility. Organizational flexibility was defined early as the ability of an organization to change without becoming severely disorganized. Related works on the changing structural forms of business organizations have evolved into studies on labor flexibility and teamwork. Manufacturing contexts have evolved from grouping machines to matching human flexibility with microprocessor technology (Sethi & Sethi, 1990).

General model of a manufacturing system Variations in the manufacturing process can be exacerbated by random orders for finished products and random arrivals of raw materials. Given the variability of demand, production capacity, and production flexibility, Courcoubetis and Weber (1994) proposed a general model of a manufacturing system as merely a number of distinct queues. Queues include orders for products, inventories of raw materials, machine parts, and subassemblies of products. Work-in-process inventories are also queues that wait for further processing. Deterministic changes in queues are made by reducing items from some queues and increasing items to other queues. Reducing items refers to the consumption of raw materials or subassemblies in the completion of finished products. Completion of finished products depends upon a stock of working knowledge
(Kusterer, 1978).

Any stock of working knowledge in a manufacturing environment can be divided into five areas: fundamental working knowledge of routine procedures, supplemental knowledge about the materials or documents that are handled, the use of equipment, the patterns of customer behavior, and the expected work-role behavior of others in the firm that the worker interacts with during the performance of the job. The degree of either routinization or specialization involved in a job is what determines the amount of working knowledge needed. Routinization refers to the degree of variation in the performance of job functions. Specialization involves the number of work functions assigned to a job. Extreme routinization of jobs occurs in mass production of identical products from materials with little variation. Specialization requires supplementary working knowledge, and thus is more creative and necessary to solve difficult problems (Kusterer, 1978).

Local efficiency measures, such as standard rates, are based on the assumption that the output of an entire production system is maximized (or its costs minimized) if the output of each resource in the process is maximized. In a progressive bundle system, production operators are usually evaluated and paid by the number of units or operations they process in a given amount of time. After a training period, operators are expected to perform to a standard, and are given a financial incentive to perform beyond that. This encourages them to maximize the output at each resource (operation) in the production process, keeping work-in-process inventories high, rather than moving to do an operation that is needed to maximize the output of the entire system (Gardiner, et al., 1994). However, some studies show that a system's productivity is not supported completely by local productivity measures (Lambrecht & Segaert, 1990).

Behavioral theory of the apparel firm A behavioral theory of the apparel firm has been proposed by Kunz (in press). This theory recognizes internal constituencies related to functional specialization in merchandising, marketing, operations, finance, and executive
management. The model interprets the roles of executive management as being that of relating to the needs of the other four constituencies in the establishment of company mission and goals, decision making, and development of business plans. Therefore, the production constituency is restricted by constraints imposed on it by the executive constituency in carrying out its functions of producing goods according to specifications and production schedules. The model accommodates the issue of organizational power by recognizing that the most powerful internal constituencies control acquisition of the most critical resources. The firm's most powerful external coalitions can control the most critical activities by influencing allocation of the firm's resources (Kunz, in press). Findings from a descriptive case study of a tailored clothing producer supported the behavioral theory of the apparel firm (Scheller, 1993).

**Other theoretical constructs related to flexibility**

The literature is not well developed on theoretical aspects of production flexibility; however, there are some other issues related to flexibility that have been described from a reasoned perspective. These include the philosophies underlying push vs. pull production systems, the role of buffers, and the costs of flexibility.

**Production systems: Push vs. pull** Control of production in a factory can be classified as either a push system or as a pull system. Push systems depend on information flowing from the beginning of the production process. Demand for production originates at the raw material stage, when the materials are ready to enter the process. Each operation or stage in the production process is activated by the completion of the operation that precedes it, so that work is essentially pushed through the process (Takahashi, Hiraki, & Soshirodas, 1994). Push type production systems are dependent on product demand forecasts and have dominated the apparel industry.

Many manufacturers adopted medium level production control systems that monitored and scheduled the raw material resources. Known as material requirements planning (MRP),
current research is demonstrating that MRP leads to high inventory and poor lead time performance if forecasting error exists (Chang & Yih, 1994). The flexibility of MRP type ordering systems can be quantified. Differences in production ordering systems affect qualitative as well as quantitative influences of change in production systems. Under some conditions, pull type production ordering systems are more flexible than are push type systems. However, a simulation study demonstrated that the influences of downtime fluctuation makes a push-type production ordering system more flexible than a pull-type system (Takahashi, et al., 1994).

Pull-type production systems calculate production order on the basis of feedback information and the actual production quantity of the succeeding operation or stage in the production process (Takahashi, et al., 1994). Demand originates at the end of the production process, so that information flows from the end to the beginning. Kanban and just-in-time (JIT) are types of production information and control techniques that provide discipline to pull-type production systems. A kanban is a card that indicates job type and quantities of parts. The information helps materials to flow through the production process while keeping inventory as low as possible. These systems have worked well in repetitive processes that function with stable demand, but dynamic environments reveal their limitations.

With variations in product demand and processing times, it is difficult to design a master schedule that can manage the flow of materials in a dynamic environment like that of apparel production. Even though the kanban is a simple and effective method for implementation of a JIT plan, it is designed for environments with stable demand, low changeover, reliable production processes, and sufficient excess capacity (Mitwashi & Askin, 1994). Chang and Yih (1994) have proposed modifications to a generic kanban system that can be adapted for use in dynamic manufacturing environments.

**The role of buffers** Buffers exist primarily to protect the manufacturing core from uncertainty (Gardiner, et al., 1994). Buffers may include inventories, quoted lead times, and
excess capacity cushions (Newman, Hanna, & Maffei, 1993). Inventory buffers serve to protect a production system from delays. Larger inventory buffers provide more protection, but also cause long lead times and high work-in-process (Gardiner, et al., 1994). By insulating the production process from the implications of external uncertainties with buffers, manufacturers have been able to respond to increasing uncertainty without assuming the costs of increasing flexibility (Newman, et al., 1993).

Production systems such as kanban and drum-buffer-rope (DBR) are "pull" production processes that keep a fixed level of inventory in the system. In a DBR system, the system's constraint determines the pace of production. In terms of a popular "theory of constraints" (Gardiner, et al., 1994, p. 13), a constraint may be a machine, a department, a raw material resource, or even the market. The constraint has two protective buffers: one is the material buffer in front of it to protect it from upstream disruptions, and the other is the space beyond the constraint to protect it from downstream disruptions. Materials for another product are released into the system only when a completed product is shipped. In the kanban system, each operator has a small buffer of inventory. Kanban work stations are blocked from receiving more inventory until its buffer is depleted and it is ready for reorder. Lambrecht & Segaert (1990) showed that an assembly line generated more output using a DBR process than one using a kanban process. Other industries have reported dramatic increases in production by moving from kanban to DBR (Gardiner, et al., 1994).

**Costs of flexibility in production** Manufacturing firms are investing in technologies that are flexible in order to enlarge the scope of their capabilities. Flexible factories are more costly than dedicated factories, because meeting market demand for a varied product mix with shorter lead times requires different resources than traditional mass production plants required. Capital intensive technologies involve substantial investment. Even though firms are shifting away from economies of scale in production and toward economies of scope, technology choices and capacity expansion decisions continue to be determined by
economies of scale criteria. Li and Tirupati (1994) have proposed a model to help managers make decisions on appropriate mixes of flexible and dedicated capacity that takes into account variables appropriate to flexibility.

Training costs for flexible production are a recurrent issue. Cross training operators for production modules leads to inevitable inefficiencies in some operations. Labor flexibility is the ability of workers to transfer from one work center to another. Because workers are not equally efficient at every work center, Bobrowski and Park (1993) developed a rule model of how to assign labor to work centers when differences in worker skill exist. However, the premise of this type of model is consistent with a basic assumption of traditional apparel production: that speed of production is the goal and that efficiency of an entire system is earned through optimizing the performance of each task in isolation (Alic, 1993).

Speed in production is not always beneficial. There may be significant costs associated with completing an order before the customer is ready to take delivery. Costs of finishing an order early include time value of materials inventory as well as storage and related costs. Ideally, materials are released into the production system in time for finished orders to be shipped when the customer expects them (Gardiner, et al., 1994).

**Summary of ideology**

This section has covered literature related to the understanding of flexibility as an ideological construct. Ideology has been defined, while its role in the development of manufacturing organizations has been considered through metaphorical management systems. The contrasts between inflexible organizational structures and the mental models of managers that support those structures are salient. Descriptions and definitions of manufacturing flexibility are numerous, but few specific theories relating to flexibility as an ideology in production have been developed. Theoretical and anecdotal support for the activities related to flexible behaviors in manufacturing firms exist. The following section describes the flexible activities of manufacturers and apparel producers.
Behavioral and Technological Forms of Flexibility

Behavioral and technological forms of flexibility involve activities and technologies that apparel producers select as they seek to decrease production cycle time and increase the range of products. A variety of approaches to flexibility have emerged in recent years as a response to changes in the environment. This section will focus on behavioral and technological innovations in the organization of apparel production and techniques related to flexible forms.

Innovations in the coordination of apparel production

Innovations in the organization of production is one of the primary flexible strategies of the apparel industry (Bailey, 1993; Mytelka, 1991). Apparel production activities consist of pre-assembly processes, assembly processes, and post-assembly activities related to warehousing and distribution. A useful framework for analysis of production activities related to flexibility is offered by Taplin (1994). Changes that producers have made in response to competitive pressures are of three types: changes in pre-assembly, changes in assembly, and changes in the structural organization of the work process.

Changes in pre-assembly stages

Within the past ten years, the pre-assembly stage of production has seen advances in computerized technology for product design, pattern grading, pattern marking, and fabric cutting (Mytelka, 1991). These tools have helped producers respond more quickly to shifting market conditions while reducing costs and improving quality (Alic, 1993). Integration of the four processes of design, grading, marking, and cutting has resulted in dramatic reductions in both the labor and the time needed to perform them. Improved fabric utilization has reduced materials costs (Mytelka, 1991).

Considerable time reductions have been gained through the adoption of computer-aided design and marking systems (CAD/CAM) (Hoffman & Rush, 1988). These systems allow for the development of larger collections and more frequent seasonal selections. Designers
use CAD/CAM systems for drawing new designs on video screens, as well as recalling former designs that have been stored electronically. Alterations in designs are easily made. Fabric swatches or existing hard copy patterns can be scanned into the system, so designs can be viewed in full scale and color. The grading and marking of patterns that used to take several days now takes only minutes or hours. Design software allows communication of pattern marking to computerized cutters (Schoer & Ziemke, 1994). In larger firms, high-speed, computerized cutting has outpaced the capacity of the slower assembly process in materials handling (Taplin, 1994).

The knowledge embedded in this electronic equipment and in the software that is required to operate it has altered the level of international apparel competition from one based mostly on price to one based on both innovation and price. These technologies also create higher entry barriers, primarily in the forms of more capital and skill, especially for producers in newly industrialized countries (Mytelka, 1991). The skill requirements for running and integrating this equipment are changing from low to high skill. What used to require knowledge in mechanical and electrical engineering fields is now requiring technical knowledge related to electronics, programming, and systems design. Because these skills are not widely available, there may be a "technological capabilities" barrier to entry in newly industrialized countries (Alcorta, 1994, pp. 765). U.S. apparel companies face this difficulty in Latin America and the Caribbean where they are taking aggressive approaches to adopt sophisticated production equipment for their "807" operations (Black & Cedrone, 1994).

Changes in the assembly process Because fabric handling has been difficult to mechanize, advancements in the assembly process have focused on incremental improvements in sewing machines (Taplin, 1994). Sewing machine efficiencies have been improved by mechanically activated thread trimming attachments, needle positioners, stackers, and air lifts. During the 1980s, sewing equipment was developed that manipulated garment pieces while they were being sewn. These machines can handle a wide variety of
fabrics, styles, and sizes (Seiling & Curtin, 1988).

Common sewing machines have been upgraded with digital attachments such as stitch counters and stitch type variation capabilities (Schoer & Ziemke, 1994). Belt loop attachers, seamers, pocket setters, and buttonhole and button sewers have contributed to increasing the productivity of the assembly process. Innovations in fusing, pressing, and finishing equipment with microprocessor controls and automatic unloading have also introduced technical changes to the assembly process. However, highly specialized equipment that requires large volume production for investment justification can be inflexible in its limited task range and product specificity (Hoffman & Rush, 1988; Seiling & Curtin, 1988).

Computerized tracking systems, known as electronic point-of-entry systems (EPOS), track garments throughout the assembly and shipping process (Taplin, 1994). Retailers involved in Quick Response partnerships with producers are expecting product bar coding and advance ship notices to extend further with sophisticated identification technology. For example, an emerging technology to track inventory is radio frequency (RF) units that are laser scanners. Through the capability of reading bar codes anywhere in a plant, paperwork, data entry, and downloading batches of information is eliminated (Cedrone, 1994, June). Taplin (1994) notes that tracking systems also have the capability of monitoring assembly operators.

Changes in the organization of the production process As the industry begins to move away from the progressive bundle system for mass production, it is adopting two general types of production technologies: unit production and modular manufacturing.

Unit production Although theoretically similar to progressive bundle systems, computer controlled unit production systems (UPS) offer a variety of advantages. Cut garment parts are attached to hangers on an overhead conveyor that routes garments in "bundles" of one to individual sewing operators. In many cases, the garment parts to be sewed for a particular operation do not have to be removed from the carrier when the operator receives it. The task is performed, and the operator touches a switch that sends the hanger away. Another hanger
is then routed to that operator. The reduction in handling and bundling time allows dramatically faster throughput time.

The throughput of a particular style may be completed in several hours or less than one day, depending on the number of workstations, the complexity of the garment, and the volume of the order. Shorter throughput time allows the system to handle rapid style changes. More than one style can be in production at a given time, because each hanger containing garment parts can be routed differently. Managers can track each garment, plan the sequence of garment orders, and monitor the work of every operator (Bailey, 1993). Through computerized collection of up-to-the minute data on operator performance, the system can display payroll information to each operator, who is usually paid on a piece-rate incentive basis.

Hill (1992b) provides extensive detail on UPS in a comparison study with the progressive bundle systems. Reduction in direct labor content occurred from the elimination of bundle handling and clerical tasks associated with piecework tickets. The increase in the number of garments produced per hour rose by an average of 18.4%. Direct labor excesses included overtime, operator make-up, and repair costs. These were reduced using UPS by an average of 33.8%. Total cycle time was reduced from an average of 14.9 days to 5.9 days. Defects were reduced by 11%, and it was thought that the hung garments needed less inspection cleaning and pressing than did garments produced in bundles. Although no methodology for this study is explicit, a variety of other advantages were reported. Plants using the UPS were thought to have fewer claims for back injuries related to bundle handling, increased operator earnings, and narrower floor space requirements.

Besides reduced throughput time, UPS offers a significant reduction in work in process inventory and improved cash flow, which helps to justify the high cost of initial investment in the system. However, with limited space for inventory buffers, balancing the flow of garments through unit production systems has been a challenge when variations, such as
machine failures or slower operators, occur. Bailey (1993) reported that a UPS operation in his study was most successful as a fast throughput, mass production technique for standardized styles in children's sleepwear. In the same firm, style variations in women's sleepwear caused operator dissatisfaction from having to shift stations often due to line balancing difficulties on the UPS. In a study of North Carolina apparel producers, Taplin (1993) included four firms that had experimented with UPS systems, but abandoned them because they were unable to manage the flow efficiently. Bailey (1993) notes that the limitations of unit production systems include operator isolation, repetitive tasks, mechanical pacing of the assembly line, and piece rate incentive compensation.

**Modular manufacturing** The modular manufacturing concept is a form of organizational innovation that has been borrowed from techniques used in Japanese automobile manufacturing. Modular production systems require the management of material flow so that work-in-process inventory is kept to a minimum. Small teams of cross-trained operators are organized with a set of dedicated equipment to assemble an entire garment together. Bundles of garment parts are brought to the module stations, where each operator moves between several machines and hands completed work off to the next operator (Taplin, 1994). Many variations of this system have been reported, including the Toyota Sewn Products Management System (Schroer, Wang, & Ziemke, 1991), and sit-down modules with small bundles of inventory.

Team members usually receive special training to handle communications, conflicts, goal setting, and quality control. Pay of individual operators within the group is usually based on the output of the entire group. In a manufacturing sense, teams are defined as a group of people (perhaps 8-15) who is responsible for producing a defined output while rotating from job to job "under a flexible allocation of tasks" (Mueller, 1994, pp. 383-384). Important to the concept of work teams is the team's fulfillment of tasks that were formerly supervisory in nature. Decision making, training, maintenance, scheduling, and personnel tasks are falling
under the responsibility of teams.

There are quantifiable disadvantages associated with adopting teamwork, such as the costs of training team members, decreased production during the training period, and the requirements for new facilities, or greater space and equipment (Mueller, 1994). A study of teamwork among clothing producers in The Netherlands found four major disadvantages during the process of adopting team manufacturing: initial resistance to change on the part of operators and managers, investment in more equipment, investment in time and deliberation to adapt the company structure, and a lack of an adaptable wage system (Peeters, 1993).

Compensation of team members has been another difficult hurdle for apparel producers. Former bundle operators were paid on a piece-rate basis, with superior operators enjoying relatively high earnings. Conflicts arise when operators who earned high wages in a bundle system are transferred to a modular system and essentially take a reduction in pay because the team is usually rewarded as a group, and the group is comprised of some less-skilled operators (Hill, 1992a). Production quotas may be established by management, or by the experienced teams themselves. Workers in the team are usually paid a base rate for completing the quota production, with an incentive bonus for exceeding the quota on quality production (Taplin, 1994). Variations of team-based compensation systems are being developed (Hill, 1992a).

Literature on teamwork and group development strategies is growing; however, not much research has been done on the internal dynamics of team member behavior. The two major obstacles to the effectiveness of teams are in the provision of expertise to teams when they need it, and the requirement for a common language among team members who have an inconsistent and specialized knowledge base (Meyer, 1994). In one survey, teams reported that the three main advantages to teamwork were improved team involvement and performance, positive morale, and a sense of ownership and commitment to the organization (Kulisch & Banner, 1993). Hill's (1992a) study of modular apparel production found similar
reports of increased operator job satisfaction as well as improvement in production quality. Also, throughput time, space utilization, and employee turnover were reduced, while morale, attendance, and productivity were improved.

Discrepancies between the qualitative and quantitative results on the advantages of teams was the main finding in Bursic's (1992) study of various types of manufacturing firms. This study sought to identify which factors contributed to the successful use of teams in manufacturing as well as what value the teams provided. Interview data indicated that employees involved in teams perceived improvements in organizational performance, especially productivity and production quality. However, the quantitative data analysis did not indicate strong relationships nor potential causality between time and productivity or quality. Contingency tests failed to show a relationship between employee motivation, decision making, and job satisfaction, and the employees' participation in teams. Although job satisfaction and motivation among team members was high, statistical evidence from standard measuring instruments did not support that teams had a direct effect on these variables. The researcher pointed out that the literature offers many accounts of the advantages of teams in manufacturing, but little empirical evidence over the long term (Bursic, 1992). Spender (1993) has found that one of the most important advantages of teams is that they develop a body of hidden knowledge that cannot be easily detected nor can it be imitated. Because operators have knowledge that managers do not, that knowledge may be out of reach to those outside the team, and the value of it not quantifiable.

The literature does not offer survey data on the adoption and diffusion of team technologies in manufacturing industries. Business trade publications have focused on teamwork in the automobile industry, including the extension of teamwork into product development. It is not known how widespread the use of teams in manufacturing is. For example, Tunc and Gupta (1993) found in a large survey of manufacturers in Indiana that product quality was the most important competitive priority, not time or flexibility. Flexible
manufacturing system adoption was low among respondents in that study.

In practice, group technologies in manufacturing have a great deal of variation, such as in labor and machine selection for each group. This makes the systematic comparative evaluation of group technology impossible. Many researchers have selected simulated modeling techniques that are able to manipulate variables for predicting production system behavior (Aurrecoechea, Busby, Nimmons, & Williams, 1994). In one such model, plants that have both traditional production systems and cellular manufacturing systems (hybrid factories) did not always perform better. These authors concluded that group technology was not necessarily the best method to cope with bottlenecks or improve productivity. They pointed to the value of assessment that considers product selection, capacity allocations, demand conditions, and the impact of the non-group production system in the same plant. Of greatest importance was the conclusion that measuring the effectiveness of single cells (groups) in themselves does not account for the impact on the entire plant (Burgess, Morgan, & Vollman, 1993).

In a simulation experiment that compared machine arrangement strategies for a cellular (group technology) layout and a process layout, batch size emerged as an important factor in determining total run times, fixed move times, average waiting times, and the number of required setups. Process layout did not prove itself to be superior to cellular layout in some parameters. Use of group technology provided shorter setup times, smaller batches, and shorter queues, but serious flow problems resulted from unavailability of dedicated machines. The significance of this study was that producers face a trade off between the cellular technology's lower setup, move, and run times against higher waiting times (Flynn & Jacobs, 1987).

Other techniques related to flexibility in production Other techniques of flexibility that are evident in the literature relate to specific tasks, such as production scheduling, just-in-time techniques, training, machine layout in production plants, and global sourcing.
Because manufacturing facilities are often in a transient state, there is a growing use of simulated modeling. Rapid analysis of many scenarios with predictions of outcomes is possible by manipulating the program variables. Queuing network model software is being used in manufacturing industries to provide reliable statistical analysis of work-in-process, machine utilization, and flow time for scheduling (Jackman & Johnson, 1993).

Neural networks for scheduling. Demand for apparel products cannot always be met immediately. Problems in the production process, such as equipment failures, material shortages, and abrupt demand changes prevent a balanced flow throughout a plant (Han & McGinnis, 1989). Production planning determines the ways that production resources are used. To allow for flexibility and responsiveness to problems as they arise, production scheduling must be essentially dynamic in nature (Levin, Fielding, & Ackhurst, 1993).

Development of production scheduling methods that can maximize throughput and reduce product lead time have focused on constraints and variables such as due dates of orders, machine requirements, and workload distribution. These considerations are the result of expert strategic decisions relating to production, demands in the market, or inventory management. Expert knowledge about production scheduling is accumulated during work experience. However, questions have been raised about the ability of human schedulers to consistently synthesize the complexities of interactions among variables in a dynamic manufacturing environment (Sim, Yeo, & Lee, 1994).

An emerging technique that combines expert knowledge of the production process with an artificial intelligence system of variables that influence scheduling in dynamic production systems is known as a neural network. The learning capability of the neural network has potential for adaptive and reactive scheduling to meet variations in demand (Sim, Yeo, & Lee, 1994). Artificial intelligence systems designed to capture human expertise and solve problems in defined domains are expected to play an increasing role in the future improvement of manufacturing productivity (Wong, Chong, & Park, 1994).
Just-in-time Numerous suppliers and manufacturing firms have implemented a pull-type control system known as just-in-time (JIT). The objective of JIT is to create a balanced flow of material through a manufacturing process by avoiding queues and intermediate buffers. The principles behind JIT are to eliminate waste and to fully utilize the capabilities of people, equipment, materials, and parts (Davy, White, Merritt, & Gritzmacber, 1992). Because the suppliers in a JIT system are located outside the assembly plants, close relationships between suppliers and manufacturers are critical to the success of the system. The suppliers must be able to provide the buyers (manufacturers) with frequent deliveries of small quantities of quality products that have delivery schedules directly tied to the production schedule of the buyer. JIT systems are designed to eliminate waste in all forms, so manufacturers have reduced inventory costs, reduced need for storage, and shorter lead times on supply orders (Karlsson & Norr, 1994). Suppliers are responsible for allocating their resources so they can service the demand. Ideally, manufacturers will provide their suppliers with a container supply schedule, so that suppliers can optimize their resources and the manufacturer will not suffer supply disruptions (Pleschberger & Hitomi, 1993).

Theoretical support for JIT can be found in an empirically derived model proposed by Davy, et al. (1992). Inputs include holistic aspects of work culture, design, supply, and customer demand. Implementation constructs involve operating structure and control, product scheduling, and quality implementation. Two output constructs are quality products and timeliness matched to demand. Unique to this model is the significance of decentralized control in decision making and the required philosophy within the organization to support employee involvement. The model also incorporates a systems perspective on management of the input and output dimensions, requiring JIT to be managed as an open system in which all of the input constructs are integrated (Davy, et al., 1992).

Activity-based product costing Determining the actual cost of producing an apparel product has been based on traditional cost accounting methods. Some apparel firms are
changing their costing systems to more accurately reflect product costs. The activity-based product cost approach identifies all significant activities involved in producing a product, including support activities. Costs are traced through the activities, and include those of research and development and manufacturing engineering. A product cost then becomes a sum of all of its traceable activity costs involved in designing, procuring materials, manufacturing, and distributing the product (Brimson, 1991). Apparel firms are adopting this costing technique because it more accurately measures the performance value of flexible production than does the traditional costing method that allocates overhead as a percentage of labor.

Training The importance of training the apparel workforce for flexibility in production has received some attention in the trade press. Many anecdotal accounts of apparel firms that have innovated their processes reflect the emphasis on employee training (International Apparel Research Conference Proceedings, 1994). However, structure and content of these training programs has not been emphasized. In some firms, the highly repetitive manual tasks of a progressive bundle system are being replaced with broader jobs. Modular manufacturing, especially, requires more worker responsibility.

Cognitive-oriented task components such as production scheduling, machine maintenance, process control decisions, and task assignments are the elements of new jobs that apparel workers are being trained to perform. Because knowledge structures determine cognitive performance, training directed toward knowledge structure development impacts the performance of cognitive oriented tasks (Koubeck, Clarkston, & Calvez, 1994). Snell & Dean (1992) studied the relationships between integrated manufacturing techniques similar to those being used in the apparel industry and human resource management practices. Findings suggest that human and technical systems are being managed not as separate entities, but in concert. Their study raises many issues relating to employee training, upskilling, and measuring performance improvement in flexible systems.
Uncertainty about how to improve productivity and flexibility by capitalizing on the knowledge structures that existing industrial workers already have is apparent. In an experimental study to examine the effects of training on the development of manufacturing workers' knowledge structures, Koubek, et al. (1994) found interesting relationships among training materials, their order of presentation, and cognitive performance. The group of workers that had initial presentation of highly abstract training material followed by detailed material showed significant improvement along two dimensions of knowledge structure: hierarchical levels and conceptual relations.

Other issues related to training have been addressed. Labor productivity growth increased significantly in manufacturing industries when businesses that were operating below their expected labor productivity levels implemented training programs (Bartel, 1994). Production feedback as a form of training was provided to experimental groups of operators performing industrial tasks. No simple relationship existed between productivity and worker satisfaction. Workers were found to have different degrees of interest in performing tasks, but interest was not correlated with production quantity or the quality of output. It was proposed that the relationship between satisfaction and performance was affected by individual differences in values (Das & Mital, 1994). Similar conclusions about satisfaction and productivity in repetitive manufacturing were reached by Ruch and Hershauer (1974).

**Machine layout flexibility** Machine layout in a production facility is an important variable that impacts the costs and time of material handling, throughput, and productivity. Some of the flexibilities within a production process may be diluted with an ineffective machine layout. Layout flexibility is the capability of the machine arrangement to be adapted to changes in product mix, demand, volume, and routing, with the objective of maximizing the production rate. In designing machine layouts, factors that should be considered include the number and locations of input/output work stations, the impact of bypassed equipment, as well as machine utilization and capabilities (Hassan, 1994).
**Global sourcing and multinational networks**  Manufacturers in the U.S. have become increasingly dependent on global sourcing. By providing immediate cost reductions and gains in competitive advantage, outsourcing is substituting for the expensive cost structures of vertical integration (Davis, 1992). Retailers and apparel manufacturers in the U.S. import apparel primarily through licensing and contracting agreements. International contracting usually assumes one of two forms: the contractor purchases the fabric and assumes full responsibility for production, or the contractor merely assembles cut parts that have been provided (Bonacich & Waller, 1994). By taking advantage of various tax, quota, and tariff arrangements, importing firms have maximized the value of low cost production on a global scale without the investment in factories or responsibility for labor (Bonacich & Waller, 1994). Despite additional costs that are not associated with domestic sourcing, such as travel, tariffs, transportation, and brokerage fees, the trend toward global sourcing of manufactured parts and products is increasing (Handfield, 1994). European apparel firms, such as Benetton, have also grown through an integrated, international production system (Belussi, 1987).

Managers justify their dependence on global sourcing as a necessary competitive element. Overall cost reduction across all products is the primary reason for outsourcing. However, investigations into cost accounting practices and performance systems used by U.S. firms reveals that many manufacturers suffer from the inability to determine true product cost because of direct labor overhead allocation. Recent studies have shown that traditional cost accounting practices value inventory and do not accurately measure the costs of activities associated with manufacturing specific products (Davis, 1992).

Fluctuating exchange rates also have an effect on sourcing decisions, due in part, to performance measures. Despite the impact on exchange rates, Kogut and Kulatilaka (1994) note that the diffusion of new cost evaluation techniques has been slow: "The ownership of the option to shift production is of little value if the managerial information is poor, if the
incentives are tied to the wrong benchmarks, and if pricing rules do not capture the value of flexibility to manufacture at the lowest cost site" (Kogut and Kulatilaka, 1994, pp. 135). For some goods, better prices are available in reciprocity for timely delivery and prompt turnaround, thus negating the need for lower cost foreign production.

**Summary of behavioral and technological forms of flexibility**  
Most of the reforms in the organization of production have been due to the adoption of different techniques, such as modular and UPS, rather than completely new and comprehensive strategies. The absence of fundamental change in most apparel firms can be attributed to managerial traditions. Although apparel producers are clearly responding to changes in their environment, much of the response has been contained within prevailing managerialist paradigms (Bailey, 1993). This paradigm is characterized primarily by control in the forms of mechanistic processes and bureaucratic structures defined by task specialization. Until the Industrial Revolution, the craft trade was the basic unit of the labor process, where the worker was the master of knowledge and the procedures of production were left to his or her discretion. Through the evolution of manufacturing, management became the producer by planning and controlling the process that brought the product into existence (Braverman, 1974). Manufacturing forms subordinated labor to capital (Elger, 1982).

However, dramatic changes in the environment are threatening the bureaucratic structures of production. In the apparel industry, renewed interest in empowering production workers to use their knowledge and regain some control over the production process is challenged by former managerialist paradigms, including those of patriarchy and paternalism. By changing the attitudes toward apparel operators and by expanding their participation into innovative technologies, more options for flexible response can be created.

Barriers to flexibility have emerged throughout the literature on ideology and on behavioral forms of flexibility. The next section covers six categories of barriers to production flexibility that have been identified in the literature.
Barriers to Flexibility

Barriers that contribute to the slow adoption of flexible manufacturing technologies have been categorized as organizational, managerial, financial, technical, labor, and policy related (Bidanda, Cleland, & Dharwadkar, 1993). Some barriers to flexibility cannot be categorized discreetly because they are comprised of multiple sources of problems that are interdependent. Following a discussion of barriers to flexibility is a compendium of trends that represent a paradigm shift in apparel production.

Organizational and managerial barriers

Organizational and managerial barriers to flexibility are numerous and may be invisible. Included here are barriers of organizational resistance to change and failures to manage the innovation process. Also covered are organizational network barriers, attention barriers, forecast error, the neglect of informal systems, and the failure of performance measures.

Resistance to change Resistance to change within apparel companies is cited as a major barrier to the implementation of flexible production technologies (Bailey, 1994). Change involves going from the known to the unknown, and it involves some form of loss (Coghlan, 1993). Five common causes of resistance to change in organizations are: 1) lack of belief in the need for change; 2) variation in the reasons for needing change; 3) disagreement about goals for change; 4) lack of belief that goals are attainable; and 5) lack of confidence in the manager of change. Resistance to change results from differences among people or functional groups in their priorities, plans, motives, and ideas. It reveals itself through many types of behavior. Behavior that demonstrates resistance to change is as likely to be covert and unconscious, as it is to be overt and conscious (O'Connor, 1993).

An implementation model for reducing the resistance to technological change in manufacturing organizations was proposed by Endsley (1994). From the perspective of those managing the implementation process, the model offers five major stage factors that influence adjustment. The stages progress from decision and introduction to initialization,
early job experiences, and finally to institutionalization. Flexibility of both the decision
makers and the solution during these stages impacts adjustment because resistance to change
is diminished when others perceive that the change is open to reconsideration and revision.

Resistance to change has both cognitive and emotional elements. Coghlan (1993) argues
that there is a need to understand resistance from the perspective of the defender's position,
rather than from the perspective of those promoting the change. Resistance provides change
agents with important information on the content and process of change. By taking a person-
centered approach, change agents can learn from resistors and prevent denial, coercion, and
ultimately failure of the change implementation (O'Connor, 1993).

Adoption and diffusion of process innovation in American manufacturing industries has
been slow. The attitudes of managers in the U.S. have been geared toward short-term
financial gain and risk aversion, with a tendency to neglect the value of process and product
technologies as competitive weapons (Herbig & Palumbo, 1994). Difficulties arise when
there are misunderstandings or lack of agreements about what needs to change (O'Connor,
1993). For instance, American factory workers have been known to sabotage productivity
improvements that were made through automation if they feared that unemployment would
result from the substitution of technology for labor (Herbig & Palumbo, 1994).

Social systems seek ways to defend themselves against innovations. Defenders are
individuals and groups who try to protect the inner core of tradition and values. Their
importance derives from the following conditions: they perceive unanticipated consequences
of the change, they react to change that poses a threat to the integrity of the system, and they
are sensitive to indications from those who are seeking change that there is a failure to
identify with the system's core values (Klein, 1976). In a study of firms who underwent
restructuring, Young and Post (1994) found that communication processes were critical for
successful change. Managerial action emerged as an issue because it revealed implicit
messages to employees that may have been contrary to official messages conveyed by formal
Failure to manage the innovation process   Despite technical resources and skilled people, some firms fail to manage the innovation process (Webb, 1992). Innovation is described by Angle and Van de Ven (1989) as a concentrated, purposive effort to develop and implement a substantial idea that entails technical, organizational, and market uncertainty. Innovation requires a collective effort, significant resources, and a considerable duration of time. The innovation process involves three temporal stages: 1) the initiation period of planning the efforts necessary to develop the innovation; 2) the development period of concentrated effort for transformation of the idea into reality; and 3) the implementation or termination period where the innovation is either adopted and institutionalized or terminated and abandoned (Webb, 1992).

Failure to manage the innovation process is a barrier to flexibility. Four basic concepts are central to innovation processes: ideas, people, transactions, and context. Van de Ven (1986) identified that in order to manage the innovation process successfully, organizational leaders have to create an infrastructure that is conducive to organizational learning. This infrastructure defines a set of values and standards within which innovations and operations are maintained. An experimental approach helps the people in the organization to develop a capacity for learning by detecting and correcting errors. Innovation requires preserving diversity and uncertainty, not eliminating it.

Cultural conditions determine whether organizational innovation will occur. The adoption of innovative technology requires social change. In a study of technology adoption in small manufacturing firms, Harvey, Lefebvre, and Lefebvre (1992) found that firms who were successful process innovators differed from other firms. Innovation success was characterized by tighter capacity management, improved process design, better trained employees, more flexible manufacturing system, advanced product quality, and more harmonious labor relations.
Acceptance of innovations and their subsequent diffusion occurs when there is a perception of sufficient intensity of need (Herbig & Palumbo, 1994). With rising apparel import penetration and other competitive forces, the trade press has aptly written about the intensity of need for innovative change in apparel production. Many apparel firms are going through an internal examination and radical restructuring process that has been referred to as business process reengineering (Teng, Grover, & Fiedler, 1994).

Cross-functional organizational change is a radical improvement effort that is distinguished not by incremental improvements, but by dramatic changes in priorities and the methods to achieve them. Recently, flexibility has replaced cost reduction as a strategic priority of manufacturing (Dixon, Arnold, Heineke, Kim, & Mulligan, 1994). Business process reengineering (BPR) requires organizations to move from task specialization in functional hierarchical structures to the expanded use of process generalists (Teng, et al., 1994). The apparel trade press has featured anecdotal accounts of BPR in apparel firms.

Incremental process improvements can be distinguished from BPR in that they commonly involve a true strategic change in direction. Dixon, et al. (1994) refer to this phenomenon as an improvement trajectory, where people in an organization have to do things differently as well as do them in an environment where the old rules do not apply. In their study of fifteen firms that had undergone BPR, Dixon, et al. (1994) found that the change process takes time, patience, shared vision, constancy of commitment, and effective communication.

The viability of dramatic organizational innovation depends on the extent to which the organizational structure is subject to reform. Structures that are not subject to reform remain barriers to flexibility and innovation. As organizations reform themselves, the access, diffusion, and utilization of knowledge become critical factors (Ganz, 1981). Interorganizational processes and relationships affect the decisions involved in the adoption of new systems and technologies (Bobrowski & Bretschneider, 1994).
Neglect of informal systems  Adoption of innovation requires willingness to face uncertainty and take risks, a readiness to accept change, and a dynamic long-term orientation (Herbig & Palumbo, 1994). When formal systems in an organization are inadequate, informal systems of control develop over time. Because these informal systems support relationships, they can confer roles and statuses upon individuals within a firm. For example, if sewing specifications are not precise, they must be interpreted for the operators. An individual may assume the responsibility for such a task, and gain status for doing so, without any directives from a manager. Changing systems within an organization can threaten relationships that exist through informal controls, and result in resistance to change. Neglect of the existence and importance of informal systems poses a barrier to flexibility (Westbrook, 1994).

Organizational networks as barriers  A useful approach to understanding barriers to strategic change in business was proposed by Buchko (1994). Firms that operate through network relationships, such as those between raw materials suppliers and producers or between producers and retailers, develop institutionalized patterns of behavior. These patterns of behavior can become barriers to flexibility. Although the value of strategic alliances is being developed in the literature, major obstacles have also been identified that interfere with the flexibility of member firms. Such barriers involve the development of dependencies on major partners, and managerial focus on the alliance itself, thereby preventing firms from keeping in touch with their markets and other customers (Kanter, 1994; Lorange, Roos, & Brønn, 1992). The extreme demands that alliance relationships make on a firm can also conflict with the firm's investment priorities (Kanter, 1994).

Attention barriers  Restricting the flow of information between subunits in an organization results in the construction of attention barriers. Restriction of knowledge limits opportunities, activities, and hence salience of what could be critical issues. As niches are constructed by organizations through specialized capabilities and bureaucratic political
structures, mental models of the private worlds within organizations are conceptualized. Individuals and groups are then reluctant to abandon those models of organizational power and past success in favor of innovative change (Levinthal & March, 1993). Managers display mental models in the form of rigid beliefs about causal relationships. As evidence of linear thinking, a belief in unilateral causation reduces the ability to experiment. Experiments are the fundamental basis of innovation, and lead managers to discover the realities of circular causation (Grandori, 1987).

**Forecast error** Forecasting is the prediction, estimation, or projection of future events or conditions that a firm may experience. These events and conditions are beyond the firm's control, yet their prediction provides the basis for managerial planning. Forecast error or failure to seriously attend to forecasting can be significant barriers to production flexibility. Every major functional area of an organization is affected by forecasting, especially marketing, sales, and production (Herbig, Milewicz, & Golden, 1993).

Forecast accuracy contains two components: a bias component and a variability component. Bias in forecasts is revealed through the cumulative sum of errors. For example, predicting when a specific order will be finished and shipped to a customer may require many elemental and cumulative forecasts. Forecast errors have been found to increase manufacturing costs, especially in the form of buffers. Variation in forecasting depends on many variables, such as the accuracy of data, assumptions of models, and conditions in the environment. In most circumstances, forecast bias is much more critical to success and accuracy in planning, than is forecast variability (Ritzman & King, 1993).

A common belief that more accurate forecasting will lead to superior performance of a company has not been confirmed. A production facility with poorly developed lot-size parameters, for example, will not necessarily benefit from careful inventory predictions. Flexible handling of special orders in manufacturing has emerged as an interesting theme in forecasting research. Greater revenues from special orders has been thought to offset the
problems these orders create in production. However, while it is common in practice, the handling of special orders is not well addressed in the literature (Ritzman & King, 1993).

**Failure of performance measures** Process-focused multi-functional teams are improving the performance of many companies. Those organizations that have moved from control-oriented, functional hierarchies to team-based and network forms have found that traditional performance measurements systems are failing to support team effectiveness (Meyer, 1994).

For example, Hill (1992a) shows the need for apparel firms to move away from piece-rate incentive compensation to a group incentive, so that individual operators will support each other and behave according to what is best for the success of the team. Nevertheless, productivity within teams remains the key performance criterion, just as it was with individual operators. Inherent flexibilities of the team, such as skill ranges or operator contributions to the development of new products as well as the processes to manufacture those products, is not captured in a team productivity performance criterion. As long as product cost continues to be based on direct assembly labor hours, performance measurement and compensation of operators will continue to be based on the number of units assembled within a given amount of time, whether it is a modular process, a unit production process, or a progressive bundle process.

Accurate product cost data is essential to apparel producers. Product costs are required in many decisions, especially those related to price determinations, capacity planning, sourcing, and analysis of capital expenditures. Traditional accounting practices of determining the cost of an apparel product usually depends on the amount of labor in the product (Davis, 1992). First, labor and materials costs are assigned to each product. Overhead is then allocated to each product through a base rate, typically direct labor hours, materials costs, or machine time. The shortcomings of this system are that product costs are distorted because different products consume overhead resources in the organization to different degrees. Overhead,
indirect costs, and materials have become a larger percentage of product cost, while labor has become a smaller percentage. Many overhead costs are driven by diversity in products, volumes, processes, and customers (Brimonson, 1991; Johnson & Kaplan, 1987).

Efficiency addresses a production firm's ratio of inputs to outputs. However, with regard to costs, the effectiveness of the production system model is better described by the ratio of useful outputs to inputs. Efficiency in manufacturing should incorporate a measure of usefulness, such as the price that customers will pay for the output (Busby & William, 1993).

Financial and technical barriers to flexibility

Cost of flexible technology One of the major criticisms of investment in flexible technologies is that they fail to meet an acceptable short term rate of return. The cost of capital is a variable issue, while justification of the investment is difficult using traditional cost accounting methods (Bidanda, et al, 1993). Specialized equipment such as automatic pocket setters can exceed $50,000 per machine, and can be inflexible in accommodation of product changes (Schoer & Ziemke, 1994). The cost of computerized cutting technology that is integrated with design and marker making can exceed $1 million. Unit production workstations were reported by Schoer and Ziemke (1994) to cost from $4,000 to $6,000. Gerber Garment Technology, Inc. offers a unit production system with a cost that varies from $3,900 to $6,000 per station, depending on additional capabilities such as payroll processing and integration with other data processing systems (C. Newman, personal communication, March 8, 1995).

Changing to modular manufacturing in apparel production also requires increased investment. Production facilities require more equipment which is not in continuous use. Extensive training of the workforce is costly and can result in a significant loss of production during the training period (Bailey, 1993; Schoer & Ziemke, 1994). Other industries that have shifted from mass production with task dedication to multiskilling of the workforce suffered similar reorganization costs (Kaplinsky, 1994).
**Firm size**  Financial constraints of flexible innovation may be felt by smaller or less financially secure firms. Large producers are more capital-intensive than small producers because they achieve technical economies of scale by using production methods with greater capital requirements (Mills & Shumann, 1985). Larger firms have the resources to hire consultants, send staff to seminars, and have contact with other innovative firms, foreign producers, and industry organizations that offer expertise and information on new technologies (Bailey, 1993). On the other hand, small manufacturers have what Fiegenbaum and Karnani (1991) refer to as output flexibility. Small firms have many other structural advantages that allow for change.

**Labor and policy barriers to flexibility**

Labor and policy barriers to flexibility involve cultural, language, and gender differences among workers and managers. Within organizations, other labor and policy barriers include those related to labor unions, employee turnover, and absenteeism.

**Cultural, language and gender differences**  Difficulties with team organization and effectiveness have been hampered by cultural, language, and gender differences within apparel plants. Bailey's (1993) study described a production plant in the eastern part of the U.S. that had both Muslim and Hindu workers who would not speak to each other. The manager expressed his dismay at the expectation of them working together in a module.

Ethnic and gender differences between managers and operators in apparel plants continue to be sharply defined. In the vast majority of American apparel plants, managers are white males, and most operators are white or minority females (Bailey, 1993). This situation has occurred because of gender role typing in the industry. Scheller (1993) found that female operators and supervisors were convinced they did not have any advancement opportunities within their firm because of prevailing attitudes that white male managers held toward women.
Labor unions  The effects of labor unions on the apparel industry's initiative toward flexibility has not been described in the literature. However, management literature reports that labor unions and other groups can exert power over firms and may be able to erect barriers to flexibility and change (Buchko, 1994). Union membership among apparel workers is significant. Member firms of the Clothing Manufacturers Association of the United States (CMA) account for about 85% of the unionized apparel production in the U.S. The Amalgamated Clothing and Textiles Workers Union (ACTWU) represents approximately 36,000 workers in CMA plants. About 80% of tailored clothing in the U.S. is produced in the unionized sector (Abend, 1994). Differences between union and non-union producers are not known. Working conditions were found to be the same at both union and non-union plants in Schoer and Ziemke's study (1994).

Employee turnover and absenteeism  Taplin's (1994) study of apparel producers found that employee absenteeism and turnover disrupted the functioning of modular sewing teams. Annual employee turnover in some of the plants studied by Schoer and Ziemke (1994) had rates ranging from 30% to 100%. The industry continues to have a "sweatshop" image and it suffers from comparatively low wage and benefit levels in increasingly competitive labor markets. A general shortage of trained employees forces production plants to offer their own training programs, but such programs also carry high failure rates.

Standards relating to error, waste, or allowable levels of defective work can become barriers to flexibility. Bockerstette and Shell (1993) note that where policies for allowable scrap in a manufacturing process exist, scrap continues to be accepted. Likewise, when incentive rates for rework operations exist, rework continues. Because organizations have a tendency to emphasize standards, the standards can become institutionalized, thereby preventing the improvement of manufacturing processes.
Summary of barriers to flexibility

Overall, the amount of research literature on the barriers to flexibility in manufacturing is limited. Barriers are both internal and external. Internal barriers may be characteristics of the organization, while external barriers may involve environmental conditions, such as customer needs or availability of technology. Even though financial barriers are important, the major barriers to flexibility and innovation within organizations focus on people, their knowledge, and their behavior.

Organizational change literature is primarily strategic, and converges toward innovation, business process reengineering, and paradigm shifts. Issues across the literature of organizational change involve competitive forces of time, cost efficiency, and an increased focus on the value of human resources. Each of these issues is salient in the apparel trade press, as apparel firms are trying to accommodate environmental changes without investing large amounts of capital.

Moving beyond barriers: Paradigm shift in apparel manufacturing

Change in business strategy does not move linearly, nor through easily identifiable sequential phases. Strategic change is more iterative, continuous, and uncertain while it offers an organization the ability to compete within its prevailing settings. Critical to change is the reliance on two qualities: the ability to identify and understand competitive forces, and the competence in mobilizing and managing the resources necessary for the competitive response of change (Pettigrew & Whipp, 1991). Change is defined as "...an empirical observation of differences in time on one or more dimensions of an entity" (Van de Ven & Poole, 1989, pp. 32). The process of change infers a pattern of differences over time and is contained within a theory of innovation (Van de Ven & Poole, 1989).

Flexible production as a system is embedded in new forms of production organization, technology, and industry relationships (Kawano, 1993). Patterns of production change within apparel firms have focused on technology. However, between firms, radical shifts in
the organization of apparel production and distribution is focused on the nature of relationships. The apparel industry is moving away from a model of power-based relationships within and across firms, toward a network model of cooperative relationships. While the former model was characteristically hierarchical and dependency contingent, the newer model demonstrates a sense of mutual support and development within partnerships. Two powerful forces behind these changes are the importance of non-price features, such as quality, delivery, and inventory control, as well as the growing complexity of products (Bessant, 1991).

In the former mass-production model, low-cost suppliers were favored where labor was the major cost component. Now that materials make up a larger portion of product cost, and greater scope in product lines requires a wider range of raw materials, inventory management has become a source of cost containment. Focusing on quality and timely deliveries requires a different kind of relationship between buyer and seller. Inter-firm relationships also extend beyond suppliers to other areas such as design, financial services, consultancies, distribution, and marketing.

Product and product line complexity require materials, skills, production capacities, and coordination that extend beyond the abilities of most single firms. Through networking, apparel firms are extending themselves by bringing together different elements from independent specialists. As an alternative to traditional vertical and horizontal integration, networking projects flexibility in apparel production to a grand scale.

Bessant (1991) notes that the emerging networking relationships in the Italian textile and apparel industries do not repeat the historic cycle of the "putting out" system that existed before mass production. Although the putting out system was inherently flexible because of its responsiveness to fluctuations in demand and fashion, it depended on a hierarchy of control integrated into a pyramidal structure of dependency relationships. The new networks are both centralized and decentralized. Each member is dependent on the sharing of a
common information and resource system, while remaining independent in other activities. The facilitator of the network coordinates from a central position to focus resources in the system toward particular problems or needs. Rather than being power-based, the network model is essentially a set of knowledge and information-based partnerships.

The movement of apparel firms away from mass production and toward network relationships represents a paradigm shift. Paradigm shifts among scholars were first described by Kuhn (1970) as a set of beliefs, values, and practices held by a community of practitioners. Paradigms represent a perspective that is the basis of the way people view their reality (Henderson, 1991).

Paradigms are thought to function on two levels, the social level of a community, and the cognitive level of individual members of a community. Paradigms are thought to be the correct and proper way that a discipline solves its problems. Implicit in the actions of the community's members is the expectation that the prevailing paradigms will be confirmed (Rubinstein, Laughlin, & McManus, 1984).

Paradigms are believed to pass through three stages. The first stage is a period when the paradigm is accepted by the community. In apparel production, this could refer to the mass production model of bureaucratic control, task specialization and volume production. The second stage is a calm phase when problem solving activities are being carried out. In apparel production, this may be the gradual improvements in productivity that were gained within the progressive bundle system. Third, a period emerges in which an accepted paradigm becomes unstable, and alternate views are examined (Rubinstein, Laughlin, & McManus, 1984). Dramatic changes in the environmental conditions that apparel producers are confronting are forcing them to question the assumptions that underlie the progressive bundle system. Some innovative producers are now viewing their world through a new paradigm that reflects a different set of realities.

Processes underlying the function of paradigms are essentially cognitive. Fundamental
assumptions are at the core of a paradigm and influence how the members of the community view their world. Among members, logical thought rests on particular premises of a paradigm. The core premises or assumptions of paradigms are at times not subject to examination (Rubinstein, Laughlin, & McManus, 1984). Kuhn (1970) asserted that science does not progress through a gradual building of knowledge, but through periodic revolutions. A shift in the paradigm, then, is a shift in the world view and in the logic within the members of the community. The adequacy or truth of assumptions underlying the paradigm have been questioned and revealed (Rubinstein, et al., 1984).

Summary of Literature Review

The logic of mass production in apparel manufacturing is being challenged by the environmental demand for flexibility. Apparel organizations have evolved into bureaucratic forms supported by ideologies such as patriarchy, economies of scale, and task specialization. Inflexibility is the norm. The current social environment of egalitarianism, consumerism, and demand variations are not compatible with the apparel production ideologies of the past. As in other manufacturing industries, the apparel production sector is showing a trend away from mechanistic forms of organization toward organic forms characterized by sourcing and resource networks and "flatter" structures. Considering the industry's historical development, this is a difficult transition.

Flexibility literature focused specifically on apparel production is especially limited. As an emerging issue, little research has been done beyond description and technique experimentation at apparel research facilities. No research is definitive on whether flexibility is beneficial to producers according to specific conditions they operate in. Studies on the adoption and diffusion of flexible techniques throughout the American apparel industry have not been done. Many other related issues, such as the effect of NAFTA and offshore sourcing on flexibility requirements for domestic apparel producers have not been
investigated.

The literature relates manufacturing flexibility to strategy—a set of behaviors supported by a basis of knowledge and beliefs. Most research on manufacturing flexibility has focused on production planning, scheduling, inventory control, and technology. Flexibility is generally defined as a capability that a manufacturing firm develops to accommodate environmental uncertainty and market demands by changing production parameters. Production parameters, such as volume, flow control, task times, and product styles are contained within the many dimensions of flexibility that have been identified in the literature.

Changing parameters, however, involves a great deal more than merely altering tasks. Beyond the recognition that difficulties lie in changing to flexible manufacturing techniques, research studies on apparel production have not described the depth or range of problems related to cognitive issues. The essence of flexibility is its human perspectives: training, formal education, and organizational learning that are prerequisites to organizational and industrial change. Depth studies about flexibility as a way of thinking that is different from that of mass production is a major limitation of the apparel production literature.

Consequently, this research has focused on the knowledge structures of managers and consultants in the apparel production sector. No attempt was made to assess or weigh evidence in favor of technologies, nor prescribe an ideal set of flexible strategies. Rather, this exploratory study sought to examine the relationships between knowledge and actions as they relate to flexibility, using the literature as a basis of understanding the construct.
METHOD

The Research Approach

The purpose of this study was to inductively describe strategic apparel production behaviors, values, and ideologies related to flexibility. Through the perceptions of apparel managers and consultants, the study sought to explore the premises of current apparel production cultures. Influencing the selection of a qualitative research approach was the challenge of analyzing the ways that managers and consultants thought about flexibility, and how their beliefs and perceptions were affecting apparel production. Therefore, methods were selected to gather a wide range of in-depth responses from individuals with expertise in and knowledge of the apparel industry and of the inner workings of apparel production firms. Firm and participant sampling, instrument development, data collection procedures, and data analysis techniques were designed to facilitate the exploration of issues relating to the research questions.

Qualitative approach with emergent design

Because this study was conducted without firm assumptions about the relationships among the three constructs, a qualitative approach with emergent design was selected. Qualitative research is characterized by an inceptive focus, that may change during the inquiry, but that establishes the boundaries of the naturalistic investigation. The design of a naturalistic study emerges as the study unfolds because the researcher learns during the study and follows important themes as they present themselves (Lincoln & Guba, 1985). Descriptive studies using naturalistic approaches contribute to understanding of phenomena by revealing fundamental variables and constructs for the generation of grounded theory. Recent descriptive studies of apparel production using qualitative methods have opened up opportunities for focused studies on specific variables (Bailey, 1993; Schoer & Ziemke, 1994; Taplin, 1994). Descriptive theory building in business research has extended into the
development of refined variables within existing frameworks, exploring relationships among variables (Snow & Thomas, 1994), and cultivating elaborate definitions of variables from qualitative data (Miles & Huberman, 1984; Scheller, 1993). Studies of stability and change within organizations have been done through frameworks of significant variables (Pugh, 1983). Morgan (1983) describes the dialectic approach to organizational research that accepts the diversity of assumptions and knowledge while bringing competing perspectives into the construction of new modes of understanding.

Qualitative research is comprised of three major components: data gathered from various sources, with interviews and observation being the most common; interpretive techniques used to conceptualize the data; and written or verbal reports of the findings (Glaser, 1992; Taylor & Bogdan, 1984). Because of human responsiveness and adaptability, the interview is the best tool for naturalistic research. The interviewer's ability to process information quickly and emphasize the context of the data is a primary advantage of the interview technique. During the interview, probing further into themes as they emerge allows the data and the study to evolve with greater depth (Lincoln & Guba, 1985).

Trustworthiness in naturalistic research is developed through various techniques. Adequate observation of salient elements of the study serve to reinforce the credibility and dependability of the data. Prolonged engagement, and the investment of sufficient time and experience to learn the culture of the phenomena (and to build trust with the informants), are activities that increase the probability of credible findings. The use of several data sources and different data collection methods (triangulation) helps to ensure the objectivity, confirmability, and dependability of the data (Lincoln & Guba, 1985).

**Grounded theory**

Language represents native conceptual systems (Gregory, 1983). Grounded theory is an analytic procedure whereby the qualitative data of language are conceptualized and built into a richly explanatory theory which sensitively integrates and represents reality (Glaser, 1992).
In the naturalistic approach, hypotheses and theory are not proposed before the inquiry and tested, but rather emerge from the data, as data analysis is inductive and open-ended (Lincoln & Guba, 1985). As qualitative data are tediously and abstractly conceptualized by the researcher, patterns reveal themselves, so that at the most abstract and conceptual levels, grounded theory emerges (Glaser, 1992).

However, in planning qualitative studies, it is legitimate for the researcher to work initially from a body of existing literature that draws empirically derived conclusions. Insider knowledge of the domain, problems of access to informants, and identification of the best data sources become guidelines that help shape, but not limit, the analysis (Thomas, 1993). Glaser (1992) warns against forcing qualitative data into preconceived conceptual categories, unless a researcher is specifically seeking to develop merely conceptual description. Grounded theory emerges from data throughout a study by systematic and inductive analysis.

Well-constructed grounded theories are characterized by four central elements: fit, work, relevance, and modifiability. Grounded theory that is carefully induced from properties of categories will fit the realities of the informants. When major variations in behavior are explained by theory, it is considered to "work". Grounded theory achieves relevance when it both fits and works. As new data present themselves, variations in emergent properties and categories may lead to the modification of the theory so that the integration of new concepts is accommodated (Glaser, 1992).

The growing use of qualitative approaches for theory development in organizational behavior lies in the nature of dynamic business organizations and their root assumptions (Morgan & Smircich, 1980). Quantitative methods have provided valuable knowledge about processes of change, but have not captured the depth of description or culturally relative understandings of dynamic organizational behavior (Morgan & Smircich, 1980; De Roche, 1994). Workplaces, such as factories, are not stable, instrumental systems where inputs are rationally transformed into outputs with only occasional disruptions. Rather, they are
complex social systems characterized by informal structures, inefficiencies, ambiguous tasks and roles, and a variety of meanings to their members (Darrah, 1992).

All members engage in the process of shared meanings within organizations. Researchers who study organizations uncover structures of meaning and synthesize an image of the reality for reflection and consideration (Smircich, 1983a). Qualitative approaches have been useful in production research studies characterized by extended fieldwork (Darrah, 1992; De Roche, 1994; Klein, 1994; Kusterer, 1978; Snow & Thomas, 1994; Taplin, 1994), thick description of cultural systems (Geertz, 1973), and grounded theory development (Glaser, 1992).

In this study, naturalistic methods consisting primarily of open-ended interviews and observation were selected as the most appropriate means for collecting data and developing grounded theory. The personal depth interview is an effective method to capture the meanings and significance that people have in their lives through their complex personal frameworks (Jones, 1985a). Interviews as data collection techniques were supported by other activities to enhance trustworthiness. Triangulation was achieved through several types of data collection techniques and different sources of data. Techniques included audio taped interviews of a wide range of informants, prolonged presence at places appropriate to the apparel industry, recorded field notes of observations, and analyses of documents and visible systems, such as an actual apparel production process. Data sources included transcripts of interviews, field notes, and documents. Opportunities for the collection of data presented themselves as the study unfolded; consequently, all data sources were not anticipated in the original research proposal. Approval of procedures and instruments for this study, as well as the use of human subjects in research, was obtained from the Iowa State University Human Subjects Review Committee (see Appendix D).

**Preliminary data collection**

The design of this study included a combination of deductive and inductive techniques. A preliminary interview instrument was developed by deductively drawing concepts from the
literature related to flexibility. Visits were made to three apparel production plants in the midwestern United States. Plant tours, observations of the production systems, and interviews with production managers about flexibility served to pre-test the evolving instrument. Themes were identified from these informants, which added focus to the study in subsequent instrument development.

Next, a similar interview instrument was developed based on a combination of concepts in the initial instrument, the literature review, and themes identified from the initial interviews. This instrument was designed to collect knowledge and insights about flexibility from the perspectives of apparel industry consultants, with a particular focus on the problems producers encounter when they adopt flexible techniques. Visits were made to two nationally recognized apparel research facilities in the southern United States: the Textile/Clothing Technology Corporation in Cary, North Carolina, and Clemson Apparel Research in Pendleton, South Carolina.

The Textile/Clothing Technology Corporation (TC²) conducts a wide variety of research on innovative apparel production techniques. It serves to educate individuals who are involved in the industry, through their roles in government, private apparel firms, or educational institutions. As a teaching factory, TC² manufactures apparel daily using state of the art equipment and techniques. Clemson Apparel Research is a similar apparel production research facility, affiliated with Clemson University and The Southeast Manufacturing Technology Center. In both facilities, observations of flexible production techniques and discussions with experts who staff the facilities contributed further to the evolution of the study.

Attendance at a two-day seminar for apparel producers on the theory of constraints provided an in-depth analysis of managing production flow from the perspective of a production consultant. The seminar also allowed for introductions to and discussions with industry managers. From these preliminary activities and interviews, a set of three salient
constructs were identified. In turn, from these constructs, five research questions were developed.

It became very clear from the initial discussions with managers and consultants that techniques of flexibility in apparel production had to be supported by an underlying philosophy, or abstract set of reasons. This philosophy, or ideology, was a conceptual system within the minds of consultants and managers and was based on their knowledge, experiences, and perceptions of flexibility. Other ideologies have dominated the apparel production industry for decades, namely productivity, profit, and, more recently, quality. Conflicts between flexible techniques and the preservation of these former ideologies were causing difficulties among producers. Furthermore, initial discussions revealed that producers were demonstrating a wide variety of flexible behaviors, and were encountering numerous barriers and conflicts related to change. Thus, the constructs and research questions below reflected the focus of the study and served as a basis for the evolution of the final instruments.

<table>
<thead>
<tr>
<th>Construct</th>
<th>Research question</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ideology</strong></td>
<td>How do apparel producers perceive the concept of flexibility in production? How does the concept of flexibility relate to the dominant apparel production ideologies of quality, productivity, and profit?</td>
</tr>
<tr>
<td><strong>Forms</strong></td>
<td>What are apparel producers doing (behaviorally, technologically, and structurally) to support their perceptions of flexibility?</td>
</tr>
<tr>
<td><strong>Barriers</strong></td>
<td>What are the barriers to the implementation of flexible production philosophies and techniques? What knowledge do apparel producers need to overcome their resistance to change?</td>
</tr>
</tbody>
</table>

A third interview instrument was designed to capture elements within the research questions (see Appendix B). The intention of this final instrument was to gather meanings of
flexibility in production from a range of managers and consultants representing a wide variety of apparel firms, product lines, and production processes.

**Professional development of researcher** Activities related to the preliminary data collection phase also served to prepare the investigator by providing knowledge about the industry, language, possible informants, and potential problems and issues that could not be learned from literature. A previous naturalistic study of quality issues within a large apparel producer completed by this investigator offered a valuable frame of reference for the design of the present study (Scheller, 1993). Over the past three years, tours of apparel plants, discussions with plant personnel, and attendance at industry meetings and seminars made valuable contributions to the development of the researcher's knowledge and relationships within the industry, thereby helping to provide trustworthiness in this study. Extensive undergraduate coursework related to business, strategic and operations management, as well as graduate level coursework related to apparel production served as a basis of knowledge from which to conduct this study.

**Sample and locations**

**Criteria for sample** Overall, the sample of 38 informants was purposively selected to represent diversity. Informants represented 29 different apparel and consulting firms. In order to reduce response bias, other researchers have found that selecting informants who are at higher levels in business organizations assures more reliable data (Miller & Roth, 1994). Therefore, informants were selected who were thought to have a significant level of knowledge about apparel production.

Individuals were invited to participate as production representatives of apparel or related soft goods firms of varying size, product line, and type of production system. The sample was also selected to achieve geographical dispersion, some gender balance, and varying levels of industry experience. Three factors were taken into account during the sample selection: 1) informants had to be actively involved with flexible techniques in production; 2)
informants had to have some experience with production of apparel or related soft goods that had a style range, such as clothing or handbags; and 3) preferably, informants had an accessible production plant for a visit by the investigator. Time and financial constraints of the study did not allow for travel to all of the firms and plants; therefore nine of the informants were interviewed by telephone. Confidentiality and anonymity both verbally and in writing were assured to each informant. A letter from the researcher detailing the study was received by each informant either in person, by mail, or by facsimile after they had agreed to consider participation.

Access  In a qualitative study of Asian apparel production firms, Ram (1994) relied on the development of connections and trust to earn access to the workplace culture. Likewise, the task of identifying managers and consultants who might be regarded as representative of firms involved in flexible production techniques for this study was difficult and time consuming. Through snowball sampling techniques, several methods of contacting participants were pursued. Identifying most of the potential participants was dependent on relationships with academic colleagues and industry acquaintances that had developed over the past three years. A list of members belonging to a regional sewn goods organization led to five informants. A depth interview with an apparel production quality retail consultant led to the identification of four individuals who were actively involved in innovative flexible production techniques at a variety of firms in the midwest.

Finding people who had expertise in flexible production required extensive travel. Attendance at a major apparel production trade show led to six informants. Three apparel production seminars and one academic apparel research meeting gained introductions to three informants. Also, attendance at a national apparel research conference sponsored by the American Apparel Manufacturer's Association led to five people who were willing to participate in the study. One participant was an apparel production consultant in Honduras who provided a group of American apparel industry visitors, including the investigator,
access to six "807" production plants in two free trade zones in Honduras. From that experience, two other informants who had been deeply involved in transforming a large American apparel producer toward flexibility were identified.

**Sample characteristics** The final sample of interviewed informants consisted of 26 men and 12 women (n=38), as consultants or managers representing 29 firms in fourteen states and Honduras. Four of the informants were sewing operators at a national apparel research facility. Because these operators traveled to perform demonstrations of flexible production techniques and had definite teaching roles in the industry, they were categorized for this study as consultants. Roles of the informants ranged from plant managers, plant engineers, corporate engineers, vice presidents of manufacturing, quality assurance managers and consultants, to owners, general managers, and chief executive officers. Sales of the referent apparel firms ranged from $2.5 million to over $500 million. All of the informants had experiences with flexibility and had high levels of knowledge about apparel and soft goods production. Some of the informants had been involved in the apparel industry for less than ten years, while others had been in the industry for their entire careers, in some cases, exceeding twenty years.

**Instruments**

The final data collection instruments consisted of two parts and were based on the research questions. Instruments were designed to reflect knowledge across the three constructs of the conceptual framework: ideology, behavioral and technological forms of flexibility, and barriers to flexibility (refer to Appendix B). One semi-structured interview schedule was developed for apparel production managers. It consisted of fifteen primary questions that were intended to reflect the managers' knowledge about production flexibility. Additionally, this instrument sought the informants' perceptions of what was happening in their firms, the industry, and the markets relating to flexibility. Issues of profitability, quality, and productivity were addressed. Depending on their responses to individual
questions, probes were developed to stimulate further response or clarify vague statements.

A separate semi-structured interview schedule was developed for apparel consultants and consisted of ten primary questions with probes. This schedule was designed to compliment and verify the managerial contribution to the data. It addressed the broader issues across firms, and included questions about conflicts that were related to changes in production and the industry. Several questions were the same on both schedules, and contained probes for identifying and stimulating further exploration of concepts. For example, all informants were asked about the meaning of flexibility in apparel production. Also, informants were asked to describe the most important characteristics of successful apparel producers.

**Procedure**

The interviews were conducted in a variety of settings throughout the United States and in Honduras. Eighteen apparel production plants were toured. Attendance at two apparel research centers, three apparel production seminars, one apparel research conference, and one major apparel production trade show contributed to the study in the form of knowledge, documents, introductions to informants, and observations of apparel production equipment and techniques. Data collection took place over nine months.

Twenty-nine personal interviews were conducted. They ranged in time from twenty minutes to three hours. In some cases, an entire day was spent visiting a production plant, and discussing issues related to flexibility with production operators, supervisors, engineers, and managers. Four of the interviews were conducted with two individuals representing the same firm. For example, two senior managers from a large apparel producer were interviewed together. Each offered his views on the question or discussion, and each had a unique set of experiences and knowledge to draw from. This small focus group technique was very effective for stimulating conversation and achieving depth analysis of flexibility issues.
Nine of the informants were interviewed by telephone. Telephone interviews ranged from twenty minutes to one hour. However, in all but two cases, in-person introductions and discussions had taken place before the informant was interviewed by telephone. For example, one consultant was introduced at an apparel research conference. That individual spent some time discussing the study with the investigator and agreed to be interviewed at a later date by telephone. Individuals at seminars and trade shows often did not have the time or an appropriate place to be interviewed on-site; therefore, telephone interviews were preferred. Getting acquainted with potential informants through social activities, such as luncheons and dinners, was an important element of the study. Several informants who agreed to participate could not be contacted by telephone within a reasonable period of time or were not available for the interview at the scheduled time. Setting up some telephone interviews required as many as ten telephone calls for scheduling. Informants varied in their travel schedules and telephone availability.

Prior to beginning formal interviews, two small tape recorders were engaged. In some cases, informants offered more information after the tape recorders were turned off and the formal interview ended. If the informant indicated that sensitive information given while tape recorders were off was not to be used, it was not included in the data. Opportunities for observation and in-depth explanations of production processes during plant and research facility tours presented themselves. Information from these incidents was recorded from memory as field notes soon after the visit was completed. Because of excessive background noise, four of the tape recorded interviews were not usable, but notes taken during the interviews were included in the data. All transcripts and documents were identified with an assigned informant number.
Data Analysis

Data analysis followed the recommendations of Glaser (1992). Inductive analysis proceeded within and across the conceptual categories in order to discover the deep structures of meanings in the data. In listening to the tapes, care was taken to absorb the non-linguistic elements of the data, such as emphasis and emotions (Jones, 1985b). Reading and coding the transcripts then did not occur without the memory of the data collection scene and informants' intonations. Data analysis was also stimulated by discussions with research partners. Through these activities, further conceptualization of the data emerged.

Coding

Interviews were transcribed into a word processing program and printed. Six were selected for the initial development of an evolving coding guide. These six transcripts were purposefully chosen because they contained wide ranges of relevant concepts and substantial depth of knowledge from informants who had experience with flexibility. The transcripts represented interviews of five managers and three consultants. Initial coding began with the identification of discreet first-level abstractions in the data. Each discreet abstraction was given a name as a code, and all subsequent abstractions were constantly compared to previous codes, as first-order codes were refined. Codes were listed on a coding guide. Comparison and discussion of the six transcripts and their codes with another researcher brought a decision to use the coding guide to code the remainder of the data. Throughout the remainder of the initial coding process, some codes were combined or renamed to more precisely echo the meanings within the data. Further discussion and negotiation with the research partner verified such coding decisions.

Development of emergent themes

All of the data, including the interview transcripts, documents, and field notes were coded. First-order codes were then grouped into ten major emergent themes. For example, all first-order codes that were related to the informants' perceptions of demand for apparel goods,
such as changes in the types of products or changes in the volumes of orders, were clustered. These clusters were named product volume, order range, and product range, and they represented second-order codes. Across clusters, these codes together constituted a larger theme, more abstract than any cluster code, but capturing the meaning in individual codes and in groups of codes. The larger theme was named demand variation and represented the sources and types of pressure with which apparel producers were coping.

Appendix C offers the reader a guide to the coding and theme development process for one major theme, as well as samples of data representing the other major themes. One full example of first and second-order coding is provided for the emergent theme entitled Environmental Diversity. A sample of data representing this theme is presented. Two clusters of codes were selected from all of the codes across all of the data to show the range of ideas that compose this theme. One cluster was named market characteristics and the other cluster was named competitive forces. They are second-order codes. These two clusters were named as such because the first-order codes listed underneath them as a group represented more abstract ideas. Some first-order codes, such as time competition, are elements in both clusters. The environmental diversity section of the results chapter does not address all of the first-order codes because some of them were more salient in other sections of the results. Nevertheless, the reader can see how codes are developed from raw data and grouped to represent higher meanings. Moving from the concrete data to the abstract ideas across data is the distillation process of content analysis.

The ten emergent themes were distinct, and their first-order codes and second-order clusters represented nearly all of the data. Some themes were directly related to others, for instance, as causes or consequences. These thematic relationships were composed in an outline to reveal the inherent structure in the data. It is noteworthy that the deep structure within the data did not mirror the structure of the interview schedule, but emerged across all responses to represent the scope of meaning. The thematic structure within the data became
the anatomy for the description of meaning. From the ten emergent themes, a grounded theory of flexibility in apparel production emerged, and is reported in the next chapter.
RESULTS

The structure in the data was profiled by ten emergent themes. The emergent themes were further structured by five superlative categories: external context, internal context, barriers, meanings, and theory:

<table>
<thead>
<tr>
<th><strong>EXTERNAL CONTEXT</strong></th>
<th><strong>INTERNAL CONTEXT</strong></th>
<th><strong>BARRIERS</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental diversity</td>
<td>Planning variation</td>
<td>Barriers to flexibility</td>
</tr>
<tr>
<td>Demand variation</td>
<td>Sourcing variation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Process variation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Product variation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Structural/functional variation</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>MEANINGS</strong></th>
<th><strong>THEORY</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Perspectives of flexibility</td>
<td>Mechanisms of flexibility</td>
</tr>
</tbody>
</table>

These inductively developed themes demonstrated why and how producer ideology and behavior had changed and continued to change. Most perspectives on each of the ten major themes complimented each other and enhanced the depth and credibility of the aggregate data.

As circumstantial phenomena, both environmental diversity and demand variation were primary themes that represented the external conditions that had impacted producers and had compelled them to respond. Behavioral and ideological responses to environmental diversity and demand variation comprised five major themes of continuous change that were internally derived.

The five internal themes included planning variation, sourcing variation, process variation, product variation, and structural/functional variation. These themes represented changes within a wide range of beliefs and activities from the perspectives of producers and consultants.

With such dramatic internal changes, producers had encountered, and in some cases
overcome, three types of barriers to flexibility: structural, functional, and cognitive. Barriers emerged throughout the data and were often categorically integrated. Two domains that were integrated with barriers and that appeared to affect all ideology and behavior were the cognitive domain and the affective, or emotional domain of responses.

Definitional perspectives of the informants offered a scope of meanings for the concept of production flexibility within firms. Meanings of flexibility were represented through five perspectives as a set of abilities, as relationships to profit and productivity, as a solution to quality failure, and as a conception of the value of time. The concept of time ascended from the data as a new basis of competition in apparel production and as the ultimate interpretive concept of flexibility.

From the five themes of continuous change and the perspectives of flexibility emerged a higher order definition of producer flexibility as the internal capacity to change the firm itself into an entity that was then able to make ceaseless changes. For apparel producers to achieve the internal stability to react and adapt to the environment and the types of demand within it, transitional capacity depended on an organizational knowledge and information base that was extraordinary in the industry.

By deductively tracing the course of informant reasoning and behavior through the major themes, a theory of transitional capacity in apparel production emerged. As the iterative process of acquiring the necessary knowledge to create a structural and functional organization that was capable of adapting to changing demand and environmental conditions, flexibility obligated apparel producers to develop traits of character that extended beyond traditional production wisdom.

**External Context: Environmental Diversity**

Producers and consultants were well aware of competitive conditions. A major theme that emerged across the data was environmental diversity. This theme represents the new and
different circumstances in the external environment over the past ten to twenty years that have impacted producers and influenced their strategies. As social, technological, economic, and legislative percussions over which producers had little or no control, these changing environmental conditions had been growing in complexity and diversity. The operating environment discussed by producers and consultants involved issues related to retailers, vendors, labor markets, offshore competition, and the availability of computerized technology.

**Retailers as elements of environmental diversity**

The informants thought that because turning inventory rapidly was the basis of retail profitability, time had become the most significant element in the retail environment. Retailers were perceived to be focusing on increased velocity of sales with less overhead.

One apparel manager outlined a progression of circumstances that brought the temporal component of apparel markets to a priority status:

> Competition is increasing, specifically in the 1990's, a revolution occurred in which the number of retailers decreased. And as a result, the number of manufacturers in turn decreased as competition increased. Because of that, it became important to compete on a different scale. Traditional scales include equality in styling and price. All of a sudden, time became the largest issue of competition. 108

Consolidation in the retail sector with the emergence of larger and more influential retailers was evident throughout the data. Producers made references to their relationships with large customers such as Wal-Mart, K-Mart, and J.C. Penny. The kinds of relationships were different than they were in the past. The new relationships were based on electronic communications, production planning, and quality control. The larger producers were involved in replenishment programs with retailers on some categories of products, thus requiring EDI and regular interactions with retail representatives on production scheduling and quality.

A quality control consultant for one of the large retailers reported that apparel producers
continued to ship poor quality goods to the retailer. The retailer implemented a quality control program that offered assistance to producers within their production plants. The program fostered producer partnerships with the goals of improving production quality and subsequently reducing the retailer’s returns. It involved extensive factory inspections of in-process variation data with random product sampling and testing. Quality control consultants regularly visited plants and worked with production personnel to reduce process and product variation. Goods were also inspected after delivery to distribution centers and retail stores. This consultant described what she told producers when they had consistent production quality failures:

But when I walk out this door (of the apparel plant), if you ship the goods out there tomorrow, or you don’t do something to change it, I'm not saying you aren't hurting us, because our customers are affected by what you are sending us, but the thing is that you are hurting your own company. It may be OK today, but it’s not going to be OK tomorrow, and as long as there is a documentation trail... So, the thing is, if you want to be successful for today, practice that kind of business. But if you want to be successful for tomorrow, join our team, have an avenue into the amount of sales we have nationwide. Then, let's work together on that partnership. And there will be bumpy roads along the way, but I will help you. 200

Producers perceived that retailers were impatient, and had become intolerant of delivery delays, poor quality, and high production costs. Retailers expected them to have better production quality, lower price points, faster turnarounds, lower minimums, higher held inventories, and on-time deliveries. Also, producers reported that retailers had expanded their expectations for service from producers to include time-related components such as electronic communications (EDI) and the extra preparation of floor-ready merchandise. Some producers had systems that electronically tracked orders and sent out advance ship notices to retailers, as can be seen in the following statements:

Well, there are shorter lead times that are demanded by the retailers. And they also want to be able to change and to buy closer to the season to improve their throughputs. And this is seen as an advantage when they can buy closer to the season. 206
They want turns really quick. (Large retailer), they have an EDI, an EDI system with us, so we get orders in ones, twos, threes, and fours. 204

The retailer is directed by the consumer to have the right product at the right time. And in many ways, the consumer is pushing the retailer who is pushing the producer/manufacturer. 107

I think they are trying to cut their inventories, have us hold their inventories for them. 204

They are demanding the EDI systems to be in a, just a continuous link-up with what is going in our ordering systems, out shipping and all that... They want to know exactly what we know. 208

I know that we do have to bar code and we do have to put their hang tags on certain things, so we have to be more aware of that. 205

Because the retail environment was becoming intolerant of poor quality and long apparel production time cycles, producers were having to pass on these time and quality imperatives to their suppliers. Suppliers of materials and trims were also elements of environmental diversity.

**Vendors as elements of environmental diversity**

The inflexibility of vendors emerged as a source of conflict for producers. Numerous difficulties with vendors were cited, the most common being lack of trust, problems with deliveries and quality, as well as uncertain availability of fabrics. One consultant revealed the seriousness of the situation with textile vendors:

I think the biggest pressure has been that in, a lot of people now are trying to service replenishment programs, and have had to do with shortening their manufacturing cycles. Unfortunately, the biggest problem they have is with their suppliers. The textile people have not traditionally done the job improving their ability to service and provide flexibility to the apparel manufacturer. Consequently, what you've got is a lot of pressure coming from both sides. You've got the retailer wanting you to service these orders every week and replenish, at the same time you've been able to take your cycle times down to a fairly competitive level, but your textile supplier is still requiring x number of weeks to color piece goods. Or provide piece goods. 223

Despite a general awareness of JIT as an inventory control technique, overall, the informants' experience with varying degrees of it were negative. At an apparel production seminar, a consultant told the audience jokingly that "...JIT stands for jammed in trailers." A
persistent message in the data is that neither the retailers, producers, nor vendors want to hold
inventory:

In my opinion, it goes back to the inventory again. No one really wants to
hold inventory, but when they place an order, they would like to have that
order filled immediately. 219

The reality of JIT in one firm was explained by a quality production manager:

Yes, what the vendors do is they pretend like it's a just-in-time system, but
what they do is they make all the fabric and leathers and so forth in advance
and then they just store it at their end. It's supposed to be just-in-time, but
what it is, is they're just storing it out of our sight, and then they feed it to us
as we need it. And the way we know that they produce a lot of product in
advance, before we've even placed orders, is that when it comes in and then
QA rejects it, that raw material, then you'll often hear, you know, well that it's
not just this shipment that came in, "We have a warehouse full of it". "You've
got a warehouse full of it? Who told you to make a warehouse full of this
stuff?!" That's how you find out that they did that. But I think that's another
reality of just-in-time, you know, I think that just-in-time is somewhat difficult
to handle for anybody. 202

Due to lower volumes of material inventories, this manager explained the importance of
dealing quickly with vendor problems:

If we have a vendor problem, as far as this material, we only have so much in
the warehouse we can just pull out. Our people expect us to get on our
vendors like that, and have the problem solved tomorrow. 216

Labor as an element of environmental diversity

Another area of environmental diversity involved labor: issues related to supply, skill,
wages, and legislation. Apparel producers who were operating in tight labor markets
reported that they were unable to compete with other industries that paid more to their
production workers. Some midwestern producers complained of the dual problem of labor
shortage and having to assume the total cost of training. Producers had faced many other
labor costs in terms of compliance with legislation related to safety, benefits, and
compensation. These midwestern producers revealed how tight the labor markets in their
areas were:

Right now, we don't have any problems with compensation issues, we have
problems with getting somebody to walk in the door so that we can hire them. We don't lose people very often because of compensation. Then, once we get someone in here, the atmosphere is so much different than a piece rate factory, there's not the pressure, there's more of an everybody on one team kind of concept, we are all trying to get one job done.

We definitely have a labor shortage. In the four counties that our plants are in, as far as in (this state), we're all in the top ten (unemployment figures), and two are in the top five, so basically there are no employees out there—we're strapped.

In terms of economic development funds and tax incentives for manufacturing establishments, some midwestern states are reportedly not supportive of local growth in the apparel industry. One midwestern apparel manager stated that production jobs in "high-tech" industries that offer better wages are preferred over apparel jobs. In contrast, an Eastern producer had skilled labor readily available because of other apparel plants in the region closing.

**Offshore competition as an element of environmental diversity**

Reductions in trade restrictions through GATT, as well as the impending changes of NAFTA, were of concern to producers. Although many mentioned global trade and global competition as significant conditions, none of the informants offered specific details or predictions of the direct implications of these types of legislation on their firms or on their industry. The informants who were involved in 807 operations, however, were knowledgeable about the logistics and what they perceived to be advantages. One manager predicted that faster throughput in the Caribbean would be a serious threat to American producers:

I think what the real key here, also, that you have not mentioned in any of these questions, is the concept of flexible manufacturing applied to the overseas market. If you can get two and three day turns, let's say on merchandise out of the Caribbean Basin at ten cents on the dollar, I think that will be an unbelievable growth area and eventually catch up to the United States and just bury us.

The following comments, ranging from the general to the specific, reflected concerns from managers and consultants about offshore competition. One comment demonstrated how
retailers have bypassed American apparel manufacturers and producers by sourcing directly from foreign producers. Another manager referred to the issues of time and money involved in moving overseas goods to the American market:

The market is more difficult today than it was four years ago, five years ago. I think it's more difficult now because of GATT, NAFTA, and so forth. 220

Well, domestic suppliers really have to become more flexible in order to be able to compete anymore, because on any kind of basic styles, retailers themselves, much less other manufacturers can go offshore and program that kind of business out a year in advance. ...so they can go to the Far East and plan that a year in advance. 224

A lot of money is tied up in inventory, and especially with the overseas market, if we tend, if we don't expect apparel manufacturers can get the overseas goods to market, then we can get that share of the money coming back. 103

Well, your commodity production, mass production, a lot of it has been moving to lower cost, lower labor cost countries, and consequently, the only thing left here, or a lot of what's left here cannot be, where the labor cost issue, cannot be offset by technology. What you are left with are product segments that require, that have a lot of styling, and require a high level of diversity and flexibility in manufacturing. So, what it amounts to, is you either be fast and flexible, or you be outside of this country producing at a lower cost. 223

**Technology as an element of environmental diversity**

Besides the fact that major retailers were requiring producers to install EDI systems, the availability, within the past decade, of new computerized technology for apparel production was a significant environmental change. Because new technology for production as well as for all other aspects of business operation was there, and competitive conditions were mandating it, producers who sought flexibility stepped into a cycle of substituting capital for labor through technology adoption. One producer's comments about technology adoption and competitive advantage reflect the elements of capital expense and risk:

The whole reason my division got started is because we are the only ones in the country that have an operation like this. There is one other company that does something similar to this, but they go after the low end market, so they don't really attempt to do the quality that we do. But it took a lot of guts for the owner of the company to see the possibility that this (type of) machinery that makes the (product) without the seams, to go after that. It's been a huge,
huge capital investment before we even saw our first sale. And he's like that. He's your true entrepreneur. 224

In addition to production technologies, recent advances in integrated data management systems were also having an impact on the internal data processing functions of apparel producers. These managers offered the following range of insights about technology availability and adoption:

I think the apparel industry have always been the last ones to move on technology. Up until eight, nine years ago, you could still walk into a factory and never see technology, old sewing machines... Academia is now pushing technology. I think (the other manager) and I being at the level we are at, are saying the only way we are going to compete with the future is being at the edge of the future, which is bringing in technology. Academics, the (trade organization, apparel research center), getting involved and knowing technology... Look at the apparel industry ten years ago and look at the apparel industry today. We are just barely coming out of our shell. It's the ability to invest, and that's what we say. The technology is out there, the problem is that the old mentality of 'I'm just going to build it, my machines are my machines, a single needle is a single needle, if I need a trimmer, I can have a human body do it.' Nowadays, we can just walk away from that. Why have somebody trim it when we can have a machine do it?... It's people drawing from historic learning. This is why the US Army is using lasers to guide missiles. Why can't we use a laser to center a cutting device? So, six years ago, we decided to use it like that. Why not?... To take us through the year 2,000, that's what we have to do, and it (light sensors to track and count goods) costs us money. But five years down the road, who doesn't do it says, 'We can get away with just a human being.' Well, if that human being miscounts five or six times, you get charge backs of $500 every time you ship an item, then what is it worth? Is it worth that initial $2,000 investment? Absolutely. 220

And obviously, technology helps. The computer is invaluable. What can help is a CAD system, and obviously a marker system, laser cutting, any of that stuff that cuts the cost of your labor is invaluable for domestic suppliers. 224

As far as cutting, we are trying to use every automated knife, cutter, anything that we can do to try to speed up the process... 216

Technology, you know, most people's perceived idea is that technology is hard to use in a flexible work system. And I think that is one of the greater challenges before industry is to figure out how to marry the soft and the hard technologies. 206

We have had bar codes for years. EDI has been around, but we really haven't known for the past several years how to integrate it into our business systems, and for the past several years, that is where the focus has been. 105
We have new embroidery technology that has tackle twill and it is all computerized and it is something that no one else does.

We've got 53 retail stores and we have gone through a major transition in our data processing department going off maybe a 20 year old system or a 10 year old system and upgrading to an AS400 with EDI capabilities.

The environment that producers were operating in was perceived to be more competitive and more costly in terms of growing or maintaining market positions. Producers had to respond to the demands of retailers and corporate customers who in turn were responding to the demands of persuasive consumer markets.

Within the broad theme of environmental diversity was the concept of market demand. For producers, contending with retailers and corporate or government customers was an environmental challenge that became more specifically related to demand. The following section takes environmental diversity a step further into the details of demand.

**External Context: Demand Variation**

Informants expressed a relatively narrow range of opinions about what they thought was causing producers to become more flexible. Themes relating to retailers and consumers were represented by one broad area of coherence: demand variation. According to the informants, demand for apparel products had varied from the norm in the parameters of volume, order assortment, range, and lead time over a period of approximately 10-20 years. Informants were aware that retail demand continued to vary, absent the predictability of the past. Retail demand in the data was not limited to traditional stores, but included catalogs as well.

**Sources of demand**

The direct sources of demand on producers represented in this data included retailers, as well as institutions that purchased apparel for their members, such as schools, teams, corporations, and the military. Products represented in the data encompass both basic goods and fashion goods for a whole market range, including tops, bottoms, dresses, underwear,
children's, and outerwear. Other products were customized uniforms and jackets for sports teams and all types of professionals, a variety of sewn goods for the military, and unique corporate uniforms for such entities as hotels and restaurants.

Consumers were perceived to be the source of variation within the retail demand. Reflected in the statement of one observant consultant was that the wants of consumers in the past two decades had changed. Consumer demands had shifted to wider varieties of apparel. The demand for faster merchandise turnover accommodated personal changes in consumer tastes and clothing needs, as well as consumers' desire for more immediate gratification.

Producers were cautioned by this consultant to be aware of the changes in demand:

Think about yourself as a consumer 20 years ago, going into the stores. I remember when I was a kid, even. We would go to the store to go back to school, and that was the time when everything that was new for that period of the year was in the store, and if you didn't get it during those first couple of weeks, you might not get it, and you would wait until the Spring stuff came about. So, you had limited choices and a limited time frame in which to get first choice of those choices. And what has happened, several things, but the consumer has changed and technology has allowed it to happen. But now you go into a store and you have hundreds of different things to choose from and then it is just, you can't even count how many different things there are, and as consumers, we want them today... The other thing we want to be able to do is to go back into the store a month from now and have a lot of choices, but they would be different choices, so we are developing the mindset that I want to be able to change, I want to change much quicker. So we are driving that in a sense, whether that was created by the retail environment or technology or a combination, I am not real sure. But the key is that the consumers are the ones that are going to drive it and those that are realigning manufacturing to adjust to that are the ones that are going to be around. Those that recognize it and change will be around. Those that don't will not be around, because their processing times in many cases are still 6 to 8 weeks. So, how do you go into the store a month from now and have a completely different set of choices in what you have today? Can't do it. 104

Characteristics of demand variation

Variation in product range In an increasingly complex marketplace, the range of products that "customers" were demanding of apparel producers had increased in terms of sizes, colors, materials, price points, quality, and style variations. This demand variation across customers was reflected in the following statements by these producers:
...more products, more styles, more colors, more products, more SKU's, more SKU's, more SKU's. We struggle from fabric to fabric, style to style. 216

The retailer wants design, design, design... 202

There's more interest in unique corporate identity now, and that demand is growing exponentially. People are no longer satisfied with a uniform that looks just like company B or company C. They want a unique corporate image. 217

Ah, quality, (large retailer) is one of our customers and they are very strict with quality. 210

People in the 90's are looking for values. It is nothing unusual to see a Mercedes parked at a Wal Mart. So, cost is another thing, and they want it quicker. They want what they want, when they want it, and they want a lot of different styles, so it is tough. 210

Now, we are going into more of a fashion type of an atmosphere, and we are going with fashion colors... 207

Variation in order volume and range  The volumes of products that customers ordered from producers was moving from a dominance of large orders in single styles, to smaller orders of more styles. This manager's statement reflected such a change:

In the past, they were ordering in big quantities and big shipments; now it's short and sweet. 204

...any given order is likely to be different from another-no two individuals are the same. So the degree of customization, or the amount of work that must go into an individual's order varies day to day, and in such a way that you can't really predict anything. 222

Producers were seeing a change within orders toward more variation per order with perhaps the same overall volume. This phenomena was evident in the following manager's statement:

The customer is driving it. They want more choices, they want to buy fewer of those choices. Instead of buying 10,000, they want to buy 20 different products, and maybe buy 100 of each one of those. 216

Variation in lead time  Part of the predictability for apparel producers in the past was the relatively long lead times that customers provided them when ordering goods. A common theme throughout the data is that lead times were getting shorter because retailers
needed to buy closer to the season, and that there were more retail seasons. Also, retailers
wanted continuous replenishment on basic goods, as well as reorders within season on best
selling items. This producer was asked whether point-of-sale (POS) data from her retailers
reflected what other garments were selling in that same environment by her competitors:

No. Not by other vendors. No. What you are looking at is you have a model
stock that is set up in the store's computers. And you look at your rate of
sales, based on what your stock level was. And I have salespeople that handle
certain accounts, and that is their main job, is to make certain that the model
stock reflects how the merchandise is actually selling. So if the percentage of
white is 40%, the model stock should be 40%, and they do it twice a season,
which means four times a year they review the store's model stock to make
certain that... Now the difficult thing, and the only way you know what is
going on with other vendors is you ask, and the retailer tells you, "Well, you
should really be making a high cut string because (competitor) has it, that's
doing really well." And that's what happened to us, so we put a high cut string
in the line. There we go. And what will always happen to you is, styles, you
put them in, and they will fall out because there are some that just don't sell as
well as others, or colors that won't sell as well as others. Obviously the
challenge, from a manufacturing point of view even on a basic business like
this, is to come up with "What's new?" "New" this year was taupe! I know
that sounds really boring, but we were doing white, ivory, pink, and black, and
we did taupe last summer, and now taupe is like a big color.

Informants thought that retailers wanted to avoid ordering apparel merchandise that would
not sell at first price and require markdowns to move. By ordering as close to the season as
possible, they may have been able to better forecast what would sell, as well as predict their
cash needs and inventory tolerances. A production manager revealed the new reality of short
lead times:

Used to be that the major retailers would place their orders much earlier in the
year. In our product, 60% of it is sold at Christmas, 60% of annual sales
occurs, you know, somewhere around Thanksgiving, up to Christmas. And
previously, your major retailers would place their Christmas orders in June or
July, and they may take delivery shortly thereafter on it, and store it
themselves, or just tell us well in advance that, "OK for this Christmas season,
these are the things that I want." But in the last few years, these retailers are
now placing orders at the last minute. Its early November, and in will come
these very large orders for us, and so we needed to set up a system that could
change over much faster.

Within the shortened retail lead times, informants thought they had found a competitive
advantage over offshore producers. Producers and consultants believed that reducing the
cycle time from fabric to finished product in order to meet the retailers' timing needs, was the most critical factor in their competitive advantage. The following statements reflect the impact of timing that retailer demands were having on producers:

Well, of course, we have a seven day delivery service, which no one else seems to have, and that is a big plus. They are after us all the time about it anyway. 218

The biggest thing we look at is the number of products being imported. We can't always be the most price competitive. So, if we can satisfy other needs of our customers, we can build on our business. Timeliness, quality, minimums is the big thing in our business. 203

They want it faster, they want it high quality and they want it at a really good price. 200

Well, there are shorter lead times that are demanded by the retailers and also they want to be able to change and to buy closer to the season to improve their throughputs. And this is seen as an advantage when they can buy closer to the season. 206

The search for and the adoption of different technologies, processes, and organizational structures was an adaptive response to this variation in demand. The data show that in response to changing demand and environmental diversity, producers had altered their operations within five spheres of action: planning, sourcing, processes, products, and structure. These internal changes had occurred over time, and varied in depth and range within and across firms represented in the data.

Internal Context: Production Planning Variation

By transposing flexibility with predictability, flexible producers, as revealed within the data, had changed the way they plan their production. With former progressive bundle systems making large volume orders under long lead times, producers were able to plan production months or seasons in advance. These flexible producers, however, now had more variables and less time through which to plan. Planning production involved predicting the needs for certain types and quantities of capacity, equipment, and labor skills. Variation in
production planning was one of several adaptive responses to demand variation. This retail consultant complained about the planning time element in merchandising:

Constantly, every single day, one of the biggest problems that I run into from a planning standpoint is that people don't plan the production and lead time into merchandising. And even though we are in fashion industry and fashion turns quickly, the plans, designs, and table, the lead times are incredibly long. We've already put to bed Fall of 95, its already done and planned and the orders, materials, etc. As an example, I just looked at a dress just on Friday (mid-August), a maternity 2-piece outfit and the production sample was tested in our test lab in March.

When the same consultant was asked if she thought there was much flexibility in apparel production, this was her reply:

No, because the lead times were not put into it. If you could put in lead time so we could react to problem, we take away all of our reaction time. We absolutely take it away because we don't have people planning properly, planning those steps into it. And they think, "Oh gosh its going to take me, its just going to take longer". I've had whole seasons fail because of problems we found. And the time frames built into it. Because if we did find a problem or if we had a material problem, well then you know you hear, "Well my fabric supplier can't get the grey goods from the mill. The mill is having a problem with the yarn and then they can't do it because the yarn was twisted incorrectly and we are now having a pilling problem with the fabric and no one thought about how maybe we should have tested the yarn out before we wove it. Or maybe we should have tested the crocking or the print before we made ten thousands pieces." And the thing is, it's not hard, you have to have certain check points and you have to implement your checkpoints throughout your system. They don't. They just figure, "Well I haven't had to do it up to this point." And nobody's making them accountable for it, although they are totally responsible for the goods.

**Lead time consolidation**

Informants who were flexible producers had learned to plan production within shorter lead times. One consultant explained how producers who used a progressive bundle system had difficulty planning production because they were unable to predict when specific orders would be finished. He went on to explain that a flexible production system had much less work in process inventory and allowed the producer to predict more accurately order completion and schedule production:

The other way is in scheduling, some of the front end aspects of your business, the back end aspects of it is the planning. When you have 8 weeks
worth of work in process and a tremendous amount of cuts to manage and so forth, you can't, most manufacturers with that much in process, and that many variables are going to have, and quality was one of things (the other informant) was talking about. They can't tell you to within 15 minutes of when a cut is going to finish. They are lucky if they can tell you within a couple of days when that particular work is going to finish. You take all of that out, streamline it, reduce all the work in process and production planning and scheduling and so forth, can literally know within a matter of 15 minutes when a particular product is going to be finished. You can run that much closer to the manufacturing process so it makes those jobs, it allows you to do a much more accurate, I am not going to say it is easier, because it changes the way that you schedule and that might be what makes you that much more accurate in your abilities to determine that. 105

Informants reported that changing styles in a flexible system required a different type of planning. Several producers using modular systems had operator teams involved in the production planning process. One large producer who had many plants operating with a variety of flexible process combinations devised a spreadsheet system to plan equipment needs within plants according to style changes. A consultant noted that planning from a systems perspective was necessary to support a flexible production process because style changes require more variations:

Well, first and foremost, is the systems part of it. And that again goes back to production planning and forecasting. But also, how work is scheduled from orders, or whether it is a QR mode kind of situation. The first component supporting this has to be the system side, and...typically we try to improve the manufacturing processes without getting ample systems support to make it more flexible, to support it. That has been one of the missing links. 223

Flexibility means that basically, you cannot micromanage, getting down to the old scheduling and production control techniques that were used in apparel manufacturing. When you are introducing wide variety of styles and product into, we used we be looking at, the only real style change in a factory twenty five years ago was a thread change, (now) it's thread, fabric, style, as well as product. 223

Another consultant revealed some examples of how production of different styles can be planned in a modular plant:

I think it (the number of styles that can be managed) can be greater in flexible systems. If you think of a plant in a progressive bundle, you try to set that plant up with, you are going to handle 50 different styles, you are trying to mix all of your equipment so that you have all of your pockets setting here and all of your darts here and whatever the jobs are and you want them to be able
to handle the variations of all the different products as they all come through that line, whereas on a team system or a flexible system, you look at small groups of people that make the whole product. You can either duplicate that group so that every team makes the same product or, every team could be making a different product and have that, that group configured for that particular product which I think offers some great opportunities for style variation. They handle a lot of different styles by doing that. (Large producer) has done a great job with that in one of their plants where they have a lot of different teams and each team, they may have two teams on this product, one team on this product, three on another product, one on another product. Changes the whole day's schedule. 104

One of the flexible producers offered evidence of effective planning within a UPS production process for a women's fashion garment:

Recently, we had a 2,000 unit order for a wet print stirrup pant that we were able to turn around in less than three weeks, from design, to fabric allocation, to manufacturing, to shipping. By coupling our highly skilled technicians with current technology, we were able to cut, sew, finish, and pack the entire order in two days. 220

Some of the producers represented in the data did not have all of the production capacity that their customers demanded. For example, one producer would accept larger orders than he could handle in his facility because he had planned a network of other producers to contract with. This aspect of planning for flexible production involved not only the sourcing of production capacity, but also sourcing of other things that improved production capacity.

**Internal Context: Sourcing Variation**

Flexible apparel producers represented in the data expanded their capacities by seeking options. Sourcing is a term that refers to the acquisition of whatever was necessary to satisfy demand. The informants thought that having options and being able to source were elements of flexibility. The five areas of sourcing identified in the data were those related to skills, knowledge, materials, products, and capacity.

**Skill and knowledge sourcing**

The process of becoming more responsive to the variation in market demands for producers involved substantial education of production personnel. Guidance to enhance
skills was sought from different sources: consultants, technical support programs of equipment vendors, apparel research centers, seminars, and trade shows. Some firms hired people with expertise from other producer firms. Computer simulation programs, such as those that demonstrate and model flow balancing for modular production, were another source of skill development for production personnel.

**Raw materials sourcing**

The rising impact of 807 production through the Caribbean initiative had offered producers the opportunity to cut U.S. made fabric, ship the cut parts to assembly facilities in the Caribbean, and sell the finished garments in the U.S. market with duties applied to the value of labor added in the assembly process. Many producers represented in this data had taken this approach, and they did not rely heavily on imported fabrics.

Informants reported problems related to raw materials sourcing that involved lead times, availability of piece goods, minimum order volumes, selections of colors and fabrics, and availability of trims and supplies:

"A lot of it obviously is gonna rely on what kind of product you are making and how quickly you can get the raw materials. That's a big, big part of it, because you can have a plant that can turn things around, but if you can't get the parts, you might as well forget it." 224

When a consultant was asked if the textile producers were becoming more responsive to the timing needs of the apparel industry, he replied:

"They are aware of it. They are developing technologies that are allowing them to be more flexible. There are still some major hurdles that they have to overcome to be good suppliers and so forth. They are not there yet, to be able to support what we are envisioning as agile manufacturing." 105

Another consultant experienced frustration in working with offshore 807 facilities because of the lack of support from the U.S. parent firms in sourcing materials, equipment, and supplies:

"This is going to be the one that I have to blame the people in the US the most for. Most of the people cutting and shipping up in the States have been cutting and shipping for the American factory and then for the factory down here...They often forget that it takes a couple of weeks to get something down here, the time and the shipping schedule...Or the container's leaving and they..."
screwed up and they didn't get all the cut pieces or they didn't get some machine parts or something...now the container comes and maybe all the folders (specifications) to make the garments didn't show up...Then, they end up air freighting the folders, or, like the other day, air freighting probably $10 worth of pins... 211

One producer noted that as an extension of sourcing, buying supplier companies assured his firm availability, pricing, and ultimately control over critical supplies. Acquiring supplier companies as a form of vertical integration, was also a sourcing strategy of this producer:

I think we have not necessarily outsourced, but have outgrown, to acquisition of other companies that used to supply us with our leather tops and our liners. 201

Another producer sought flexibility through the establishment of a diversified supplier base, although, he noted that the limitation of this technique was the variation among suppliers.

**Product sourcing offshore**

All but two producer informants reported that their companies were sourcing apparel products offshore, mostly in Asia, Mexico, and the Caribbean:

We are sourcing more and more offshore, in China. Really trading all over, trying to get more of a better base in sourcing, so we can adjust to the market conditions. I think more offshore sourcing has helped us by probably 50%. Being able to adjust to the market conditions and getting the right product that you need. That is where offshore has really helped us. 209

The few producers that did not source offshore were specialty and high fashion apparel producers who maintained a firm commitment to domestic production. Another producer who had not done any offshore sourcing was seeking information on it. Sourcing arrangements include wholly-owned production facilities and joint-ventureships in the Caribbean, as well as contracting with other producers throughout the world. Some firms had expanded their sources of finished goods, but not without quality concerns:

We are doing extensive off shore purchasing of finished goods, that is all over the world, we can't give you the name of the countries, it is extensive. So that, that gives the flexibility in regards to supply of a particular item, we had it made by a couple of different suppliers which is great, but it creates another problem. It's not all right if there is variability in their products, but the flexibility from that aspect, yeah, it helps very much. We are very diversified
in our supplier base as well. Different suppliers find the same component, but again you do have small degrees of variation which is not always controllable.

Offshore sourcing involved coordination among many people. These statements by a U.S. manager and an offshore production consultant revealed some of the difficulties with communications:

I think right now, in this day and age...a lot of companies are having to, in order to compete, they are having to go off shore and...there is a lot of coordinating that is involved and coordination of the organization that is involved in this. Because it is not going to be, like you have your plant that you can jump in a car and go visit any more. It is dealing with faxes and long distance phone calls. And, you know, whenever you call a division, you can't threaten. That, I think the industry is having to turn towards that a lot more to be competitive.

The cost of shipping samples, and getting things, and doing the communications from down here to up there, that's very difficult. I think that it comes more from (the need for) sending people designing, or whoever is in charge of obtaining the cut parts, and putting them down here for about four or five weeks and making them work through it, and understand what kind of problem it is, so that maybe they've got a little bit more sensitivity of how to coordinate this thing.

As an example of a sourcing dilemma, an 807 production consultant complained about designers and apparel firms in the U.S. who had come to Honduras with inappropriately constructed garment samples that represented products they had already sold to major retailers. Lacking the knowledge about types of equipment needed to produce the garments, as well as lacking the specifications for the garments, these designers confronted situations where they could not find contractors to produce the garments they had sold within their time and price constraints.

**Domestic production capacity sourcing**

Several producer informants reported that sourcing more pre-production or production capacity offered them increased flexibility. This manager related the ability of sourcing production capacity to the meaning of flexibility:

I mean, one of the things that leads to flexibility is not only using your own plant, but having access to using other people's plants, if you need it for a
special item. And having those kinds of relationships. A lot of people do use contractors. In fact a lot of people in the dress business don't even own their own plants, they just use a series of contractors. And if x number of dress is hot and its got a certain type of stitching, they put it in this plant, and vice versa, and so the amount of flexibility they have really depends on the relationships that they have developed with these different plants, and obviously with their raw materials suppliers, you know their fabrics, mostly their fabric people. 224

Informants whose firms were striving for more flexibility were not operating in isolation from other firms, but were looking for ways to use the capacities of others. Changing attitudes toward capacity sourcing were revealed in these comments:

The one thing I think, in addition, means that flexibility in regard to partnering that is in place. And partnerships that have to be in place to receive the appropriate information as to what needs to be produced. And two, you have to call on people that you don't generally have those capabilities. You have to go out of house for someone that does, and having that network set up such that you can, responds to the needs, whether or not you can produce it in house or not. Traditionally, we thought of, "Well if I can't do it, within our four walls, I can't make money at it" and, "I can't do it, it's too hard to control" and this and that. That's is not necessarily true. 105

We are outsourcing some of our leather tops due to our lack of production availability up to one of our plants. 201

A production manager reported how his firm was able to alter the volumes on orders by sourcing excess production capacity:

The volume for a particular style can be as low as 300 garments and up to 20,000 or 30,000 garments. Some of the large orders are at times allocated to outside contractors which can provide us with additional production capacity. 220

Sourcing capacity was essential to his firm's philosophy that flexibility was the ability to respond to the market and the customer:

Change. Never say "No", and "When can I deliver it to you?" Those are the three things that I always say. 220

Even though sourcing variation was understood to be an important set of elements that improved the flexibility of apparel producers, sourcing alone was an insufficient means to flexibility. Sourcing was supported by and supportive of changes in the production process.
Internal Context: Process Variation

The informants believed that changing the production process from the progressive bundle system to another type of system was the principal source of flexibility. Those whose firms were responding to demand variation by changing the production process offered anecdotes of both success and failure. Informants justified the changes in the ways they produced goods according to different tendencies in their thinking: recognition of the limitations of the progressive bundle system, advantages in blending processes, and issues related to the development of production personnel.

Limitations and advantages of the progressive bundle system

Informants provided numerous descriptions relating to the limitations of the progressive bundle system and offered evidence for the need to vary the production process:

Well, progressive bundle systems have so much work in process that you can't do a quick turn and you can't change quickly. 210

If you are using progressive bundle, or planning to use progressive bundle, I think what you need to do is just close your shop. At least in this country. Close your shop and hang it up... You are talking about a dinosaur. You can't track, you can't look at quality, you can't look at work in process, WIP, you can't judge how you are going to produce an item. If you have a thousand items laying on the floor subdivided into 8-12 to a bundle, if there's a problem in one bundle, then that technician can cause that problem throughout the whole production line and it takes 10 days of seeing that problem. That technician has caused that problem throughout thousands of units. If you invest in a bundle system, and you are in Bangladesh, and you are making T-shirts and you know you will be making T-shirts for 30 years, fine. Labor is low, you're making T-shirts. But in the US, you're working progressive bundle, you are doomed. Absolutely doomed. 220

Progressive bundle systems require a fair amount of time to go from one end of the factory to the other. There is a tremendous amount of work in process time. 108

Another concept that is often overlooked, is that the progressive bundle system encourages an operator, coupled with piecework, encourages an operator to stay on the operation which he or she knows best. 106

But I don't think it (UPS) is any more flexible than progressive bundle, it just requires a lot less inventory, and of course, that's dollars on the floor. 217

For some types of products and markets, the viability of the progressive bundle system was
supported by comments such as this one:

Where you have large runs, or where you are able to do large runs of consistent production, I think the progressive bundle system is much more efficient. 108

One firm produced and sourced garments from plants that used bundle systems, but garments were then individually customized in a highly flexible distribution center. A consultant noted that there was still a need for commodity production, and in some cases, that type of production had achieved time efficiency as well as cost efficiency:

Now there are some situations where we have plants, where half of them are modular and half of them are progressive bundle units. And in those cases, modular units are set up for quick service, replenishment type business. They change frequently, they are paid on a different situation than the traditional progressive bundle system. But the progressive bundle systems are sitting there cranking out the mass commodity type production. Their cycle times have still been greatly reduced. We’re talking of, in some pants plants I know of, where they have taken the cycle times down to about 7 or 8 days in a mass, a progressive bundle system. Then they’ve got their teams producing in a day and a half. But it’s just two different systems, two different cost systems, two different objectives. And the cost per SAH, or the cost per product, they’re trying to optimize that on both sides, for what they’re trying to do with the system. 223

In whatever manner, modular, UPS, and combination systems were perceived as being the primary strategy for accommodating demand variation. Not all informants were convinced that process variations were the solution to the problem of high cost production, however. References were made to the three largest apparel manufacturers in the U.S. and how their strategies had revolved around basic goods:

There is a tremendous move amongst many of the larger manufacturers and here I am talking about (two of the largest apparel firms, in sales) those guys. It is very simple. They don’t want any variability. They don’t really need flexible manufacturing. They want one product over and over again. They are interested in doing the basics, not the fashions. They want basically consistency, consistency, consistency. And that is really their game. 108

Even though informants offered equally valid opinions on process variations, issues related to preferences of one production system over another were controversial. Ranging from persuasive arguments to unsolicited personal opinions about the value of a particular
production process, most of the informants had decided on what were the best or worst characteristics of various production systems. These comments reflect experiences with and attitudes toward unit production systems:

(We) had one, in all the complexity of a unit production system, that was counterproductive to flexibility. If you look at the history of UPS, rarely have I seen successful, long-lasting installations. They've been good in a couple of things. They've reduced, they help control and reduce work in process, by definition help reduce cycle time, but nearly everybody that uses them in a factory, doesn't, they don't use them in an entire factory, they use them in a portion of the factory, so they still stage work prior to putting onto the UPS and stage work after it comes off. And they say "I've reduced the cycle time", but the only place they've really reduced it is when it's on the UPS... 221

UPS systems enable decreased work in process and increased throughput. Flexible group systems, more commonly known, I believe, as modular manufacturing units, at least that's the term out in the field, also enable you to do very, very specific production on short basis for specific orders. Flexibility is less because efficiencies often drop in UPS or flexible group systems. By that I mean, increased overhead that occurs. 108

I actually believe that unit production system is nothing more than a mechanization of the modular of concept and in fact, enhances flexibility even over and above the typical modular concept because a UPS will handle more than one style at a time. And because of the pacing that the system itself generates within each operation, it therefore, gives a little higher level of productivity because it doesn't allow the operator to delay in the movement of product between workstations. It does that just as fast regardless of the styling. 106

I think the jury is still out. I think there are pros and cons to the concept (UPS). Is it faster? Sure, it's faster. We're getting garments off in two hours where it's normally taking 8-10 days. Quality level is about the same. And I think it's a new type of approach to manufacturing, and I think that's something that's been sorely missed in our industry, I think with the workplace being more competitive, attracting skilled and unskilled labor to our industry, we've got to offer different things to make it more interesting, make it exciting for these people who want to make a career in sewing and manufacturing. And we have got a welcomed response from our employees who have offered to work on it. The individuals that we have are very, very pleased. There are a lot of individuals who would like to go on it and we have not had but one person volunteer to come off of it. They just were more comfortable with the progressive bundle environment. From the standpoint of morale, it's been a big boost. And the standpoint of throughput, and reduced work in process, it's been a big plus. 217

These comments reflect knowledge and attitudes toward modular production systems.
They also reveal some of the considerations that producers went through to assess or evaluate variations in production processes:

We have considered modular manufacturing, but that's been the extent of it, it's just considering. I have never seen a modular manufacturing environment that I was pleased with or happy with. 217

Despite what everyone says out in the field, our systems for modular manufacturing often do not show the same economies scale as the throughput that is allowed by having piece rate systems and continuous production. By this, I mean the specific styles for known quantities can pass through a system, although the time is increased, the efficiency is tremendously increased because of the consistency of work. 108

I am interested to see what route it (modular) is going to take. You know, I have seen it put in and I have seen it taken out. I know of companies who have spent a half of a million dollars in some plants to convert in one way and then turn around and convert it back, so I am interested to see if all the factories will do that or not, but I am definitely in favor for the standup. It is in having the one unit being passed that seems most effective. I really think it is going to progress even better than the traditional sit down modular type. 212

With a modular group, you can be making one style this morning, feed another style right behind it and have product coming out within an hours time of a different style. 210

Producer informants did not always offer a reason for the process changes they selected.

A consultant expressed concern regarding producers' lack of "vision" about what they were trying to achieve by varying their production process:

The third, is not really have an understanding of what they are trying to achieve, redesigning process there's unlimited types of combinations that you can put together between modular, quick line, UPS, and other linked processes, and the objective are trying to, there's not really a clear vision of what they are trying to achieve, do we need two days throughput time at this much cost per SAH, do we need this, do we need that. It's really... a lot of people have gotten into it just thinking it's one way to achieve some downsizing, a way to achieve some reengineering, and maybe a way to cut costs. But they really don't have a real vision of what they are trying to achieve. 223

This producer, however, was certain about his reasons for adopting a modular system.

Improving productivity or producing at a lower cost were not primary goals, but rather the development of the human resources:
We are supplying things to a DC which supplies things to a hundred and four rental service centers, so we're really vertically integrated, and so it's an inter-company supply issue. Therefore you've got a extremely stable production environment, in a factory in our company, and there you've got real question about that modular installation being more productive. Even in a total sense, I don't think we've proved it yet. The main drive, the main reason we did it, is we wanted to change people's basic relationship to the workplace and to each other, not because we felt there would be huge cost savings. The manager that originally initiated it thought there would be. My attitude was, even if there weren't huge cost savings, if it were equal, I still wanted to do it, because I wanted to break the traditional piece-work, "I'm in this business for myself" mentality. I wanted to destroy that to see if there were merits in that. That's the reason I did it. You know, we've been doing it for almost two years...

A confluence of production systems

Many producers who are experienced with flexible production have found advantages in using a combination of production processes both within plants and across plants. Unit production lines may have been supported by mini-bundle lines of sub-assembly work:

Well, the first thing you do, the main items we're doing on unit production are the assembly of our trouser. The small parts, the flies are still assembled offline, still on a progressive bundle environment, our waistbands are pre-made, our pockets are pre-made, our hip pockets are pre-made, flies, and accessories that go onto the finished garment. And then from there, we will start out with right after serging the panels, because we have automated sergers... so it's not practical for us to do this serging off the progressive bundle environment, but from there we will go into the darts, and back pockets, but right after that we'll go into finished back pockets, and attach flies, and so on so forth, all the way through the production line.

Modular plants trained operators on a bundle system or did partial modular production side-by-side with progressive bundle systems. Entire plants remained on progressive bundle systems for basic goods, while other plants within the same firm produced different garments using modular production or UPS. Modules may have been buffered by small bundles of work between sitting operators who moved among two or three machines. Stand-up modules may have had no buffers within operations because operators passed off each garment, moving among machines to reduce the handling time. UPS systems were being used within a team concept. Clearly, the data indicated a blend of technologies and process variations that were selected for conditions appropriate for the producer's needs.
You have to wonder are you achieving optimum cost? For the lead time requirement, or the production time requirements that give optimum service to your customers. I deal with that quite a lot in some of our consulting engagements, is trying to wrestle with question of: Does the quickest throughput time, shortest throughput time match the lowest cost? And if I am putting the stuff in the warehouse and letting it sit there for 6 months, I'd have to question sometimes, what am I really trying to do.

Their game is much more consistency than it is, in my opinion, than it is going out and being flexible. Oh, you know, the CEO, (name) gets some in-vogue thing like doing flexible, you know, modular manufacturing. Yes, the people are out there trying to convert all of the systems, but the fact of the matter is, if they have one style that they have to produce 10,000 dozen a week, the flexibility is secondary to throughput and really they are able to do it with consistency. You would not believe how easy it is to do modular manufacturing with consistent 10,000 dozen of the same style per week. It is simple. The problem is when you have everything changing...

We are in the process right now of implementing a UPS. We have been, probably about 25% of our trouser manufacturing is done on a UPS which is a Gerber mover. In our (state) location, we are presently manufacturing about 1500 units a day, of which we have about 45-46 operators, with some varied results. It's been a real learning curve for us to adjust to the unit production environment, compared to progressive bundle.

A few informants mentioned the installation of flexible processes in their 807 operations:

Domestically, we don't do a whole lot of production anymore. I know that we are manufacturing plants down in Puerto Rico, actually making plants, building a couple of plants down in Puerto Rico, and there are plans to do some modular systems in those. They are trying to develop the team atmosphere, and the management down there is going through a bunch of seminars, and they will try to get them up to speed on, on these philosophies and all that.

**Issues related to the development of production personnel**

The data reveal evidence of extensive efforts to train apparel operators beyond former limits imposed by the task specialization of the progressive bundle system. Operators who learn to produce goods in a modular system are systematically cultivated through many training sessions and experimental trials:

I'd say when we first begin a team, we try to set parameters for them. As that team matures, though, they are given more flexibility within a specific, you know, we have tolerances set up, we make these decisions, you make these within this box. They have their box. Sometimes they want to step out of that box into our box, and we have to draw the line and say "No, that's not an issue or a question that you can solve or that you can decide."
These groups are highly supervised. They must complete different levels of training before given higher levels of decision making responsibility.

I did want to emphasize in that especially starting out, I mean starting out for several years, that developing the team process, it is slow, decisions, things take longer to develop consensus, especially when some of the team members may or may not have the skills, the knowledge base to be able to make that decision that you want incorporated in there. And from experience of facilitating that process, you are sitting there and you know a way based on your experience that will work, it is very easy, the tendency is to want to just go on and say that should be, but in growing a team, you have to allow for fear of failure and you have to, it can't be fear of failure, you have to allow for them to do samples tests, not that you want to see them fail, but they have to have the opportunity to work on things and problems themselves. Obviously there are some parameters there.

As operators learned about throughput, cycle times, cross-training, and effective teamwork, they developed a confidence in reasoning. Because modular teams were usually held accountable for the assembly of an entire garment, members learned to evaluate the consequences of each others' actions. If paid on a group incentive, team members were essentially rewarded to develop the skills and productivity within the group:

Now we are saying, "You're a team, work together. Your pay depends on each other".

Ultimately, benefits of the modular team that emerged in the data were that teams provided themselves with two critical elements: discipline and direction. These two elements were those that supervisors and rules formerly provided in the progressive bundle system. In the words of one engineer who did extensive training for modular teams:

When we take the six dollar earners, the low earners just making pay, those teams do a lot better, because TSS is disciplined. There is no time to get up and go to the bathroom. There is no time to talk to your neighbor. You gotta pass that piece to the next girl, she's waiting. There's nowhere to hide, so it disciplines those operators who don't do well on bundle systems.

Teams of operators received guidance from engineers, managers, and other production personnel. This statement reveals how teams pursued their own direction while seeking assistance from supportive specialists:

It is imperative that the team is in a physical environment where they can see
everything else happening and they have full control over the performance of the task. And the way I define empowerment, is having the authority to make all the decisions in regard to the performance of the task. So when I do this, I give the garment to the team and I say, "Here's the product we have to make. Here is the machine configuration and labor content that the engineering staff has come up with. Now you take this and improve upon it and call upon engineering, management, supervision, maintenance, whoever you need to help you get what you want. But you are the boss, you make the decisions on the performance of this task." Now, I believe the team should have the full authority to make those decisions. 106

Within the perspective of operator training, few firms managed the transition from a progressive bundle system to a modular system well. Support for change was not developed through existing social networks of operators:

That is really hard, but it is not as hard on them as it is on management, because management, we are saying, "Hand off your power and authority." Actually, they are gaining by giving up but it is harder to see that. So I think the change is what is so hard. Also, from going from individual incentive to a group incentive or an hourly pay with bonuses, people think that they are really getting cheated because they will remember that big paycheck. "I was on that job one week out of the year and I run the top percentage and I got in 44 hours." They don't look at the end of the year total and compare that to the way they are paid now. So they get in their minds, this isn't fair because I can make, you know, they think of that biggest paycheck, but they don't think of how much of the time that they were at home for lack of work and those other things, so I think, I think that is part of it. 210

Operators who did not understand the financial and environmental demands on their firms may not have been given enough information by managers to appreciate the need for flexible production:

You know, we need to keep talking about teamwork and empowerment of people, but they don't really want to empower them or include them in managerial relations, you know, or let them know why we have to import. Our people right now are so afraid of the imports, does this mean, "Am I gonna lose my job?" "They're just doing it to make money." Nobody is sitting down with them and saying "This is why we import". I'm being told by top management... because I'm often asked these questions from the people, "Well, just tell them it's temporary, just tell them its temporary." They don't want to give them the whole story, and, I'm the first to say that there are some people out there, you know, I don't want to tell everything to either, because they misinterpret, they're gossipers, they run, they make trouble for you. But I think if we could just include the people more, and right now they are desperate for top management to tell them, to explain to them why do we have to go to cellular manufacturing, why are we importing, why is quality my job now when it used to be the Quality Assurance Department's job, and those
answers are not really coming from them, you know, it's all, it's smoothed over, and I think they could handle it more, and then they'd understand why they need to be more flexible. I spoke with an operator yesterday who seems to have really gotten the message, and she was complaining about the others and saying these other people have got to wake up, the realities of the marketplace dictate that we make these changes, but she was saying so many people around me think that this is just short term, if we complain about it will go away. They (the company) gotta be making money, why are they doing this? And not understanding this from more of a business standpoint, and why we need to change and our manufacturing to change. 202

Outcomes of training programs were not necessarily predictable. References were made to the maturation process that teams go through. Due to a lack of experience, teams that were not "mature" may not have been able to make decisions with confidence. In such a struggle, one consultant thought that immature teams needed to have managerial support, and at times, needed to be able to fall back onto a manager's decision skills:

Go back to the staircase. If you don't, if your teams are not mature, oftentimes decisions can be made better if you go back to the old system and let the boss or the manager make the decision because the teams might not have all of the training that they need in order to make the decision, so they are going to struggle with it for a longer period of time. 104

In such situations, managers had a tendency to expedite the situation, make the decision, and deny the team the opportunity to reach consensus. Consultants cautioned that the teams who were given opportunities to decide on taking a particular course of action have a commitment to that action. And despite the manager's preference for a different solution from a cost or labor standpoint, better results were often realized:

You don't let them struggle forever. That's a tough trade off and that takes time. Until they develop those skills but generally what you find out is you might have had a way that you wanted, a course of action that you would like to have taken and if you had done it, they would have done it. The results could have been okay. Even though their way may not be the best time wise or cost wise, if it is theirs, they are going to work a lot harder against it, plain and simple...They own it and that is the key to the process. A lot of times, you get better results even though it may not be the best way and had it been the worst way. 105

Beyond compensation and personal conflicts among team members, other problems that operators had in modular production were ill-defined. It was one consultant's opinion that
operators who were in pilot modules that were being studied for amounts of productivity improvement exhibited the "Hawthorne" effect whereby they would excel during the study, but eventually slow down to a more steady pace. He thought that over time, modular teams got "worn out" from persistent initiatives to increase productivity.

*Flexible production and operator compensation* Nearly every firm that made a transition to modular production had difficulty with operator compensation. One producer who had made a complete transition to modular production throughout a new plant facility reported that monthly operator meetings with the CEO had operators pleading to return to their former piece-rate system. The group incentive compensation system continued to be perceived by the skilled operators as unfair. This consultant recognized the prevalence of the problem throughout the industry:

20% of all people, in going to a team environment, may be faced with some kind of wage reductions. This has been a major problem throughout the industry. Companies have not dealt with this very well. Big companies, little companies, its whether they go through some sort of grandfathering clause, or red circling, or whether they just try to buy back the old pay rate, there's been all kinds of things tried. Unfortunately, you wind up with 20% of the people realizing some wage reduction, and this has caused some significant problems.

One manager noted that her best operators left the company over the issue of compensation. Another manager in a large production plant had these comments about compensation that were representative of other informants' experiences with a transition from piece-rate pay to group incentive pay:

Every issue that we come down to is pay. Every single time. We have training as management supervisors, "Oh, pay is not an issue with the employees, it's number eight, you know..." It's number one. It's sad to say, but it does matter... Part of the problem we had, the very first clusters we took very high earners, we wanted to make sure this was gonna work. We got good operators, therefore, their average, you know, averaging nine, ten, eleven dollars an hour. It's hard to get that with a team.

We did provide the people historically with quite a large monetary incentive to be a good piece worker versus the guaranteed rate when you just walk in the office. You could go up significantly if you got good at this, and our people did become quite good at their individual operations, and they were
making some pretty good money out of it. Some of the supervisors would complain because the checks they were handing out to the employees were larger than their own, that sort of thing. Well along comes flexible cellular manufacturing and now we have groups of people and the individual. Your reward as an individual contributing to the organization is no longer recognized, it was this group contribution to the organization, and if people were in the same group, some were high performers and some were low performers. And the high performer suffered in pay while the low performer was pulled up in pay, so in essence, you punished your productive people and rewarded your non-productive people. 202

When one consultant was asked about problems with modules, her reply alluded to operator anger toward the team member who was the low earner. The "slowest member of the team" issue was reported by several producers. None reported a technique for balancing teams by skill. Operators who worked in a bundle system on a piece-rate never had to be concerned with the output or skills of other operators. In the modules, operators had their pay affected by the skills and productivity of all team members:

Some of the problems with, I mean again as far as communications are concerned, I have seen where you get, say five operators that are working as a team. You know, they end up, four of them ganging up on the smallest or the least effective operator. The one that is not quite as efficient. Again, that is just, I think it is just human nature, you know, if you are all being paid the same wage, and someone is not, you don't think they are carrying their load, they tend to gang up on them. So as far as communications, I definitely see that whereas, in the progressive bundle system, you know, "So what? She doesn't do 100%, then I don't care, she has got her own paycheck, I have got mine". When you are having to share your paychecks, then you tend to get angry at the low earner. 212

Most producers who developed modular plants began with volunteers for pilot teams. After a period of time, more teams were formed, and conflicts regarding team members, problem solving, and other issues became commonplace. This producer experienced similar problems with modular team members asking for managerial assistance in settling earning conflicts within the team:

We've had some problems with everyone wanting to get rid of the slower people, but our comeback is "OK, we'll get rid of her, so now, you're the slowest one, so now they're gonna get rid of you." So you see, its a vicious cycle, if you have four people, there's always gonna be one who's the slowest. The slow one may be exceptional, from the group that she's in, they all four may be great, but there's always gonna be one, two, three, and four. So, we
basically, unless it gets to the point where it's getting very unproductive, just make them stay and work together.

Consultants have focused on solutions to resolve the compensation conflicts. Several group-based incentive plans have been developed, but managers complained that in order for the plans to be fair, they must become complicated. When neither the operators nor the managers could understand the compensation system, it failed to be an incentive.

We're not gonna use his (consultant's) pay system. It's too complicated for the operators to understand. Up to a certain break even level, you make your hourly rates, then so much goes in the pot and you share...

The underlying assumption with productivity-based compensation was that operators had to be paid a financial incentive to work hard. Working hard continued to be perceived as sewing fast, moving fast, and constantly pushing the team for higher production numbers:

TSS, basically group piece-work. They are paid a per piece price. What they put out is what they get paid. So its basically piece-rate, however, they are all paid the same.

Compensation was also an issue with unit production systems. Even though many producers maintained a piece-rate incentive on UPS processes, this producer was reconsidering its value from a flexibility perspective:

We are evaluating right now whether individual incentives are the best way to go with unit production. We are looking at a group incentive, possibly, tied into production, as well as tied into possibly giving split people that do more than one job a bonus, in addition to the production quota for the day. Also, we're entertaining tying that into some kind of a quality count, zero defects might be a 10% bonus, and every one defect might be a minus a certain percentage below that. So, those are areas that we've never had to entertain before with progressive bundle, and now we are having to basically go through a learning curve just like the operators. Learning how to manage, as well as learning how to best pay these people on a unit production system.

A small producer offered his example of the compensation system they had devised that they believed actually supported the company's goal of completing finished garments. Many producers, especially those with union shops, classified operators according to seniority. This firm took a different approach:

A technician is classified by the quantity of equipment he or she can operate
and the number of operations he or she can perform. This fixed hourly range of pay averages between $6.25 and $9.00. Beyond the fixed rate, a technician can earn up to a 4% bonus per quarter based on production goals which are set at the introduction of each new style run. This bonus can be matched up to 100% based on the overall performance of the company. Additionally, 1% is given based on attendance and attitude. This bonus system also has been adapted to apply to every company employee.

**Labor unions** Many of the informants were affiliated with firms that had union representation of operators. The informants believed that the national union officials were supportive of flexibility, but that some of the local officials were guarded or simply misinformed about it. This manager noted the stages of transition that the union had to go through as her company developed flexible production processes and compensation systems to support that flexibility:

Union rules, yes, we have problems with, if you are familiar with the stages of team development the union will go through stages too. Sometimes, there is a stage where they are still protecting their turf and they have to evolve and learn their new role too.

Positive statements about cooperative efforts between unions and production managers were made. A negative comment about union rules preventing labor-management teamwork was mentioned by a manager with production plants in many states. Apparel managers wished for some guidance from the unions in dealing with the compensation conflict.

**Professionalization of labor** The process of developing operators to make the transition to a flexible production system was difficult because of the core values that the operators inherited from the bundle system. Many informants referred to the need for readjustment in attitudes, because the former ways of producing garments and organizing the labor depended on different ways of thinking. Obedience to the "...sit down, shut up and sew concept" (223) had given way to operators who had a base of decision making knowledge and some power to voice and demonstrate their proficiencies.

One producer was hiring former progressive bundle system operators from plants that had recently closed and was cross-training them for a unit production system with rapid style
changes. In addition to being trained for at least three sewing operations, operators at this plant were also expected to understand how to read cutting and specification sheets, unload items from a UPS carrier, press, fold, and bag garments. The essence of their flexibility was that they were able to recognize when and how tasks had to be done, and had the confidence and functional power to get up and do those tasks. The philosophy of this producer was that all production personnel did whatever was necessary to ship finished products. If that meant that operators came in on Saturdays to learn new skills, or managers worked on Sundays to plan weekly production, that is what was done.

Flexibility and professional development of operators was not only initiated from managers and consultants and introduced to operators. Informants voiced an awareness of operators wanting more responsibility and bigger jobs:

I think the worker today is looking for more of a challenge, more responsibility, more authority, and the flexibility factor, it all kind of fits together. It's being able to change and do more jobs, do more operations, have more skills, take more responsibility, it all kind of goes together. 223

As operators developed their task and knowledge ranges, they could accommodate changes in products more readily.

**Internal Context: Product Variation**

Informants thought that flexible producers should be receptive to changes in their product lines. Some producers had abandoned the notion that they were in business to manufacture a certain category of apparel. Variations in products offered multiple domains of value to the flexible producers. Wider varieties of styles, sizes, and materials within categories, as well as newer product categories like cruise and exercise wear were reported. This producer demonstrated open-mindedness in the process of considering new orders and products:

Saturday, I was on the phone with someone talking about producing an item for their line, like [designer name] does some bags and we've done some of their dresses and tops and they called us and said, "Can you do some bags for me?" And I know what [the other manager] would say, "We really don't want
to be in the bag manufacturing business." And they faxed us, and I sat down with (the other manager) the other day and I said, "(other manager), why not? It's only a couple thousand, you know we've got 5 or 6 people sitting around in subassembly, why not?" It's that type of mentality that keeps us alive. Whereas most manufacturers will say things like "All we do is pants. We don't want anything but pants." Or "Tops, all we do is tops". We're like, "Baby clothes for (another designer name)? What do you think?" "Let's give it a shot!"

A consultant explained that as products had changed, the attitudes toward product types were also changing. Several producers thought that fashion goods were a successful market niche for them. Consequently, continuously changing products was the core of their businesses. A uniform producer noted the changes in product types and fabrics in his industry as being more significant than style changes. The following statements reflect these issues:

Well I think the thing that we tend to deal with today is in the old days, people did not make, if you were a knit product plant, you didn't make wovens. If you were wovens, you didn't make knits. We are seeing a lot of those boundaries falling away. For instance, on rugby shirts, you've got woven collars on a knit shirt.

Where Americans and domestic suppliers can still do a decent business, is by doing the high fashion stuff that they can, if something's hot today, they still, because everything's close by can make garments quickly.

Our unique approach is to remain a versatile style shop. We specialize in knits and we can do any type of garment, from pants, to constructed tops, to t-shirts, to dresses.

I see changes in the area of fabrics, more so than designs, also in the type of products that we're offering. We're getting into a GoreTex clothing, we're getting into a line of flame retardent products for fire departments, as well as our traditional uniform clothing for police, fire and postal.

Throughout the data, product variation was a consequence of demand variation. Flexible producers that were accepting more variation in their orders had found it necessary to make internal changes that supported variation.

**Internal Context: Structural and Functional Variation**

In their attempts to become more flexible, most firms represented by informants had changed the way they functioned. Some firms had changed the way they were structured.
Variations in internal functions and structure went beyond production process variations, in that the changes supported flexible processes and influenced the abilities of personnel to increase throughput and manage product variation. The data offered many more examples of functional variation than of structural variation. Examples of functional variations included changes in policies, changes in job descriptions, and changes in departmental specialization. These changes required a concomitant change in thinking:

Everything has to change. Everything means from our raw materials, supply deliveries, integral parts, you cannot plan a little JIT without having supplier involvement and discipline and commitment. So raw materials was the first thing they began to change. And we couldn't understand what our customers, everything revolves around the customers, of course, by what their demands were, so we had to get them on board. Our manufacturing means in regards to the work centers again, okay, having small companies within the big company, to, run specific styles that can be worked with that type of equipment. That obviously reflected a management change of thinking, and employee change of thinking. 208

In some cases, the structural forms that flexible producers were assuming were both adaptive to demand variation and supportive of increased flexibility. They were adaptive and supportive because they promoted and sustained functional changes. Flexible producers were modeling the forms of their organizations toward a single goal of increasingly faster throughput. This producer had undergone both structural and functional changes with the consolidation of divisions and development of electronic communications among production plants:

We have gotten everything closer together. Instead of having different divisions, we are all under one division now. We are more flexible than we used to be. One factory can, you know, they can adjust to what the other factory has made. We have our uppers being made in one place and (other) stuff in another place. With better communications, we can adjust quicker and be more flexible... We have given people more empowerment, group quality teams. We are dealing with statistical process control... We have a computer now that we can show our problems on and it goes right to the other factory's computer... Well, before, there was no communication between factories. They just would either write them a letter or call them, tell them what you needed. But now there is much more better communication between factories as far as group meetings and the computers, much more closer relations now. Ah, you know the hard-line is that you don't need this, they will do their own thing. But now it is more of a team effort with everybody to open it. 209
Some structural forms were localized changes. For example, this producer attempted to build brand loyalty with younger consumers by developing products through a team-based design structure that allowed newly hired young designers to function freely:

And I think that's where our designs have changed the most. We still have the traditional, but now we are trying to appeal more to younger people. We did that by, our design center somewhat works like a cell, or a team-type environment. And what we did there was to hire young, a couple of young gals right out of designing college, and then, just let 'em loose...

In some firms, teams were used not only for modular production, but also in managerial structures and functions:

As far as flexibility, our company has gone to teams, teamwork. Everything is teams and teamwork. Managers are teams and teamwork attacking problems, in a team approach rather than an individual, which makes it, gives us different angles to each problem, solves problems quicker.

One consultant noted that the most successful apparel producers had the functional ability to learn from within the organization what the problems were:

The more successful companies I've seen seem to truly solicit from below what problems exist in the company. And truly listen to it. Have a system that where the people can say right to the guy at the top, "What the ---- are you all doing? Can't you see that this ---- isn't working?" And it's heard.

These consultants noted the importance of company-wide structural and functional changes that were needed to support flexibility:

I think every single thing. There is no exception. Everybody, every function in the plant must change in order to accommodate the new objective... I do think that first line supervision is a necessary function, but not the job description that we currently exist under. And that job description is, with the way we operate in progressive bundle, is an almost impossible job... It is much more of a coach and a cheerleader and it is responsive to the needs of the team rather than dictating orders to the team.

It is also important to include some of the peripheral people, not just engineers and supervisors and plant managers and operators, but some of your support people too because they are just as important in this environment as well. The accounting folks have to understand the process much better than they did in the past, maybe not better than in the past, but they have to be educated and trained about this entire process as well as the people who are doing the sourcing and whatnot. It is important to include them as well and a lot of times, they get excluded until it is directly affecting their ability to support it.
The role of managerial and functional changes that supported flexibility within a large corporation were revealed by this producer's comments:

Certainly, management has had to change from the standpoint of training and the role they play is a whole different type of role. In a flexible process, a modular type of process, teamwork process, many policies have had to change, be completely rewritten. Take whole boxes, in terms of looking at things, old paradigms, and completely throw them away. And getting managers to see that, but at the same time, still do it within the context of a corporate policy type system. It's been a real challenge. 221

For some producers, vertical integration was an important aspect of the flexibility in their organizational structures. Despite the fact that this producer used a progressive bundle system, she believed that the verticality of her operation was the firm's source of flexibility:

One of the things that, and the advantage my whole business, is that everything is done under one roof and we are completely vertical. That is one of the reasons my business, granted it's a panty business, but we take yarn in one door, we knit the panties uncolored, we sew on the leg elastic, close the gusset seams, then it goes in and the garments are dyed in a dye machine, dried, and then they have the bows put on, and they are put on hangers and they go into the warehouse. So, we do it all under one roof, and obviously, that gives us a lot of flexibility. Everything is bar-coded, so we know where every bundle is at all times, so that we can monitor how much is in knitting, how much is in sewing, how much is in dyeing, finishing and so on. We found for us, what works the best, is a bigger bundle that we're working from, because it's white panties, or whatever, you get it dyed. 224

Across the data, small producers had less difficulty making structural and functional changes that supported flexibility. One consultant noted the importance of the "small company mentality" that large companies needed to adopt. This large producer explained how dramatic the structural and functional changes in his firm had been:

But again, it's something we can see. It's something we've had to address. All of the processes have changed. Every single process within the entire DC has had to be completely re-engineered, process mapped, in some cases, just thrown away and start over again completely... I mean, we are re-engineered to the point of tearing things apart and building them all over again. Not just the concept and processes, but equipment lay-out, utilization, how things are used, real complete re-engineering, not a partial type of a thing. Materials have changed. Locations of materials, types of threads, types of needles, how a machine works, supplier involvement, basic types of things, but operator driven, which is really different from the standpoint "This thread works well, this one doesn't." Those types of things have changed. Where the supplies are located at, how the supplies get to the people, so that you have better...
utilization. There are those kinds of things that do change relative to... And of course, the biggest change is labor. There's no doubt about that. Just from the training standpoint, trying to get people to throw away old baggage and attitudes, trying to re-socialize them into a different way of doing work, and just getting people to accept that this is not the way you typically had to do business before, and you are truly being given knowledge and skills and being expected to use them. Very, very high expectations, which is sometimes a challenge, so I would say all of these have changed...Because our disciplines, manufacturing and distribution are relatively new in the way they fit into the company, I think we're less encumbered by our successes, so we don't keep visiting those, because we've changed it so radically. We don't have a past reference point anymore. I would say, that, we in the manufacturing and distribution phase of the business are much more open minded. Customer driven is an essential driving force throughout the whole company. And certainly was a large element in our changing. 221

Barriers to Flexibility

All informants alluded to circumstances, both internal and external, that hampered the implementation of flexibility. Three major internal barriers to flexibility were identified in the data: structural, functional, and cognitive. External barriers were the costs of flexibility, the inflexibilities of specialized technology that was available for the industry, and the barriers involved in sourcing, vendor relationships, and labor unions.

Internal barriers

Structural barriers One of the most serious frustrations that producers discovered during their transitions to more flexible capabilities was the rigidity of their organizational structures. Most of the firms represented had not yet overcome all of the structural barriers that continued to impede flexibility. Some comments reflected the general problems of bureaucratic structures, as they related to decision making, power, and the important element of time:

Management hasn't changed that much. We still have the same type, we have the same structure, you know, organizational chart, that really has not changed a great deal... That will have to change. We'll have to be what you call flat organization to make other parts of the company more flexible. 202

Bureaucratic inflexibility is the major failure of offshore operations. And I'm sure it does play a role in the States also. Most of the excess costs goes to
bureaucratic inflexibility. You make the plant as flexible as you can... I hear that "empower the people", but empowerment only works if the people really have the power to make the decision and carry it completely through. If the people want, they can prove to their own group and show proof than an investment in a machine or a change in the manufacturing method or something is going to solve it, they ought to be able to carry it out, as long as it can be justified. Anything be justified. 211

And the bureaucracy, the management style that we had, the autocratic style, where people had to wait for the decision to be made at the top level, today just can't exist. It can't work. It's not working. 223

So that there are companies, that I'm afraid are in deep trouble today as they have seen their explosion in styles, explosion in SKU's and they have not changed their manufacturing processes, they are in real trouble. They are incurring high costs, what we call high direct labor variance, underabsorbed overhead, wide discretion in earnings, a big difference between earnings one week and the next week, and consequently it causes a very unhappy workforce, low morale, high turnover, high absenteeism, all great things that go with that. And they trying to use 1950 processes and systems to deal with the new millennium's production requirements. 223

Informants recognized the limitations of local flexibilities and the need for changes in the structures and functions of their firms beyond the production process. For example, some producers had changed their production processes to effectively implement short cycle manufacturing, but then were hindered in their abilities to acquire raw materials on time. These comments relate to problems associated with local flexibilities and the maintenance of centralized corporate control:

We are not all the way to flexibility. We have got modular teams, but we are not completely in alignment with all of our vendors, all the way to our customer. So, we are like a pocket of flexibility, and in order to be completely flexible all the way through, it would all have to change. It would have to be a more just-in-time system, probably lower batch sizes from the suppliers... Our purchasing department, which is at corporate, deal with the vendors more at this point. We (the production plants) are not into that. Like I said, we are still a pocket, which I know, that is probably our next step. 210

Right now, we're still, well, when you talk about flexibility, you are talking about manufacturing, you're not talking about the designer, or me an R&D person, or me in maintenance, or sales, salesmen. We don't touch the salesforce, they get to continue, yet they could benefit by being more flexible... And I think that if that salesman, or salesperson would have some of that information, that would be more flexible and essentially be handling the problem right on the spot. 202
With modular change, the workforce becomes more empowered. And in order to empower people, then you have to change the way you are doing things. In other words, you can’t have a dictatorship. You have to change the policies, where people are free to think and make decisions. There have to be hand-off plans for decision making in place... 210

In some of the larger companies, I know, that encounter problems, I hear everybody rumbling about what they should do, "Why don’t they do this or why don’t they do that? The top people of the corporation aren’t listening to that. They are not hearing it... And the people who need to hear it don’t (get) down to the factories, where it’s happening. They only take tours once a year... and they wonder why a lot of (things) get messed up. 211

**Functional barriers**  Both formal and informal policies that had served as the main source of control in the informants’ firms became important barriers during the transition to flexibility. Informants were aware of the functional shortcomings of their firms:

We have got to break down some functional silos and get better at focusing on the customer. 210

We personally tried the modular system and it didn’t work for us. Maybe it’s partly the way we put it together, and maybe we needed more management involved in it, but we found that we had people do work in a group and get paid. And what happened was the good people worked hard, and were paid the same amount as the people in the group who didn’t work hard. The good people got upset about this, and quit, and left us with the bad people. So, we have now gone back to paying people based on what each individual person does. Management and policies. 224

That’s one of the prerequisites, and that’s gotta come from senior management, the president all the way down. You gotta go from being a dictator to being a coach. The supervisor’s gotta go from being a "Go do this, go do that." to "What can I do for you now?" Some do well, some don’t do so well. 216

In general, most of the problems we ran into when implementing the UPS were not technical in nature, but had to do with our policies and our business. 210

**Cognitive barriers**  Although no informants used the term "cognitive," many of them made references to the ways that operators, supervisors, and managers thought about issues related to the barriers to flexibility.

But flexibility is still in the minds of those operators. You can have the right machines, the perfect system, but if you don’t have flexibility in the minds of those operators, you’re still inflexible. 216

Well, the most common is communication, the language and cultural barriers,
because you build up a culture in a company and when you change to another way of working and thinking and doing things, they have to change, and the communication up and down and across has to be able to acknowledge this. Compensation is also important because there's a fear, and part of that stems from lack of communication, and most of that fear is in two areas, and that is "Is it going to affect my money?" and "Am I going to lose my job?" 219

A senior manager of a large producer offered these insights into the danger of past success while trying to cope with a new environment:

We've tended to be, I think, tended to be somewhat cynical. But we've spent a lot of time visiting our past successes, and a lot of time praising ourselves at how well we've done in the past. I think it's a danger signal. I think it's something that senior management has to overcome. 221

These consultants offered some details on the fears and ignorances of managers regarding investment and personnel development in flexible systems, as well as the possible negative consequences they could suffer:

And the reason I think that's true is that plant managers and companies in this business are not very progressive. They are rooted in ten or twenty year old thinking and they're afraid. There is real short term thinking as far as money, or investment goes. And if you go to a flexible manufacturing, it's like when you clean your closets out you've got to make a mess to get it all back in there, and so, you are going to lose a little bit of ground, and a lot of companies work very close to their invoicing, and their customers, and they are afraid they are not going to be able to ship, or they are going to lose a customer, or an order, and also they are afraid they are going to lose their operators. 219

One of the causes is management's inability to support, truly support the needs of the team. The team has a tremendous amount of needs in this great process and not understanding what those needs are is uncharted territory. The team doesn't know well enough yet what they need from management that or how to voice it. Management doesn't always know exactly what the teams are going to need and that can be a, that can cause some conflict. 105

Resistance to change  Resistance to change emerged in the data as one of the most significant and frequent cognitive barriers to flexibility. Informants identified causes of change resistance as having many emotional and cognitive elements, including those of fear over less pay and job loss, as well as insecurities in performance capabilities.

Several informants complained about managers having traditionally kept information and strategy from lower level employees. When producers moved into flexible production
systems with operators who were empowered to make decisions, the importance of information being withheld and its impact on resistance to change became apparent:

I think they are scared, of what's going to happen. There are a lot of people who are afraid they are going to lose their jobs, and again, a lot of that falls with management not being up front and telling them what is going on rather than just springing everything on them... (Operators need) as much information as possible, really. I think if they have information and they are clear about what is going to happen and that is going to help tremendously.

These informants acknowledged the importance of managerial attitudes and the salience of functional resistance to change. Resisting change occurred at all levels in apparel organizations:

Again, attitudes of upper management. There are very, very big stumbling blocks to that. It is not a matter of being able to do something, it is a matter of convincing somebody that just because we have done something one way for twenty-five years, does not mean that it is the best way...Nobody wants to change. You can't come in and move anything, change any process, give them a computer printed form rather than hand printed form without three managers from three different departments coming in and asking you why.

It used to work, they made all the decisions, supervisors were only glorified bundle handlers, people were not allowed to voice any opinions on the floor at all, the operators, and consequently, it has evolved to this point. I think you'll see, and we have been seeing companies, plants fail because of top management inability to deal with this. And it's not a lack of education, a lot of these people are very well educated, very bright, but they just do not know another way of dealing with this, and are insecure. Insecurity really shows up in this environment.

**External barriers**

**Costs of flexibility** Although two producers offered evidence on the actual costs of developing a modular production plant, others noted that there was significant expense involved in operator and managerial training. Costs associated with lost work and more equipment in modular plants were considered to be high. Informants provided statements such as these that referred to the need for larger quantities of production equipment:

If you have a traditional bundle system, you will have less machines per operator. When you start a modular group, you may have 10 people that are solely responsible for making the product, so if there is 30 operations you may
have 2 1/2 to 3 machines per operator, so you have a lot more machines per operator. 210

Obviously, you have a big financial, capital investment at the start. Clusters that we're looking at, you're probably looking cap-wise at $120,000 per cluster. Machinery, table-tops, etc. But that's just capital expenditure you're gonna pay off. 216

Financial, yes, there is a cost to converting to teams because when you convert, you go into this training mode. You start training people. It costs a lot of money. There is not units coming out the other end, so it is a big cost. You hear people say, "Well, you know, they don't understand that it costs", but it does cost...All teams were in place by (date). During the following year, the initial training and make-up cost was between $250,000 and $300,000. 210

When this producer was asked what prevented his firm from becoming more flexible, he referred to the different types of costs as well as other potential problems that were involved:

**Money.** If you do it right, it's expensive, whether you go UPS or not, you still have to have extra machinery sitting out doing nothing, extra mechanics repairing machines, you're more susceptible to somebody not showing up with the goods, your zippers or whatever, if you're just in time, that route... Flexibility is not cheap. You need to put in a real time. 204

*Inflexibility of technology* Informants reported other functional barriers such as the incompliance of specialized production processes and equipment. One manager noted that the capital goods sector was not providing equipment to support flexibility. These comments reflect such issues:

You have less specialty equipment because you want equipment that you can use, you can flex with. You don't want as much high volume specialty equipment with teams. 210

You know those machines we bought, (name) machines, for jeans, it's not good for under size 24, so its not for boys line. We go back to the old way. The jean bounding machine (name), can't do shorts. This technology is more specialized than it is general... No one is going to buy something they can't use everyday to produce. You can't buy a $37,000 piece of equipment, and say "Now we're going to change the product". 204

Designers need to know enough to realize that there is more than one way to make something. You can do small changes sometimes in the construction, and preserve the look, fit, and quality, and make it easier on the plant. 219

One consultant believed that the way flexible producers should now understand production
technology was different than their former focus on the achievement of efficiencies in equipment utilization:

It doesn't necessarily have to change, but the way you look at technology changes. We used to look at it as something that had to be maximized, that you had technology efficiencies in the same way you looked at operator efficiencies. So you wanted 100% machine utilization in order to be at 110% machine capacity. And the flexible manufacturing, the goal is to provide what the customer wants in a very short period of time. That doesn't necessarily mean that you will be running equipment 100% of the time. You only run equipment when you need it rather than run it for the sake of running it, so in the past, much of our inventory problem came from the fact that we were trying to keep machines running 100% of the time even when we didn't have orders for their production. We would gamble on it, oh, well the orders will be coming. 105

Sourcing and vendor relationship barriers  The data contained many examples of barriers related to sourcing and offshore operations. Sourcing of finished products, equipment, and raw materials involved the common problems of unavailability, late deliveries and poor quality. There were reports of excessive corporate control that interfered with the ability of offshore operations to function independently or flexibly. This consultant commented on the frustrations that managers in 807 operations experienced when trying to obtain necessary equipment:

If they have to get approval and it will take 6 weeks for some committee or something, and they've got to sit down and decide when they are gonna do it. By that time, the situation has probably changed. Or they lose interest, they say, "Why should we try to do this? Everytime we get down to deciding what we want to do, by the time they tell us we can do it, it's too late." So, bureaucratic inflexibility is the major failure... But they bought all the computers and stuff in the States, which is or is not a good idea. But the way they gotta prove their expense account and this sort of thing, it's a real hassle for them to go out here (Honduras) and buy the keyboards and everything that they need locally, without approving it. They buy printers through (name), or a purchasing manager in the States. Instead of just going down here and buying the damn thing. Maybe it costs $50 more, but they didn't wait three weeks to get it either. 211

Barriers also involved those related to vendor relationships. Producers expressed an awareness of the industry's initiative toward cooperative partnerships. Some producers complained of a failure to implement cooperation with suppliers and cited a lack of trust and
the continuing presence of adversarial relationships with vendors:

Partnerships, I'll tell ya, that's one we're trying, and we're not very good at it. There's not a good attitude of trust, trusting relationships are very difficult to build in a very, highly competitive environment. We're in the business where the basic selling price of our product on the street to the ultimate consumer has not increased since 1984. So, that means the inputs, the raw materials and so forth of our suppliers, if they keep raising the prices, we have to get real nasty with them. And it sets up an adversarial relationship, I don't think it sets up a real partnership. So this is a challenge for us. We pay lip service to it, talk about is all the time, but we don't really do it. 221

Suppliers, lead time, design considerations, also very, very important. Up and down the supplier chain, the flexible manufacturing is not working all that great... for the most part, most suppliers and most manufacturers continue to work in the traditional system where they have inventory. And inventories continue to increase. 108

Another consultant also spoke of the importance of developing partnerships. Paradigm shifts in the ways that firms had to communicate with one another in order to achieve flexibility focused on the retailer-manufacturer relationship, which was also a vendor-supplier relationship:

We have had bar codes for years. Electronic data interchange has been around, but we really haven't known for the past several years how to integrate it into our business systems and for the past several years, as we mentioned, that is where the focus has been. It has been on the technology side, not on the partnering, in the use of those tools, we have thought Q.R. was those technologies, and indeed it is not. The top part is the partnering that has to transpire again. The reason that it has taken so long is that paradigm shifts change in the way that we do business together. It used to be if you had, when the retailer and the manufacturer had some communication, was either when the retailer didn't pay the manufacturer on time, the manufacturer picked up the phone, or if, the reason the manufacturer will call and the retailer promises the manufacturer something, the manufacturer didn't deliver on time. The rest is done through the U. S. mail, paper purchase orders the whole works. I mean literally, that is somewhat exaggerated but that is the extent of it. That is what is starting to change, even to the point where some of the retailers are starting to recognize there has to be win/win situations, it can't be an 800 pound gorilla, beating the manufactures over the head although there has to be some push to start change. What really is going to make it work is the partnering that has to be in place and they are starting to recognize that, I think even more than they did even a year and a half, two years ago. 105

Poor quality was perceived as a major barrier to successful sourcing. Quality control managers reported that they had the responsibility to monitor the finished products and raw
materials that vendors supplied. In some cases, vendors did not suffer any consequences for failures in their production quality. This manager explained how his company established a strict procedure for dealing with suppliers who shipped them poor quality goods:

We used to receive, import finished goods. They used to just go in the field with no quality audit. Well, now, we not only do a quality audit, but we have got a, a procedure put together that all of our world suppliers are fully informed on, narrowed the procedure down to step 1 and step 2 that if you fail, you know, we will advise you and provide you with samples and audit the results and so forth. And we will charge you back. And we will sort at your expense. And we will be compensated portion of the trade duty, everything... Yeah, and if you don't fulfill it, you are going to pay the price, not us. So we have reached a new degree of quality.

Labor union barriers Labor unions that represented apparel workers were believed, by some of the informants, to be barriers to flexibility. A manager in the eastern part of the U.S. thought that the frequent apparel plant closings in his area were directly related to the inflexibility of the unions:

Most people in the (area) are, the shops that are piece rate are union, and right now the union is just killing the facilities. Just in the past 3 months we've had four major people go out of business. One with about 500 people. Another one with 200, another with 100, another with 150. So, piece rate people that are looking for jobs in this area, are looking for hourly, plus bonuses, plus benefits. And they also, most of the people that are out there are looking forward to becoming a cross-trained person. We tell them, "For this amount of money, this is what you are going to learn." "You can come in here and earn $7-$8, but to earn that $7-$8, guaranteed, you have got to become cross-trained"... We still advertise for people because we want to bump up our manpower, but what happens is the union convinces them to stay out of the industry. It is the union. It really is. We get a lot of people that really feel the union has given them a hard shake and they stay with us, and we've had people for nine years.

Unlike many other areas of the country, this firm was not facing an acute labor shortage, nor a shortage of trained sewers. However, trained sewers in this local labor force were task-specific operators whose single specializations had lost value in their marketplace. In order to regain their marketability, the operators had to learn more skills.

Union rules that had been established prior to flexible processes interfered with producers' ability to make deep changes in the organization of production. Some producers had to
rewrite the language in union contracts as well as educate the union officials about the flexible production processes:

The biggest one (problem with union rules) is seniority. Plant seniority, line seniority. And when you reform teams for flexibility, and you have different levels of seniority mixed together, typically the line seniority issue disappears. In other words, if you had seniority as a side seamer, in a team environment, you don't really have side seamers, so the line seniority disappears, and that can cause some problems. 223

Informants found that the challenges of becoming flexible could be found in the ways that they learned to overcome barriers. Producers were unable to keep everyone in their companies and production plants committed to flexibility and pleased with the changes.

**Meanings: Perspectives of Flexibility**

When specifically asked, each informant offered an explanation of what flexibility in apparel production meant. Abstract meanings of flexibility also emerged across many other responses in the data. As informants discussed what was happening in their markets and industry that was encouraging producers to become more flexible, their words imparted meanings of flexibility through experiential needs. Likewise, when describing the characteristics of successful apparel producers, flexibility was represented through behaviors as an essential definition of success.

Flexibility was illustrated in the data through five perspectives: as a set of abilities, as a means to profitability, as a quandary of productivity, as a solution to quality failures, and as a renovated conception of the value of time.

**Flexibility as a set of abilities**

The technique of asking questions from different perspectives around the issue of flexibility generated a series of responses that ranged from the rare to the redundant. The most common response was that flexibility was an *ability*. That ability involved having knowledge and skills to do or be something, as these quotes regarding the meaning of
flexibility reveal:

... the ability to react quickly to changing demands.  221
... being able to pace what you're doing.  224
... being able to deal with a wide variety of styles.  223
... the ability to respond to the market, the customer, and delivery dates.  220
... being able to adjust to the new styles.  209
... being able to stop what you are doing and deal with a different situation.  102
... being able to satisfy a variety of different needs of our customers.  203
... the ability to become moldable to whatever the company needs to get the garment out the door.  220

Dozens of statements like these throughout the data indicate an acute awareness of the need to be flexible within the dynamic apparel production environment. The informants believed that apparel producers needed to have an internal capacity for changing quickly in response to demand. The informants who were consultants had experience and knowledge about many firms that had developed flexibility, and offered these summaries:

Being flexible to me means having the ability to deal with a wide variety of styles, as well as some cases, being able to deal with a wide variety of products... No, I guess, I should put on there with some degree of efficiency. Unfortunately, there's a lot of people out there, I'm afraid, they start thinking about flexibility, the level, degree of styling varies a lot from plant to plant. And, we seem to find a lot people having trouble putting a real definition in terms of what is styling and what is flexibility to handle that.  223

We used to think flexibility was in place if you could change a plant over in six months, then you were pretty flexible. And then that went to six to eight weeks and now it is down to a couple of weeks that you need to be able to respond, you need to be able to change. You see that really beginning to happen on a daily basis, product by product where the next one you make might be slightly different and as long as you have the information about it and the tools that you need, then you will respond to it, the ultimate in flexibility.  104

Flexibility in apparel production, to me really means that you ought to be able to make about anything, and changeover to do it quickly. It means to me that you don't have a knit factory, you don't have a woven factory, you don't have a tops factory, you don't have a bottoms factory, you have a factory that can do just about anything.  211

Perceptions of flexibility as they related to profit

Informants had a range of opinions on the profitability of flexible production systems. Most comments reflected conditional statements, such as the relationship of profitability with
types of products or with environmental circumstances. Some informants were uncertain or did not think they had enough experience to judge the profitability of flexible production. Others were convinced that their systems were profitable because they had data to verify it. These are some of the responses that producers gave when they were asked if they thought that flexible production systems were more profitable:

- In a variable, highly variable, small lot environment, no question. In a mass manufacturing, high volume, stable environment, the jury is still out. 221
- The greater the need for flexibility, the greater the potential for more productivity and more profitability. 222
- Well, I'd guess I'd have to say that the jury is still out on that. 202
- Absolutely. 208
- Yes, because your turnaround is going to be a lot faster. The work in process is going to be slower and you are going to be able to get those fashion garments out. So, yes from that standpoint, definitely. In the bundle system, the work in process is a little bit longer. 207
- Yeah, in the long run. Obviously, you have a big financial, capital investment at the start. Clusters that we're looking at, you're probably looking cap-wise at $120,000 per cluster. Machinery, table tops, etc. But that's just capital expenditure that you're gonna pay off. 216
- Yes, yes they are. Project much better, and the facts and figures show they are much more profitable. 209
- Heidi, I think it depends on the environment, it depends on the manufacturer... If you have a number of different products that you are wanting to run at the same time... 217
- If you need to react quicker to your retailer's needs, yes, definitely. 205
- Absolutely. It takes a fair amount of time to see that profit come back in your hand. It will become profitable in a shorter time. It's all proportional. The more you can shove through the system, the quicker you get your return on investment. Definitely. 220

Perceptions of flexibility as they related to productivity

Responding to the question of productivity within flexible production systems posed a dilemma for some of the informants. Virtually all of the informants were experienced in the traditional systems and conceptual frameworks of apparel production, with productivity
having been the key performance measure. This consultant explained the fundamental differences between the progressive bundle system and flexible systems as they related to productivity:

Well, I think the inherent problem with the progressive bundle system has always been the individual incentive system. And the individual incentive system promotes individual efficiencies which promotes staying on the same thing and being, getting to high efficiency levels out of individual operations. And that has not always, and will not continue to be the thing that supports a flexible manufacturing systems. Unit production systems can or cannot, or may or may not change this if it's still an individual piece rate system. In a UPS, you haven’t really done a whole lot to support flexibility. Modular and teams, and quick lines, all the variations that exist in these other processes, have expanded flexibility, primarily because they have moved away from individual performance on individual operations. And the team performance, and cross training, and multi-skilled sets are what's supported that, or what is supporting that. 223

Some comments reflected the predicament of productivity as a performance measure within flexible production. The following came in response to the question about whether flexible systems were more productive than bundle systems:

No. 217

OK, they're not as productive... If we achieve the optimum in a flexible system, it will more profitable. But while we are still in the learning part of this, while we still keep tweaking the system to try to make flexibility occur, that is certainly not more profitable than just the old system of "Let's pound the stuff out", you know, for the max profitability. 202

Despite what everyone says, out in the field, our systems for modular manufacturing often do not show the same economies of scale and throughput that is allowed by having piece-rate systems and continuous production. By this I mean, the specific styles for known quantities can pass through a system, although the time is increased because of the consistency of work. Where you have large runs, or where are able to do large runs of consistent production, I think the progressive bundle system is more efficient. 108

The jury is out. 221

Other statements are positive and reflect more confidence with a different understanding of productivity:

What you can produce in a week, I can produce in two days. There's no doubt about it, the numbers show it, pure... 220
Yes. Like I said, the bundle systems were hard to track, and it could sit there for days before it gets to the next department. Or, it might go through three departments in one day, based on how they happen to be pushing or pulling it through the floor. 205

Labor has to change, in flexibility, I think we are going to have to have a tradeoff. We should teach Susie, or, I think John, let's not have machismo here, we can teach John to hem pockets and hem a thousand pockets a day. He can hem pockets for his whole job everyday. But, we can teach John to hem pockets, and sew on labels, maybe he's going to do 800 pockets a day and sew on 5,000 labels. We have this tradeoff. We are not going to be making the same thing all the time, so therefore we're going to have to teach the people to be flexible, the operators have to have flexibility. That's the hard thing to do and we are going to lose some production for particular operations, but the thing we are going to gain is that they will be able to change around a lot quicker. That's takes selling of the people. It may be a little more of the production, but on the other hand we may have more sales, because of our flexibility and being able to take the lead. And we don't have as much required, for a particular client or product that we are selling, so then you can usually get a little more money out of them. 211

Basically, in my case it (modular) is more productive in terms of cost per minute, and that is pretty straightforward. 222

Yes, definitely, because I think they are disciplined. They, from peer pressure are disciplined. A lot of operators, a lot of low earners are not bad sewers, and most of the jobs we have, and you know, menial time is not the majority of a rate, bundle handling, it's just discipline, it gives them a lot more productivity. 216

I think we could prove it and quantify it, that it's more productive. And I think you could say, and even measure it in traditional ways. Efficiency, output per person, I think, once those units have matured, I think your output per person will be definitely superior to the traditional way that you are trying to do it. Unquestionably, in a variable environment that he's in, with tremendous changes, small lot sizes, and so forth, to me, there is absolutely no question. 221

Flexibility as a solution to quality failure

Production quality was perceived as important benefit of flexible systems because lower work-in-process allowed quality failures to be readily apparent. All of the informants thought that quality had improved as a result of flexible systems:

But then there is a quality issue. Even if you do not build the mindset about quality into the people, just a flexible system in itself will cause quality problems to surface. They are not going to get buried under mounds and mounds of inventory, which is what happens in a progressive bundle system. You have all this work in process, and you don't know whether it is bad or
good, oftentimes until weeks later and by then, it is too late to respond to it. Whereas in a flexible system, you usually are talking about much shorter throughput times and even if you don't detect it until it gets all the way through the process, that is in most cases, the same day in which it was produced, or the same day in which the defect was created to begin with. 104

Typically, the benefits have been achieved in some sort of flexible environment, empowered environment, where with teams, it's been, I can't think of one where there hasn't been significant improvement in overall quality performance. Whether or not TQM has been a part of it, of the overall approach, the results have still been significant. So that one is one that we can typically. I normally quote anywhere from, outgoing quality levels typically at least 50% of what they were in the old PBU environment. 223

These managers explained how they controlled quality within the flexible production process through operator training:

As far as our people, that's something that's just drilled in their heads. Quality, quality, quality. That's really not a problem we ever have, just from day one their almost too good. In a lot of cases they are too good, our quality, they're too picky, too finicky. We don't have a quality auditing system, yet, we're working on getting one... In a cluster, the last girl is part of the inspection, so we are leaving it up to them. Like I said, they've been drilled and schooled. 216

Everybody is trained to be an inspector. Inspecting the processes. We do have end-of-line feedback, it's much easier to provide feedback to a few workers than it is to hundreds of workers. Therefore, it's easier to manage and control quality with a flexible system, a modular system, than it is with an individual task type system. 222

Quality problems remained an issue with modular manufacturing. This manager revealed how quality assurance had changed from inspection to a system where operators accepted responsibility for improving the process. It did not always work:

With the cellular system, you know, you are trying to empower the people to be their own quality assurance. And so instead of the QA technicians being inspectors, they now have to be teacher and coach and quality facilitator. So, they essentially teach the cell people what is the quality requirement, they will then also teach them how they can solve their own problems. All right, now again the reality of that is that sometimes they want to solve their own problems and sometimes they don't. So, we can talk all about, you know, we let our people solve their own problems all you want, but if they're busy, if they need to get something out, if they're having a bad day, they say "No, I don't want to solve that problem." And then they'll turn it over to the QA so they can dump it into a different area. So you know, its that human factor again, you can empower people, but people are still people, and I have a bad day at work, too. 202
Flexibility as a renovated conception of the value of time

Some of the producers had shifted their priorities from keeping their equipment and plants running at full capacity to continuously shipping products to customers on time. For them, changing some or all of their production processes from the bundle system to short cycle manufacturing processes reduced materials inventory cost and improved cash flow. Even though time remained a critical element of the production process, flexibility required that time be conceptualized from an overall system view, rather than from a local maximized capacity view. This renovated concept of time was apparent in the words of the following informants:

With the bundle system, the focus was on individual productivity of the operators... Now, we look at how many pieces are shipped out the door, because that is what we need in order to remain competitive. Focusing on individual productivity in the chain can bring the whole chain down... Hence, (our) goal is to have employees work together to continuously ship our customers their products on time, at all times, instead of keeping the plant running at full capacity at all times. 220

It's more critical to get it shipped out. 204

Well, take the last one, technology. The big factor there is changeover time, and how flexible technology is, typically is a product of the length of changeover. 223

So they still stage work prior to putting onto the UPS and stage work after it comes off. And they say "I've reduced the cycle time", but the only place they've really reduced it is when its on the UPS...But from dock to dock, there hasn't been a real, significant reduction. 221

Processing times. If your throughput time or manufacturing time is reduced from 6 to 8 weeks, down to 6 to 8 minutes or 6 to 8 hours, then the ability to adjust to what consumers want is improved dramatically. 104

If a plant uses such a criteria of average efficiency, then flexibility is deemed to be a detriment and would decrease flexibility and plant managers think that is costing them money. Of course, I don't agree with that and the plants that we have worked with, flexible manufacturing, we have given them new methods of measurement and in many cases, they are based on throughput and operating expense concept of the theory of constraints. But flexibility in fact, increases throughput because you are able to meet the demands of the customer and therefore, it doesn't cost money. 106
Summary of perspectives of flexibility

In summary, there was no single definition of flexibility that was best. The range of definitions provided by informants was more useful, because each definition liberated the concept of flexibility from the boundaries and shortcomings of the other definitions. As a group of definitions, flexibility emerged through the data in multidimensional form as actions supported by a different background logic in cultural, social, and technical domains.

Although informants described production flexibility as a set of abilities applied to a shorter production time frame, another view of flexibility emerged in the data that mirrored the capacity of an apparel producer to transform itself into an organization that was then able to sustain production flexibility. This transitional capacity of referent firms was characterized by a process of specific responses to challenges in demand variation.

Mechanisms: A Theory of the Transitional Capacity of Apparel Producers

Within the collected data, transitional capacity was the apparel organization's internal aptitude for integrating the technical and human spheres of change with the structural and functional spheres of the business system. This capacity accommodated both idealistic and realistic expectations, in that managers provided guidance from a theoretical foundation of condensed cycle time, while functional personnel used local decisions that were rooted in circumstantial compromises. Transitional capacity was the apparel producer's power to change itself into an entity that could then make ceaseless changes.

For apparel producers who had transitional capacity, the process of change became one of redefining their organizations. By effecting the passage from traditional structures and practices consistent with industry norms of cost efficiency, to distinct cultures that supported the design of apparel production around knowledge and information, production firms interpreted themselves as flexible entities.

People within these organizations had to redefine their priorities as they witnessed the
erosion of their commitments to their former organizational structures and progressive bundle systems. For some of the apparel managers, leading the transition to flexible production had become the greatest challenge in their careers. Managers and operators had to abandon the security of a known system for blind faith in a system that was difficult to preconceive and that could develop only over an unknown period of time. For those who were earning wages that were barely able to cover their financial needs, the threat of changing compensation systems or the viability of their jobs involved serious risks. One consultant divulged what he believed to be the three major problems for producers who had made the transition:

I tend to think there are three major problems when people change from one to the other. Number one, they grossly underestimate the time required to evolve from one process to the other. The training that's required for people to assume a greater level of responsibility, and so consequently what happens is a lot of people just miss estimate I guess, or grossly underestimate the time required for this to happen. We're talking years, not months. And, that's one problem. Second problem is the level of sponsorship that comes down through the organization. And if you have someone who believes that this is the right thing to do, either from a business strategy or from a human strategy sort of thing, are they prepared to sponsor this through the long process that I just talked about, in terms of getting it implemented. They sometimes lose their enthusiasm and move on to another flavor of the month. That I guess is kind of the second major problem that I run into. The third, is not really have an understanding of what they are trying to achieve.

Language contained within the transcripts and documents reflected a limited range of knowledge sources about flexibility. Informants were asked about their knowledge sources, or where they had learned about flexibility. The data contained production language that had evolved from common influences. These influences could be recognized as the trade and business press, ideas shared from company to company, industry trade shows, and seminars. The language that producers and consultants used to describe elements of flexibility such as: "you gotta walk the walk and talk the talk," "empowerment," "JIT," and "quick turns" was part of the transitional process. Having a language of flexibility may have added legitimacy to the changes in the firms because the language represented true change in the ways of thinking and the ways of behaving.
The process of earning transitional capacity in apparel production

The data offer direct evidence for the reasons that apparel producers pursued flexible strategies. How the transitions were made was not as evident, but the data reveal a pattern in the process of earning transitional capacity that was characterized by specific behavioral and ideological turning points. It should be emphasized that the process of earning transitional capacity among producers had a beginning, but did not have an end and did not follow a linear sequence. The process was continuous and iterative as the firms developed themselves ideologically and behaviorally in different ways at different times. For example, the data show evidence of process variation failures and abandonment of those variations. Later attempts to vary the production process within the same firms had been quite successful.

The first turning point was the recognition of demand variation. Deciding what demand variation meant to their firms led to the identification of adaptive variants in sourcing, products, process, planning, and organizational structure/function. Concomitantly, other turning points included the assessment of value and risk in adaptive variants, the development of measuring techniques that supported flexibility, and the process of intensive knowledge and information acquisition.

Recognition of demand variation Informants had a strong awareness of changes in demand. How they perceived the impact of those changes on their organizations ranged from a fear for their survival to opportunities for profit and growth. Some producers reported being "forced" into flexibility by customers or other competitive pressures. Others were not immediately threatened, but sought the variation in demand as a type of market niche. They perceived variation in demand as something that could provide them with unlimited opportunities to demonstrate to customers their competencies in product and volume variations within concise delivery occasions. Once producers had recognized demand variation and decided to do something in response to it, they began the learning and changing process with search behavior.
Identification of adaptive variants

Search behavior on the part of producers was the first turning point in the process of becoming flexible. Virtually every producer had undertaken some form of learning about flexibility, usually in the forms of benchmarking and of visits to other producers who had adopted specific technology or the production system of interest. Some informants were aware of successful modular or UPS installations in a variety of firms and they emulated benchmarking techniques. Many informants did extensive travel. They attended seminars and trade shows as well as read books and trade press articles about flexibility. Producers making the transition sought the support of others who had also done it. Some producers hired consultants to help them identify adaptive variants, design strategies, and provide managerial support and education.

Development of mechanisms to assess risk and determine the value of variants

As producers experimented with sourcing options and process variations, they learned to assess risk and determine the value of a variety of flexible forms. Decisions about purchasing CAD/CAM or computerized cutting equipment to improve throughput was a prime example of a cost/benefit determination that most producers reported. In order to assess whether or not they could "justify" it, some reported that they predicted the payback period of the equipment through a set of sales forecasts. Vendors of equipment were expected to provide producers with data so the producers could evaluate the value of the equipment. Anecdotes of trial and error in production processes showed that operators were also able to assess risk and determine the value of behavioral variants.

Cultivation of measuring techniques that support adaptive variants

Performance measures such as piece-rate incentives, productivity per Standard Allowable Hour, and traditional product cost did not allow producers to account for the value of improved throughput and customer satisfaction. As a result, some producers began to search for methods of measuring what was newly important, instead of continuing to make decisions on measurements of what used to be important. One large producer who had about eight years
of experience with flexible production reported that his firm was trying to develop new measuring systems even though they had continued to use old measurements such as direct labor cost. Producers who had cultivated transitional capacity and had learned how to measure its value discovered that they could seek out and serve customers who needed lower volumes, wider product ranges, and reduced cycle times.

**Earning transitional capacity through intensive knowledge acquisition** Informants in this study were in various stages of learning about flexibility. Knowledge was acquired through processes of exploration and experimentation. The method of acquiring transitional capacity depended on a concentrated learning effort for the individuals within the organization. Informants had to reason their way to levels of understanding about flexibility. Operators created knowledge by acquiring a wider range of task activities. Some producers hired consultants to manage the transition to a different production process, while others hired consultants to do specific kinds of personnel training. Producers who had adopted forms of flexibility without the concomitant structural and functional changes in their firms, learned first hand about the barriers to flexibility.

The process of individual and organizational learning was implicit in the data, in the form of changing behaviors, beliefs, and organizational structures. Behind all of the behaviors and beliefs was knowledge based on a different set of assumptions. It was in the structures of the organizations that the ideology of flexibility was honored. Producers could change what they did (forms) to act flexibly, but only those who changed their operating structures, changed who they were (ideology).

**Summary of theory of transitional capacity of apparel producers**

The five behavioral constructs of this theory are as follows: 1) recognition of demand variation; 2) identification of adaptive variants; 3) development of mechanisms to assess risks and determine the value of variants; 4) cultivation of measurement techniques that support adaptive variants; and 5) earning transitional capacity through intensive knowledge
acquisition. Adaptive variants are concepts that were developed throughout the findings and include variations in apparel producers' production processes, products, planning activities, sourcing, and structures/functions. Producers were found to move through a series of these behaviors as they developed transitional capacity.

Contribution to the Literature

The results of this study contribute to the literature according to the three constructs that supported the study's design: ideology of flexibility, forms of flexibility, and barriers to flexibility. The meanings of flexibility that emerged in the data reflected the broad scope of flexibility identified in the literature and embraced the cultural components of flexibility: ideology and forms. Furthermore, the results helped to document a paradigm shift that is occurring within the apparel production sector.

The deGroote framework

The results of this study were supported by a useful framework of three theoretical concepts developed by deGroote (1994). These concepts were derived from the generic properties shared by the models of flexibility proposed in the literature: flexibility as a property of technologies, diversity as a property of the environment, and performance criteria. As a hedge against uncertainty, flexibility is considered in the framework as a property of technologies. Technology is defined as "... any aspect of a firm's production resources, control procedures, and overall strategy" (deGroote, 1994, pp. 934). This study found that flexibility was indeed a set of technologies and behaviors that provided apparel producers with options for coping with demand variation (uncertainty).

The second concept of the framework is diversity. Diversity is a property of environments in which technologies are operated. Because diversity refers to general notions of variety, complexity, or variability, flexibility and diversity are two complementary properties. Therefore, the more diverse the environment, the more flexibility is required to cope with that
diversity. These findings point to the environmental diversity as well as the profound changes in market demand that apparel producers were perceiving. The more demand variation the producers believed was present, the greater their perceived need for the adoption of flexible behaviors.

The third concept is a performance criterion for evaluation of differing technologies in different environments. A given technology would be considered more flexible than another if an increase in the environmental diversity produced a more desirable change in performance. Producers who had earned transitional capacity were in the process of learning how to predict the future consequences of adopting behavioral variations. Profit, quality, and productivity were the desirable outcomes that producers had measured.

**Ideology**

Among the respondents, flexibility was recognized as a significant competitive strategy. Consistent with Gerwin’s (1993) model and analysis, informants were responsive to environmental diversity and reported advantages in the use of strategic flexible options both defensively and offensively. Informants were not familiar with academic literature or studies on general manufacturing flexibility and did not make references to terms such as mix flexibility or rerouting flexibility. Nevertheless, implicit to their responses were dimensions of flexibility that appeared in the frameworks of authors listed in Table 1. For example, reports of the relative inflexibility of specialized apparel production equipment referred to the machine flexibility dimension of Swamidass (1988), Sethi and Sethi (1990), and Gupta and Somers (1992). Mix flexibility alludes to product variation, which was a major theme in this study. The concepts of static and dynamic flexibilities of Cohen and Zysman (1987) offer an analogical interpretation of transitional capacity in apparel production.

Other ideological aspects of flexibility appeared in the findings of this study. For instance, the data showed evidence of producers trying to overcome mechanistic management systems that were viable when apparel production conditions were more stable. The
components of mechanistic systems described by Burns and Stalker (1961) were demonstrated clearly as elements of behavior producers were trying to vary from. Organic management systems were evolving within flexible apparel firms. From the perspectives of communications, sourcing, empowerment of operators, and networking, flexible producers were adopting organic forms of management systems as a redefinition of the firms' value sources.

Within apparel producers' responsive product, planning, sourcing, and process variation activities, craft forms of production administration were evident. Local decisions and cross-functional teamwork for problem solving characterized a movement away from bureaucratic administration and toward craft administration. Cultural interpretation of the data through Baligh's (1994) theory found support for the importance of "fit" between the structural components of the production firms and the teamwork cultures that flexible producers were trying to establish.

Central to Frederick Taylor's (1992) theory of management was the encouragement of workers to build on their knowledge bases and contribute to innovation in production processes through the development of new techniques. The results supported this principle because operators who were in functioning in modular teams were expected to experiment with process innovations and advance themselves in efficiency and skill.

**Behavioral and technological forms of flexibility**

Behavioral and technological forms of flexibility cited in the literature were consistent with what producers were adopting. The literature focused on flexible production processes as isolated systems. Studies such as those by Bailey (1993) and Schoer and Ziemke (1994) on modular and UPS failed to emphasize a blend of systems that the informants in this study reported.
Barriers to flexibility

Producers experienced a variety of barriers to flexibility. Firms that demonstrated the ability to transcend barriers had an internal capacity for change that Willmott (1993) alluded to in his discussion of strong corporate cultures. As in Hill's (1992a) study, operator compensation conflicts emerged as a major barrier in modular production processes. Resistance to change was reported by informants, but was not as well developed in depth as the literature. These findings show both the cognitive and affective components of change resistance. Endsley's (1994) model for reducing the resistance to technological change in manufacturing organizations may offer apparel producers guidance in the management of flexible innovations.

Paradigm shift in apparel production

This study documented differences in the organization of apparel production as the industry was moving away from a model of power-based relationships toward a network model that emphasized sourcing and cooperative relationships. Consistent with the discussion (Rubenstein, et al., 1984) of paradigm shifts, the adequacy or truth of assumptions underlying the former apparel production paradigm have been questioned. Members of the apparel manufacturing community represented in this study had shifted their world view by questioning the assumptions of former production canons as they related to changes in market demand.
SUMMARY

Conclusion

Naturalistic researchers are cautioned against presenting grand conclusions that push the work beyond the boundaries of the results. The account of a qualitative study should stand on its own. Wolcott (1990) claims that bridging the gap between describing the results and prescribing solutions to problems based on those results requires the imposition of judgment. That judgment may be from the perspective of the researcher, the informants, or an expert. Nevertheless, a researcher who has the privilege of examining phenomena from an insider’s perspective is certainly affected by the experience and can share personal reflections. Therefore, as the results of the content analysis are valid in themselves, the conclusion to this study is no more than personal opinion and professional judgment on the part of this researcher. In conclusion:

Flexibility is essentially a state of mind, be that the mind of an individual or the mind of an organization. Even though apparel producers have to invest in technologies that support flexibility, flexibility cannot simply be bought—it must be earned. It is not a static state of achievement, but a dynamic process that never ends. Flexibility as transitional capacity is developed by apparel firms who are capable of self-critique.

Some activities that apparel producers undertake are those that insure the producers’ current survival. Other activities help producers to progress and grow. Flexibility supports both survival and advancement. As a virtual fountain of youth, flexibility allows producers to look at the market through an unimpaired vision, then respond with the maturity of production experience.

The philosophy of flexibility lies in demand. Market demand is a stream of information and a body of knowledge that solves the big question for apparel producers: What ought we do? The market speaks, and to those producers who are capable of listening to the market
and capable of accommodating it, financial rewards are assured. Historically, listening to the market is not something that the United States apparel industry has done well. Now that the mass market concept has been outgrown, niche markets pose unique demands in terms of fit, aesthetics, quality, materials, and price points. For example, ready to wear clothing manufactured in the U.S. does not fit many individuals within this increasingly diverse and aging population. Our growing African, Asian, and Hispanic populations possess clothing needs and wants that extend beyond the past awarenesses of the large corporate producers and retailers.

By collecting data, retailers have assumed the role of staying in touch with consumer needs and preferences. Like retailers, producers should be restructuring their production plants and organizations around knowledge and information about their markets instead of around cost efficiencies. With wide ranges of options for sourcing, processes, planning, and product lines, flexibility should encourage producers to abandon the belief that each production plant must act as a "stand alone profit center."

The dynamic nature of markets makes them penetrable by those producers who have cultivated a capacity to change continuously. Producers that recognize market need and have innovated internally are capable of integrating product development with production. Flexibility requires apparel producers to develop cognitive complexity—many ways of gathering information, creating knowledge, and processing both through organizational structures that have easy communication between specialists. Traditions in apparel production are maintained by its members within a framework of assumptions, language, and values that define them as a system. The ideology of flexibility is honored within the structure and functional policies of the apparel firm.
Limitations

The major limitation of this study lies in the possibility that the informants were not a representative sample of the population of apparel managers and consultants in the United States who had knowledge and experience with flexibility. Even though informants had varying levels of expertise about flexibility, depth interviews of a defined number of informants was more than adequate to analyze the questions and fulfill the objectives of the study. However, the sample size relative to the size of the potential population was very small. Some of the informants were limited in the amount of time they had available for interviews.

Recommendations for Further Research

Because this was a descriptive study of a relatively new phenomenon, the results exposed several issues worthy of further inquiry. They include the educational development of managers and production personnel, the compensation of operators within flexible production processes, the alterations in the administration of apparel production, and the development of appropriate performance criteria that capture value in the ability to change.

The study was not designed to gather data from the perspective of sewing operators and supervisors. Although four of the informants were operators who functioned at a research center and had advising roles in the industry, they were not as representative of operators in private firms who learn flexible production techniques without expert guidance. According to the informants, training and experimentation were found to be critical to the organizational learning process. Research that focused on the types of learning styles and effective training content for managers and production personnel who are developing flexible production techniques would be of value to producers. For example, an appropriate research question might be: Under what conditions are managers, operators, and supervisors best cultivated to become critical thinkers and decision makers as their firms develop transitional capacity? Such research could be conducted through a collaboration of academic institutions and the
apparel industry, with its outcomes forming a basis for technical education programs.

Operator compensation was another serious issue for producers who adopted variations in their production processes. An analysis of the various types of pay systems and the assumptions that underlie the systems that flexible producers are adopting would be useful for other members of the industry. Such research could be a combination of a quantitative and a qualitative study. The economics of apparel production wages with a documentation of pay systems could be combined with a qualitative study from the perspectives of managers and operators on the motivational issues related to pay systems.

Because the bureaucratic structures and functions of apparel firms were the most significant barriers to flexibility that were identified, research that focused on methods to prudently disintegrate such barriers within the context of viable business activities would be useful to many producers. For example, from the results of such a study, some producers who need to maintain bureaucratic structures for the purposes of financial control required by outside stakeholders, could learn to operate flexibly within their boundaries.

As the industry moves away from using anthropometric data for sizing standards and develops the capacity to manufacture clothing for individuals based on their digitally recorded body measurements, producers will require process innovations that can accommodate much more demand variation. Most producers use traditional measures, such as cost accounting and financial statements to evaluate their performance, but this study demonstrated that there is value in the ability to change. Therefore, research that seeks to discover what types of performance measures are appropriate for producers to use in decision making related to flexibility might be of considerable merit.

**Summary**

The purpose of this study was to inductively describe dimensions of flexibility in apparel manufacturing. Using qualitative methods, 38 interviews of apparel production consultants
and managers were conducted in a variety of settings throughout the United States and in Honduras. Eighteen apparel production plants were toured. Attendance at two apparel research centers, three apparel production seminars, an apparel research conference, and a major apparel production trade show contributed to the study in the form of knowledge, documents, introductions to informants, and observations of apparel production equipment and techniques. Sales of the referent apparel firms ranged from $2.5 million to over $500 million. All of the informants had experiences with flexibility and had high levels of knowledge about apparel and soft goods production. Through content analysis of data across conceptual categories, a grounded theory of flexibility within apparel firms emerged.

Flexibility in apparel production was defined as transitional capacity: the ability to accommodate the variation in quantitative and qualitative demand for apparel products. Apparel producers go through a process of earning transitional capacity that begins with the recognition of demand variation and the need for change. Concomitantly, the identification of adaptive variants, the development of mechanisms to assess risk and determine the value of adaptive variants, and the cultivation of performance measures that support process variation are undertaken.

The major barriers to the development of production flexibility were found to be structural, functional, and cognitive. Examples of barriers include bureaucratic inflexibility, incompliance of specialized production processes and equipment, and the mechanistic view of apparel production that has supported the productivity paradigm of the progressive bundle system and its piece-rate incentive assumptions.

As producers face profound environmental diversity and demand variation, they have increased their range of products and reduced their cycle times by adaptively using a variety of behavioral techniques: computerized technologies, variation in production processes, professional development of labor, sourcing of materials and products, changing organizational structures, and development of vendor-retailer networks. Producers
essentially earn transitional capacity through an intensive process of knowledge acquisition and dramatic changes in the structures, functions, and ways of thinking within their firms.
REFERENCES


ACKNOWLEDGMENTS

Gratitude is extended to the informants of this study for sharing their knowledge of the apparel industry with the academic community. Special thanks to the staff of the apparel research centers and the apparel industry hosts in Honduras.

This work found its confidence in the expertise of my faculty committee: Mary Littrell, Grace Kunz, Barbara Flynn, Ann Marie Fiore, and Dave Roberts. I thank the other members of the faculty within the Department of Textiles and Clothing for their contributions to my graduate degrees.

The best lesson of my graduate education came from William Logan Bender, whose indirect perceptions taught me how to smooth out life's big equation.
APPENDIX A: DATA COLLECTION INSTRUMENTS
Questions for development of interview schedule

What kinds of strategies does your firm have or is your firm planning to have that will affect its production flexibility?

How much flexibility does your production system have? Is it the right amount for the present? How about for the near future?

What could make your system more (or less) flexible?

What constraints does your company face in becoming more flexible?

How valuable is it for parts of your production system to be flexible, and other parts to be inflexible?
  a). flexibility in obtaining fabrics and trims
  b). flexibility in skills/training of labor
  c). flexibility in process
  d). flexibility of management
  e). flexibility in equipment/technology

In your opinion, does the cost of becoming more flexible justify the rewards? In other words, is flexibility cost-efficient?

Do you think that an apparel production system can become too flexible, to the point of being unstable?

If you could imagine the ideal production system for the apparel business environment of the nineties, what would that system be like? Can you describe it if you didn't have any financial or legal constraints?
Interview Guide for Apparel Production Managers

1. What does "being flexible in apparel production" mean to you?

2. What has been happening in the market and in the industry that is promoting apparel producers to become more flexible?

3. Where do you get information about flexibility? How did you become more informed about it?

4. Which parts of a production system have to change in order to achieve flexibility?

   Probes: Labor (plant locations, training, attitudes, etc)
          Materials (suppliers, lead times, design considerations, etc)
          Process
          Management/Policies
          Technology

5. In what ways are unit production systems and modular team systems more flexible than progressive bundle systems? In what ways are they less flexible?

6. Do you think flexible production systems are more productive than bundle systems?

7. Do you think flexible systems are more profitable than bundle systems?

8. What are the challenges of managing quality in flexible production systems? How do you manage quality in a flexible production system?

9. What is your company doing to become more flexible?

   Probes: Changing production systems
          Sourcing offshore
          Establishing offshore plants or joint ventures
          Technology (EDI)
          Partnerships with vendors/retailers

10. Can you share with me some of the problems and issues that occur in production systems when they change from a traditional bundle system to a different system?

    Probes: Constraints-labor shortage, union rules, financial, materials, equipment, time
            Compensation issues
            Communications-language & cultural barriers
11. What contributes to your company being more flexible?

12. What prevents your company from becoming more flexible?

13. Has there been resistance to change in your company? If so, why do you think people don't want to change?

14. What do you think people need to know in order to become more flexible?

15. Can you describe the most important characteristics of successful apparel producers?
Interview Guide for Consultants

1. There has been an emphasis on flexible production systems in the apparel trade press. What does being flexible in apparel production mean to you?

2. Is it important to be flexible? Why or why not?

3. What has been happening in the market and in the industry to require apparel producers to become more flexible?

4. In what ways are unit production systems and modular systems more flexible than progressive bundle systems? In what ways are they less flexible?

5. Which parts of a production system have to change in order to achieve flexibility?
   
   Probes: Labor (plant locations, training, attitudes, etc.)
   Materials (suppliers, lead times, design considerations, etc.)
   Process
   Management/Policies
   Technology

6. How valuable is it for parts of a production system to be more flexible, while other parts are inflexible?

7. Can you share with me some of the problems and issues that occur in production systems when they change from a traditional bundle system to a different system?

8. What are the most common labor/management conflicts that are occurring within individual companies when they change to flexible systems?

   Probes: Constraints—labor shortage, union rules, financial, materials, equipment, time
   Compensation issues
   Communications—language and cultural barriers
   Quality

9. What kinds of conflicts are occurring in the industry as it shifts to more flexible systems?

   Probes: Retailers
   Suppliers
   Transportation
   Market pressures

10. Can you describe the most important characteristics of successful apparel producers?
APPENDIX B: INTRODUCTORY LETTER
Introduction of Research Project for Personal Interviews

Dear Participant: October, 1994

I am a graduate student from the Textiles and Clothing Department of Iowa State University in Ames, Iowa. This year, I am conducting a research project to learn about flexibility in apparel manufacturing from the perspectives of people who work in the apparel industry. I have selected you for an interview because of your experience and expertise. Therefore, I would like to talk with you in some depth about flexibility in apparel production. Your participation will help me to fulfill my research goals, which are:

1. To explore and describe issues related to flexibility, such as changes in the market and industry that may be requiring flexibility, and issues related to labor, management, materials, quality, productivity, profit and growth.
2. To understand how flexibility issues compare within three different production systems: progressive bundle, modular (flexible work groups), and unit production systems (overhead conveyor systems).

I have prepared a guide to the topics which I want to discuss with you. When I visit you, I may be taking some notes. All records of the information you share with me will be identified by number only. No names will appear on any information from you. Any publication from this research will be written without identification of names, companies, cities, or people.

Because accuracy is of critical importance, I would like to tape record your interview. The information you give me is most valuable in your own words. No one but me and perhaps my faculty supervisor will hear this tape. Any references to people or companies will be deleted from the transcription of the tape. After my research results are complete, all of the tapes will be destroyed. I will be using the information from the interviews to write my doctoral dissertation and one or two research articles.

Your participation in this study is voluntary. I would like you to participate, but if you cannot, I will understand. You may withdraw at any time.

If you wish, I would be pleased to send you a copy of the summary and recommendations of this research. They will be available by next summer. Thank you!

Heidi P. Scheller
(address and telephone)
APPENDIX C: THEME DEVELOPMENT
Theme Development

Emergent Theme: Environmental Diversity

Sample data representing environmental diversity theme:

The other major component, point here is that prices have not been increasing, so, and we've got a very flat market, so we've got a limited number of consumers, prices are not going up, global competition, and so how do you compete in that environment? 223 (market stagnation; price resistance)

Well, the market. The market is more difficult today than it was four years ago, five years ago. I think its more difficult now because of GATT, NAFTA, and so forth. What keeps us apart from everybody else is our ability to listen to what consumers want. Not just the people who come in through the door, but the actual people who wear the garments. 220 (free trade; fashion demands)

Well, your commodity production, mass production, a lot of it has been moving to lower cost, lower labor cost countries, and consequently, the only thing left here, or a lot of what's left here cannot be, where the labor cost issue cannot be offset by the technology. What you are left with are product segments that require, that have a lot of styling and require a high level of diversity, and flexibility in the manufacturing. So what it amounts to, is you either be fast and flexible, or you be outside of this country producing at a lower cost. 223 (segmented markets; fashion demands; time competition; labor costs)

Basically being flexible in apparel production to me means that you are going to survive in this industry. If you are not flexible, ah, the market place, the customer is demanding flexibility. He is demanding that he has the right product at the right time and he has his socks, his color, his style that he wants. If we are not able to produce the flexible production as demanded by the customer, we are not going to be in business. 107 (fashion demands; time competition)

Competition is increasing, ah, specifically in the 1990's, a revolution occurred in which the number retailers decreased and as a result, the number of manufacturers in turn decreased as competition increased. Because of that, it became important to compete on a different scale. Traditional scales include equality in styling and price. All of a sudden, time became the largest issue of competition. 108 (time competition; consolidation of retailing; consolidation of manufacturing)

Codes from first and second order analysis:

<table>
<thead>
<tr>
<th>Market characteristics</th>
<th>Competitive forces</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market stagnation</td>
<td>Free trade</td>
</tr>
<tr>
<td>Price resistance</td>
<td>Labor costs</td>
</tr>
<tr>
<td>Time competition</td>
<td>Consolidation of manufacturing</td>
</tr>
<tr>
<td>Segmented markets</td>
<td>Consolidation of retailing</td>
</tr>
<tr>
<td>Fashion demands</td>
<td>Time competition</td>
</tr>
<tr>
<td>Offshore sourcing</td>
<td>Availability of technology</td>
</tr>
<tr>
<td>Retail power</td>
<td>Vertical integration</td>
</tr>
<tr>
<td></td>
<td>Networking</td>
</tr>
<tr>
<td></td>
<td>Government regulation</td>
</tr>
</tbody>
</table>
Theme Development

Emergent Theme: Demand Variation

Sample data representing demand variation theme:

because what we see our customers headed towards is more personalized products, but not at the expense of what custom made or tailor made clothing has been as that connotes high and very expensive. You are going to pay if you are going to get something tailor made, but yet people want things that are customized for their own individual likes and designs and in an agile environment, an organization can respond to those requests, those requirements and the term that is being used with that is mass customization and that does not connote high price in the same way that tailor made does. So, to me being flexible is being able to respond to the changing demands of the customer, whatever that is and the time frame in which we have to do that is becoming shorter and shorter. 104

They are demanding more accurate forecasts. They are demanding the EDI systems to be in a, just a continuous link-up with what is going on in our ordering systems, out shipping and all that, ah, so it is going hard core in the other direction. They want to know exactly what we know. So we have better responses. 208

Well, there are shorter lead times that is demanded by the retailers and also they want to be able to change and to buy closer to the season to improve their throughputs and this is seen as an advantage when they can buy closer to the season. 206

The retailer is directed by the consumer to have the right product at the right time and in many ways, the consumer is pushing the retailer who is pushing the producer/manufacturer. 107

The biggest problem in the intimate apparel industry right now is that the retailers put us on sale way too much, so the customer doesn't know to come in and buy anything at regular price, they just wait for the sale. It's kind of like buying sheets. 224

Retailers are pushing the whole thing and basically, they don't really care about flexible systems. All they want is as cheap as can be on time. 108

The customer is driving it. They want more choices, they want to buy fewer of those choices. Instead of buying 10,000, they want to buy 20 different products, and maybe buy 100 of each one of those. 216

Women are going to work in more casual type of clothing. It's not any more the suit. If you are a professional woman, it could be relaxed knit bottoms with pockets. The ability to get there faster and work with people, like (name), the style is good, but you also have to understand this is your market also, part of that cycle. 220

there's more interest in unique corporate identity now, and that demand is growing exponentially. People are no longer satisfied with a uniform that looks just like company B or company C, they want a unique corporate image. 217
Theme Development

Emergent Theme: Sourcing Variation

Sample data representing sourcing variation theme:

Yeah, we are sourcing more and more offshore, in China. Really trading all over, trying to get more of a better base in sourcing, so we can adjust to the market conditions. 209

In applying this to flexible manufacturing, modular manufacturing, most people initially think of supplying people and equipment. You have to have people that are cross trained. Therefore, flexible people have to have flexible equipment. The one thing I think, in addition, means that flexibility regard to partnering that is in place and partnerships that have to be in place to receive the appropriate information as to what needs to be produced and two, you have to call on people that you don’t generally have those capabilities. You have to go out of house for someone that does, and having that network set up such that you can, responds to the needs, whether or not you can produce it in house or not. Traditionally, we thought of, “Well if I can’t do it, within our four walls, I can’t make money at it” and I can’t do it, too hard to control and this and that. That’s is not necessarily true. 105

A lot of it obviously is gonna rely on what kind of product you are making and how quickly you can get the raw materials. That’s a big, big part of it, because you can have a plant that can turn things around, but if you can’t get the parts, you might as well forget it. But you do have to have a plant. So, part of it is standardizing what you are doing. What kind of equipment you have ahead of time, I mean, one of the things that leads to flexibility is not only using your own plant, but having access to using other people’s plants, if you need it for a special item. And having those kinds of relationships. A lot of people do use contractors. In fact a lot of people in the dress business don’t even own their own plants, they just use a series of contractors. And if x number of dress is hot and its got a certain type of stitching, they put it in this plant, and vice versa, and so the amount of flexibility they have really depends on the relationships that they have developed with these different plants, and obviously with their raw materials suppliers, you know their fabrics, mostly their fabric people. 224

Ah, we are doing extensive off shore purchasing of finished goods, that is all over the world, we can’t give you the name of the countries, it is extensive. So that, that gives the flexibility in regards to supply of a particular item, we had it made by a couple of different suppliers which is great, but it creates another problem. It is all right if variability in their products, but the flexibility from that aspect, yeah, it helps very much. We are very diversified in our supplier base as well. Different suppliers find the same component, but again you do have small degrees of variation which is not always controllable. 208

I think what the real, the real key here, also, that you have not mentioned in any of these questions, is the concept of flexible manufacturing as applied to the overseas market. If you can get 2 and 3 day turns, let’s say on merchandise out of the Caribbean Basin at 10 cents on the dollar, I think that will be an unbelievable area for growth and eventually will catch up to the United States and just bury us. 108
Theme Development

Emergent Theme: Planning Variation

Sample data representing planning variation theme:

The other way is in scheduling, some of the front end aspects of your business, the back end aspects of it is the planning. When you have 8 weeks worth of work in process and a tremendous amount of cuts to manage and so forth, you can't, most manufacturers with that much in process, and that many variables are going to have, and quality was one of things ___ was talking about. They can't tell you to within 15 minutes of when a cut is going to finish. They are lucky if they can tell you within a couple of days when that particular work is going to finish. You take all of that out, streamline it, reduce all the work in process and production planning and scheduling and so forth, can literally know within a matter of 15 minutes when a particular product is going to be finished. You can run that much closer to the manufacturing process so it makes those jobs, it allows you to do a much more accurate, I am not going to say it is easier, because it changes the way that you schedule and that might be what makes you that much more accurate in your abilities to determine that. 105

any given order is likely to be different from another-no two individuals are the same. So the degree of customization, or the amount of work that must go into an individual's order varies day to day, and in such a way that you can't really predict anything. 222

I guess in a system like that, what you probably have to do is you would have to, of course, plan and think of things that would possibly come up with that. Maybe like getting more mechanics trained and uh, having them assigned to a specific module and that module only. 207

I guess companies would kind of have to think ahead and foreplan, you know, for things like that.

Flexibility means that basically, you cannot micromanage, getting down to the old scheduling and production control techniques that were used in apparel manufacturing. When you are introducing wide variety of styles and product into, we used we be looking at, the only real style change in a factory twenty five years ago was a thread change, (now) it's thread, fabric, style, as well as product. 223

We used to think flexibility was in place if you could change a plant over in six months, then you were pretty flexible and then that went to six to eight weeks and now it is down to a couple of weeks that you need to be able to respond, you need to be able to change. You see that really beginning to happen on a daily basis, product by product where the next one you make might be slightly different and as long as you have the information about it and the tools that you need, then you will respond to it, the ultimate in flexibility. 104

Constantly, every single day, one of the biggest that I run into from a planning standpoint is that people don't plan the production and lead time into merchandising. And even though we are in fashion industry and fashion turns quickly, the plans, designs, and table, the lead times are incredibly long. We've already put to bed Fall of 95, its already done and planned and the orders, materials, etc. As an example, I just looked at a dress just on Friday, a maternity 2-piece outfit and the production sample was tested in our test lab in March. 200
Theme Development

Emergent Theme: Process Variation

Sample data representing process variation theme:

As far as flexibility, our company has gone to teams, teamwork, everything is teams and teamwork. Managers are teams and teamwork attacking problems, in a team approach rather than an individual, which makes it, gives us different angles to each problem, solves problems quicker. 216

We use a system where various operators will do various jobs, and various parts of jobs. We don't run a bundle system. An operator may do a whole job, may do part of a job. The concept that we use is whatever it takes to get the product out the door, is what we have to do. That's part of our being flexible. 203

Everything has to change. Everything means from our raw materials, supply deliveries, integral parts, you cannot plan a little JIT without having supplier involvement and discipline and commitment, you know, so raw materials is the first thing they began to change and we couldn't understand what our customers, everything revolves around the customers, of course, by what their demands are, so we had to get them on board, our manufacturing means in regards to the work centers again, okay, having small companies within the big company, to, run specific styles, ah, that can be worked with that type of equipment, you know, ah, that obviously reflected to a management change and thinking, employee change and thinking. 208

If you're doing the same thing over and over again, like (name) blue jean, I can't see that unit production is going to be any more profitable, or any more flexible than progressive bundle. If you have a number of different products that you are wanting to run at the same time, I can envision that you would have four or five different assembly lines set up on a flexible manufacturing concept and you would be able to achieve a much quicker throughput than running one thing through progressive bundle environment, and then the next thing and the next. It's, when you change styles in a progressive bundle environment, it's very disruptive. 217

You've got to be flexible enough to change around your operation. Sew that fabric, press that fabric and meet that customer's desires. Who knows? Maybe it's not gonna work out long-term, maybe the cost is not gonna work, and the people are gonna change, and next year, we're not gonna be doing wrinkle-free, or two years from now. That's the hot thing right now. As you noticed one of the plants their building a big end on, that's for wrinkle-free. It's the hot thing right now. 211
Theme Development

Emergent Theme: Product Variation

Sample data representing product variation theme:

Saturday, I was on the phone with someone talking about producing an item for their line, like (designer name) does some bags and we've done some of their dresses and tops and they called us and said, "Can you do some bags for me?" And I know what (name) would say, "We really don't want to be in the bag manufacturing business." And they faxed us, and I sat down with (name) the other day and I said, "(Name) why not? It's only a couple thousand, you know we've got 5 or 6 people sitting around in subassembly, why not?" It's that type of mentality that keeps us alive. Whereas most manufacturers will say things like "All we do is pants. We don't want anything but pants." Or "Tops, all we do is tops." We're like, "Baby clothes for (another designer name)? What do you think?" "Let's give it a shot!"

Well I think the thing that we tend to deal with today is in the old days, people did not make, if you were a knit product plant, you didn't make wovens. If you were wovens, you didn't make knits. We are seeing a lot of those boundaries falling away. For instance, on rugby shirts, you've got woven collars on a knit shirt.

Where Americans and domestic suppliers can still do a decent business, is by doing the high fashion stuff that they can, if something's hot today, they still, because everything's close by can make garments quickly.

I see changes in the area of fabrics, more so than designs, also in the type of products that we're offering. We're getting into a GoreTex clothing, we're getting into a line of flame retardant products for fire departments, as well as our traditional uniform clothing for police, fire and postal.

Well, domestic suppliers really have to become more flexible in order to be able to compete anymore, because on any kind of a basic styles, retailers themselves, much less other manufacturers can go offshore and program that kind of business out a year in advance. A pair of shorts, it's not gonna change from year to year. The color might change, but you're still gonna have cotton twill shorts, and so... A perfect example is many of the retailers will go, and they know that they sold x number of dozens of this short last year and so what they might do is they are going to run the same short next year, but they may just make a slight change maybe in the color, they might change the belt they put on it, or the button close or some thing, but in essence, they may not change the pant at all, they may not even change the fabric. So they can go to the Far East and plan that a year in advance, and know it's a pretty stable business.
Theme Development

Emergent Theme: Structural/Functional Variation

Sample data representing structural/functional variation theme:

But, for dresses and sportswear, people that are trying to turn items quickly, obviously with relationships with their own contractors, and supplementing it obviously with a plant they own themselves, that may have the equipment that does the special trimming, maybe binding is important one season, piping or something, and you have to have special sewing equipment to put that on. So, either having that yourself or having relationships with people that can do that for you is obviously gonna add to your flexibility. 224

And that is again that goes back to production planning and forecasting, but also how work is scheduled from orders, or whether its on a QR mode, kind of situation. The first component supporting this has to be the system side, and we are, our mode of operations, typically we try to improve the manufacturing processes without getting ample systems support to make it more flexible, to support it. That has been one of the missing links. 223

There is an adversarial relationship between vendors and manufacturers and that has to stop. The walls have to break down between the vendor to the manufacturer to the retailer. Absolutely. All the things that go to make a garment, there has to be a team concept across different companies being the vendor to the manufacturing. You have got to kind of open up yourself to the and, and let them know that you have got to have this and this is the reason why because some say that maybe the best situation is that you produce the garment and know where it is until it is sold. That is very vertical.

Today, you are looking at more of a flat line management system, everybody manages from one level, although it has to come from top down. All the way down. 220

Yeah, we have gotten everything closer together. Ah, instead of having different divisions, we are all under one division now. We are more flexible than we used to be. One factory can, you know, they can adjust to what the other factory has made, like we have our uppers being made in one place and other stuff in another place. With better communications, we can adjust quicker and be more flexible. 209
**Theme Development**

**Emergent Theme: Flexibility as Transitional Capacity**

Sample data representing flexibility as transitional capacity theme:

The ability to revisit the way of doing things. In other words, challenging the process that they are currently employing constantly, will be probably the most essential element in their future success. Abandoning the old, traditional, tried and true methods is gonna be an absolute necessity. Ahh, and there are a few around that do that. 222

Well, directly related to manufacturing, it would refer to the flexibility of a manufacturing or assembly line to adjust from product line to product line. 217

Flexible manufacturing, also could deal with the flexibility of working with contractors, working with vendors, different sourcing, offshore, to basically streamline and prepare on a real-time type of basis or just-in-time type of basis to supply your needs. 217

Different styles, different, you know, all licensed and different products like that and fast deliveries. That's what it means to me. 218

It's our philosophy, it's just the way we decided to build our company. We decided very early on to not have a product line, we only have a capability, so when we have a customer that comes to us and they want a widget cover, we can't say "Well, which widget cover do you want?" But we can ask them how they want that widget cover built and it's all, everything is customized to what they want. We try to address the customer's needs. 203

Being flexible to me means having the ability to deal with a wide variety of styles, as well as some cases, being able to deal with a wide variety of products. 223

I think that you should be open to new ideas, producing the garment in the best way, the best way from a cost standpoint, from a people standpoint, and from a time limit standpoint. 205

Basically being flexible in apparel production to me means that you are going to survive in this industry. 107

Being flexible in apparel production is the ability for a company or entity to meet the market demands. 108

Most important characteristic. The ability to shift with change of situation. You have to be flexible in your approach. Now, I am not talking about flexible in terms of the way you are talking about it. I am speaking of it in terms of flexibility to do whatever is necessary, fly in goods if necessary, to react to what needs to happen and to have your line managers also be able to react to what needs to be, you know, happening. 108

To us, information. That is the bottom line. We can do whatever we need to do, but we need the proper information, the proper information has to be routed forwarded to the next people who need that information. We try something new. We want to make sure that we take into consideration the ramifications for the next person and maybe even two people down the line, but it is all information as far as being flexible. We need the information from sales and scheduling early enough to make the right arrangements, training, machinery requirements,
get those things set up, so it is information, would be #1. It is important.

Everything has to change proportionally. If anything you do in management has got to fall all the way through to production and every other facet. You just cannot change one item. If you change a production to be highly mechanized and technically oriented, you've got to educate and retrain to better manage the technology and the people. It's a balance. I guess its sort of a weird way to explain it, but when you build a race car, the carburetor has to balance out with the motor and the exhaust. Your management team, if you build a technology center that can produce an item very quickly and efficiently and you have to train your management to train the people how to use the equipment, the technology efficiently. If you don't make the training fall all the way through, then, there's a miscommunication all the way through. You can't expect production to understand what management wants.

We've got 53 retail stores and we have gone through a major transition in our data processing department going off of maybe a 20 year old system or a ten year old system and upgrading to an AS400 with EDI capabilities.

Because our disciplines, manufacturing and distribution are relatively new in the way they fit into the company, I think we're less encumbered by our successes, so we don't keep visiting those, because we've changed it so radically. We don't have a past reference point anymore. I would say, that, we in the manufacturing and distribution phase of the business are much more open minded. Customer driven is an essential driving force throughout the whole company. And certainly was a large element in our changing.
Theme Development

Emergent Theme: Barriers to flexibility: Structural, functional, & cognitive

Structural barriers

Sample data representing structural barriers theme:

Management hasn't changed that much. We still have the same type, we have the same structure, you know organizational chart, that really has not changed a great deal. 202

And the bureaucracy, the management style that we had, the autocratic style, where people had to wait for the decision to be made at the top level today just can't exist, it can't work, it's not working. 223

That will have to change, we'll have to be what you call flat organization to make other parts of the company more flexible. 202

Functional barriers

Sample data representing functional barriers theme:

We personally tried the modular system and it didn't work for us. Maybe it's partly the way we put it together, and maybe we needed more management involved in it, but we found that we had people do work in a group and paid. And what happened was the good people worked hard, and were paid the same amount as the people in the group who didn't work hard, the good people got upset about this, and quit, and left us with the bad people. So, we have now gone back to paying people based on what each individual person does. 224

So that there are companies, that I'm afraid are in deep trouble today as they have seen their explosion in styles, explosion in SKU's and they have not changed their manufacturing processes, they are in real trouble. They are incurring high costs, what we call high direct labor variance, underabsorbed overhead, wide discretion in earnings, a big difference between earnings one week and the next week, and consequently it causes a very unhappy workforce, low morale, high turnover, high absenteeism, all great things that go with that. And they trying to use 1950 processes and systems to deal with the new millennium's production requirements. 223

Again, when we talk change in our organization, we are generally talking about change for the shop people, and it's hands off for everybody else. 202

Cognitive barriers

Sample data representing cognitive barriers theme:

I tend to think there are three major problems when people change from one to the other. Number one, they grossly underestimate the time required to evolve from one process to the other. The training that's required for people to assume a greater level of responsibility, and so consequently what happens is a lot of people just miss estimate I guess, or grossly underestimate the time required for this to happen. We're talking years, not months. And, that's one problem. Second problem is the level of sponsorship that comes down through the
organization. And if you have someone who believes that this is the right thing to do, either from a business strategy or from a human strategy sort of thing, are they prepared to sponsor this through the long process that I just talked about, in terms of getting it implemented. They sometimes lose their enthusiasm and move on to another flavor of the month. That I guess is kind of the second major problem that I run into. The third, is not really have an understanding of what they are trying to achieve, redesigning process there's unlimited types of combinations that you can put together between modular, quick line, UPS, and other linked processes, and the objective are trying to, there's not really a clear vision of what they are trying to achieve. "Do we need two days throughput time at this much cost per SAH, do we need this, do we need that?" It's really... a lot of people have gotten into it just thinking it's one way to achieve some downsizing, a way to achieve some reengineering, and maybe a way to cut costs. But they really don't have a real vision of what they are trying to achieve.

Look at the apparel industry ten years ago and look at the apparel industry today. We are just barely coming out of our shell. It's the ability to invest, and that's what we say. The technology is out there, the problem is that the old mentality of "I'm just going to build it, my machines are my machines, a single needle is a single needle, if I need a trimmer I can have the human body do it. Nowadays, we can just walk away from that. Why have somebody trim it when we have a machine that can do it? We've tended to be, I think, tended to be somewhat cynical, but we've spent a lot of time visiting our past successes, and a lot of time praising ourselves at how well we've done in the past. I think it's a danger signal. I think it's something that senior management has to overcome.

I think very simply that there's a comfort zone that people establish, saying "You know, I became famous, and this is a world-class company because I did these things. Now, you want me to change those things that made me successful? That'd be crazy!" That's what does it. I think, the more experienced, the more successful... The thing that really hit me the other day, was success is the greatest enemy of long-term profitability. Now, do you understand what I'm saying? So, our past success, and we are really one of the most successful companies in America could be the foundation of future failure if we don't evolve.

Well, 20 years ago when you were in manufacturing, you manufactured, and they bought what you manufactured. The complete shift is now they tell you what they want and that is basically going now in a virtual way, they not only tell you want they want, but they tell you when they want it and how much they are going to pay you for it and those things create major problems and attitude in thinking of the managers that have to deal with this. They have, some can never deal with it. And unfortunately, because of their manufacturing experience and education, unfortunately, they send many companies down the tubes. It is sad to say, but it does happen.

It (technology) doesn't necessary have to change, but the way you look at technology changes. We used to look at it as something that had to be maximized, that you had technology efficiencies in the same way you looked at operator efficiencies, so you wanted 100% machine utilization in order to be 110% machine capacity. And the flexible manufacturing, the goal is to provide what the customer wants in a very short period of time. That doesn't necessarily mean that you will be running equipment 100% of the time. You only run equipment when you need it rather than run it for the sake of running it, so in the
past, much of our inventory problem came from the fact that we were trying to keep machines running 100% of the time even when we didn't have orders for their production. We would gamble on it, oh, well the orders will be coming. 105

Right now we're still, well when you talk about flexibility, you are talking about manufacturing, you're not talking about me a designer or me an R&D person or me in maintenance, or sales ... salesmen. We don't touch the sales force, they get to continue, yet they could benefit by being more flexible. 202

Flexibility in terms of thought processes, would get so locked in to the way things have been that there is just a very strong resistance to change and flexibility connotes change, it means change and so if you are going to be successful, you have to be able to accept whatever it is that is coming along, whether it is new equipment or new systems or new ways of tackling the old problems. 104
APPENDIX D: HUMAN SUBJECTS REVIEW
Information for Review of Research Involving Human Subjects
Iowa State University
(Please type and use the attached instructions for completing this form)

1. Title of Project: Dimensions of flexibility in apparel production

2. I agree to provide the proper surveillance of this project to insure that the rights and welfare of the human subjects are protected. I will report any adverse reactions to the committee. Additions to or changes in research procedures after the project has been approved will be submitted to the committee for review. I agree to request renewal of approval for any project continuing more than one year.

   Heidi P. Scheller 5/1/94
   Typed Name of Principal Investigator
   Date
   Signature of Principal Investigator

   Textiles & Clothing 1052 LeBaron Hall 294-2628
   Department Campus Address Campus Telephone

3. Signatures of other investigators

   Date
   Relationship to Principal Investigator

   Mary Lustbee 5/2/94 Major Professor

4. Principal Investigator(s) (check all that apply)
   □ Faculty □ Staff □ Graduate Student □ Undergraduate Student

5. Project (check all that apply)
   □ Research □ Thesis or dissertation □ Class project □ Independent Study (490, 590, Honors project)

6. Number of subjects (complete all that apply)
   50 # Adults, non-students  # ISU student  # minors under 14  # minors 14 - 17

7. Brief description of proposed research involving human subjects: (See instructions, Item 7. Use an additional page if needed.) Managers, sewing operators, and consultants in the apparel industry will be interviewed about issues related to flexibility in producing apparel. Two apparel research facilities will be toured, along with a variety of apparel production plants within the United States. Interviews will be tape recorded and content analyzed for themes relating to the objectives of the study.

(Please do not send research, thesis, or dissertation proposals.)

8. Informed Consent:
   □ Signed informed consent will be obtained. (Attach a copy of your form.)
   □ Modified informed consent will be obtained. (See instructions, item 8.)
   □ Not applicable to this project.
9. Confidentiality of Data: Describe below the methods to be used to ensure the confidentiality of data obtained. (See instructions, item 9.)

Interviews will be held in private areas, where others cannot hear responses. Transcribed tapes will delete all names of people and firms that are referred to. No names of respondents will appear on transcriptions. Transcriptions will be identified by a coded number that only the researcher can identify.

No information will be provided to respondents about how others in the study responded at the time of data collection. Respondents who so wish may receive a summary of the study's results.

10. What risks or discomfort will be part of the study? Will subjects in the research be placed at risk or incur discomfort? Describe any risks to the subjects and precautions that will be taken to minimize them. (The concept of risk goes beyond physical risk and includes risks to subjects' dignity and self-respect as well as psychological or emotional risk. See instructions, item 10.)

None.

11. CHECK ALL of the following that apply to your research:
   - A. Medical clearance necessary before subjects can participate
   - B. Samples (Blood, tissue, etc.) from subjects
   - C. Administration of substances (foods, drugs, etc.) to subjects
   - D. Physical exercise or conditioning for subjects
   - E. Deception of subjects
   - F. Subjects under 14 years of age and/or Subjects 14 - 17 years of age
   - G. Subjects in institutions (nursing homes, prisons, etc.)
   - H. Research must be approved by another institution or agency (Attach letters of approval)

If you checked any of the items in 11, please complete the following in the space below (include any attachments):

Items A-D Describe the procedures and note the safety precautions being taken.

Item E Describe how subjects will be deceived; justify the deception; indicate the debriefing procedure, including the timing and information to be presented to subjects.

Item F For subjects under the age of 14, indicate how informed consent from parents or legally authorized representatives as well as from subjects will be obtained.

Items G & H Specify the agency or institution that must approve the project. If subjects in any outside agency or institution are involved, approval must be obtained prior to beginning the research, and the letter of approval should be filed.
Checklist for Attachments and Time Schedule

The following are attached (please check):

12. ☐ Letter or written statement to subjects indicating clearly:
   a) purpose of the research
   b) the use of any identifier codes (names, #’s), how they will be used, and when they will be removed (see Item 17)
   c) an estimate of time needed for participation in the research and the place
   d) if applicable, location of the research activity
   e) how you will ensure confidentiality
   f) in a longitudinal study, note when and how you will contact subjects later
   g) participation is voluntary; nonparticipation will not affect evaluations of the subject

13. ☐ Consent form (if applicable)

14. ☐ Letter of approval for research from cooperating organizations or institutions (if applicable)

15. ☐ Data-gathering instruments In development—will submit later.

16. Anticipated dates for contact with subjects:

   First Contact                             Last Contact
   June 13, 1994                             August 15, 1994
   Month / Day / Year                        Month / Day / Year

17. If applicable: anticipated date that identifiers will be removed from completed survey instruments and/or audio or visual tapes will be erased:

   May 1, 1995
   Month / Day / Year

18. Signature of Departmental Executive Officer

   Mary Littrell
   5/12/94
   Textile & Clothing

19. Decision of the University Human Subjects Review Committee:

   ☐ Project Approved    ☐ Project Not Approved    ☐ No Action Required
   ☑ Project approved with the understanding the interview schedule will be submitted when it is completed.

   Patricia M. Keith
   Name of Committee Chairperson
   5/18/94
   Signature of Committee Chairperson

GC: 1/90