

Mass Customization in the Apparel Industry using New Technologies

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Abstract

The purpose of this study is to define mass customization in the apparel industry and to discover the apparel industry's potential to deliver customized apparel products. Different from product-centered mass production, mass customization is focusing on customers' unique needs. The goal of mass customization is for customers to find exactly what they want at a reasonable price. Using new technologies such as 3-D body scanning and digital printing, mass customization can give customers customfit and personalized garments. Mass customization can satisfy a customer in terms of personalization, fit and design. Adoption of mass customization will open new opportunities for the apparel manufacturer of the future. Mass customization is a strategy that apparel manufacturers should consider for their goals.

Key words : mass customization, customer, 3-D body scanning, digital printing, personalization, customfit.

I. Introduction

To compete in the global marketplace, manufacturers are adopting mass customization as a means to be more responsive to their customer's needs. Mass customization, a new paradigm, allows customers to create their own products and manufacturers to individualize their products.¹⁾

The purpose of this paper is to define mass customization in the apparel industry, and to discover the apparel industry's potential to deliver customized apparel products.

Apparel companies are being faced with

higher competition than ever before, and having difficulties in forecasting because fashion trends are moving so fast and customers' needs change so quickly. Now it's time for apparel companies to look for different business strategies to define themselves in this changing business environment.

New technologies such as 3-D body scanning, digital printing and laser cutting allow apparel manufacturers to deliver one customized clothing cost effectively. Thanks to internet technologies, apparel manufacturers can communicate better with consumers and within the organization. Apparel manufacturers can now establish direct contact with customers to learn what they

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¹ Ledna Jo Anderson et al., eds., "Discovering the Process of Mass Customization: A Paradigm Shift for Competitive Manufacturing", *National Textile Research Briefs* (March, 1997), 21.

desire in products. Mass customization can be utilized as a competitive business strategy with a focus on the development of a consumer driven model.

This study will research on the paradigm shift from mass production to mass customization, the new technological developments which enable mass customized apparel, and three categories of mass customization for apparel. I assumed personalization, fit, and design as three categories in which apparel customers can benefit from adopting mass customization.

This study inquires into the theories of mass customization and examples of leading apparel companies which adopted the mass customization strategy. This paper will foster a proactive approach to launching mass customization in the apparel industry.

II. Mass Customization and the Apparel Industry

I. From Mass Production to Mass Customization

Unstable economic climate, changing consumer needs, and new emerging technology have challenged the existing manufacturing paradigm of mass production.²⁾ For more and more industries, 'mass production' is out and 'mass customization' is in.

Mass customization can be defined as manufacturing one-of-a-kind products to a customer's exact configuration requirements with the same efficiencies expected for a mass-produced product.³⁾ Mass customization calls for a customer-centered orientation in production and deli-

very processes, requiring the company to collaborate with individual customers to design each one's desired product or service, which is constructed from a base of pre-engineered modules that can be assembled in a myriad of ways.

In contrast, product-centered mass production calls for pushing options into distribution channels. Inventory is built in anticipation of potential, yet uncertain, demand. Forecasting becomes the critical activity. Even if companies can accurately forecast their total finished-goods-inventory requirements, they can err in their projections of exactly which goods will be needed at which locations and at what times.⁴⁾ Mass customization minimizes costs by not keeping inventories of finished products. Instead, they stock raw materials or component parts and then make finished products only in response to the actual needs of individual customers.

To understand the differences between the mass production and mass customization system, the concept of consumer sacrifice must be understood. When manufacturers shifted from craft manufacturing to mass production, the customer could purchase only products the manufacturer decided to offer and build. In exchange for limited choices, the customer would be rewarded with lower prices.⁵⁾

Consumer sacrifice is the gap between what each customer truly wants and needs and what the company can supply. This gap is the place to start customizing where customers experience greatest sacrifice, "the cost of one-size fits-all." The purpose of customizing must be to decrease customer sacrifice, and decrease it at least

² Ledna Jo Anderson et al., ed., "Discovering the Process of Mass Customization", <http://www.humsci.auburn.edu/ca/-ca.old/html>, 2002. 1. 15.

³ Gardner & Associates Consulting, "Mass Customization : ERP Implementation challenges what to do about it", <Http://www.gardnerandassoc.com/ERPMCCChallenges.html>

⁴ B. Joseph Pine II, Don Peppers, and Martha Rogers, "Do you want to keep your customers forever", in *Market of One* (Boston: A Harvard Business Review Book, 2000): 55-58.

⁵ Gardner & Associates Consulting, *op. cit.*

⁶ James H. Gilmore and B. Joseph Pine II, "The Four Faces of Mass Customization", in *Market of One* (Boston: Harvard Business Review Book, 2000): 124-125.

enough that customers are wooed away from competing offers and locked into the customized alternative.⁶⁾

To identify dimensions of sacrifice and then create significant value for each customer became easier thanks to new interactive and database technologies. As information about individual customer needs and preferences is collected and filtered back into the supply chain, the product development process will incorporate this feed back and become more customer-centered.

2. Mass Customization in the Apparel Industry.

Mass customization is not appropriate for every market. Joe Pine addressed, "those companies whose markets are highly turbulent because of factors like changing customer needs, technological advances, and diminishing product life cycles are ripe for mass customization."⁷⁾ For apparel industry there are great opportunities to add value through mass customization.

Since the apparel industry is seasonal and trend-based, its products have a limited life span. Michael Cheshire, CEO of Gerber Scientific, said, "Since apparel wear typically has five seasons, which overlap, many retailers overproduce, then either force the overage back onto the manufacturer or offer huge discounts and sales, to make way for incoming merchandise."⁸⁾ And more and more the seasons are divided, trends are moving faster, product cycle is becoming shorter, and costs for stock of ready-to-wear garments are soaring. Because forecasting is not done correctly, companies miss

potential sales and profit erodes.

Apparel customers have complex individual tastes. Every customer has a different physical appearance and his taste on fabric, color and shape is diverse. And there are growing demands of dissatisfied customers who are demonstrating an increasing desire for their own look, their own feel and their own fit.

Apparel sales on the internet calls for mass customization. Fit and trial issues and difficulties with color and texture perception on computer monitors continue to be problems that keep the internet sales relatively low compared to the total market.⁹⁾ But new technology such as 3-D body scanning and electronic catalogue which simulate near-human forms and characteristics will improve the fit and trial problems. Using these new technologies, mass customized apparel sales on-line will grow.

Mass customization can make the production life cycle shorter, cut inventory and brings extra value to the apparel company and customers. Mass customization will be one key strategy to establish a win-win situation in the highly competitive apparel market.

Levi Strauss is a successful example of adopting mass customization. In 1995 Levi Strauss introduced the 'Personal Pair' program for women. It boosted repeat purchases to 38%, more than triple the repeat purchase rate on other Levi's products. The company has since expended the customization strategy to the vital youth market, under its Original Spin banner.¹⁰⁾

Brooksbrothers Digital Tailoring offers diverse items such as suits, sports coats, blazers, pants and dress shirts. Customers can choose

⁷⁾ B. Joseph Pine II, Bart Victor, and Andrew C. Boynton, "Making mass customization work", in *Market of One* (Boston: Harvard Business Review, 2000): 156.

⁸⁾ "Surviving validity, A dialogue with industry experts, Joseph Pine and Michael Cheshire", *1 to 1 Marketing*, February 2000.

⁹⁾ According to the results from the 1997 Cyber Shopper Survey conducted by the Cobb Group, the sales of apparel via internet were sixth in volume behind software, books, computer hardware, travel and CDs/videos. Teri Ross, "Made-to Measure: Finding a 'Fit' with the industry", <http://www.techexchange.com/thrlibrary/madetomeasure.html>, 2002. 1.25.

¹⁰⁾ Martha Rogers, " You Can Learn From These Blue Jeans", *Inside 1 to 1*, 12 April 1999.

fabrics, styling details and can have custom made items within 3 weeks at a little extra cost.¹¹⁾

Besides the obvious tailored suits, shirts and jeans, a growing number of companies are experiencing mass customizing for swimwear, wet suits, uniforms, costumes and footwear. Still in its embryonic stage, leading apparel companies are looking for possibilities in mass customization.

III. New Technologies

There is a growing number of tools becoming available to both facilitate and automate mass customization. 3-D body scanning, digital printing, computer-aided design and pattern making, data mining and flexible manufacturing are technologies which are moving manufacturing toward mass customization. Among them 3-D body scanning and digital printing are key enabling technologies for creating individualized products.

1. 3-D Body Scanning

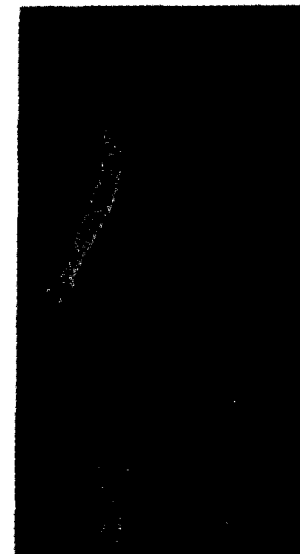
3-D body scanning is emerging as a method of collecting body measurements to be used in the development of patterns for customized apparel. Through body scanning, a three-dimensional image of a person's body is captured electronically. Current major scanning systems are using either light or laser. Image Twin, Hamamatsu, and Telmat are using light, and Techmath, Cyberware, and 3-D Scanner are using laser.

Joint venture with Image Twin, a leading 3-D body scanner provider, U. S. Government industry alliance The Textile/Clothing Technology Corp (TC)² developed a body scanner with initial focus for the apparel industry. (TC)²'s body scanner uses the white light phase measurement profilometry (PMP) approach.¹¹⁾

A captured image translated into a 3-D point cloud (fig. 1). The PMP method employs white



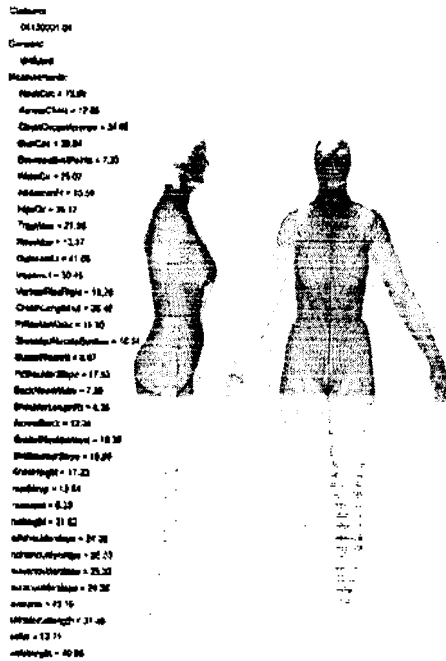
<Fig. 1> 3D Point Cloud Generation.



<Fig. 2> Point Data Reduced and Body is Segmented.

light to impel a curved, 2-dimensional patterned grating on the surface of the body. The system can collect 400,000 data points. The point cloud data is reduced and the body is segmented in

¹¹ <http://www.brooksbrothers.com/digitaltailor.html>, 2002. 2. 5.



〈Fig. 3〉 Automatic Measurement Extractor.

order to determine the appropriate landmarks for measurement extraction (Fig. 2). 〈Fig. 3〉 is an extracted measurement data set. From the 3-D point cloud, a possible 128 measurements may be extracted for input to a pattern alteration system. The altered patterns are placed in a marker, and garments are cut and assembled. In the 3D Body Measurement System, the data flows through five major processes¹²⁾:

- 1) 3-D body scanning
 - 2) 3-D point cloud generation
 - 3) measurement extraction and output file creation
 - 4) 2-D pattern alteration heuristics and marker generation
 - 5) 2-D to 3-D garment generation
- Numerous apparel CAD packages have made-

to-measure or pattern alteration functions which can be used in concert with the scanner based measurements. A problem exists in the consistency of measuring techniques between scanners. Since there are no standard formats for transmission of body scan data, a recipient cannot know that they received the critical measurements needed. We need to have some common definitions or signs of body landmarks to describe pattern generation methods and later to match points when moving from 3 D- body scanners to pattern generation/alteration on a CAD system.¹³⁾

Through the 3-D body scanner, body measurements are done without contact, instantly (10~20 seconds) and accurately. Electronic measurement data can be kept on file by a company so that subsequent purchases by the same client can be altered with ease. Personal measurements and fit preference can be translated to a portable digitized format like a "smart card". A "smart card" which keeps a customer's accurate personal measurement can be conveniently used for on-line apparel shopping or for shopping at the company's different stores which have no body scanner. A smart card can be used as a marketing tool to build a consumer's loyalty. It will increase the number of frequent purchasers.

2. Digital Printing

Digital printing is the process of creating prints generated and designed from a computer, as opposed to analogue printing, which requires screens and printing plates. The integration of digital textile printing into the apparel supply chain is instrumental to the ability to provide mass customized printed apparel.

Sewn products which manufacturers typically issue orders months in advance of production also require minimum purchase quantities. Digital printing reduces traditional order to

¹² Karla Peavy Simmons, "Body Measurement Techniques" (Ph.D. diss., North Carolina State University, 2001), 4-8.

¹³ C. Carrere et al., eds., "Automated Garment Development from body scan data", *National Textile Center Annual Report* (November 2000) : 2-3.



〈Fig. 4〉 Digital Printing by Inkjet Technology.
The Inkdrop Boutique.

delivery times' and it eliminates the minimum purchase quantities, which in turn greatly reduces the risk.

Japanese textile printer, Seiren offers 'the multimedia shopping system' that allows customers to create their own, original products. While Seiren's printing process is believed to cost two to three times that of conventional rotary screen printing, the company is trading money for time. Furthermore, production according to actual orders protects any remainders to be sold at discount.¹⁵⁾

Electronic technology, Ink jet technology, Thermal work transfer technology are three major printing technologies. Among them, the most promising digital printing technology for the apparel industry is ink jet printing. There are two primary categories of ink jet printing. One is called continuous stream ink jet printing because the machine creates a continuous stream of drops that are either deposited on the substrate or deposited in a gutter to be recycled. The other method, called 'drop on demand', creates individual drops of ink only when they

are needed at the substrate.¹⁶⁾

No longer limited by the inherent nature of the screen printing process, it is possible to engineer a print design according to the shape of garment pieces (fig. 4). This will allow garments to contain engineered designs that continues across the entire product. It is possible to insert darts and pleats without distorting the print image. In addition, the ability to cross seams without losing the continuity of the design will allow new families of products to be developed.¹⁷⁾

But there are some challenges to overcome. Different textiles respond very differently to printing chemicals, and so a printer for textile materials must have an effective way of frequently flushing its system. In addition, a fabric's hand can be impacted significantly by the digital printing process. Post-processing also poses complications for digital printing.¹⁸⁾

Although digital printing has limitations for its usage, it will increasingly play a role in production of mass customized apparel, rapidly responding to individual print preferences in an efficient manner.

The growing number of software solutions which includes the 3-D body scanner and digital printing are being offered by Lectra Systems, Gerber Garment Technology, Assyst, Wild Ginger and Investronica. These softwares are designed to provide quick and easy data entry of customer details, body measurements and orders, and integrate that information with patternmaking software, plotters, cutters, production, shipping and accounting processes. 〈Fig. 5〉 and 〈Fig. 6〉 shows data entry of customer details and the production flow of Lectra System's Fitnet solution.

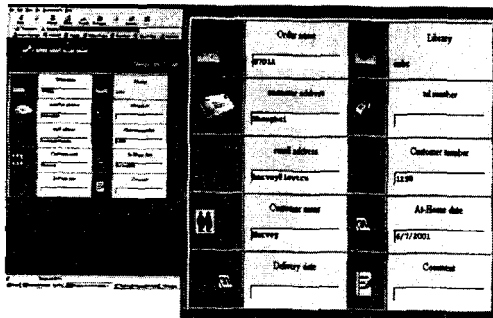
¹⁴ *Ibid.*

¹⁵ "Digital Printing : Prelude to the Revolution", *Bobbin*, January 1997.

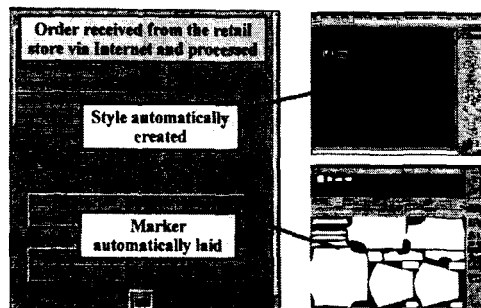
¹⁶ Michael T. Fralix, "From Mass Production to Mass Customization", *Journal of Textile and Apparel Technology and Management*, Volum 1, Issue 2 (Winter 2001): 5-6.

¹⁷ *Ibid.*

¹⁸ "Digital Printing : Prelude to the Revolution", *Bobbin*, January, 1997.



〈Fig. 5〉 Fitnet Order Entry, Lectra System.



〈Fig. 6〉 Fitnet Order Process, Lectra System.

IV. Three Categories of Mass Customization

Customers are demanding more variety and personalization in apparel offering. According to KSA's 1997 Annual Consumer Outlook survey, 36 % of consumers said they would be willing to pay 12 to 15% more for custom made apparel and footwear.¹⁹⁾ Customers are looking for more variety in terms of styling, color and fit. Mass customization can satisfy the demands of customers in terms of personalization, fit and design.

1. Personalization

Apparel customers have complex individual

tastes. Everybody has a different body shape, and different tastes. Everybody's color, shape and fabric perception which depends on his personal experience is diverse.

Mass production ignored the customers' desire for individualization for the sake of price. But flexible manufacturing & information technologies permit customize apparel at a relatively low price.

Now customers are demanding change from being a slave of fashion to wanting products and styles that reflect their own unique personality. D. I. Y. (Do It Yourself) trend shows an increasing desire for personalization.

Andrea Seidl said, "While products are getting more and more similar(me-too effect) consumers search for products to express their individualism and stand out of the mass. Increasingly consumers set up resistance against the dictate of fashion and seek for the way to express their individual taste."²⁰⁾

Mass customization is a great strategy which can satisfy customers' desire for personalization. Spearheading apparel companies are providing new services which can satisfy the customers' increasing demands for personalization. Levi's San Francisco store installed the custom embroidery station and a hot tub into which a customer can wear his jeans for a custom shrinking job.²¹⁾ Instead of doing the cumbersome shrinking job in their bathrooms at home, customers can do it in the store conveniently.

Design Your Own T-shirt Kits provide customers with dyes, sequences, embroidery or other decorative materials for their T-shirts and pants. The company provides customizing service after purchase of the apparel items. Y2Jamin produces apparel and other sewn products personalized with custom logos (company, sport, event). The company practices component choice mass customization by offering

¹⁹ Scott Lajoie, "300,000 Points of Light", *Forbes ASAP magazine*, 12 April 1999.

²⁰ "Lectra System and Techmath partnership mark a new beginning in made-to-measure", *Lectra Mag*, Vol. 1, 2000, 5.

²¹ Adair Lara, "Levi's Wears the Pants in New Store", *San Francisco Chronicle*, 13 April 2000.

customers a choice of fabric, colors, styles and logo styles(embroidered, screenprinted, rubberized patches, molded or stamped metal) in addition to the custom logo.

Joseph Pine said that customers are becoming used to getting exactly what they want in the Internet, and that's affecting their desires in other product areas.²²⁾ Customers do not want more choices, but they want exactly what they want. Apparel customers cannot be conveniently categorized into aggregate market groupings anymore. Apparel companies must interact one-on-one with customers to ascertain their needs.

2. Fit

People's bodies are highly individual. One's best look can be achieved by clothing that fits well and that is comfortable, and that suits her body shape. The problem is that "off the rack garment" can't produce the best fit for every-body.

According to the studies by Kurt Salmon Associates, more than half of the female population cannot find apparel in the market place to fit their bodies. And fit was the third most frequent reason for not making an apparel purchase.²³⁾

Levi's came up with a survey which indicated that in search for well-fitting jeans a woman will try on an average of 17 pairs before buying.²⁴⁾ And most customers have experience of frustration because of ill fitting garments. Many customers are spending a lot of time and money going through alteration processes.

Customers had to give up their best fit when they buy clothing off the rack, relying in one or two numbers to determine every dimension of

clothing. Making a variety of sizes cannot be an answer, because it will result in risk of inventory. Mass customization is a strategy which can decrease sacrifice due to the fit issue.

Much of the technical work on fit revolves around the use of body scanning or personal measurements attached to a computerized pattern drafting system. Key data captured by a 3-D body scanner describes the whole body contour and proportion. The measurements are accurate and constant.

People differ not only in their physical measurements but also in how they prefer their clothes to fit and look. There is a gap between the translation of physical measurements into garments and consumer satisfaction with it. Beyond physical measurements, consumers' perceptions of physical comfort, psychological comfort, and appearance all have an impact on the consumer's decision process.²⁵⁾ Subjective fit issues must also be addressed in order to ensure a satisfactory final product. Levi Strauss is capitalizing on these differences by mass-customizing blue jeans for women.²⁶⁾

3-D body measurement and customfit manufacturing will also affect the apparel sales on-line. On-line apparel sales are growing but the on-line apparel sector is lagging behind other markets. The research of E-Buyers-Guide.com in 2000 found that the first reason was the consumer's overwhelming concern with fit and correct sizing(28% of respondents). Dissatisfaction with purchase will result in losing customer loyalty. According to a recent study by iMarketing News, 62% of consumers that describe their experience as unsatisfactory will not purchase from a site again.²⁷⁾

²²⁾ "Customizing for the Mass", *Businessweek*, 20 March 2000.

²³⁾ Ledna Jo. Anderson et al., eds, "Understanding Fitting Preferences of Female Consumers", *National Textile Center Annual Report* (November 2001): 2.

²⁴⁾ "Suit yourself", www.european-quality.co.uk, 2002. 1. 18.

²⁵⁾ Ledna Jo Anderson et al., eds., *op. cit.* 2, 2001.

²⁶⁾ B. Joseph Pine II, Don Peppers, and Martha Rogers, *op. cit.*, 62, 1995.

²⁷⁾ Brian Beck, "Key Strategic Issues in Online Apparel Retailing", <http://www.techexchange.com/theLibrary/online-fit.html>

Personal pair jeans from Levi Strauss come in more than 10,000 different sizes, all made on the same assembly line.²⁸⁾ A successful on-line jean made-to-measure company, Interactive Custom Clothes Company(IC3D) developed a program to create a unique pattern for every individual customer.

Garment fit is a major factor in achieving customer satisfaction. Especially mass customization can offer products to the sector such as the tall or petite sized person whom is constantly neglected by mass production. By offering customfit garments using 3-D body scanning and flexible manufacturing, and keep the customer's measurement and fit preference data for the next purchase, a company can get great competitive advantage. The company can get loyalty from the satisfied customer who is coming back for the best fitting garments.

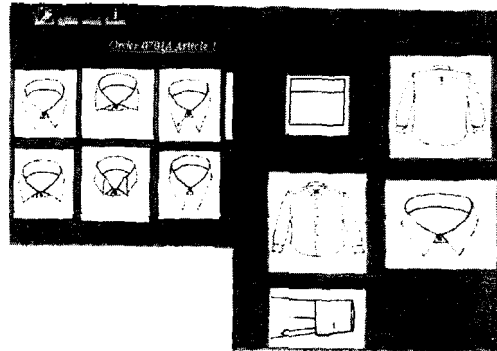
3. Design

In mass customization the needs of an individual customer are translated into design. The important point is that the customer is involved at the design stage and they are equal partners in the production process. Mass customization has turned customers into product makers rather than simply product takers.²⁹⁾

Joseph Pine said, "Key to a successful mass customization is a design tool that enables customers to figure out what they want, while simultaneously ensuring that the company can provide"³⁰⁾. Design tool or what Lenda Jo Anderson called "apparel style bank"³¹⁾ can be developed with CAD and digital printing. Designers and software experts can establish a design tool or "an apparel style bank" based on current fashion.



(Fig. 7) Design Tool for Fabric Selection, Lectra System.



(Fig. 8) Design Tool for Shirt, Lectra System.

Customers at the point-of-sale can view the available materials for their particular style on screen.(Fig. 7) They can then create combinations of materials, colors and prints to design the style of their choice. For example, when a customer orders a shirt he can choose fabric type, print, neckline details, and cuff details, and so on.(Fig. 8) A french made-to-measure shirt company, C2S offer no less than twenty collar options, five types of wrist, four pocket shapes,

²⁸ Don Peppers, "Leading the one to one marketing Revolution", *TELUS Interactive Magazine*, 18 December 2000.

²⁹ "A framework for customer relationship management", *CNN*, 12 October 2001.

³⁰ "Surviving Volatility, A dialogue with industry experts, Joe Pine and Michael Cheshire", *op. cit.*, 2000.

³¹ Lenda Jo Anderson et al., eds., "Discovering the process of mass customization : A Paradigm shift for competitive manufacturer", *National Textile Center Research Brief*, (August, 1998).

eight backs, eight fronts, and 700 different fabrics and delivers within five days.³² Also it is possible for customers to create their own fabric print. Digital printing can customize design elements and colorways according to individual customer preferences in an efficient manner.

Sometimes a customer doesn't know which fabric, style or color fits their body, and what he wants to wear. Design tool or "an apparel style bank" should help to identify a customer's unarticulated needs and resolve the inherent trade-offs.

Paris Miki is a good example for discovering customers' unknown needs through a successful design tool. Paris Miki understood that consumers rarely have the expertise to determine which eyeglass design best fits their facial structure, desired look, and coloring. Paris Miki allowed each customer to explore and manipulate a digitized representation of the potential final product. With this sophisticated design tool, trained opticians assisted customers in discovering the perfect, unique look that they would not otherwise have identified or found.³³

Digital imaging of apparel products that allows the customer some flexibility to interact with designs with options is much more complicated than that of eyeglasses. Color and texture perception on computer monitor could be different with actual appearance, and a customer doesn't know how the garment looks and fits on himself. New tools such as "virtual model" or "virtual dress room" can help customers make easy and fast decisions. Lands' End pioneered the concept featuring a model by which a customer can personalize on its Web site. Some consumers are either insecure in their creative and artistic ability or do not have either the technical skills or time to devote to learning the enabling technologies associated with the process. Co-design should be supported by a customer manager. To make the co-design pro-

cess enjoyable and satisfactory, the role of customer manager is very important.

Information a company acquired through co-design will affect the way products are designed. Feedback about new-product introduction and consumer behavior will influence product design, as this information becomes more accurate and travels back to designers more quickly. Combining mass customization strategies with mass production will maximize competitiveness based on customer needs. Also apparel companies can benefit from combining on-line and off-line sales.

V. Conclusion

Thanks to digital technology and flexible manufacturing, companies can mass customize products for individuals at the speed and cost of mass production. More and more 'mass production' is out and 'mass customization' is in.

In mass production, inventory is built in anticipation of potential, and uncertain demands of customers. Then a sacrifice gap between what the customers truly want and what the companies can provide occurs. This gap is the place to start mass customization. Identifying dimensions of sacrifice and creating value for each customer became possible thanks to new interactive and database technologies.

Apparel companies are being faced with high levels of market turbulence because trend is moving fast, customers' demands are changing quickly, and apparel seasons are getting more divided. Mass customization is a strategy which can make the production cycle shorter, cut inventory and bring extra value to the apparel company and customers.

Technical developments such as 3-D body scanning and digital printing are moving production toward mass customization. 3-D Body Scanning provides a set of accurate digital measurements that can become the basis for

³² "Shirts of made-to-measure elegance", *Lectra mag*, Vol. 1, 2000, 12.

³³ James H. Gilmore and B. Joseph Pine II, *op. cit.* 123, 1997.

making customized patterns for apparel. Digital printing allows short runs and limited quantities of printed fabrics. It is a great tool for customizing design elements and colorways according to the individual customer's preference efficiently.

Mass customization can be positioned into three categories : personalization, fit, and design. Mass customization can satisfy the customers' increasing desire for individualization, and decrease the sacrifice due to the problems regarding fit. In mass customization, the preferences, tastes and needs of an individual customer can be translated into design. The product development will become more effective because of the expanded ability to understand and keep the customers' body measurements, preferences, and tastes. But most of all, a company can retain more customers, especially the most valuable ones : frequent purchasers.

With new technological developments, the future of mass customization in the apparel industry seems promising. Mass customization is a strategy that apparel producers should consider for their companies' goals.

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