

# Slow Adoption of Technology in the Apparel Manufacturing Industry's Implementation of Mass Customization

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## Abstract

This paper outlines and discusses the possible causes of the slow adoption of technology for mass customization in the apparel and fashion industry. The study first identifies (based on a number of interviews with apparel producers) the performance indicators and the integration of technologies necessary for the implementation of a system of mass customization in the garment industry. The interviews with these producers reveal certain factors and characteristics that can explain this slow adoption. Our research looks into the factors and industry characteristics in large part explaining the apparel industry's difficulties and lateness in implementing one of the most important recent innovations: the mass customization of garment products. We argue that one of the major difficulties arises from the lack of integration between the technologies presently used by the industry and those offered by the providers of new systems. The products offered do not meet the apparel manufacturers' and distributors' needs and expectations. Our interviews with different stakeholders point to: (1) a lack of technological fluency on the part of both managers and labour, (2) a strong resistance to change in a very traditional industry that still relies on outdated work habits, (3) a lack of proactivity and implementation of strategic or technical watches, (4) minimal investment due in part to the difficulties of borrowing money, and (5) the bad press often given to technology and mass customization implementations by certain important industry actors. Past research has demonstrated the importance of understanding the mass customization of garment within the context of trade globalization and the industry 4.0, which has led to ever more fierce competition in the global fashion and apparel market. But, why is the manufacturing industry so late in understanding this? According to your results, the principal cause is the lack of integration between technologies currently in place and those offered by suppliers which do not adequately respond to the needs of manufacturers and distributors.

**Keywords:** Mass Customization, 3D Body Scanning, Product Configurator, Apparel Industry 4.0, Performance indicators.

## 1. Introduction

Although the role of clothing manufacturing has changed greatly over the past few decades, the fashion and apparel industry still remains an important source of economic activity and employment. Following sustained growth in the 1990s, the industry is currently experiencing disruptions as a result of massive imports and economic fluctuations due to e-commerce in its primary markets. Significant breakthroughs by foreign-based newcomers to the industry have only added to existing local competition. Moreover, as apparel products now seem to have an ever-shorter life cycle, a phenomenon exacerbated by the introduction and implementation of new business models, commercial strategies are facing mounting pressure. This situation has forced all manufacturers to revise their organizational strategies in order to survive in this highly competitive market.

In addition to this, apparel companies are busy adapting to all the technological and managerial developments that have taken place in the last few years. Customers' expectations in terms of quality, cost, lead-time and service are constantly on the rise, whereas profits margins have steadily decreased over the past twenty years. To compete, businesses must find new approaches to product development and marketing, such as reducing life cycle times, improving productivity, and redefining customer service. Hence, they have turned to technology to identify potential new approaches to support their business strategies. Technology firms smell the kill and multiply their promises on « sure bet » new products. Yet reality often is more down-to-earth and; businesses encounter a number of obstacles on their road to reinvention.

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Our research looks into the factors and industry characteristics in large part explaining the apparel industry's difficulties and lateness in implementing one of the most important recent innovations: the mass customization of clothing products. We argue that one of the major difficulties arises from the lack of integration between the technologies presently used by the industry and those offered by the providers of new systems. The products offered do not meet the apparel manufacturers' and distributors' needs and expectations. Our interviews with different stakeholders point to: (1) a lack of technological fluency on the part of both managers and labour, (2) a strong resistance to change in a very traditional industry that still relies on outdated work habits, (3) a lack of proactivity and implementation of strategic or technical watches, (4) minimal investment due in part to the difficulties of borrowing money, and (5) the bad press often given to technology and mass customization implementations by certain important industry actors.

These findings should encourage the actors that make up this industry to readjust. The above list of difficulties should also trigger a wake-up call to the new reality in the clothing industry: more demanding consumers, globalised markets, new technologies, etc. Apparel industry businesses must be proactive, adopt, and adapt to new mind-sets and management tools to take full advantage of information technologies. To successfully implement mass customization, it is of the utmost importance that they emphasize analysis, decision-making, performance evaluation, and added value. Indeed, flexibility is a must as the market increasingly expects it.

## 2. Literature

Reviewing the writings on this subject tells us that paradoxically, at a time where the global key word in most industries is standardisation, the focus in the apparel industry is on "uniqueness." Fashion is first and foremost a subjective world; consumers are ever more focused on their own needs and expectations and are therefore resisting product standardization [22]. Hence Piller [12] has identified mass customization as an important development axis. Ashdown [2] confirms that consumer demand for mass-customised apparel is steadily growing and that the capacity to fulfil this demand is made possible by new technologies and information systems. Inala [7] states that mass customization is a highly competitive strategy for organisations offering personalised products. The more the product can be adapted to individuals' requirements, the more competitive the seller can be [8]. Yet this requires a thorough understanding of consumers' needs and wants.

Currently, some confusion still exists between personalisation and mass customization [4]. When garments were tailor-made, each individual piece was cut and sewn for the eventual user; the garment was fitted for a particular consumer [23]. As Pine [14] states, this was a hand-made and personalised production. Yet, to implement a mass customization program [24], one needs high-volume manufacturing operations based on flexible processes enabling the producer to quickly meet individual customers' demands. As Pine [14] states, the success of mass customization is based on a complete integration of the value chain, which must simultaneously perform on two opposing axes: (1) quick turnaround times for (2) products meeting individual clients' specifications.

Tian, Bearden and Hunter [18] confirm that consumers increasingly want a personal touch in their garments to make them "unique." According to Piller [8], they want to exhibit creativity in all domains, particularly with furniture, automobiles, sports accessories, and clothing. This is why, according to Pine [14], in such large markets, business must incorporate mass customization in every step of the process, from a garment's conception to every aspect of its manufacture. But Agrawal, Kumaresh and Mercer [1] see product adaptation to individual consumers' needs as mass customization's main problem, while Von Hippel [21] goes so far as to say that consumers' lack of experience and knowledge makes them unable to know exactly what they really want or need. One must therefore simplify and guide this demand. The information technologies used must transform the masses of data into meaningful and understandable information [2]. The objective is clearly to produce realistic garments, yet the constraints make a compromise between performance, realism, and technical characteristics very difficult. Some suggest that a product configurator may offer the solution.

## 3. Technological solution

Many apparel businesses are currently researching technological ways to produce, adjust, sell and deliver, in a systematic and automatized fashion, personalised and made-to measure products. Brown and Bessant [3] highlight that product configurators, by determining the level of personalisation offered, will play an important role in supporting the mass customization paradigm. For Piller [12], the first objective of the configurator is to facilitate the consumer's experience when confronted with a

website. The configurator is the bridge between the producer and the consumer [7]. Over and above the product decision facilitating function, the configurator should also lead to cost reductions [13] as it allows for time-savings when pacing and receiving orders.

A product configurator must be based on a strong technological platform in order to enable a consumer/producer product co-design and co-production. It operates as the interface between consumer and producer and must facilitate this co-creation offering both parties a value-added proposition. At the present time, the configuration of a product that meets the client's requirements is a complex task requiring increased time and effort as the number of product options and components increases. Kincade, Regan and Gibson [8] explain that, as the number of product variations increases, the number of potential errors multiplies, production start-up and lead times extend, and therefore the number and cost of potential errors can skyrocket. This same observation led Ashdown [2] to highlight the number of challenges one has to currently face to produce a mass-customised garment. Rogoll and Piller [16], for their part, point to the fact that a configurator must fluently interface between different programming languages (different languages are often used in programming for data acquisition from the consumer on the internet, for pattern-making, laser cutting, etc.), yet they must also be fully autonomous. All these human, technological, and product dimensions obviously make the development of an apparel configurator all the more difficult.

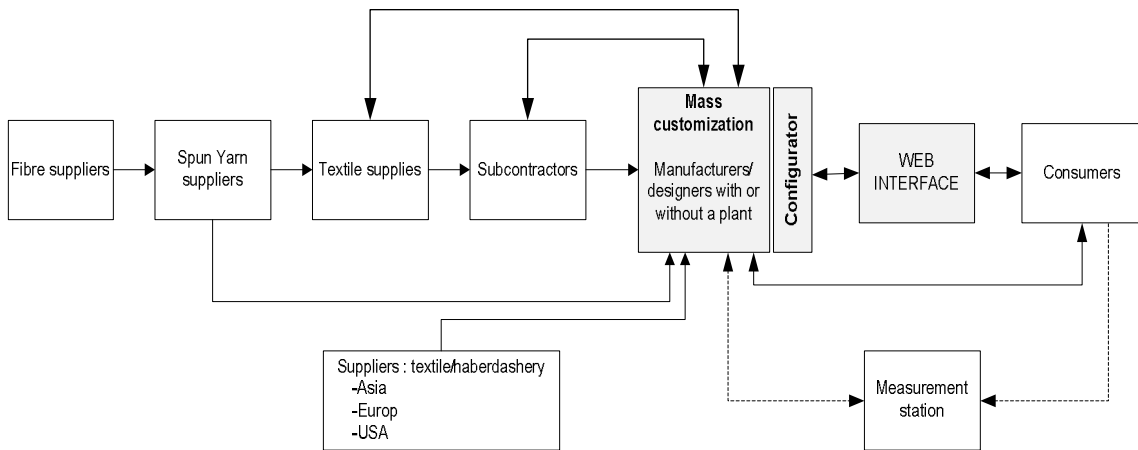


Fig. 1. Configurator in an apparel mass customization context

The technological risks associated with a configurator project are essentially related to the development of a system that can share and process data and parameters (the parameter configurator) originating from various sources such as: the data entry tools (e.g. the 3D body scanner), software, the automatic process and the administrative and financial data. Yet development is only one part of the challenge: the apparel business must then implement it at both the consumer input end and in production processes. Henderson and Venkatraman [6] point to the fact that performance indicators become all the more important as they offer managers the tools to evaluate whether objectives are met (both short- and long-term). Rogers [15] adds some precision to this point in identifying two types of indicators necessary to evaluate implementation: performance indicators and integration indicators. One must remember that an apparel producer may perform well, yet be deficient in terms of integration of its technologies (i.e. using highly effective and efficient processes and offering a well-adapted product, yet arriving at this result due to the quality of a company's personnel, resources, and historical management approaches). Performance indicators (stock rotation, return percentage, number of complaints, etc.) enable organizations to know if they are meeting their goals and objectives. They provide information on the efficiency and effectiveness of the use of resources, whereas integration indicators provide a reading of the adjustment in the technologies used to attain the organization's goals and objectives. They help technology suppliers in fine-tuning their offers to the needs of the apparel producer. Venkatraman [20] tells us that when business processes and technologies are well adjusted, managers and employees develop a better attitude toward new technologies and a greater openness to mass customization [13]. Thus, our research focuses on the link between business processes (order management, production, distribution, etc.) and technologies currently in use or intended to be implemented. We purport that this will enable us to better comprehend the slowness of apparel producers in adopting technologies to facilitate mass customization.

### 4. Methodology

Having observed that, despite numerous opportunities, apparel manufacturers have been rather reluctant to adopt mass customization, our research aims at better understanding the apparel producers' use of the most up-to-date technologies in their overall business and decision-making processes. The basic selection criterion for such producers to participate in the research was an expression of interest in developing a mass customization project within the next 10 years. Hence they must plan on coupling mass customization technologies to their current processes and technologies. The research comprises 20 producers. The interviews and questionnaires used focus on understanding their current systems/technologies integration and the variations found in this aspect within the industry. The questionnaires were handed out on a one-to-one basis and/or sent via e-mail. We also conducted lengthy interviews with three technology suppliers in order to understand their perspectives in terms of technology products/services currently available on the market.

### 5. Conceptual Framework

The primary objectives of the survey focuses on the integration of new technologies within the operations of clothing manufacturers who wish to implement mass customization. More than just simply recognising the concept, this will allow us to evaluate whether the available performance and technology integration indicators, touted by the equipment and software companies and presented as important management and development tools, have any effect on the business processes used in manufacturing, distribution, and general management. This will help us understand the elements leading to delays in implementing mass customization in the apparel industry from a technological point of view.

Thus, we asked three specific questions in our study. First, we wanted to know if the level of current results highlighted by the performance and integration indicators (on a scale from high to low) had an impact on the management's attitude towards technology and innovation as well as its intention to pursue mass customization. Second, we wondered whether the results on the indicators employed (performance & integration) had an effect on the business processes. Third, we wanted to know what effect the management, manufacturing and distribution processes in place had on the management's attitude towards technology, innovation and intention to pursue mass customization. Figure 2 presents the technology's performance and integration indicators which we position as our independent variables in the model. These indicators focus on the most important areas of improvement put forward by technology and services suppliers to the apparel industry.

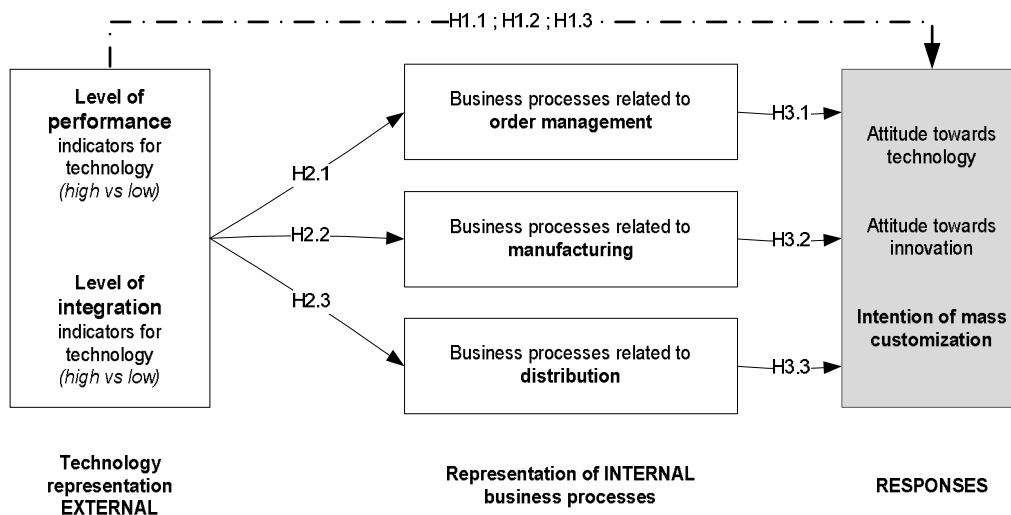


Fig. 2. Conceptual Research Framework

Our three dependant variables consist in three types of reactions frequently found in operations management regarding the effects of technology, namely: attitudes towards technology (Toffler [19]; attitudes towards innovation (Ostlund [11]; Rogers [15]; Venkatraman [20]; Midgley and Dowling [10]); and the actual intention to utilise mass customization (Pine [14]; Teresko [17]; Kotha [9]; Duray et al. [4]).

## 6. Results of the indicators

The first element of our research deals with the producers' current use of technology, as well as the performance indicators used. Our results show that the performance indicators perceived as the most significant are those that focus on data transfer technologies such as EDI, RFID and bar codes. Our respondents indicate that technologies which better enable sourcing, production and distribution operations management will have an immediate impact on business processes, and that both upstream (suppliers) and downstream (distributors, retailers) business partners require their use.

Yet, our research results also show that the critical integration indicators focus on other technologies such as ERP, SCM, EMS, all of which emphasise the optimisation of internal processes. Our respondents confirm that implementing and using such technologies would require major changes within an organisation's management systems. Some also stated that this implementation often takes quite a bit of time, yet does not bring the expected results. Our results show that 61% of organizations use relatively non-integrated technological systems and that their performance indicators are inadequate. Moreover 12% confirm that their existing technological systems are "heavy" and hard to manage, and that they present a poor fit with the structure in place in terms of performance and process integration. Table 1 shows the results of the performance and integration indicator levels for the 20 manufacturers surveyed, on a scale of 1 to 10 (10 being the highest relative impact).

Table 1. Average indicator levels, based on the variable response.

VARIABLE RESPONSE	Level of the performance indicators	Level of the integration indicators
Attitude towards technology	4,613	3,331
Attitude towards innovation	2,472	2,906
Intention to implement mass customization	6,679	4,254

Figure 3 presents the manufacturers' evaluations of both performance and integration indicators used in operations management on the impacts of technology with respect to the to our three dependant variables: attitude towards technology, attitude towards innovation, and intention to implement mass customization.

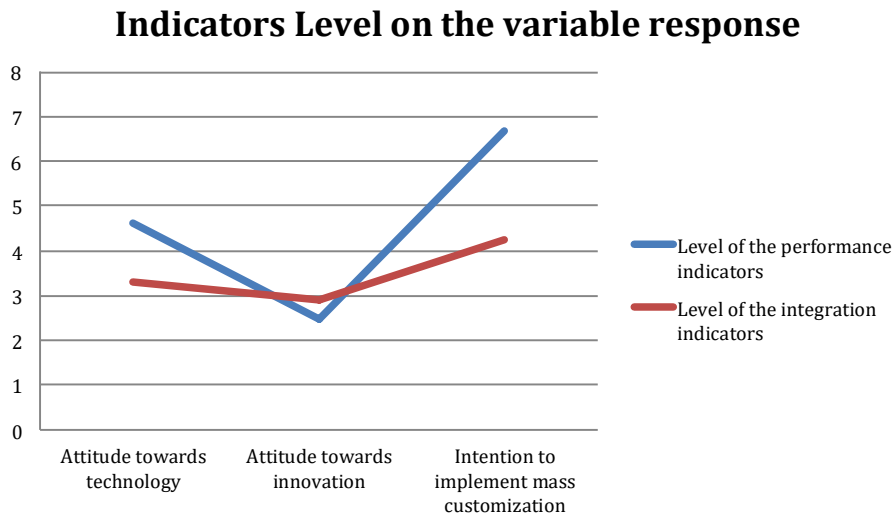


Fig. 3. Indicators level based on the variable response

### 6.1 Lack of innovation

Another notable feature is the lack of innovation, which is not merely a question of technology, according to the suppliers, but is also (and primarily) based on efficient work habits cultivated by motivated and experienced teams—a distinctive set of traits possessed by the workforce of any successful organisation. Thus it appears that the lack of information sharing and best practices within the apparel industry is a crucial problem. We have witnessed that decisions are often made at the last minute and that crisis management is a permanent condition. Indeed, many companies have serious problems with management, control and responsiveness due to an obvious lack of vision within organisations, both internally and externally.

Only two out of 20 respondents said they were satisfied with the systems in place and are ready to continue to implement mass customization. Technology suppliers also stated that organisations need to better understand that technology is not an end in itself but requires massive financial and personnel investments.

### 7. What is mass customization?

The concept of mass customization as a principle of widespread personalisation via the internet seriously puts into question traditional manufacturing techniques and production methods. We asked the following question in our survey: “According to you, what is the minimum number of units necessary for customization to become ‘mass customization’?” The responses vary widely according to the experience of the manufacturers. According to them, on average they must have the capacity to produce at least 200 units that respect the customers’ quality requirements for it to constitute mass customization. The following table presents the results of this question in our survey.

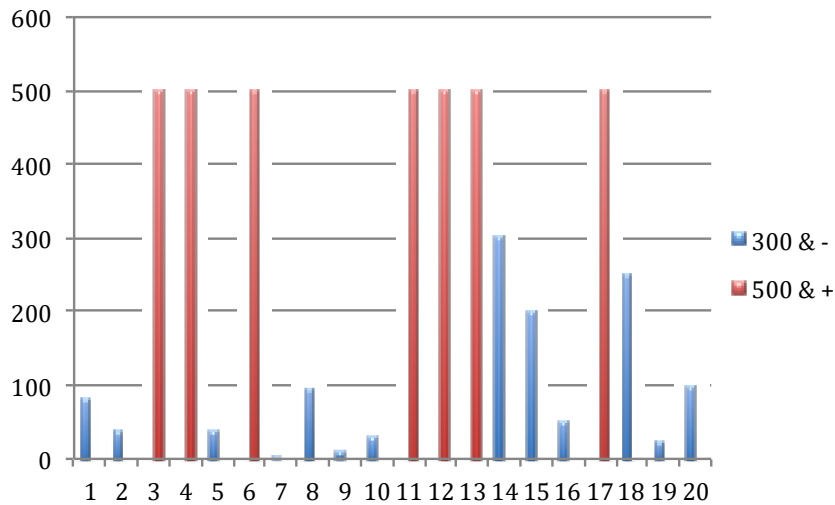


Fig. 4. Production volume necessary for mass customization

### 8. Perspectives and limits

Our research validates the idea that the use of performance and integration indicators has a direct and significant impact on the implementation of a mass-customization strategy. It also highlights that this observation is in great part due to a fundamental cultural problem. The industry is comprised of a large number of family businesses, managed in a more or less autocratic manner not very conducive to market adaptation and the implementation of revolutionary technologies. Indeed, for these companies, technological innovation is seldom a priority. The generally limited education level of the apparel producers’ managers leads to a lack of competencies, of market knowledge, and ultimately of leadership.

Our research shows that apparel producers seldom have a strategic plan and that even fewer invest in a strategic watch, and the information systems in place are often deficient and poorly integrated with the rest of the firm’s activities. One cannot help but notice a strong reluctance to change, along with a lack of vision on the part of higher management. We also have to underline that our research has a number of limits which, viewed more positively, constitute avenues for future research. First, we decided not to consider certain characteristics and traits among producers’ and/or managers’ that may have an impact on technology adoption (e.g. size of the organization, other market strategies, etc.). Second, our research examined only one subset of one specific sector, which undoubtedly had an impact on its external validity.

### 9. Conclusion

This study confirmed that performance and integration indicators had a significant effect on the implementation of mass customization, as seen in the responses to our survey questions. They have also helped us understand the factors and characteristics that lead to significant delays in the fashion and apparel industry regarding the adoption of such systems from a technological, organisational and

strategic point of view. Our interviews have confirmed that for the concept of “mass customization” to operate, there must be significant investments made in information decoding and data-mining, as well as in all aspects of understanding client relations, as consumers have increasingly less time to spend shopping and at the same time have more demands and needs.

We remain surprised that the results of our interviews and surveys indicate a strong resistance to the introduction of mass customization among manufacturers who want to put in place an element of personalisation. However, these results also give us the opportunity to provide valuable information to develop a mass customization program for the garment industry. An analysis of the results allows us to identify five major components that will potentially be useful for such a program: the fostering of a culture of innovation, improved organisation, vision, implementation, as well as configuration and design.

Mass customization offers a number of innovation possibilities and may constitute a major opportunity for some apparel industry players. To take advantage of this opportunity, the order givers will have to better understand what is possible in terms of product personalisation and on-demand garment production. They will need to radically rethink their marketing and production strategies, remembering always that mass customization must start with consumers, involving them in both product design and production.

Nor should mass customization be considered strictly as a short-term marketing strategy. It may lead to significant cost savings for the producer and greater supply chain integration. It may also provide producers with a better understanding of their consumers, their preferences and wider opportunities for market segmentation. Taking the mass customization route is an avenue to create new opportunities, give a competitive advantage, and better position an organisation within the global market. It may be true that the western apparel industry cannot currently compete with producers from “emerging” countries in terms of costs, but a technology-based strategy may yet offer definite advantages.

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