

Customer demand and acquisition	Customers' demand could be increased by garment virtualization as they can get the required measurements. It also affected by the return rate as it causes a lack of trust between them and manufactures. The product modularity could also raise the customer acquisition rate while excessive modularity causes a negative influence on operational performance like manufacturing cost and delivery speed. That's why, the higher customer satisfaction, the higher firm profitability could be gained.	Power 2013 Difrancesco , Rita Maria, ArndHuchzermeier, 2018 HwangandSuh 2018
Variables	Remarks (Associated factors)	References
Cost reduction	It is considered as one of the main criteria affects the profitability and could be achieved by the lean and integrated supply chain.	Iannone , R., Martino, G., Miranda, S. and Riemma, S.,2015
Delivery Speed	The fast delivery speed attracts more customers and improves the supply chain agility this can be associated with the response flexibility	Chan Alan TL, Eric WT Ngai, and Karen KL Moon, 2017

Table 1: Variables Definition and its Associated Factors in this Study

Results and Discussion

In this paper, Vensim® is used to develop a stock and flow diagram according to the interview with supply chain professionals as shown in figure (1). The model variables have been discussed on the previous section and the next one is going to discuss the interaction flow among them as per figure (1). The MC supply chain profitability is depending on the difference between the total cost and the total revenue as well as the return rate. Therefore, the higher revenue at low cost and return rate, the more profit could be gained. Besides these assumptions, there are another factors affecting on their performance that absolutely has a great influence on the profitability increment. The Vensim software could provide how these variables interrelations are dynamically connecting. Consequently, the total cost should be reducing through manufacturing cost and shipment cost. The manufacturing cost depends on several factors including product variety, the lead time and product quality along with other cost parameters that have been discussed in the previous section. The mass customization depends on the increasing of the product variety according to the customer requirements that positively increases the sales and customer acquisition rate. Such variety can be found on the diversity of size, design and color. That's why it certainly has an impact on the lead time in which the complex design manufacturing takes longer production time comparing to a standard style. In addition, the lead time is affected by the raw material availability which is the heart of implementing the mass customization. The raw material availability depends on the supplier selection where the cost and delivery time play important roles on selecting the right choice. Moreover, these varieties affect the garment simulation because it is affected by the sample approval that depends on the achievement of customer product characteristics. On the other hand, in the case of mass customization, the customer preferences are high and focus on their requirements details including product quality that is considered as an important element of the return products rate.

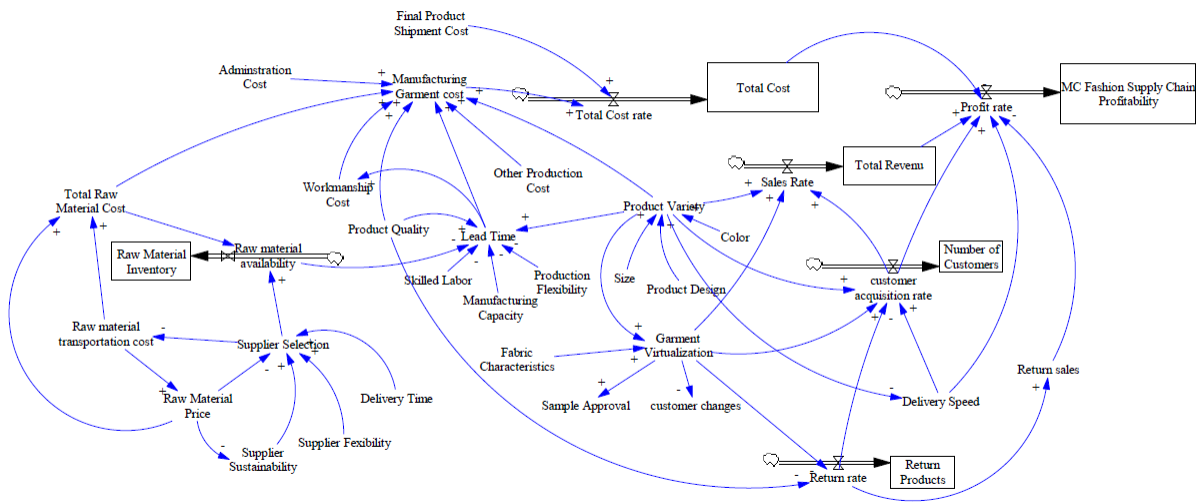


Figure (1): the Stock and Flow Diagram of MC Fashion Supply Chain using Vensim Software

Based on discussion with apparel supply chain professionals, Lead time has a direct relation with the style production difficulty. The more complicity of the design, the more time is consumed and higher cost is reached. In case of zero-return policy, Figure 2 shows that the increase of product variety leads to the increment of the profitability up to a certain limit (17 weeks lead time) after which it starts to decrease until there is no profit. The manufacturing cost is increasing due to different styles of production while the price has some kind of stability as the manufacturer must sell the product within a limited duration and price. On the other hand, if the price increases during the increasing of product variety, the profit will be increased definitely over the time period.

Other case provides a return allowance policy which causes the cost to be increased by 1%. Figure 3 shows that the profit has the same behavior of previous figures but with a dramatically reduction in case of fixed price where the changeable price has seen an increment but lower than before because of the negative impact of the return.

In the third case, the customer could return the product after the delivery because of many reasons particularly the quality is under the expectations. Most apparel companies follow Accepted Quality Level (AQL) system for optimizing the quality level towards customer satisfaction [Keist, C.N., 2015]. It is the maximum average defective product in a lot so that the higher AQL percentage, the lower quality, and low price garments. Figure (4) shows that the increasing of AQL percentage leads to decreasing the return refund as the product is at a low-quality level in which the customer accepts the defects and don't return the product. On the other hand, the low AQL % the higher return refund because the customer here requires high-quality garments and has high expectations. That's why another behavior has been studied containing the return percentage in which net profitability could be got.

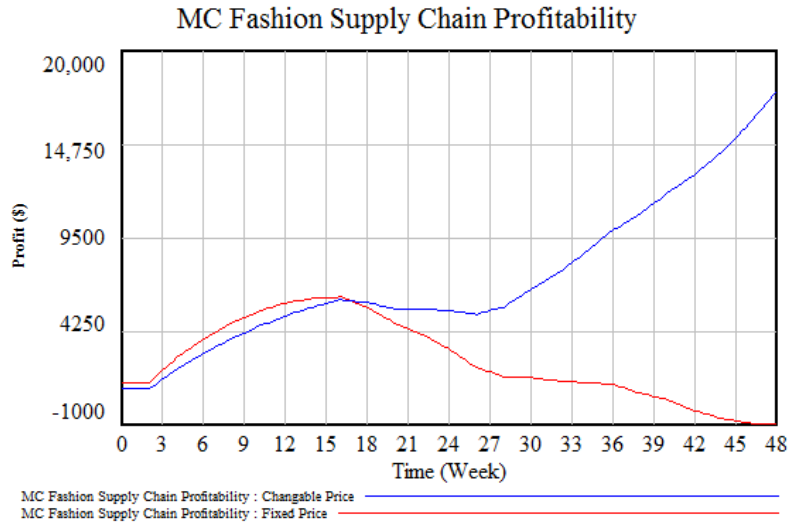


Figure (2): The Effect of Product Variety on MC Fashion Supply Chain Profitability At fixed and changeable price.

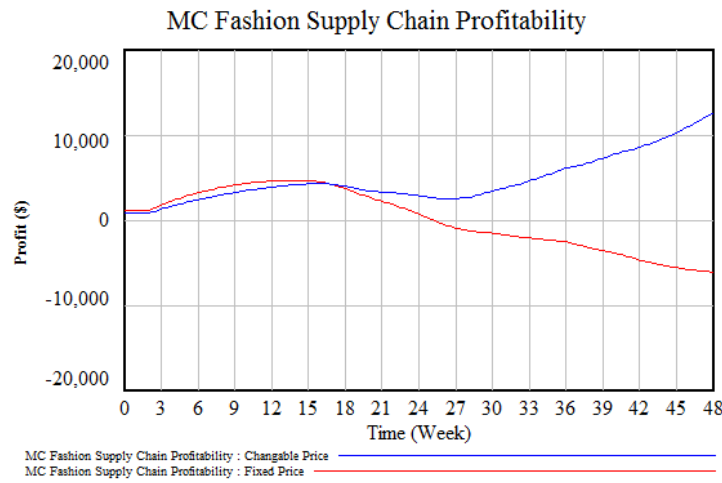


Figure (3): The Effect of Return Products on the Supply Chain Profit At Fixed and Changeable Price.

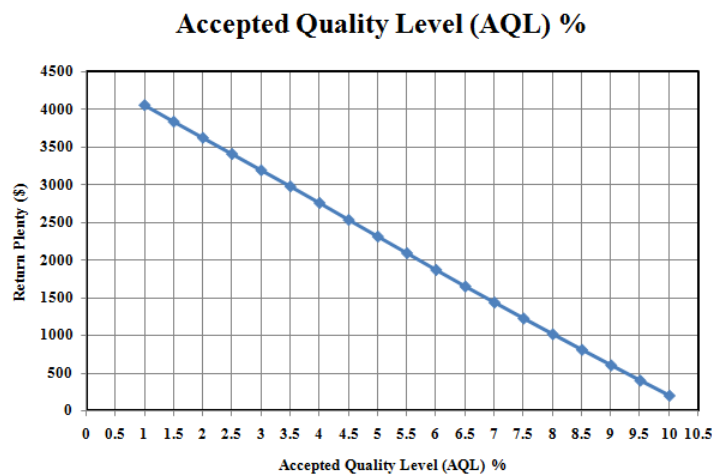


Figure (4): the Effect of Accepted Quality Level (AQL) on the Return Cost

Conclusion

This research presents a system dynamics model for the apparel supply chain under mass customization. The model could be used to investigate the relations between apparel supply chain variables under mass customization. Numerical analysis shows different ways to increase the firm profit. It can be concluded that the company should optimize the quantity of each product variety versus its market price according to the lead time consumed knowing that there is minimum quantity for each fabric color as it is strongly correlated with the ability of fabric production itself. Furthermore, the calculations of the profit should include the return percentage and the plenty or the compensation should the customer got almost overseas buyers are not able to return the products again because of return shipping cost so they don't have any option rather than accept the product as a second quality. That's why; it should set a convenient return policy so that the negative impact of the sales and customer demand could be neglected. However, this return issue is so common through online shopping; managed regulations should be put into consideration to focus on the reverse logistics that provide companies with opportunities to improve their business.

Further Studies

One of the limitations of this research is the use of a verbal source of information rather than real values from the company. That's why more studies are required to study in deep the influence of such activities on the whole profit chain including garment virtualization and the merchandising issues. In addition, there are some potential areas should be studied first before implementing the MC fashion and apparel. One of these areas of improvement is to increase the researches of the down, middle and up steam supply chain performance of the MC fashion and Apparel industry when inventory is zero as the product follow the Made – to – Order Criteria. The raw material stock level is a critical factor to accomplish such customized system; nevertheless, it needs to be well controlled. The discrepancy between online sales and customer expectations should be investigated to restrict the return and to reach their satisfaction.

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