Competitive Edge Through Automation: A Study on the Sri Lankan Apparel Industry

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Abstract— The Sri Lankan Apparel Industry is one of the significant contributors to the country's economy as it generates considerable amount of export income. Tasks in the apparel industry which involve a higher amount of labour involvement have been replaced by automated technologies such as Robotics, Computer Aided Designing and Computer Aided Manufacturing technologies in order to achieve a competitive position in the industry. The objective of the study is to examine the impact of automation on achieving a competitive edge in the Sri Lankan apparel industry. Process automation, intelligent manufacturing and the global customized production were used in this study to achieve the objective by using cost advantage as the mediator. This study employed the deductive approach, and quantitative data were utilized to achieve the objectives. A questionnaire was distributed among 65 respondents selected to gather quantitative data. An exploratory research was conducted by the researchers conducting three interviews with industry experts, which helped to design the overall study. The researchers analysed the effect of the mediator through the Sobel test. As per the data analysis conducted in this study, it was found that there is a correlation between process automation, intelligent manufacturing, and customised production with competitive advantage, and there is a strong relationship between cost advantage and competitive advantage. The qualitative findings of this research conclude that apparel companies should invest in automation to gain a popularity in the global market. Thus this study proves that automation should exist in a developing country like Sri Lanka to achieve a competitive advantage.

Keywords— automation, competitive advantage, apparel industry, cost advantage

I. INTRODUCTION

A. Background of the study

The apparel industry of Sri Lanka has shown a steady growth in the past three decades proving it to be a most significant contributor towards the Sri Lankan economy (BOI, 2020). It has been the largest gross export earner in Sri Lanka since 1986 and 52 percent of total export earnings resulted through apparels. The apparel industry has been the largest net foreign exchange earner since 1992 (Dheerasinghe, 2009).

With the development of the apparel industry in the world Sri Lanka also initiated towards producing textiles and garments with the intention of distributing to the domestic market in 1960 and garments were manufactured with the objective of distributing worldwide from 1970 (Dilanthi, 2015). According to (BOI, 2020) due to apparel exports Sri Lanka has earned a total export revenue of 5 Billion Dollars and a contribution of 44 percent to the national exports of the country in 2018.

Sri Lankan apparel industry being considered as a low-wage cost-competitive model of production, the apparel manufacturers provide advanced solutions to the industry's complex and changing global needs focusing more on creativity and experiencing in vast amounts of fields such as Design, Research and Development division and Innovation. This has transformed the Sri Lankan garment industry to a regional apparel hub (BOI, 2020).

With the competition which arose in the world apparel market, the Sri Lankan apparel industry too have faced with many challenges. Proper

Identification of challenges will help the industry gain success and be stabilized among other key players in the global market. In Sri Lanka MAS Holdings, Brandix are considered to be the apparel giants as their competitiveness, advanced technology, and knowledge transfer capacity tends to be superior than other players (Dilanthi, 2015).

The GSP+ scheme which removes import duties on exports to the European region encourages increased value addition within Sri Lanka. Sri Lanka reported the highest export earnings which is $15.1 Billion in 2017 (Anon., 2018). Thus, the Sri Lankan garment industry has become successful due to the GSP+ scheme given by the European Government. Thus, if it was not given, it might have been difficult to achieve a competitive advantage in the apparel industry.

During the past more human capital existed in the apparel industry, but now it has been automated, replacing human operators with industrial machinery. The challenges faced by the apparel industry could be faced successfully and a better and consistent quality could be achieved in the apparels while increasing the organization productivity with the help of automation (Michelini, 2013). The apparel industry will achieve competitive advantage in market depending on the level of advanced technologies and automatic tools and equipment that are used in Planning, Manufacturing, Supply chain and Retailing. High quality garments could be achieved by clothing manufacturers through automation while retaining the global demand (Enam, 2009).

B. Research Problem

The apparel industry of Sri Lanka was mainly based on labour intensive techniques in the past decades. With the introduction of technology Sri Lankan apparel industry started automating their processes by reducing human labour. The Sri Lankan apparel industry will have to automate their processes in order to compete with the competitors successfully and to be the best in the apparel industry. This research will find out whether automating processes while reducing labour involvements will lead to achieve a competitive advantage in the market and whether automation will lead to achieve a cost advantage in the Sri Lankan apparel industry.

C. Research Objectives

The objectives of this study are two folds; To identify the impact of automation on achieving competitive advantage of apparel industry of Sri Lanka and to identify how the Sri Lankan apparel industry achieves cost advantage through automation.

D. Literature Review

Existence of mechanization provides human operators with machinery to assist them with physical work and automation will greatly reduce the need for human sensory and mental requirement. Automation exists in most parts of the apparel industry such as in fabric inspection, fabric spreading and cutting, sewing, pressing and material handling (Enam, 2018). It is expected that automation will ultimately lead to the decrease of the production lead time of the apparel company, increase the product quantity and increase the worker efficiency (Goldnfiber, 2016).

This study will focus on the effect and the relationship between independent variables such as Process automation, Intelligent manufacturing, Customized production towards the dependent variable competitive advantage and the mediating relationship of cost advantage due to automation to achieve the competitive edge in the apparel industry which will be based on the Porter's Generic Model.

1) Impact of Process Automation towards Competitive Advantage

According to Singh & Prasad (2009), Process Automation could be briefed as the use of computer technology to control the industrial machinery while replacing human operators.

Competition tends to be one of the major challenges in the apparel industry of Sri Lanka. Challenges which arise through competition could be faced successfully with various technological advancements. Use of model-based approach for automatic inspection of fabric, use of laser knife or water jet in the cutting department, and use of pressing robot in the pressing process of apparels have been implemented in the apparel industry to gain a competitive advantage in the apparel industry. Through these technological advancements, vertical integration and horizontal integration could be achieved in both the apparel manufacturing sector and all parties in the value chain (Jayatilake & Withanaarachchi, 2019).

2) Impact of Intelligent Manufacturing towards Competitive Advantage.

Intelligent manufacturing is considered to be a specific work environment where integration and application of intelligent technologies become possible (Han, 2017). Through automating the apparel industry by implementing various techniques such as Robotic Process Automation, the business processes could be made more efficient as the employees will have more time to work on product innovation and its improvement. This will eventually lead the apparel producing companies to distribute the apparel products faster than the competitors and achieve a competitive advantage in the market (Putzer, 2018). The robotic technology introduced in apparel sector in the sewing department, pressing department and fabric handling department as stated, will prove that intelligent manufacturing will have a positive impact towards achieving competitive advantage in apparel companies (Ahmad, et al., 2020).

3) Impact of Customized Production towards Competitive Advantage

Customized production of apparels will refer to manufacturing apparels in standard designs where their sizes will be produced to fit the individuals and designs will comprise of different pockets, cuff shapes, fabrics and colours that are personally embellished to suit different consumer tastes (Saravanan, 2009).

The competitiveness of companies could be seen in the ability to react quickly to the rapid changes in customer requirements and to cope up with these changes various flexible automation tools such as CAD and CAM are used to design apparels (Kim & Culler, 2014).

Information technology efficiently supports customized production of apparels by shortening the virtual distance between the manufacturers and consumers. Customers at present prefer quality, style, and uniqueness in apparel products over homogeneous products making apparel companies focus on mass customization to gain a competitive advantage in the whole apparel industry (Nayak, et al., 2015). According to Bernard, et al. (2012) Companies are interested in customized production strategy because they expect a competitive advantage and an increase of their profit.

4) Impact of Cost Advantage towards Competitive Advantage.

According to Porter (1985), if a firm succeeds in achieving and sustaining the cost leadership, then the company could be identified to be an above-average performer in its industry which means achieving competitive advantage. According to (Singh & Prasad, 2009), the main objective of automation is to focus on reducing the manpower and costs using automated machines in the apparel industry such as automatic collar marking machine which marks the collar pieces point, buttonholing indexer which allows button holes between one and twenty to be inserted at a time, front pocket hemming unit which is used to hem front trouser pockets, and fully automated pocket setter unit which allows the pocket to be folded automatically once the operator places the pocket into the loader of the creasing unit. Automation makes it possible for apparel manufacturers to increase the efficiency while reducing defects and most importantly they could reduce the overall cost of manufacturing (Enam, 2009). As low costs can be achieved due to automation in the apparel industry, it is clear the fact that apparel industries could achieve competitive advantage due to cost advantage which is as shown in Porter's Generic Model.

5) Relationship between Process Automation and Competitive Advantage.

According to Nayak & Padhye (2018), automating the processes of the garment industry will help to achieve the competitive advantage in the apparel industry while producing apparels of high quality at lower costs. Thus, it is clear the fact that a process automation will ultimately lead to achieve competitive advantage in the industry because challenges which arise through competition could be faced successfully with various technological advancements (Jayatilake & Withanaarachchi, 2019). Cost advantage will be mediating the relationship between process automation and competitive advantage because cost advantage could be achieved through process automation as low costs could be achieved in the apparel industry through automating all processes (Singh & Prasad, 2009). Thus, apparel companies could gain a competitive advantage by being superior than the competitors due to the low cost that will be achieved through process automation.

6) Relationship between Intelligent Manufacturing and Competitive Advantage.

In the near future, intelligent manufacturing will be an important tool in the garment manufacturing industry as it will lower the operational costs of the apparel company although the initial investment is high (Nayak & Padhye, 2018). Use of intelligent manufacturing techniques will also lead the apparel producing companies to distribute the apparel products faster than the competitors and achieve a competitive advantage in the market (Putzer, 2018). It is also clear that a cost advantage could be achieved due to the application of intelligent manufacturing techniques as the operational costs in the apparel industry could be reduced (Nayak & Padhye, 2018). Thus, cost advantage will be mediating the relationship between intelligent manufacturing and competitive advantage to gain a superior position than the competitors.

7) Relationship between Customized Production and Competitive Advantage.

According to Bernard, et al. (2012) companies are interested in customized production strategy because they expect a competitive advantage and an increase of their profit. Thus, the cost advantage will mediate the relationship which exists between customized production and competitive advantage. By supporting the cost advantage in the apparel industry through customized production, a firm will succeed in achieving the cost leadership in the industry. Eventually, after achieving the cost advantage, the apparel company could be identified to be an above-average performer in its industry which means it could achieve the competitive advantage (Porter, 1985).

II. METHODOLOGY

This study was conducted under the Independent variables Intelligent Manufacturing, Process Automation and Customized Production while Competitive Advantage was used as the Dependant variable and Cost Advantage as the Mediate variable. Saunders, et al. (2019) have explained research design through the concept of research onion and it shows the issues highlighting the techniques used to collect data and analysis procedures. The researchers of this study have used the deductive approach under the survey strategy to conduct the study on the impact of automation in achieving the competitive advantage in Sri Lanka. Realism was used as the philosophy to conduct this study and cross-sectional time period was used. The researchers conducted the study under mono method, collecting quantitative data using questionnaires during the time period October 2020. The data was analyzed using different quantitative and techniques. In this study both primary and secondary data have been used to gather data. A questionnaire was distributed by the researchers under the survey strategy to the target population. Secondary data which were required to conduct the research were obtained through previous researches, various journal articles, reliable websites and government statistics.

A. Conceptual Framework

According to the Conceptual framework illustrated in figure 1, Process Automation, Intelligent Manufacturing and Customized Production have been considered as Independent variables and Competitive advantage has been considered as the Dependant Variable. According to Baron & Kenny (1986) the researchers considered Cost advantage as a mediating variable in this study.

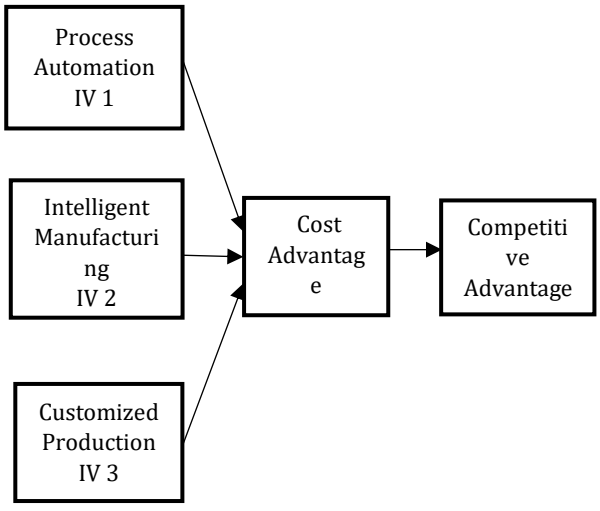

Figure 1: Conceptual Framework
Source: Developed by Researchers

Corresponding to the conceptual framework, following hypothesis were developed by the researchers.

H1: Process automation will have a positive impact on competitive advantage.

H2: Intelligent manufacturing will have a positive impact on competitive advantage.

H3: Customized production will have a positive impact on competitive advantage.

H4: Cost advantage will have a positive impact on competitive advantage.

H5: Cost advantage will mediate the relationship between process automation and competitive advantage.

H6: Cost advantage will mediate the relationship between Intelligent manufacturing and competitive advantage.

H7: Cost advantage will mediate the relationship between customized production and competitive advantage.

III. DISCUSSION AND ANALYSIS

A. Normality

Normality could be termed as the degree to which the sample data distribution corresponds to a normal distribution. Negative Kurtosis values indicate a Platykurtic distribution while positive values indicate a Leptokurtic distribution and positive skewness values indicate a leftward shift of the distribution while negative values denote a rightward shift (Hair, et al., 2014). In this study, Cost Advantage shows a platykurtic distribution while all other variables show a leptokurtic distribution. All skewness values in this study show a negative skewness indicating a rightward shift of the distribution.

B. Linearity

In this study linearity was tested between Competitive Advantage, the three independent variables including Process Automation, Intelligent Manufacturing, Customized production and the mediate variable cost advantage.

R-Squared or R2 refers to the amount of variation and the value ranges between 0 and 1 while a higher value will indicate a higher amount of variation (Almquist, et al., 2019). In this study the researchers obtained values between 0 and 1 proving a higher amount of variation. The R2 value for process automation and competitive advantage is shown as 0.562 which shows that 56.2% variation of process automation exists according to the findings. All other variables which are Intelligent manufacturing, Customized production and cost advantage shows 0.296 (29.6%), 0.342 (34.2%) and 0.571 (57.1%) variations respectively. The R2 value for the linear indirect relationships are 0.650, 0.579, 0.583 which are 65%, 57% and 58% respectively proving a higher amount of variation.

C. Reliability

Reliability is considered to be the degree to which the variable measures the "true" value (Hair, et al., 2014). According to (Taber, 2016) Cronbach's Alpha is commonly used in studies as an indicator of instrument or scale reliability. Cronbach's Alpha is considered to be a measure of reliability that ranges from 0 to 1 and values of 0.60 to 0.70 is considered to be an accepted level of reliability. If the value is 0.8 or greater it is a very good level (Hair, et al., 2014). According to this study all independent variables and the mediate variable have a value greater than 0.8 while the Dependent variable represents a value of 0.903. Thus, it indicates that the data analysis was measured effectively and efficiently.

Table 1: Reliability Test

	Cronbach's Alpha	**No. of items**
Process Automation	0.896	05
Intelligent	0.880	04
Customized	0.885	05
Competitive	0.903	05
Cost Advantage	0.856	04

Source: Researchers

D. Validity

Validity depicts the extent to which a set of measures which correctly represents the concept of the study and it relates to the consistency of the study. It is the degree to which a measure accurately represents what it is supposed to (Hair, et al., 2014). The questionnaire prepared by the researchers was approved by the supervisor.

E. Multicollinearity

According to Hair, et al. (2014), Multicollinearity is the extent to which a variable can be explained by other variables in the analysis. It is believed that as multicollinearity increases the interpretation of the variate will be complicated because it is more difficult to determine the effect of any single variable. To check whether there is any

multicollinearity among the variables the Variation Inflation Factor (VIF) can be used. It denotes how much variance or standard error is inflated when multicollinearity exists (Hair, et al., 2014).

According to the findings of this study all the tolerance values are greater than 0.1 and all VIF values are less than 10 which indicates that there is no multicollinearity.

F. Correlation

A correlation test will test the relationship between two continuous variables and the strength of the variable will be interpreted as a coefficient. Values between -1 and +1 will result in a perfect relationship and values between 0.7 and 0.9 will result in a Strong relationship. Furthermore, values between 0.4 and 0.6 will result in a moderate relationship while values between 0.1 and 0.3 will result in a weak relationship (Almquist, et al., 2019). Thus, it can be concluded that there is a strong relationship between process automation and competitive advantage and also in between cost advantage and competitive advantage. A moderate relationship will result in between the variables intelligent manufacturing and competitive advantage and between customized production and competitive advantage.

Table 2: Correlation Test

Hypothesis	Pearson's Correlation	Significance
H1	0.750	0.000
H2	0.544	0.000
H3	0.584	0.000
H4	0.756	0.000
H5	0.744	0.000
H6	0.629	0.000
H7	0.664	0.000

Source: Researchers 2020

All the Pearson correlation values obtained in the study are positive. Therefore, there is a positive linear direct relationship between the independent and dependent variables while there is a positive linear indirect relationship between independent, mediator and dependent variables. This study shows the Pearson correlation coefficient is between -1 and +1 which could be identified as the accepted level.

G. Regression

Regression analysis is used to predict the missing values of a variable based on its relationship to the other variables. Multiple regression will be carried out if there is more than one independent variable (Hair, et al., 2014). Linear relationship will be used to analyze the relationship between Process automation, Intelligent manufacturing, Customized production towards Competitive advantage in the Sri Lankan apparel industry.

Table 3: Modal Summary

Model	R	R square	Adjusted R square	Std. error of
1	0.769[a]	0.592	0.571	0.525

Predictors: (Constant), Process Automation, Intelligent manufacturing, Customized production, Competitive advantage.

Source: Researchers 2020

According to the modal summary given in the table, R value represents a positive linear relationship with the dependent variable as it is a positive value of 0.769. The R square value also stated a value of 0.592 which is a value between 0 and 1 and it can be shown as a percentage which is 59%. Values between 0.7 and 1.0 indicates a strong positive linear relationship (Ratner, n.d.). Thus it can be concluded that this study contains a strong positive linear relationship because the value of R is 0.769. The adjusted R squared value of this study is 0.571 which is 57% of the variance of competitive advantage which is determined by the changes in process automation, Intelligent manufacturing and Customized production. The adjusted R squared is considered to be a modified version of R squared which has been adjusted to the number of predictors in the model. The adjusted R squared value which is 0.571 is statistically significant as it suggests the variance of Process automation, Intelligent manufacturing and Customized production which is 57% of the variance of competitive advantage. According to table 2 overall standard error of the estimate defines the measure of variation. The standard error of estimate is 0.525.

Table 4: ANOVA

Model	Sum Of Squares	Df	Mean Square	F	Sig.
Regression	24.337	3	8.112	29.453	.000[b]
Residual	16.802	61	0.275		
Total	41.138	64			

a. Dependable variable: Competitive advantage

b. Predictors: Process automation, Intelligent manufacturing, Customized production

Source: Researchers 2020

According to the above table it can be concluded that the overall regression model is significant where F=29.453 and P < 0.05 under 95% confidence level. Therefore, by looking at the overall significance level given in the ANOVA table which is .000 it can be concluded that the study is statistically significant.

Table 5: Coefficients

Model	Unstandardized coefficients		Standardized coeff	t	Sig.
	B	Std.	Beta		
(Constant)	0.45	0.39		1.145	0.257
IV1 Process automation	0.614	0.111	0.604	5.523	0.000
IV2 Intelligent manufacturing	0.071	0.127	0.064	0.559	0.578
IV3Customized production	0.184	0.119	0.178	1.539	0.129

Dependent variable: Competitive advantage

Source: Researchers 2020

As per the beta values in table 5, a change of one unit in Process automation results in a change of 0.604 units in Competitive advantage while all other variables constant. As such there is a direct impact of process automation with high significance. However, the significance value of intelligent manufacturing and customized production are above 0.05, which indicate that there is no direct influence towards the Competitive edge. Accordingly, the final regression model can be derived as below.

Competitive Advantage = β0 + β1 + β2 + β3

=1.145 (Constant Value) + 0.604 (Process Automation) + 0.064 (Intelligent manufacturing) + 0.178 (Customized Production)

H. Sobel Test

The researchers conducted the mediating analysis using the Sobel test carefully elaborating the conditions of the mediator as per (Baron & Kenny, 1986). As per the Sobel test statistics, process automation has a partial mediation where as intelligent manufacturing and customized production has a full mediation. Accordingly, Intelligent manufacturing and customized production can be used to reduce the overall cost of the production.

Table 6: Sobel test statistics

Models	Sobel test Statistics
Process automation → Cost advantage	3.581
Intelligent manufacturing → Cost advantage	4.546
Customized production → Cost advantage	4.579

Source: Researchers 2020

I. Discussion

Apparel industry has become a prominent industry worldwide and Sri Lanka will have to focus on using automated techniques in the apparel industry in order to achieve the competitive advantage with the help of process automation, mass customization and intelligent manufacturing while achieving a cost advantage as discussed by the researchers in this study.

As discussed in this study all challenges which arises due to the competitiveness in the industry could be faced successfully with technological advancements and automation which will help apparel companies to stay competitive in the industry while being the best player. Various intelligent manufacturing techniques such as robotics and artificial intelligence will help distribute the apparel products at a faster pace than the competitors helping to achieve a competitive advantage in the industry. Providing differentiated products from what the competitors will distribute to the market will help become superior than competitiors as customers will always prefer unique apparels over homogeneous ones. The relationship between cost advantage and competitive advantage was proved by Porter's Generic model in this study as a company will be known to be an above average performer if it succeeds in providing apparels at a low cost. For Sri

Lanka to sustain in the market as a third world country, it should always have to go with the cost benefit which could be achieved through Automation. With the invention of technology such as CAD and CAM in the apparel industry apparel companies could offer customized products at a low cost.

IV. CONCLUSION

This research study could be considered important since this study was conducted by taking Senior level managers and industry experts in the apparel companies of Sri Lanka. According to the findings it can be concluded that a competitive advantage could be achieved in the apparel industry of Sri Lanka by utilizing Process automation, Intelligent manufacturing and Customized production. It can also be proved that Cost advantage will mediate the relationship between process automation, Intelligent manufacturing, and customized production towards competitive advantage. Cost advantage could be achieved in the apparel industry using automation as low costs in production could be achieved while producing high quality apparels.

It also can be concluded that, in Sri Lanka, even though people working in companies prefer to have less automation, in order to sustain in the market and to achieve a cost advantage, automation should exist in apparel companies.

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