Evaluating the Effectiveness of Process Automation in the Sri Lankan Textile Manufacturing Industry

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Abstract Process Automation, the strategy of automating the processes to achieve business success is becoming a trend in current industries. Textile manufacturing industry plays a leading role in the Sri Lankan economy and contributes a lot to the country's development. But recently the Sri Lankan Textile Manufacturing Industry is depicting a downfall where it puts the country's economy in great danger. Therefore this industry is paid attention on the context of its performance and technology usage. Information on processes before and after automation and the strategy for automation was gathered based on the supply chain. The study was mainly carried out to reveal the significance of the least explored areas of concern and get the awareness of the community. Upon the industry performance, a framework was amended to evaluate the effectiveness of process automation to suit to the Sri Lankan context. An analysis was done for the whole industry based on the sample major players of the industry (Brandix, Hirdaramani and MAS Holdings) about their performance based on Porter's Value Chain and a detailed discussion about the performance was derived. Through the research outcomes, the major players can identify ways to measure their current performance and improve their effectiveness, and the SMEs can get a better idea on better performance practices and automation strategies to move forward to improve their performance.

Keywords — Textile Manufacturing Industry, Process Automation, Supply Chain, Effectiveness, Framework

I. INTRODUCTION

Textile Industry environment is growing significantly at a pace recently, which urges the companies to search for better ways to create and deliver superior values to customers. Therefore the need to practice fine mechanisms to assess their existing state and move ahead is becoming ever stronger. It is noteworthy that eventhough the textile industry is more prominent in the economy of Sri Lanka there is no proper mechanism to evaluate their existing state and use of technology. Sri Lanka is considered a lower-middle income developing nation with a population of 19.7 million. GDP: $23 billion; Per capita GDP: $1.170 and boasts relatively good social indicators. The annual imports are about $9 billion. U.S.-Sri Lanka bilateral trade totaled U.S. $2.2 billion in 2005, mostly Sri Lankan apparel. After the liberalization of the economy in 1977, the apparel industry in Sri Lanka started growing rapidly. During 1990s, the industry grew at 18.5% per annum. The export-led expansion of the industry led to the replacement of tea by apparel as the nation's largest foreign exchange earner [1], [2], [3].Accordingly the Textile Industry contributes a great deal to the Sri Lankan economy.

Thus this industry needs to have more attention, since it is been leveraged by the new technological innovations, the industry depicts a great possibility for further advancements.

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When analyzing the industry with the use of technology the industry has gone through several ups and downs. As textile manufacturing industry commenced, it showed a rapid growth compared to today, eventhough there was no outstanding information technology initiatives at the time, the textile industry proved to be a leader in the industrial sector of Sri Lanka as stated in the Annual Reports of Central Bank of Sri Lanka. But in the current context the exports from the textile (manufacturing) industry has been decreased but the use and improvements of information technology has been increased [4], and its uses in the textile industry also has been increased. But then "why the industry is showing a downfall?" becomes a question on stage. Therefore it becomes important to identify the impact caused by the technology on the textile industry. A special consideration needs to be given for this interrelation of technology use in the textile industry. This research aimed to pay attention to the Sri Lankan textile industry effectiveness in the context of technology usage, and it mainly addresses the developments that took place with regard to supply chain and value chain as a start to the researchable area. It primarily concerns about the question "Has the automation/ technology enablement in processes brought the expected outcome to the textile manufacturing industry?" Throughout the research "Textile" refers to the variety of apparel manufactured in the selected sample.

II. METHODOLOGY

By taking the previous literature into consideration the research team acquired background knowledge while having visits to the selected companies and collecting information on their overall business processes. Researchers reviewed the previous and current operation of the processes in the selected companies. The gathered information was analyzed to decide on the consequences of the process automation in the supply chain of the particular companies. Results revealed by the analyses were taken into consideration to identify and amend a framework for the assessment of effectiveness. The researchers developed this framework commonly for the textile manufacturing industry and proposed practicable suggestions for further improvements.

2.1 Study Design:

An exploratory study was carried out to understand and identify a solution to the prevailing gap of not having a proper mechanism to assess the effectiveness of process automation in the textile manufacturing industry in Sri Lanka. The 'before-and-after study design' was used to measure the performances in the situation change.

2.2 Sampling:

The study was carried out concerning on the supply chain of the three major players (MAS Holdings, Brandix Lanka Ltd. and Hirdaramani Group of Companies) and two sub companies (Noyon Lanka (Pvt.) Ltd., Linea Intimo (Pvt.) Ltd., T&S Buttons Lanka (Pvt.) Ltd., Brandix Casualwear Ltd., Hirdaramani Industries Ltd. and Hirdaramani International Exports (Pvt.) Ltd.) from the major companies in textile manufacturing industry.

A questionnaire was e-mailed to a Manager, an Assistant Manager or an Executive, who has the knowledge on the activities that took place in the supply chain before and had under gone the changes occurred by the automation and an interview was conducted and with further process observation. Information was collected in specific areas; former and current process of the supply chain, automation need and strategy together with the improvements achieved.

The non-probability sampling method was used as each entity in the population could not be identified individually. "Judgmental/Purposive Sampling was used out of the existing non – probability sampling methods for the research purposes as the research group uses a subset of the population to represent the whole population in Textile Manufacturing Industry in Sri Lanka. The subset was not selected to provide a statistical representation of the population, but because their experience and knowledge is valuable to the research.
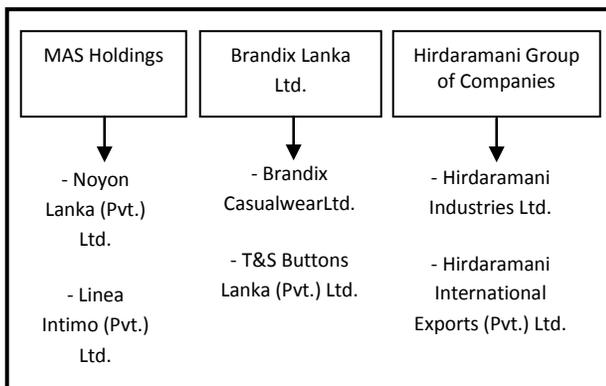

Fig.1. Selected Companies

2.3 Data Analysis:

Data analysis was carried out in qualitative and quantitative measures through the information gathered from the six companies mentioned above. The qualitative information was gathered on the former and current supply chain operation after automation, and it was studied and analyzed to gain knowledge on the performance improvements that took place due to

technology. This analysis was used in providing further improvement suggestions.

When the analysis was carried out the research group amended a framework to measure and improve the effectiveness of their processes, and then a test questionnaire was sent to the sample companies in order to identify whether the framework suits for the overall industry or not.

III. DETAILED ANALYSIS

The detailed analysis was carried out in accordance to "Michael Porter's Value Chain" [5] [6]. For the research context the primary activities: Inbound Logistics, Operations and Outbound Logistics were discussed, and from the Supportive activities: Human Resource Management, Firm Infrastructure and Technology Development were discussed. The following is the discussion of the findings for the Industry.

3.1 Primary Activities

3.1.1 Inbound Logistics

In the earlier process Purchase Order (PO) creation took a lot of effort and time as PO creation required various information from different departments. The raw material supplier had to wait until he is being informed and it was a risk to companies because if the supplier is unable to meet the target date, the company has to delay or terminate their processes until the raw materials are received.

Furthermore all the details about the PO and invoice were maintained manually and when the PO is created they manually check the inventories in the warehouse. Once the raw materials were received the information on the Good Receive Note (GRN) was entered manually to the excel files and they have manually checked the goods against the invoice.

The current system helps the company to have an internet enabled supply chain where it provides integration among all the relative parties. All the inventory details are maintained through the system. It further eliminates the risk of raw materials being out of stock since it provides a vendors' window where the vendor can keep track of their inventories and plan their operations according to the updated Material Requirement Planning (MRP) which increases the efficiency and effectiveness of the process. The system embedded barcode system helps the company in checking the PO and GRN. At the end of each month the system generate many reports and these could be used in the profitability calculation process. The system further provides communication facilities with the external parties that help an uninterrupted process flow.

3.1.2 Operations

Fabric Request Note (FRN) was produced manually by concerning the number of required products and then sent to the warehouse. The creation of the FRN resulted in lot of errors and was really time consuming, as it needs to go through several documents. Materials were cut manually which incurred lot of time in finishing a single line and many man made errors were visible. At the dying plant once the dye batch was received the operator has entered the details to the excel sheet. In the packing process the carton sticker was written manually, this was time

consuming when it comes to a large shipment and the end result was not elegant. The cartons were loaded to the trucks by people at warehouse.

The new system integrates all the functional units. Therefore it has increased the visibility of information and reduced data redundancy. The cutting unit sends a FRN through the system to the warehouse and receives the material they needed for the production process. In the cutting unit the new machines fed data on the required size and a line finishes with minimum errors easily. Currently at the dying plant colour mixing is done by feeding the data into the system, and once it is fed the system selects the colours and mixes them accordingly to produce the customer expected outcome. In the dyeing operation some of the companies use barcodes in the batch card where it enables easy upgrading. The carton sticker in the packing process is also now printed with the information on the system. With the help of technology the industry has developed a scanning system for the loading operation. The cartons are loaded to trucks through a converge belt.

3.1.3 Outbound Logistics

Previously according to the information received through the Purchase Order, the manufacturing company sends products to the buyer. All the shipping details were maintained/ handled manually and it was inconvenient to access and confusing in recording. The shipping schedules and all the relevant information about the order fulfillment is now stored in the system where it provides easy storing and retrieval.

3.2 Supportive Activities

3.2.1 Human Resource Management

Because of heavy work load there were lots of complaints from the employees and less value was given to the ideas of the employees. After the implementation of the new system, when recruiting and selecting a new employee to the company the management gives higher priority for the candidates who have a rich knowledge on existing systems and new software. Training programs are being carried out by assigning employees on selected projects; quality circles and activity planning.

3.2.2 Firm Infrastructure

In the former process interdepartmental interactions were not visible. Due to these reasons the departments were deviating from the company's end goal. This created many errors, data duplications in the process and was very time consuming. They had no proper mechanism to view all the company process related data in one place and when carrying-out an activity they had to collect information from several places in several formats.

The current process integrates all the functions and departments of the company. The system operates a central information repository where it provides efficient communication between all the process related parties. And it further enables the visibility and exchange of information among them. This eliminates the inconvenient communication barrier within the process. This system facilitates a smooth flow over the entire process.

3.2.3 Technology Development

The companies at commence of business has used entirely manual approaches. With the technological advancements they have started using excel files. Mostly the reports were generated manually. Today most of the companies use Six Sigma approach and ERP (Enterprise Resource Planning) system (SAP) which includes highly developed technology infrastructure, and support the company to make the processes efficient and effective.

IV. RESULTS

This section of the research paper will describe the research outcomes based on two main sections and sample gathered information.

4.1 Results: Framework for Evaluating the Effectiveness of Process Automation

One of the sub objectives to be achieved is the modification of a suitable framework to evaluate the effectiveness of process automation in the textile manufacturing industry in Sri Lanka. By utilizing the primary and secondary information gathered on the industry a framework was selected and amended to suit the requirements of the industry. The key factor for this framework selection was the industry practice of lean manufacturing, six sigma and the belief that automation could not be carried alone but it needs certain human interactions to be successful. Therefore the framework shown in Appendix is derived from the original Toyota Production System (TPS) with technology and human attributes and modifications to suit to the Sri Lankan context. The original TPS framework is designed in compatible with the Japanese environment where they have used concepts like Just-In-Time (JIT) and waste reduction. For example they define JIT as producing the right part, in the right amount at the right time where it needs advanced machinery, but in Sri Lanka the companies practice mass production to minimize the machinery investments.

The ultimate expectation of following the framework stated practices is to achieve the shortest possible leadtime, high quality, increased profit, etc. Once the framework was derived it was tested on the industry to verify its validity. The team identified that all the sample companies are currently practicing some of these framework stated practices upto some extent which can be mainly described as either not implemented, pilot implementations, halfway implementations or complete implementations. MAS Holdings has most of the practices at the halfway implemented stage which is enough for them to sustain in the industry and have further potential for development where others' implementations lies at the initiation stage.

To validate the framework the team used a quantitative method by assigning weights based on industry used ranges for each of the implementation stage, as they contribute different values to the entire industry process as a whole. Then the weighted average for each company is derived based on the responses for the framework practices implementation stage. These derived weights were depicted on a horizontal line to clearly represent the implementation extent of each company. All the functions carried out in a company has been categorized under the areas depicted in the framework and has been analyzed with the sample.
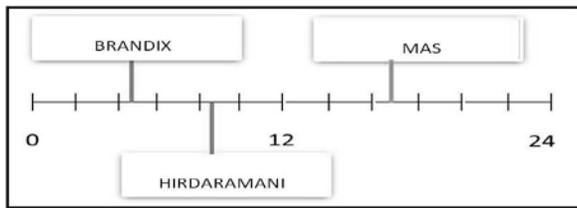
Fig. 2. Response Weight (Avg.) Scale [Developed by Research Team]

Therefore it can be said that the amended framework is applicable for the industry as the sample companies are aware of the practices in the framework and are in use of them to some extent.

4.2 Results: Evaluating the Effectiveness

As per the general effectiveness definition talks about doing the right thing, the research team derived a definition for the research itself based on the general effectiveness definition. It says "The extent to which the needs of automation are attained through the use of technology and effectiveness practices".

As described in section 4.1 a framework was declared as a collection of practices that could aid the Sri Lankan textile industry in achieving effectiveness in their overall process and reduce leadtime. Since each implementation stage is given a value, based on each company performance the total for each company is gained. This according to the derived definition is the effectiveness for each company, or in other words it is the amount that each company is utilizing the framework stated practices for effectiveness.

When a percentage is obtained MAS Holdings has the highest effectiveness of 67.82%. From the other two sample companies Hirdaramani Group of Companies lies ahead with an effectiveness of 32.12% where Brandix Lanka Ltd. has the lowest effectiveness of 23.75%. Further the final result was presented from the amount of practices currently the companies are using and upto which extent.

When considering about the real information from the industry they have been able to reduce the leadtime of their processes through the use of automation. Furthermore the framework also points out that the companies are effective in their effort in process automation. The framework derived results have been proved with evidence from the industry real information, which at the end implies that process automation helps the companies in being effective in their operations. Therefore the research concludes that the process automation in the textile manufacturing industry has a positive impact on their processes, and enables the industry in achieving effectiveness through their need to reduce leadtime.

V. CONCLUSION

The research 'Evaluating the Effectiveness of Process Automation in the Textile Manufacturing Industry' a detailed analysis for the Sri Lankan major textile manufacturers' performance before and after automation was prepared, and a framework and a method of evaluating the effectiveness of process automation were presented. When observing the industry players' performance it was evident that the use of technology in their processes has started very small and has grown with the

experience and technology advancements. Therefore the selected companies have faced at least one or more technology transformation eras within their company which in turn has helped them in achieving great business performance and increase and extend their customer base. Furthermore through the framework effectiveness analysis it depicted that out of the selected sample MAS Holdings lies at the top of effectiveness where they have most of the effectiveness practices on the halfway implemented stage and still they have more potential for growth.

Hirdaramani Group of Companies has a medium effectiveness in effectiveness where Brandix Lanka Ltd. lies at the bottom according to the research analysis. Therefore these companies can use the framework to identify their performance and improve, and the SMEs can use the performance analysis of the major players in upgrading their existing state and to become leaders in the market. This research does not provide a statistical solution for the entire industry as a whole, but a general conclusion has been derived on the basis of the major players' performance.

One of the research objectives was to identify the former performance of the industry, but as the situation experienced employees has left the company it has been hard to collect the detailed information. Further the research work was carried out on the information from the major players of the industry due to the time constraint, therefore anyone interested in doing research would be able to improve it further by analyzing the SMEs processes and give assistance to them to identify their current standard and upgrade their performance.

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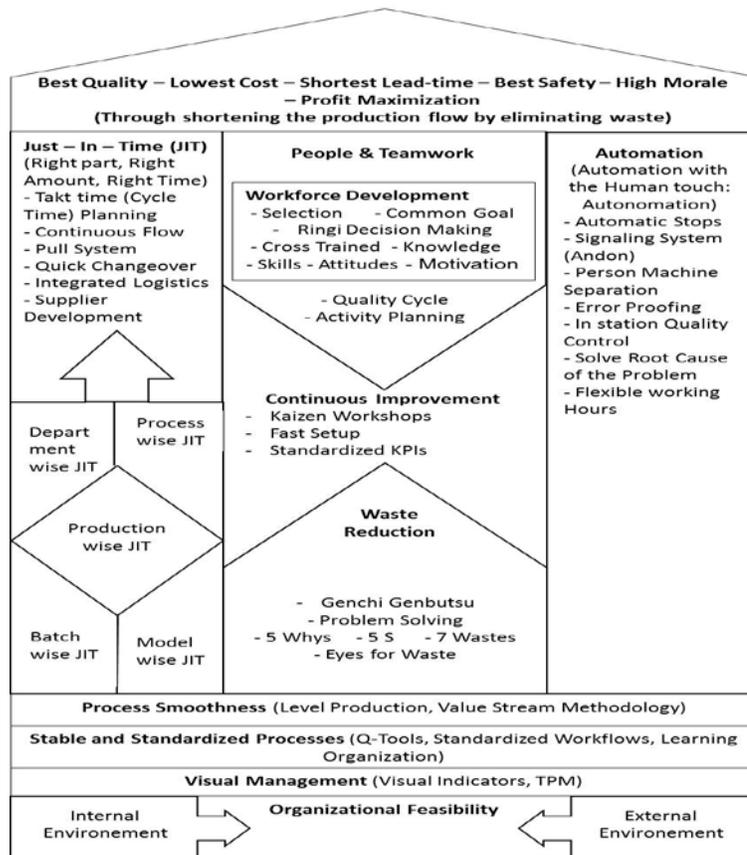http://stu_.mit.edu/afs/athena/course/2/2.810/tstemp/TPS-Overview.ppt

APPENDIX: **Amended Framework**

Fig. 3. Amended Framework