Implementing Industry 4.0 in the apparel industry; A study to design a customized smart apparel production plant

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Abstract—**The world is now witnessing the 4th industrial revolution which is commonly known as Industry 4.0. This research has been focused on possibility of developing a customized smart apparel production plant which will be a novel approach in the apparel industry based on the identified issues of the current sewing process and the suggestions to improve them. The proposed model has been developed using the Arena® by analyzing an apparel production plant and the generic benchmarking process with the Volkswagen production system.**

I. INTRODUCTION

INDUSTRY 4.0 can be identified as the current trend of automation and data exchange in manufacturing technologies which includes cyber-physical systems, the Internet of things and cloud computing. The smart factory concept has been designed under the Industry 4.0 as a future aspect of the manufacturing industry. Currently the world is in the edge of Industry 3.0 which has been primarily driven by Information & Communications Technologies (ICT) enabling both manufacturing and service sectors to achieve many gains. Today, sensors, RFID chips, 'cyber physical' systems and the Internet of Things (IoT) are transforming manufacturing and services across their entire supply chains [1].

When considering about the concept of the fourth industrial revolution as a country, the major question that would arise could be, whether Sri Lanka has the capability to adopt the concept. Even though this concept originated from the high end technological industrial world, Sri Lanka should consider of adopting the concept as this shows the world is heading to a technological standardization process with the smart factory concept which is a backbone of the 4th industrial revolution. The Annual Survey of the Industries of Sri Lanka reveals that the manufacturing is dominated by having 98.5% of the industry establishments and 20% of them contains the apparel production [2].

The Joint Apparel Association Forum, also emphasizes that the, automation of the industry would be an ideal solution, to face the challenge of labour shortage. The future goal of the apparel manufacturing would be minimizing human intervention at all levels of manufacturing to increase productivity by using the resources available optimally. It is evident that the apparel manufacturing organizations has the potential and the strength of adopting the concepts like smart factories as aligning their corporate strategies along with the fourth industrial revolution [3].

Smart factories and customized apparel

The main focus of this research is to identify the possibility of designing a customized apparel production plant based on the smart factory concept. This concept is mainly based on the Volkswagen production system, where one of the leading automobile manufacturers in the world used to manufacture customized vehicles. In the Volkswagen production system, customers can directly place their orders as per their requirements and interests. According to the customer requirements, each part of the vehicle is produced in the different production units. In here the traditional production line system has been completely eliminated where the customized parts of the vehicle produced in different units are finally assembled in the assembly unit to make the final product [4]. Volkswagen is using the latest smart technologies such as real time production and parts tracking using RFID technology and autonomation technologies to create and effective smart production system [4].

Based on this concept, the proposed sewing process of the customized apparel production plant has been designed. Especially the countries like India is focusing on building 'mini' factories in small villages rather than building 'mega' factories in large cities in order to discourage the people moving to large cities for employment and controlling the population increment in large cities [5]. This idea is based on the concept of 'small is beautiful' where the proposed production plant is going to be a mini plant which can be established even in a small town.

II. METHODOLOGY

Initial background study has been conducted to gather the knowledge about customized apparel production and the Volkswagen production system. The generic benchmarking process has been followed in order to study about the Volkswagen production system. Sewing process of a 'T shirt' has been considered to develop the model of the current and proposed production flows with the sewing data from a real apparel production plant.
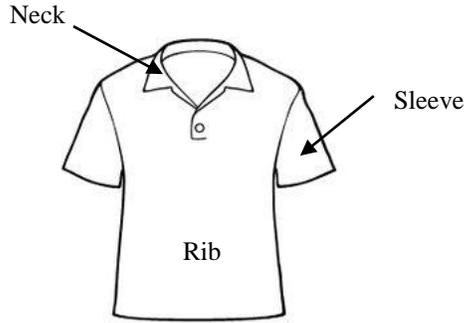
Fig. 1. The sample model of the T shirt which has been considered to design the current and the proposed production flows from Arena®.

III. DESIGN AND DEVELOPMENT

Both the current and the proposed models have been developed using the Arena® simulation software. The issues of the current sewing process also has been identified and based on them and the details of the benchmarking process of the Volkswagen production system, the proposed sewing process has been developed.
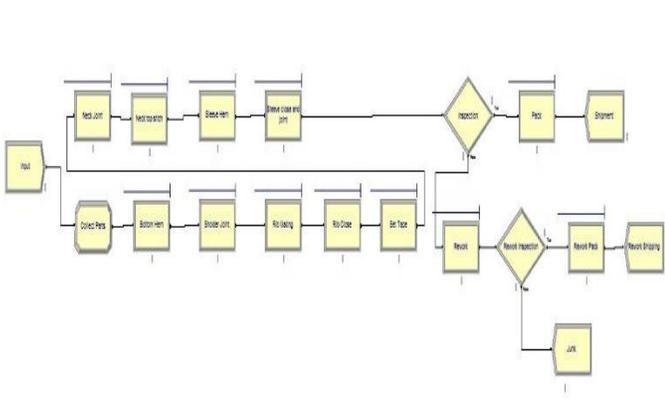
Current sewing process

Fig. 2. The current sewing process of the t shirt

In the current sewing process, the raw material of the three major parts of the t shirt entered the line as a one batch. The production flow follows a traditional production line approach where the t shirt is being produced through a sequential approach.

The major issues of the current sewing process can be identified as follows,

- Considerably high number of labor shortage and the labor turnover has led to reduce the efficiency of the production lines.
- Inefficiency in the raw material reconciliation process has led to reliability issues.

According to a research conducted by Islam, Mohiuddin, Mehidi and Sakib, it is evident that the efficiency of this sequential sewing process is considerably low which has led to decrease the productivity. Also to adapt automation for the clothing system is also so hard because, the complexity of this system has led to high labor intensity [6].

Proposed sewing process

Based on the issues of the current sewing process and the Volkswagen production system, the proposed sewing process has been designed in order to meet the requirement of a customized smart apparel production plant.
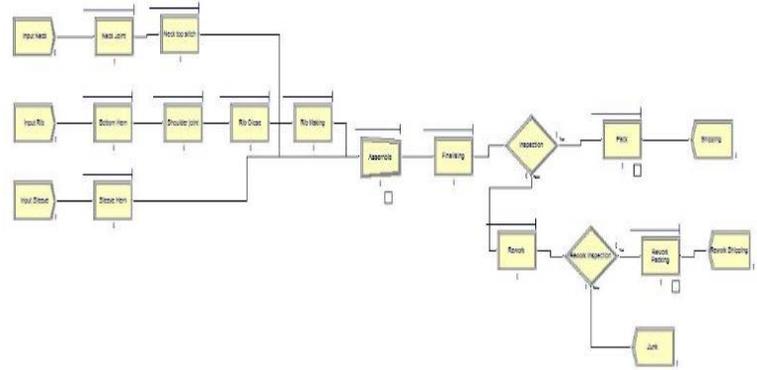

Fig. 3. The proposed sewing process of the t shirt

The main features of the proposed process can be identified as follows,

- *Production Cells*
  By following the production sections concept in Volkswagen, the proposed production process consists with the production cells where each of the major components in the t shirt manufactures and customizes in each cell before moving to the final assembly cell. This cell cab be consisted with multi-tasking machine operators and also the automated sewing machines.

- *Real time production and part tracking*
  In order to track the each customized part of the garment as per the customer order and assemble, RFID tags can be attached in each part of the garment. Having RFID tags in the garments will be beneficial to implement the real time production tracking system in order to increase the efficiency of the raw material reconciliation process.
  Cooray and Rupasinghe have already developed a real time production tracking and decision making system for a apparel production plant using the Bar Code technology. In their research it has been mentioned that by using RFID technology instead of Bar Code would increase the flexibility and the capability of the system [7].

- *Implementing Social Manufacturing with 3D designing*
  It is proposed to implement a social manufacturing platform in the ERP system where the customers can directly place their orders according to their requirements. This system will allow the customers to follow their order from inception to the end with the integration of the real time production tracking system as well. Through this

system, the 3D design of the garment can be tested using the virtual models and the 3D printed garment can also be obtained by eliminating the long sample making process.

IV. CONCLUSION

This study has provided the platform to identify the possibility to implement Industry 4.0 in the apparel industry by presenting a model of a customized smart apparel production plant. Since this is a conceptual framework developed and tested using the Arena simulation software, more effective results can be obtained if the proposed sewing production flow can be implemented and tested in a real apparel production plant.

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