Automation in Textile Industry

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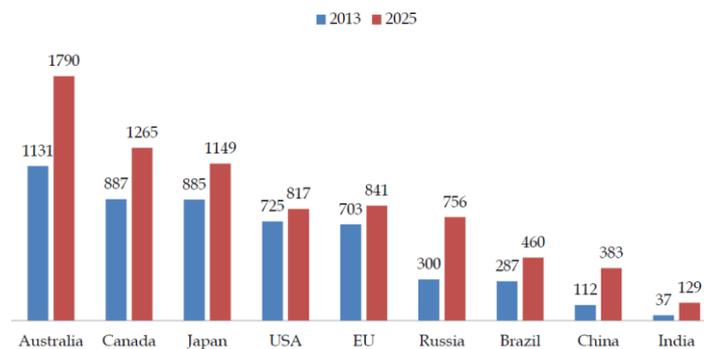[2] PhD Scholar, NMIMS, Shirpur, India

Abstract

This paper reviews the automation which has taken place in the textile industry in the recent past which has helped the industry in improving the productivity and quality of the textile products. The paper mentions various textile processes and the automation which has taken in these processes. The paper also highlights various benefits which have been achieved through automation in the textile industry.

Introduction

Textile industry is one of the oldest industry in the world and also in India. The Indian textile industry's current revenue is around US$ 108 billion which is forecasted to increase up to US$ 223 billion by 2021 [1]. Textile industry in India is the second largest employer. It gives employment to about 45 million people directly and almost 60 million people indirectly [1]. Textile consumption is increasing in developed as well as developing countries. The expected percentage increase in the spent on textiles in the developing countries is much higher than the developed countries as shown in Figure 1 [2].

Figure 1: Present and Projected Per Capita Spend on Garment

India is the second largest exporter of Textiles and also has the second largest Textile Infrastructure setup after China. Table-1 gives the glimpse of the Indian Textile Industry in terms of the install base of the various manufacturing units and products [2].

Description	Capacities
Spindles	44.73 Mn.
Rotors	7.95 Lakhs
Looms	52,000 No.
Power Loom	23.67 Lakhs
Man-made Fibers	1781.6 Mn. Kgs
Man-Made Filament	2248.03 Mn. Kgs

Source: Office of Textile Commissioner

Table-1 Install Base of Indian Textile Industry

Textile industry can be divided into two segments based on their output- Yarn & Fibre and Processed Fabric. It can also be divided into two other segments based on the sector, first as Handloom & Handicrafts and the second as Organized Spinning, Weaving & Garmenting. Handloom and the handicraft industry still runs on the traditional

methods with almost no automation, while the organised sector has started adopting the state of the art machinery and automation. Traditionally the weaving and spinning started at home and then became a cottage industry which after industrial revolution started growing as an organised sector with the inclusion of machines and automation. Since then various advancement has taken place in the ginning, spinning, weaving, garmenting and knitting processes in order to reduce the cost and improve quality. The automation has help the industry to gain productivity and efficiency. Following sections mentions various textile processes and the automations taken in these areas.

Spinning

Automation in spinning has taken place in various process like picking and ginning which were completely manual earlier. High Volume Instrument (HVI) system has made possible to carry out the cotton fiber test in seconds which used to take hours before. HVI tests have improved the accuracy in measuring the cotton's staple lengths, colour grade, micronaire, strength, elongation and uniformity index [3]. Cotton mixing has been automated so that the uniformity can be achieved in the Yarn. Blow-room performance has been improved these days by using sequence of different machines required or opening, cleaning and blending which are arranged in series and are connected by transport ducts [4]. Automation is recently done to separate out the contamination of any colour, size and nature in the fibre. Machines using ultraviolet, optic and acoustic technologies are being used for the detection and elimination of contaminant of any colour, size and nature thus improving the overall quality of the final yarn produced. Automation has been achieved in spinning by the invention of machines like ring spinning, air-jet spinning, rotor spinning, Vortex spinning etc. Improvements in Ring spinning machines have taken place through drive systems, drafting systems and use of robotics. Yarn fault detection has been automated now to improve the production and to get the uniform yarn quality. Yarn knots have now been replaced with the joints using splicing techniques like air splicing, wet splicing, hot air splicing and moist air splicing which minimizes the defects in final fabric thus produced. Transport automation is done using robots to carry out heavy takes which were earlier done by humans. Package collection from the spinning mills and even palletizing and packaging is being done these days using automated solutions. All these automation in the spinning process has reduced the need of the skilled manpower.

Weaving

Weaving machines have witnessed lot of improvement in last three decades resulting in improved quality and production. Major development like automatic shuttle and shuttleless looms has taken the industry to a different level. Shuttleless machines have made possible the production of fault free cloth efficiently. Developments have been done for shuttleless machines in three basic picking principles, i.e. rapier, projectile, air-jet and water-jet [5]. The key features of shuttleless machines are higher speed, wider width, automatic pick finding, microprocessor controls, quick style change etc. [5]. Various improvements have taken place recently in rapier looms like development in filling insertion, shedding mechanism, let-off mechanism, take-up mechanism, selvedge, quick style change etc. [6] Microprocessors are now integrated with the weaving machines which monitor, control, regulate and optimize all key aspects of the weaving machines. Automation has been achieved with the help of microelectronics to control warp tension, picking of multi-filling colours, break detection, data collection etc. which has helped in improving the production as a lesser labour cost.

Garmenting

Garmenting has undergone many advancements in in the recent past. Technologies being employed in automatic garment manufacturing are reconfigurable robotic handling devices, cutting table with automatic unloading, intelligent transportation system, manufacturability prediction, Virtual TryOn, 3D garment design etc [7]. Robots handling devices [8] are being used in the garment industry for automated handling of the cut fabric parts where they are collected and delivered to the automated transport system for transferring it to the next stage.

Dyeing

Dyeing process has multiple stages e.g. Desizing, Scouring, Bleaching, Printing and Finishing. Automation helps the dyeing process by providing the precise control on various factors which are critical for the quality like pressure, temperature, time of treatment, water level etc. Robots are being used to pick the yarn bobbins and transport them with the help of the self-propelled bobbin carriers to the dyeing and drying machines. Unloading is also automated with the help of robots. Automation in dyeing helps in reduced water consumption and lesser cost for treatment and water. It also helps in controlling the consumption of colour chemicals and hence increased utilisation of man and machine and production per shift. It also automates the colour matching in the dyeing process which increases the uniformity of the end products.

Automation using IT

ERP systems are widely being used in the textile industry for managing the Inventory, Orders, Production, Logistics, Sales and Marketing and Financials etc. Many generic ERP solutions as well as customised ERP

solutions are available for textile industry [9]. ERP solution helps in integrating the operational processes and establish synergies between various resources of the textile industries. Automated Systems are also being developed for the effective communication between the production floor and other supervisory control systems. Now a days, operating and process related data is being captured from the machines and is being analysed in various BI software for the operations analysis and further productivity improvement. BI reports are being published for the top management and are used for various decision making processes.

Effects of Automation

Automation brings in quality and also improves the productivity in the mills and garment industry. Productivity increase because of automation has resulted in reduction in the overall manpower in the textile industry. Figure 2 shows the overall decline in the manpower in Mills, Mills Products and Apparel industry in last 15 Years because of the productivity enhancements brought by the automation.
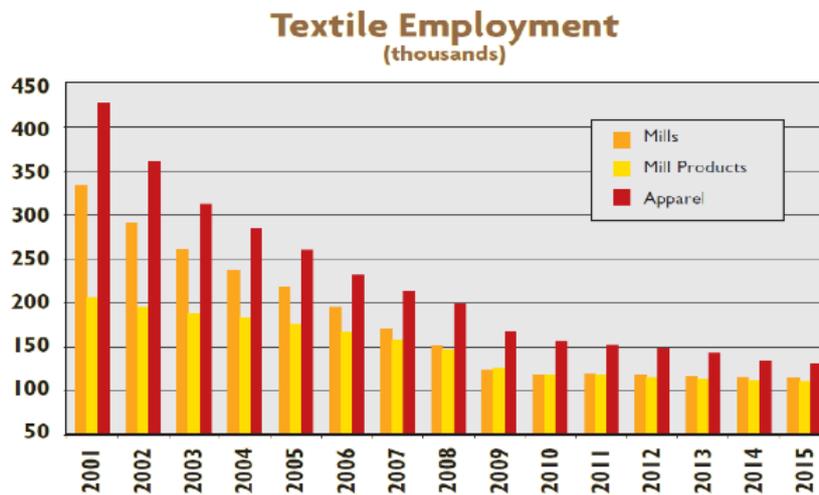
Fig-2 Textile Employment in US

Future Textile Machinery

Research and development is being done in the textile machinery to achieve further automation and enhancements. Emphasis is to further improve the quality and production and at the same time bring down the costs. Advancements are taking place to reduce the space and power requirements for various textile machinery, increase their speed and efficiency. Big data and Internet of Things is also going to play a big role in future textile machinery to analyse the machine behaviour and proactively take decisions to improve the quality and productivity of the machines.

Conclusion

Automation technologies has helped the textile industry to increase the output multiple times that too at a cheaper cost. Automation products and solutions are available now not only for the individual process or machine, but for the entire production line. Some of the key benefits achieved through automation are:
Improved production at cheaper cost
Better quality
Safety for the humans and machines
Predictable production and inventory
Energy savings
Lower impact on environment
Better machine uptimes
Self-diagnostics and Predictive maintenance
Efficient packaging and transport
Improved customer satisfaction

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