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Automation and CAD/CAM adoption in knitwear production

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ABSTRACT : The present investigation was carried out to study the automation and CAD/CAM adoption in knitwear production. For this study, data were collected from 110 knitwear units of Ludhiana consisting 56 small scale knitwear units, 29 medium scale knitwear units and 25 large scale knitwear units by using interview schedule. The sample was selected according to the probability proportional to size by following stratified sampling technique. The results revealed that with the adoption of automation and CAD/CAM systems in knitwear production, there was considerable decrease in lead time of fabric and garment production which is very important to be competitive in the market. Majority of the units used CAD/CAM systems in pattern cutting and garment assembly. The impact of automation and CAD/CAM systems on knitwear production revealed that the rate of design production, quality of design, production capacity, quality of production and communication speed increased whereas lead time, manufacturing cost, overall labour cost, and manpower decreased.

KEY WORDS : Automation, CAD/CAM systems, Knitwear, Production

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Knitting is the second most frequently used method of fabric construction. The popularity of knitting has grown tremendously in the recent years because of the increased versatility of techniques, the adaptability of many new man-made fibres and the growth in the consumer demand for wrinkle resistant, stretchable, snug fitted garments, particularly in the areas of sportswear and other casual wear-segments (Vadhani, 2001). There have been many changes in the knitwear industry during the last few decades. Previously, knitwears used to be processed manually but now-a-days, different technologies are available for producing good quality products in less time to compete internationally. Technological advancements have brought automation and computer aided designing/computer aided manufacturing (CAD/CAM) systems in all the areas of manufacturing including textile and garment industry. During the last decade, the hosiery industry also became dependent on CAD systems.

At present, knitwear accounts for 21 per cent of the total fabric production in the country. However, the global experience suggests that knitwear has a share of about 45 per cent in the clothing consumption indicating the tremendous scope for increasing the share of knitwear fabrics. Ludhiana cluster can play a very important role for increasing the knitwear manufacturing in India. The need is to match the product quality, productivity standards and cost of production with international players (Dhawan, 2007). For achieving all this, automation is very necessary. Keeping in view the importance of automation and CAD/CAM systems, the present study was planned to conduct in Ludhiana, Punjab with the objectives to study the existing production practices and adoption of automation and CAD/CAM systems in the knitwear units and to assess the impact of automation and CAD/CAM systems on production.

RESEARCH METHODS

The investigation was conducted in 56 small, 29 medium and 25 large scale knitwear units (total 110) of Ludhiana city selected according to the probability proportional to size. An interview schedule was prepared to collect the data by using survey method. The schedule contained information related to production practices like manpower, installed machinery, automation and CAD/CAM and its impact on production. The

unit owners or their representatives were requested to give the information. Simple percentages, range and averages were calculated.

■ RESEARCH FINDINGS AND DISCUSSION

The findings of the study have been discussed in detail as under:

Lead time in manual and automatic/CAD/CAM system of production:

The lead time is the period in number of days from the order till the delivery of the product that varies according to the manual and computerized systems for fabric production.

Fabric production:

The data in Table 1 show the lead time in manual and computerized system of fabric production. There were multiple responses as some units used both the methods. The average lead time in small scale units was 109.5days with a range of 95-120 days. The average lead time in the medium scale knitwear units was 97.5 days with range of 90-100 days while the range in the large scale knitwear units was 80-100 days with an average of 92.5 days. In automatic/CAD/CAM system, twenty small scale units using automated / computerized systems, reported average lead time of 77.5 days with a range of 60-100 days.

Table 1 : Lead time in manual and automatic/ CAD/CAM system of fabric production*

Method of fabric production in knitwear units	Range of number of days	Average number of days
Manual		
Small (n=22)	95-120	109.5
Medium (n=6)	90-100	97.5
Large (n=6)	80-100	92.5
Automatic/CAD/CAM system		
Small (n=20)	60-100	77.5
Medium(n=21)	60-100	72.9
Large (n=20)	50-90	65.0

*Multiple responses

In the medium scale units, it was 72.9 days with a range from 60-100 days where as the average lead time was 65.0 days in large scale units with a range of 50-90 days.

On the whole, it can be said that with the adoption of automation and CAD/CAM systems, there was considerable decrease in lead time which is very important to be competitive in the market. More and more buyers are now asking for quick delivery of the order with shorter lead time which can be fulfilled through automation and CAD/CAM adoption (Puri, 2007).

Garment production:

The lead time in garment production is from sample to the finished product. There were multiple responses as some units used both the methods. Data in Table 2 show that in the small scale knitwear units, the average lead time reported was 111.2 days and the range varied from 90-120 days with manual system whereas it was 73.5 days with a range from 60-100 days with automatic/computerized systems. All the medium scale units that used manual system of garment production, reported average lead time of 97.9 days with a range of 90-120 days that came down to 68.0 days with range from 50-90 days in the case of units using automatic and CAD/CAM systems. In the large scale knitwear units, the average lead time was 94.1 days in manual system and 62.8 days in automatic/CAD/CAM systems with range of 60-120 and 50-90 days, respectively. On the whole, it can be said that there was decrease in lead time of garment production also.

Table 2 : Lead time in manual and automatic/CAD/CAM system of garment production*

Method of garment production in knitwear units	Range of number of days	Average number of days
Manual		
Small (n=41)	90-120	111.2
Medium (n=24)	90-120	97.9
Large (n=21)	60-120	94.1
Automatic/CAD/CAM system		
Small (n=10)	60-100	73.5
Medium(n=20)	50-90	68.0
Large (n=21)	50-90	62.8

*Multiple responses

Adoption of automation and CAD/CAM systems in the knitwear production:

Fig. 1 shows that all the small scale knitwear units had electric stitching machines and computerized stitching machines were used by 24.4 per cent units. Electric cutters and computerized embroidery machines were used by 70.7 and 43.9 per cent knitwear units, respectively. All the medium scale knitwear units had electric stitching machines whereas computerized stitching machines were used by 70.8 per cent

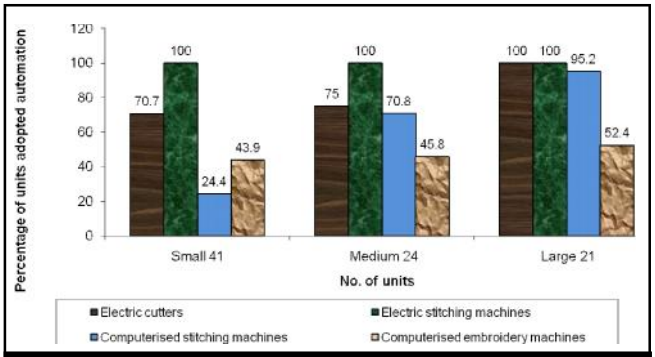

Fig. 1 : Automation adoption in garment assembly

units. Electric cutters and computerized embroidery machines were owned by 75 and 45.8 per cent units, respectively.

In case of large scale knitwear units, electric cutters and electric stitching machines were used by all. Computerized stitching machines were used by 95.2 per cent units whereas computerized embroidery machines were used by 52.4 per cent knitwear units, respectively.

Processes used in garment making by manual and CAD/CAM systems:

Various processes in garment making involved are sample patterns, sample garments, production patterns, pattern grading, layout, marker making, cutting, garment assembly, garment ironing and packing. These can be carried out either manually or with the help of CAD/CAM systems also. Table 3 shows the distribution of knitwear units according to the different manual and CAD/CAM based processes used in garment making. There were multiple responses as some units used both the systems in many processes. Manual method of making sample patterns, sample garments and pattern cutting was used by 98.8 per cent of the units. For production pattern and garment assembly, 96.1 and 93.0 per cent units, respectively used manual method. Pattern grading, layout and marker making were done manually by 87.2 per cent each of the units. Ironing and packing of the garments was done manually by all the units.

CAD/CAM based processes included pattern grading, layout, marker making, garment assembly etc. Garment assembly was done by using CAD/CAM system by 52.3 per cent units followed by pattern cutting where CAD/CAM system was also used by 32.5 per cent units. Pattern grading, layout and marker making was done on CAD/CAM system by 12.8 per cent units each whereas 9.3 per cent units made use of CAD/CAM system for sample pattern and garment as well. CAD/CAM system was used by 4.6 per cent of the units for making production pattern.

In the case of all the small scale knitwear units, all the processes from making sample patterns to garment packing were manually done except in garment assembly and pattern cutting where 24.4 and 14.6 per cent units, respectively made use of electric/computerized systems.

All the medium scale knitwear units used manual system for making sample patterns, sample garments, production pattern, pattern cutting, garment assembly, ironing and packing whereas 91.7 per cent units each used manual method for pattern grading, layout and marker making. Further 83.3 per cent units made use of computerized system in garment assembly, followed by 29.2 per cent units using electric system for pattern cutting and 8.3 per cent units each used it for pattern grading, layout and marker making (Table 3).

All the large scale units carried out pattern cutting, garment assembly, ironing and packing manually. Manual methods of making sample patterns and sample garments were in practice in 95.2 per cent units each. Production patterns were made manually by 85.7 per cent units, followed by 61.9 per cent units each doing pattern grading, layout and marker making manually. About 71.4 per cent units each were using computerized systems for pattern cutting and garment assembly whereas 42.8 per cent units each used CAD/CAM systems for pattern grading, layout and marker making. About 38.1 per cent units each used CAD/CAM systems for sample patterns and sample garments while 19.0 per cent units adopted it for making production patterns.

Impact on production:

The use of automation and CAD/CAM systems increases the production with excellent quality of the material and design in apparels. Due to fast sample production and higher productivity combined with flexibility of CAD system, the lead-time in a garment unit can be considerably reduced. Data in Table 4 show the overall impact of automation and CAD/CAM systems on production in knitwear units. It was

Table 3 : Distribution of knitwear units according to their different processes used in garment making

Garment making processes	Knitwear units							
	Small (n=41)		Medium (n=24)		Large(n=21)		Total (n=86)	
	Manual	CAD/CAM	Manual	CAD/CAM	Manual	CAD/CAM	Manual	CAD/CAM
Sample patterns	41 (100.0)	-	24 (100.0)	-	20 (95.2)	8 (38.1)	85 (98.8)	8 (9.3)
Sample garments	41 (100.0)	-	24 (100.0)	-	20 (95.2)	8 (38.1)	85 (98.8)	8 (9.3)
Production pattern	41 (100.0)	-	24 (100.0)	-	18 (85.7)	4 (19.0)	83 (96.1)	4 (4.6)
Pattern grading	41 (100.0)	-	22 (91.7)	2 (8.3)	13 (61.9)	9 (42.8)	75 (87.2)	11 (12.8)
Pattern layout	41 (100.0)	-	22 (91.7)	2 (8.3)	13 (61.9)	9 (42.8)	75 (87.2)	11 (12.8)
Marker making	41 (100.0)	-	22 (91.7)	2 (8.3)	13 (61.9)	9 (42.8)	75 (87.2)	11 (12.8)
Pattern cutting	41 (100.0)	6 (14.6)	24(100.0)	7 (29.2)	21 (100.0)	15 (71.4)	85 (98.8)	28 (32.5)
Garment assembly	35 (85.4)	10 (24.4)	24 (100.0)	20 (83.3)	21 (100.0)	15 (71.4)	80 (93.0)	45 (52.3)
Garment ironing	41 (100.0)	-	24 (100.0)	-	21 (100.0)	-	86 (100.0)	-
Garment packing	41 (100.0)	-	24 (100.0)	-	21 (100.0)	-	86 (100.0)	-

*Multiple responses, Figures in parentheses indicate percentage

Table 4 : Overall impact of automation and CAD/CAM system on knitwear production **(n=110)**

Factors	Increased	Decreased	Constant
Manufacturing cost			
Fabrics	11(10.0)	54 (49.0)	-
Garments	21(19.0)	65 (59.0)	-
Rate of design production	110 (100.0)	-	-
Quality of design	109 (99.0)		-
Production capacity	101 (91.8)	-	9 (8.2)
Quality of production	106 (96.4)	-	4 (3.6)
Fabric utilization	11 (10.0)	-	76 (69.0)
Speed of communication	108 (98.2)	-	2 (1.8)
Overall labour cost	4 (3.6)	105 (95.5)	1 (0.9)
Man power	-	100 (90.9)	5 (4.5)
Grading time	-	11 (10.0)	76 (69.0)
Marking time	-	11 (10.0)	76 (69.0)
Cutting time	-	35 (31.8)	51(46.4)
Assembly time	-	40 (36.4)	46 (41.8)
Lead time		110 (100.0)	-

Figures in parentheses indicate percentages

found that there was an increase in the rate of design production (100%), quality of design (99.0%), speed of communication (98.2%), quality of production (96.4%) and production capacity (91.8%) in a large majority of units. All the units reported decrease in lead time. The decrease in overall labour cost, man power, manufacturing cost of garments and fabrics was reported by 95.5, 90.9, 59.0 and 49.0 per cent units, respectively. Sixty nine per cent units each found that fabric utilization, grading and marking time remained constant

So, it can be concluded that with the adoption of automation and CAD/CAM systems in knitwear, rate of design production, quality of design, production capacity, quality of production and communication speed increased whereas manufacturing cost, overall labour cost, manpower and lead time decreased or reduced which are very important to meet the market requirements in the competitive world.

Conclusion:

In fabric and garment production, considerable decrease in lead time was reported by majority of the units with automation and CAD/CAM adoption. Majority of the units used CAD/CAM systems in garment assembly followed by pattern cutting, marker making, pattern layout and grading. With the adoption of automation and CAD/CAM systems in knitwear, rate of design production, quality of design, production capacity, quality of production and communication speed increased whereas manufacturing cost, overall labour cost, manpower and lead time decreased or reduced which are very important to meet the market requirements in the competitive world.

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