A Comparative Study on Supply Chain Key Performance Indicators of ERP Software Solution-Aided Apparel Export Units with Non-ERP Apparel Export Units

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Abstract:- The main purpose of the study is to compare ERP (Enterprise resource planning) software solution-aided apparel export units with non-ERP apparel export units with respect to supply chain key performance indicators (KPI) such as delivery performance, organisation efficiency and inventory management. The study adopts a survey approach to data collection. Apparel units are also categorized into two, namely apparel units with ERP system implemented and apparel units without ERP system. The study focuses on south Indian apparel export units located in Bengaluru, Tirupur and Chennai, as these cities are major cluster of apparel production in south India. The key respondents selected were senior managers who are actively involved in managing the supply chain activities. To the potential impact of ERP software solution on KPI's of 22 apparel units was assessed. Data collected from 22 apparel units was analysed to identify significance differences between ERP implemented apparel units and non-ERP solution apparel units, using two samples t test for the difference of means. It was found that ERP solutions irrespective of any provider, enhanced the efficiency of supply chain, as evidenced by its effect on the KPI's and overall better utilisation of the company's resources. The positive contribution of the ERP solutions on supply chain efficiency is thereby validated. The study contributes, the importance and role of ERP software solution on supply chain efficiency and its impact on KPI's. The scope of the study was confined to the apparel export units located in Bangalore, Tirupur and Chennai only. Therefore general inferences cannot be drawn for whole of India.

Keywords – ERP (Enterprise resource planning), supply chain, key performance indicators, apparel export units

1. INTRODUCTION

Apparel industry is one of the leading and relatively ancient export industries in the international market. Apparel is an essential platform for the development of nation and it has remained as an initiator for nations involved in export – based business because of its low fixed costs and labour intensiveness. The process in the apparel industry includes the conversion of textile products namely yarns and fabrics into finished apparel products, based on the buyers specified design requirements or specifications. In the apparel industry, operational activities are further classified into designing and development of the product, material or inventory management, production of apparels, finishing including trimming, ironing, packing and sometimes washing process.

According to So, 2000 [10], time remains as an important governing factor in the apparel industry thereby demanding operating efficiency in the global market and hence directly affecting the costs. He defines that delivery time performance strengthens the bond between the global buyer and producer. The apparel export units follow the process by receiving orders from the buyers and in turn for those orders, they procure the raw materials from suppliers many months ahead of the season. Hence these initial stages lead to a lengthy order delivery cycle time. Performance issues arise due to the multiple steps that occur in every step of the process, right from the decision in placing an order, along with the generation of documentation – especially for the international transactions involving approvals of quota, letter of credit and so on and also earlier than the order enters into the purchasing stage of raw materials process i.e. suppliers process. The process of procurement of raw materials is by itself, a lengthy process.

Giri and Rai, 2013 [5], state that apparel industry in India faces several issues with respect to the supply chain namely; managing inventory level, visibility, lead or cycle time, technology, partnership collaboration, infrastructure and logistics which is a frequently cited issue for all the apparel industries throughout the supply chain. Rao, 2006 [95], argues that the apparel industry is extremely dependent on the imported raw materials. About 90% of woven fabrics and 60% of knitted fabrics are imported in order to make garments for exporting. Due to

the imported raw materials a long supply chain is needed to be maintained by the apparel industries for both backward and forward linkages. Therefore use of information technology (IT) is crucial to share information between suppliers and also buyers, thus creating supply chain something like a virtual supply.

According to Christopher, 2000 [1], ERP software is one such IT solution for creating virtual supply chain. ERP as a system facilitates, the integration of all the information resources in the organisation, so as to increase the production performance of the company, lowers inventory levels and production cycle time (Gargeya and Brady, 2005 [3]; Wu and Wang, 2006 [12]). Hence it was found necessary to study the supply chain management of the apparel industry and along with ERP software solution impact on supply chain key performance indicators such as delivery performance, organisation efficiency and inventory management. By adopting integrated supply chain management (SCM) i.e. by implementing ERP solution, apparel units can develop its reputation and brand globally by timely deliveries. Integrated SCM also enhances agility or responsiveness. Hence the foremost purpose of integrated SCM is to enhance firms profitability and ensuring survival of the company as well as to increase the responsiveness of the customers i.e. survival and profitability of the buyers and also suppliers. Therefore the main focus of the study is to assess the potential impact of ERP solution implemented apparel export units on supply chain key performance indicators.

In the supply chain of apparel industry; it is very important for the coordination between the flow of information and the flow of the product and material. In the forward integration, the flow of material and manufactured goods takes place which is based on the flow of information from the buyer's orders, demands and market needs, which in turn trends bearing backward integration from customers to the retailers and through them to manufacturers, who pass on the information regarding the raw material requirements to the suppliers. Hence both these forward and backward supply chain activities pressurises the necessity for an open system to make information available to supply chain trading partners. To overcome this gap, ERP solution is implemented in the apparel industries mainly to improve internal organization operations but hardly impacts anything outside the industries.

2. LITERATURE REVIEW

Sharif, *et al.,* 2005 [9], describes, "ERP technologies are designed to address the fragmentation of information across an enterprise's business, to integrate with intra- and inter-enterprise information". Often ERP solution provides an integrated real-time database management system and track company resources like raw materials, cash flow, and production capacity and also specifies the status of business commitments like orders, purchase orders and payroll (Kameshwara, *et al.,* 2015 [6]). Therefore application of ERP solution is to make up the system share data across the various departments i.e. manufacturing, purchasing, sales, accounting, etc. However Karwowski, *et al.,* 2007 [7], debates, "the efficiency of traditional ERP systems to provide real time synchronization among supply chain members which is necessary for effective SCM is limited".

In 2000s ERP solution uses application with multi-module software, in order to improve the performance of the internal business processes. The modules of ERP are the modules for human resources, financial management, operation and logistics management, purchasing and marketing. These modules are designed in such a way that industries are able to conduct the service of system implementation and application in every level at an affordable price (Sumner, 2005 [11]). SAP, Oracle, People Soft and JD Edwards etc. are leading vendors of ERP solution. Thus ERP system mainly integrates business activities across functional departments, from product planning, material purchasing, inventory control, product distribution, order fulfillment, to order tracking and includes application modules for supporting marketing, finance, accounting and human resources. The ERP system solutions seek to streamline and integrate operation processes and information flows in the company to synergize the resources of an organization, namely men, material, money and machine, through information. Practically by 2015, several industries worldwide have chosen to implement an ERP and it is probable in the future that 60% of apparel companies will be implementing ERP package as this will become vital to achieve competitive improvement (Gandhi, *et al.,* 2014 [3]).

Davenport, *et al.,* 2004 [2], derives that the benefits of implementing ERP system is inclined by the integration level and by the optimization of process. The ERP system makes the process smooth flow with regular well-designed schedule or sequence and practices across the entire organization. Some of the benefits of ERP are:

o   Entry with single point – data entered only at the source of that data

o   Data is same for all – visibility (single source of truth)

o   Historical and genuine data

o   Information are immediate

o   Enhanced visibility into all areas of the industry

Hence ERP system helps to improve the supply chain efficiency of the organisation. This is possible by real-time information flow among the collaborative partners, within the departments of the apparel industry.
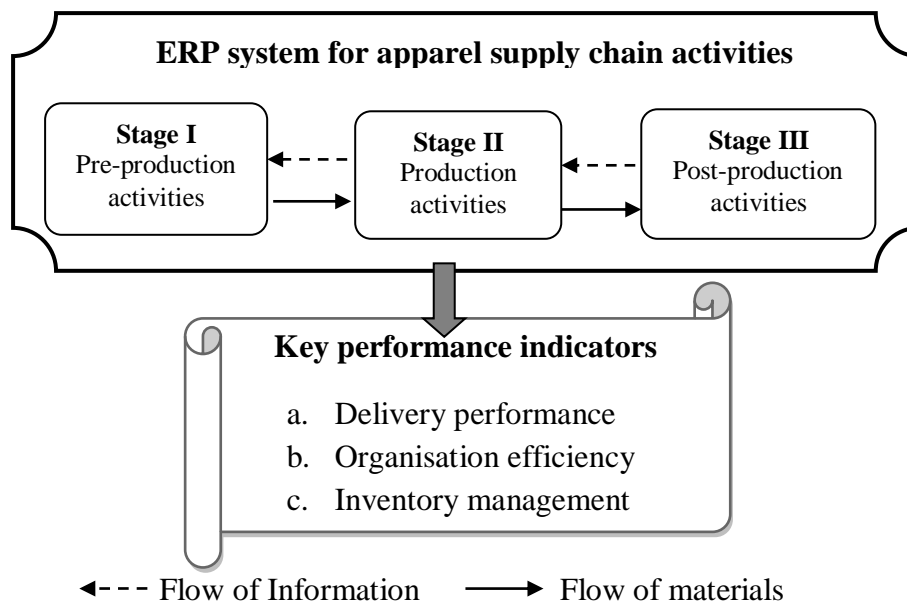
Fig. 2.1 Conceptual approach to integrated apparel supply chain

3. DATA COLLECTION

This study adopts a survey approach to data collection. Part one of the methodology entails construction of a questionnaire. This process includes reviewing current literature, and also conducting pilot study and finally conducting exploratory studies through personal interviews with supply chain practitioners in apparel units. Apparel units is also categorized into two, namely apparel units with ERP software system implemented and apparel units without ERP system. Respondents were assessed for the statements of three main key performance indicators namely delivery performance, organisation efficiency and inventory management. For assessing potential impact of ERP solution software on the key performance indicators such as delivery performance, organisation efficiency and inventory management are considered for the study. Out of 22 export units in the study, 12 units were ERP software solution implemented and remaining 10 units are non-ERP apparel units. For the analysis hypothesis stating, "There is no significance difference between ERP implemented and non-ERP apparel units" is used to test statistically, whether there is any significance difference between ERP implemented and non-ERP apparel industries were tested using two samples t test for the difference of means.

Primary data was collected from 9 to 12 key respondents from each of the 22 apparel industries (232 key respondents) with ERP systems and without ERP systems that agreed to participate in the study. The key respondents selected are senior managers actively involved in managing the supply chain activities. Participants included director / Chief operating officer (COO),

production manager / factory manager, general manager, merchandiser, HR manager, fabric and trims purchase-in-charge / store manager, industrial engineer and IT Manager or IT in-charge. Primary data was collected using semi-structured interviews from total of 232 respondents. Each interview was of 30 to 90 minutes duration.

After data collection, reliability test was conducted to measure internal consistency of responses across the items of instrument. The reliability test is used to check internal consistency of the potential impact of ERP solution on performance indicators statements. Cronbach's coefficient is calculated at every stage and for every item and overall calculated α is 0.759 for the instrument, which is equal to 0.8. Hence, it is presumed that every statement is useful to measure the opinion of the respondents about the apparel export units and the instrument is acceptable and internally consistent. Thus the instrument is reliable and also the scores are valid.

4. DATA ANALYSIS AND INTERPRETATION

Data collected were classified, tabulated and then tested statistically, whether there is any significance between ERP implemented apparel units and non ERP implemented apparel units in implementing supply chain software on supply chain indicators.

4.1 Comparison between ERP implemented and non-ERP solution apparel units with respect to the percentage of the late receipts, percentage of rework and percentage of late deliveries, which implies directly on the delivery performance

Description	% late receipts		% rework		% late deliveries	
	Apparel units		Apparel units		Apparel units	
	With ERP solution	With Non - ERP solution	With ERP solution	With Non - ERP solution	With ERP solution	With Non - ERP solution
Mean	2.92	4.8	3	3.2	4.17	5.9
Difference	1.88		0.2		1.73	
p-value	0.0011*		0.76 NS		0.0035*	
SE of difference	0.49		-		0.47	

Table.4.1 ERP Vs Non-ERP on delivery performance

Where: * - significant and NS – not significant

When tested by t- test, it is found that it is highly significant for the percentage of late receipts and percentage of late deliveries factors. Hence null hypothesis is rejected and it can be concluded that there is significant difference between ERP implemented and non ERP implemented apparel units for the percentage of late receipts and percentage of late deliveries factors that affect efficiency of the shipment in the apparel units. In case of percentage of rework there is no significance difference between ERP solution and Non – ERP apparel units and hence hypothesis is accepted. While ERP implemented

apparel units is 1.88 times lesser in percentage of late receipts when compared with non ERP apparel units and also 1.73 times lesser in percentage of late deliveries and 0.2 times lesser in case of percentage of rework. This indicates that ERP implemented apparel units are more favourable and helps in reducing cost of production, in turn decreases delay in shipment.

4.2 Comparison between ERP implemented and non-ERP solution apparel units with respect to the line efficiency, percentage of absenteeism and labour turnover, which implies directly on the organisation efficiency

Description	line efficiency		% absenteeism		labour turnover	
	Apparel units		Apparel units		Apparel units	
	With ERP solution	With Non - ERP solution	With ERP solution	With Non - ERP solution	With ERP solution	With Non - ERP solution
Mean	61.83	55.5	8.94	10	5.74	10
Difference	-6.33		1.06		4.26	
p-value	0.0009*		0.104 NS		0.0051*	
SE of difference	1.63		-		1.35	

Table.4.2 ERP Vs Non-ERP on organisation efficiency

Where: - * - significant and NS – not significant

When tested by t- test, it is found that it is highly significant for the line efficiency and labour turnover. Hence null hypothesis is rejected and therefore it can be concluded that there is significant difference between ERP implemented and non ERP implemented apparel units for the line efficiency and labour turnover factors that affect efficiency of the shipment in apparel units. In case of percentage of absenteeism there is no significance difference between ERP solution and Non – ERP apparel units and hence hypothesis is accepted. While ERP implemented apparel units is 6.33 times higher in percentage of line efficiency when compared with non ERP

apparel units and also 4.26 times lesser in percentage of labour turnover and 1.06 times lesser in case of percentage of absenteeism. This indicates that ERP implemented apparel units are more favourable and helps to enhance organisation efficiency.

4.3 Comparison between ERP implemented and non-ERP solution apparel units with respect to the percentage deviation from quantity ordered, stock turnover and percent cost of maintenance turnover, which implies directly on the inventory management

Description	% deviation from quantity ordered		Stock Turnover		% cost of maintenance turnover	
	Apparel units		Apparel units		Apparel units	
	With ERP solution	With Non - ERP solution	With ERP solution	With Non - ERP solution	With ERP solution	With Non - ERP solution
Mean	3.08	6.3	96.67	93.3	1.67	2.7
Difference	3.22		-3.37		1.03	
p-value	0.00048*		0.0006*		0.0068*	
SE of difference	0.77		0.83		0.34	

Table.4.3 ERP Vs Non-ERP on inventory management

Where: - * - significant

When tested by t- test, it is found that it is highly significant for the percentage deviation from quantity ordered, stock turnover and percent cost of maintenance turnover. Hence null hypothesis is rejected and therefore it can be concluded that there is significant difference between ERP implemented and non ERP implemented

apparel units for the percentage deviation from quantity ordered, stock turnover and percent cost of maintenance turnover factors. While ERP implemented apparel units is 3.22 times lesser in percentage of deviation from quantity ordered when compared with non ERP apparel units and also 1.33 times lesser in percent cost of maintenance turnover and 3.37 higher in case of stock turnover

percentage. This indicates that ERP implemented apparel units are more favourable and helps minimizing inventory.

Thus ERP solution apparel industries is highly beneficial as out of 9 supply chain factors that affects shipment of apparel industries 7 factors are significant. This indicates that ERP solution is more cost effective for all the 7 factors namely, percentage of late receipts, line

efficiency, percentage of late deliveries, labour turnover, percentage of deviation from quantity ordered, stock turnover and percentage of cost maintenance.

4.4 Comparison between ERP implemented and non-ERP solution apparel units with respect to the key performance indicators such as, delivery performance, organisation efficiency and inventory management.

Description	Delivery performance		Organisation efficiency		Inventory management	
	Apparel industries		Apparel industries		Apparel industries	
	With ERP solution	With Non - ERP solution	With ERP solution	With Non - ERP solution	With ERP solution	With Non - ERP solution
Mean	86.75	83.3	63.75	57.6	90.2	84.5
Difference	-3.45		-6.15		-5.7	
p-value	0.0025*		0.00013*		0.00025*	
Standard error of difference	1.42		1.3		1.64	

Table.4.4 ERP Vs Non-ERP in supply chain key performance indicators

Where: * Significant

When tested by t- test, it is found that it is highly significant for the delivery performance, organisation efficiency and inventory management. Hence null hypothesis is rejected and it can be concluded that there is significant difference between ERP implemented and non ERP implemented apparel industries for the delivery performance, organisation efficiency and inventory management and implies that ERP software package has is potential impact on the key performance indicators. With the results of data analysis, it is observed that ERP implemented apparel units have 3.45, 6.15 and 5.7 percentage higher performance when compared with non ERP apparel industries with respect to the delivery performance, customer satisfaction and inventory management respectively.

5. CONCLUSION

It is observed by the results that ERP solution implemented apparel units showed better impact on key performance indicators when compared with the non-ERP apparel units. It was also found that ERP solutions software irrespective of any provider, enhanced the efficiency of supply chain, as evidenced by its effect on the indicators and overall better utilisation of the company's resources. The potential of the ERP solutions is therefore enormous.

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