Measures to Strengthen the Supply Chain Management in Silk Industry

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Abstract: *India is the second highest producer of raw silk as well as largest consumer of raw silk in the world.The demand for Indian Raw silk is expected to grow at the rate of 5-7% per annum. The Domestic consumption of raw Silk is also expected to grow at the same rate. As on 2012-13 there was a gap of 4951 M.T. of silk between the production of 23,679 M.T.and demand of 28,630 M.T. Hence, huge quantity of Silk is being imported every year not only to fill the gap between the demand and supply but also to fill the Quality gap of raw silk. While the domestic production is totally consumed by the silk handloom sector for weaving mostly silk sarees and its allied products, the imported raw silk is consumed by high speed rapier and power looms for weaving furnishings and non-apparel products. The domestic silk industry is basically unorganized, rural, agro based and decentralized micro scale industry. However the export sector is more of organized and centralized industry. Hence application six sigma in supply chain management in these two sectors have to be diversed and specific. There were no much literature on application of six sigma in Indian silk Industry so far. This paper portrays a comprehensive picture about the supply chain management in both sectors. This paper has also spelt out measures and recommendations for implementing six sigma in supply chain management. The present study analyzed the problems in supply chain, the need for import of Raw silk and came out with clear cut suggestions to strengthen the Supply Chain in both sectors of Silk Industry by applying six sigma which will pave way to bring an orderly approach in silk manufacturing sector as well as to improve the Quality of silk products produced in India.*

Key Words: *Supply Chain, Six Sigma, Quality gap, Quality of domestic raw Silk*

INTRODUCTION

Six Sigma is a highly disciplined process that helps us to focus on developing and delivering near-perfect products and services. Sigma is a statistical term that measures how far a given process deviates from perfection. The central idea behind Six Sigma is

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that if you can measure how many "defects" you have in a process, you can systematically figure out how to eliminate them and get as close to "zero defects" as possible.

Indian Silk Industry is passing through a challenging phase both in domestic sector as well as in export sector. In case of domestic sector the challenges are shrinkage in mulberry area, practice of age old conventional system for production of raw silk, low productivity, production in small lots by the farmers and reelers, low quality silk in the International Standard, slow growth of domestic Silk production etc., On the other hand, the challenges faced by export sector are lack of demand and orders from erstwhile U.S. and European markets, rising import of cheap Chinese silk into the country through illegitimate channels resulting in an unimpressive growth in Silk exports. The application of six sigma tool has to be attempted in the areas of quality in silk manufacturing, optimum productivity levels, supply chain management for overall improvement of Silk Industry. While the authors have already documented their initiatives in the topics of Six sigma concept (David *et al.* 2009) and cocoon quality, the concept of supply chain management in silk industry is discussed in this paper. It envisages an analysis of the factors influencing the Supply Chain Management right from silkworm egg to silk fabric consumers both in domestic sector and export sector.

LITERATURE SURVEY ON SUPPLY CHAIN MANAGEMENT IN TEXTILE INDUSTRY

Supply Chain Management is defined as the integration of key business process from end user through original suppliers that provide products, service and information and hence add value for customers and other stakeholders (Lambert *et al.* 1998). In a global supply chain of textile industry, the main objective is to supply a quality product to customers at an affordable cost and to increase the profit margin for investors and shareholders. The product cost has mainly three components (1) Procurement of raw materials like silk yarn, fabric and supplies (2) the production or the fabrication process and (3) Shipping to customers. Additionally Government stability, reliability, terrorism, sensitivity to commitment and time of delivery are other factors. Hong *et al.* (2004) suggested four categories to measure the performance of Supply Chain Management in Fashion and Apparel Industry. These include organizational factor, management factor, information technology factor and relationship factor.

Firms practicing SCM seek to reduce waste throughout the supply chain by minimizing duplication, harmonizing operations and systems and enhancing quality. When production and logistics process are accomplished in less time, all entities in the supply chain are able to operate more efficiently, and primary result is the reduced inventories throughout the system. It is a common practice for apparel retailers to deal with manufacturers, with centralized buying and considerable negotiation on prices, quality and delivery schedules. However, Popp (as cited in Bruce, Daly & Towers 2004) suggests that in addition, in many chains there is an intermediary, often

an import or export agency, acting as a significant figure within the chain. Textile is a sector where quality is one of the key competitive factor, and current competition dose not only concern the individual firm but, rather, involves the entire supply chain. Indeed, the quality of the final product that reaches the customer is clearly the result of chain of successive, inter-linked phases: spinning, weaving, apparel and distribution. In this new competitive environment, quality must be a feature of all market segments basic and fashion – to meet the specific requirements and tastes of all types of customers.

The Studies conducted by Jimmy *et al.* (2006) reveals that the typical problem facing with textile and apprarel supply chain are short product cycle for fashion articles, long production lead time and forecasting errors for fashion items. The Hong Kong textile and apparel supply chain faces additional problems of distance from customers in the U.S. and European markets, long production lead time and minimum batch sizes for production and quota restriction in the U.S. Market all of which force them to improve efficiency and enhance competitiveness through supply chain management.

Visibility (Bartlett 2007) is very important in supply chain in order to improve transparency (Lamming *et al.* 2001, Svesson, 2004) through the delivery of fast and accurate information results in wrong estimates of the inventory at various stages of the supply chain resulting in variation among exact requirements orders placed and delivered inventory, which is known as "bull whip effect" (Lee *et al.* 1997) . Lack of visibility reduces the real time traceability of inventory which results in the very common problems of obsolescence of the inventory, overstocks of the existing inventory in the stores and stock out of the running inventory which is in demand. Indian Garment Companies are confronting the visibility problem at every level of their supply chain, which is the basic reason of lack of coordination and high inventory levels the industry is facing. Because of low visibility in the supply chain Garment companies face the problem of delayed reaction time and low responsiveness to the customer and market demand which is made worse by the longer lead times.

P.R. Wadje and M.J. Doshi (2008) observed that there is a biggest challenge for the textile industry in the supply chain management. It is estimated that more than 25% of the World's textile trade will be controlled by retail giants. In such a scenario an efficient supply chain management cannot be over emphasised.The retail giant will determine the export price and only an efficient supply chain will be able to compete effectively. In fact it will be the competition between supply chain and not between companies. There are hardly any companies in India having a presence in the entire textile chain from yarn to garments.

An efficient logistics system is required for an effective supply chain (Sharma *et al.,* 2013). In spite of the large and impressive logistical network and figures there are inefficiencies in the Indian logistics setup (KPMG, 2010). High fragmentation and underdevelopment of Indian logistics Industry results in the lack of economies of scale (Planning Commission, 2012). The underdeveloped andpoor physical and communication infrastructure is the main reason why Indian logistics industry is

underperforming (Planning Commission, 2012). Bad conditions of the roads and many check posts with different document requirements slow the movement of the cargo (Planning Commission, 2012; Jayaram and Avittathur, 2012) and it takes three times more time reaching its destination than the one in USA (Jayaram and Avittathur, 2012). Insufficient infrastructure of seaports and the procedural clearances lead to the congestion which results into the long waiting time of the ships at the ports which may be as long as 5 days (Planning Commission, 2012; Jayaram and Avittathur, 2012).

Using RFID (Radio Frequency Identification Device) widely will also be helpful for the Indian garment companies in order to maintain the real time tracing and visibility of the Garment products which is also termed as essential in Quick Response Practices by Choi and Sethi, 2010. RFID is effective everywhere in supply chain which detects error in manufacturing, in warehousing starting from reception area to the storage area through cross docking till the outgoing area, and at the sales floor. It makes the real time visibility of the products at all the above stages as well.

Timothy *et al.* (2011) observed that one of the first things many of the new senior managers noticed was their companies' enormous inventories. The number of inventory turns per year in textile remains among the lowest of all industries. Supply Chains extremely long and complex, and products are routinely stored, loaded and shipped many times during the production cycle. Warehouses represent a large part of the space and costs in the textile manufacturing process. The Harvard Centre for Textile and Apparel Research documented many of these stages for apparel manufacturers in landmark study funded by the Sloan Foundation and published in 1999. For some companies, such as Milliken & Co and Burlington Industries, implementing supply –Chain Management has become no 1 priority . Special projects in reducing inventories, creating fast response strategies and cutting product development times are now common in many leading companies.

Jatindra Nath (2011), states that Silk Industry has a value added chain from Silkworm eggs to fabrics or finished garments. In this chain every activities has its own importance and a specialized knowledge is required to perform each and every activity. Different activities in the supply chain are widely spread all over the state. The activities performed in the areas formed clusters such as clusters of cocoon production, Silk Reeling, Spinning, Dying and weaving. All the activities are interdependent in each other, But the linkage among all players of the chain is established by some intermediaries or traders. The researcher conducted study to identify the supply chain linkages of natural silk industry as well as different constraints in each activity of the linkage that are being encountered by the sector in Assam state, India.

SCENARIO OF SUPPLY CHAIN MANAGEMENT IN INDIAN SILK INDUSTRY

The supply chain management can be broadly divided into domestic and Export sectors in India and these two topics has to discussed in detail to explore the possibility of

introducing six sigma as both are very strong, diversely different and quite voluminous in physical and financial form.

The supply chain management in domestic sector of India is more unorganized and decentralized chain of activity, with scattered cluster based and community based activities. It involves various chain of activities starting from laboratory level production of commercial silkworm eggs, Chawki (young worms) silk worm rearing farmers, late age silkworm rearers, Govt cocoon markets, reelers, twisters, dyers, designers, weavers, master weavers retailers and consumers. Majority of domestic sector produces silk sarees which has very high demand inspite of stiff challenge due to fashion dressing and life style changing. The total lead time for production of silk sarees right from egg to fabric is estimated to be 140 days in general. This can be significantly reduced by integrating or combining into two or three activities like reeling cum twisting or reeling cum twisting cum dyeing or twisting cum dyeing or dyeing cum designing cum weaving.

The handloom weavers prefer a better quality warp thread to avoid breaks so as to weave out a better saree in shortest time. Keeping this in view most of the weavers prefer Chinese Silk for warp and the Indian Silk for weft. As stated above to meet the domestic consumption of silk, India imports raw silk from China and constitute a component in supply chain. Survey findings reveals that domestic silk is not available in large quantity and uniform quality. Higher preference for Chinese imported raw silk which is not only cheaper but also of uniform quality, length and available in large quantities. Majority of the imported silk yarn from China is confined to 20-22 denier bivoltine yarn and 33-37 denier Tassar yarn other varieties such as yarn deniers starting 13-14 deniers to 18-20 deniers and 26 and 28 denier are generally supplied by domestic reelers mainly from Bangalore. Chinese Fabrics are cheaper than the comparable domestic fabrics. Moreover the finishing of the fabrics is better in the former mainly because of superior technology being used in China (National Fibre policy report 2011)

The following table shows the quantity of Domestic Silk Production and quantity of silk imported to meet the demand of silk for domestic consumption.

Availability of Raw Silk in the country

Year	Mulberry	Non mulberry	Total	Raw silk imports	Availability of raw silk
2005-06	15445	1860	17305	8383	25688
2006-07	16525	1950	18475	5565	24040
2007-08	16245	2075	18320	7922	26242
2008-09	15610	2760	18370	7940	26310
2009-10	16322	3368	19690	7338	27028
2010-11	16360	4050	20410	5820	26230
2011-12	18272	4788	23060	5685	28745
2012-13	18715	4964	23679	4959	28638
2013-14	19476	7004	26480	3260	29740

Source: Central Silk Board

India imports silk to meet the domestic raw silk requirements, India had imported almost 8000 M.T.of silk yarn against 18,370 M.T. of indigenously produced silk during 2008-09. The quantum of imported silk yarn had declined substantially to less than 5000 M.T. in 2012-13, while indigenously produced silk had gone up to 23,679 M.T. The demand for raw silk in the country, however, has gone up by around 2000 M.T. during the five year period to 30,000 M.T. from 28,000 M.T.

In export sector, value addition is given to the raw silk imported mostly from China by modern enterprises in silk preparatory, rapier looms with or without pile weaving, dyeing and finishing and finished products are exported to U.S and European markets. With regard to import of raw silk, India has emerged in the 90's as the biggest importer of raw silk moving ahead of other traditional importers like Italy, Japan etc. Raw silk import into the country commenced as back as 1957, when probably silk export from India also took shape. There was a sustained demand for raw silk in the country right from the World War II period onwards to the present day. The demand and supply gap started widening in India ever since Silk export took momentum. This Short Supply to some extent was met by import through various means (Koshy, 2001). Silk Weavers are of the opinion that they import huge quantity of raw silk not only to fill the gap between demand and supply but also to fill the gap in Quality of domestic raw silk to have consistency of quality of raw silk import in bulk mainly from China of 2A and abovegrades.A Study conducted among the Raw Silk importers in and around Bangalore City (who constitute nearly 95% EOU sector) reveals that they Import Raw Silk due to mainly consistency in quality and availability of bigger lot size and no breakage of yarn which is suitable for high speed rapier and power looms.

Intricacies Faced by the Stakeholder of Silk Industry

The cocoon which is raw material for silk reeling is produced in traditional and non-traditional parts of Karnataka, Andhra Pradesh, Tamil Nadu and Maharashtra are brought to cocoon markets located in reeling clusters only and also for getting attractive prices. This is an indication of lengthiest supply chain in the silk industry.Similarly the non-availability of adequate quantity of cocoon for the reelers to produce quality silk is also another pretty long supply chain. As the cocoon is produced in smaller quantity by the small and medium scale farmers with less capital intensive but more labour intensive technologies, the cocoon available for the reelers is of varied quality which affects the productivity and quality of the silk produced. Another major problem is the cocoon production activity is wide spread across the country, whereas the reeling and weaving activities are concentrated in clusters.

An interaction with an Automatic Reeler at Jangoan in Andhra Pradesh shows that he has to procure the cocoons beyond 4000 kilometers radius because he is not able to get the cocoons in large quantities with required quantity nearby his reeling unit in Jangaon. The reeler is procuring the cocoons from far off placesfor which

increases his transport cost and the cost of production. This indicates that the supply chain is weak. He also informed that if he purchases the cocoon within 400 km the transportation cost can be minimized. To resolve this problem to certain extend the Government has created marketing infrastructure at Jangaon. The Supply chain management in Silk twisting activity is also one of the poor and long chain activity. The majority of raw silk is produced clusters surrounding Bangalore city including the states of Andhra Pradesh and Tamil Nadu due to well establishment of silk twisting capacity and infrastructure. Almost all silk handloom weaving clusters across India buy the twisted silk from Bangalore which itself indicate the poor link as the distance go beyond 2000 K.M between twisters and weavers. In case of silk dyeing and designing the supply chain is far most small and strong as most of the weavers get their silk dyed in their own cluster as well as get their designs locally from free -lance designers. The supply chain link between Weaver and Master Weaver is also not very strong as the products made the weavers has to be sold to the master weaver or whole sale merchants whom in general distantly placed. Similarly in the case whole merchants to retailers is also not close by but it is alarming and managed by them due to profit margin advantage. Silk Retailing in India is very popular and strong as hundreds of show rooms an malls have been established across the Country whom even name their shops in the name of silk to attract the customers.

In the case of export sector the supply chain management is sparely good and commendable due to well knit establishment of export oriented units in India. It is to place in record that the silk EOUs in india are reportedly supplying high end furnishings to Buckimham palace and white house in Washington D.C. This is was possible due to professional management of Export houses to produce quality products with innovative designs, One of the exporters expressed with pride that they are able to target the festivals like Christmas and new year eve in U.S and European markets through systematic planning, scheduling of raw material import and export of finished product with minimum lead time. However, problems crop up in this sector in sourcing of orders and its reliability which Is very essential and highly risk oriented due to large scale transaction. This needs a solution to enable better supply chain management.

SUPPLY CHAIN MANAGEMENT AND TOTAL QUALITY MANAGEMENT

SCM is the offshoot or brief form of TQM philosophy and both tools are activated for the business progress with customer satisfaction. TQM conceptual definition suggests that the efforts carried to enhance the traditional business to achieve complete excellence for satisfaction of customer. SCM is also customer-centered business process that links manufacturer, distributor, retailer, and customers to reduce operational cost. It is undertaken at various stages of production. It is a science of movement of materials, intermediates and finished products from the producer to customer effectively and efficiently. (Dharamvir Mangal 2013) The overall view indicating requirements of TQM and SCM are as follows:

S.No	TQM Requirements	SCM Requirements
1	Committee Management Participation- To provide long term Organisation support	Demand Management /Forecasting
2	Customer Centred Approach	Domestic and Import Regulation
3	Entire workforce involvement	Regulated Market and logistics from farmers to Reeler
4	Supplier Partnership concept Reinforcement	Distribution and Deployment
5	Continuous Improvement in Production process	Available to Quality (Denier Level)
6	Establish Performance measures for the process	Supply Chain Modeller

Application of Six Sigma in Silk yarn Supply Chain

The recent Research at Cranfield school of management has highlighted where the source of risk in supply chain might lie and how that risk might be mitigated and managed by the application of six sigma philosophies and procedures (Martin Christopher *et al.* 2004) Feasibility of using six sigma tools to improve silk yarn supply chain was taken up by the research team. Pre define stage study revealed that, many input factors contributing to wider gapin the demand and supply of cocoons and silk yarn are not under the control of either the farmers or the reelers. The prime reasons are lack of sufficient technical knowledge to rear the silk worm, inadequate Technical support for cultivation of mulberry (food plant for silkworm), transportation of cocoons from farm to cocoon market and reeling units, from the farmer perspective no knowledge of quality measures and the clear understanding of the need for quality of yarn on the part of reelers. Proper linkage in the supply could not be established due to farming policy, cocoon quality, testing standards, pricing policy (central and state norms), Subsidy for the produced yarn are the real practical problems, which really breaks the supply chain. The block diagram given below explains the real supply chain scenario.

It can be ascertained from Fig. 1, that there is a gap between demand and supply of rawsilk. The gap could be minimized by increasing the raw material production qualitatively and qofuantitatively. The qualitative improvement could be achieved through process improvement. Ultimately resulting in reduced gap facilitating fulfillment of customer requirements.

Six sigma plays a significant role in minimizing the variation. When we focus on the Supply Chain metrics, the variation may lie in lead time to procure yarn, cost differential in the raw material as well as logistics, quality of the product, quantity of availability in the market, facilities available for storage and handling of raw material in the market area, number of suppliers in the market (especially the farmers), just in time gap for the reelers. Since, the area of application is wide and it warrants specific zone application, the researcher thought fit to check whether six sigma can be applied in the supply chain management of silk Industry. As a result the study went on with the broader perspective of making on simple basic tool of six sigma SIPOC.
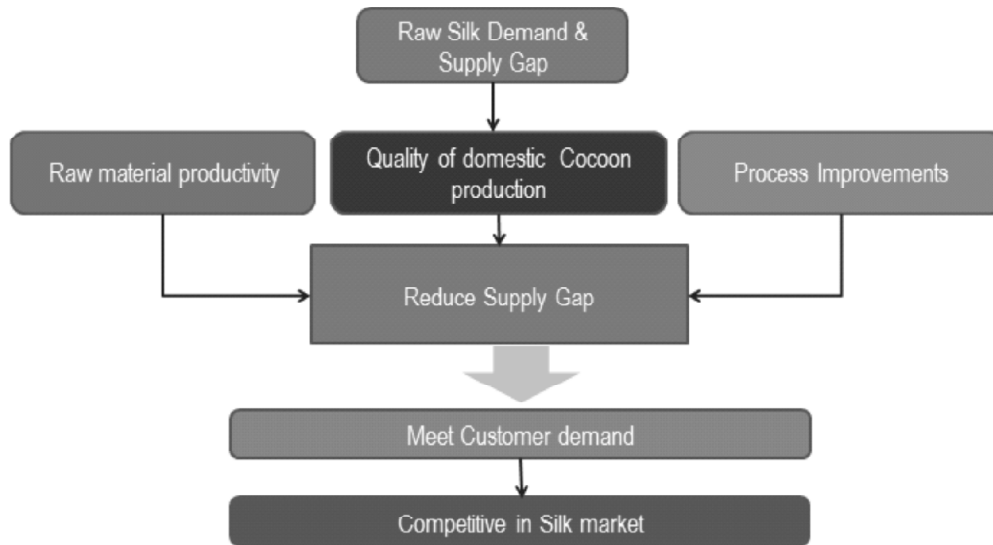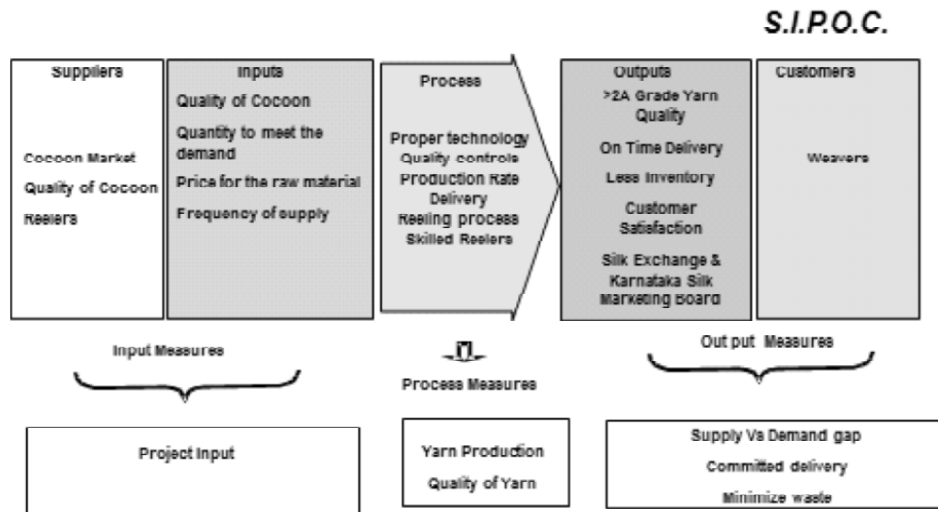
Figure 1

Figure 2

Input process and Output indicators

S.I.P.O.C.

The researcher went further on a step to use the SIPOC (Supply input process output and customers – Fig. 2) a tool of Six sigma to understand the process in a better way. A SIPOC diagram is one of the most useful and often used techniques of process management and improvement. It is used to present an "at a glance" view of work

flows. (Peter et al. 2001) The focus on process reached the level of yarn quality and quantity. Right quality yarn is produced with zero defects will enhance the quantity also. The measures which will form part of the process will be:

$Y = f(X_1 + X_2 + X_3 + X_4 + X_5)Y$ = Right quality of yarn with 2A Grade & above

X_1 = Reeling process

X_2 = Acceptance criteria

X_3 = Labour skill

X_4 = Water quality

X_5 = In-process controls

X_6 = Temperature of water

$X7$ = Cooking process of silk

From the pilot study taken up in few reeling units have given the idea that the introduction of six sigma system in reeling process would enhance the yarn quality by eliminating the quality problems. The estimate is around 15%. This seems to be a significant figure to suggest the use of six sigma tools. Further, the seasonal demand and supply gap should be fixed as the dynamic target for deciding the quantity and import substitute quality of silk yarn production by the reeler to reach the ultimate goal of minimizing the import of raw silk.

RESULT AND DISCUSSION

Well organized marketing system is essential for stimulating production and Consumption of any commodity as well as to have efficient supply chain management. The raw material marketing system well established in Karnataka and the same system has to be established in other states also. Scientific way of forecasting the demand of silk yarn could facilitate the farmers to plan their cocoon production. Transportation of cocoon from other states to Karnataka not only increase the cost of production of Cocoons but also affects the quality of cocoons due to transportation. The Quality assessment system has to be established in all cocoon markets and Automatic Reeling Units. Strengthening of marketing system for the cocoon and raw silk and transportation of commodities through fair practices are essential for the sustainable development of sericulture industry and also to strengthen its Supply Chain Management. The Study reveals on importers point of view that the quality, delivery and trust are the most important strategic priorities to be considered in the supplier selection decision. The supplier are expected to be equipped with most sophisticated machinery and the know how to produce this high quality product is very important during both development and production stages. There are soft ware systems available for supply chain management. Although the software is related to Enterprise Resource Planning (ERP) Supply Chain management focuses on planning and ERP is focused on execution. For greater advantage, organization must implement the closed–loop

supply chain management that interact with its Enterprise Resource Planning. National level ERP links exclusively for Silk industry will facilitate data capturing the supply chain process monitoring.

CONCLUSION

Supply Chain Management is a systematic approach to improve the total productivity of the Silk Manufacturing Industries by optimizing the timing, location and quantity of raw material flow from farm to cocoon market, reeling units and to weaving units site using IT infrastructure and interacting with all the related intermediates and that is expected approach for implementing TQM philosophy to improve organization System . SCM and TQM are the ways to cost optimization one all along with the chain while other related to total business, but both starting from farmers to reelers,weaving and value added units. There is a scope to strengthen the supply chain management in Silk Industry by applying six sigma methodology.

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