

# **Regaining Competitiveness using an ICT platform in a Traditional Industry: Adoption of Computer Aided Design for Carpet Weaving**

**B. Bowonder, J. Swamy and Nrupesh Mastakar**

## **Abstract**

The carpet industry is one of the most rapidly growing traditional industries in India. This is a handicraft and cottage industry that provides jobs right at doorstep of more than 100,000 workers, belonging to economically backward class of society. In the global carpet scenerio, the market share of Indian carpets is expanding rapidly. Jaipur and its adjacent districts are the major manufacturing clusters in Rajasthan that shares a substantial part (15%) of total carpet manufacturing from India. In fact Rajasthan carpets industry is more quality sensitive hence designs are one of critical elements of competitiveness. Rajasthan carpet Industry grew till 1995, but saturation in designs and increasing cost made it difficult to compete.

PLC Consultation Ltd. offered a viable design solution by providing computer based designing system for carpets in 1998. In Rajasthan, Sarswati Carpets and K. P. & Company were the pioneers in implementing this technology to create a new range of designs. To make the technology available to all manufacturers, Rajasthan Carpet and Woolen Development Society, Jaipur has set up a Carpet Designing Centre in 2000. This society makes designs available at affordable prices, thereby facilitating the technology adoption.

Results of technology implementation were remarkable in terms of revenue and other operational aspects. In a short period of 4 years revenue grew more than five fold. Enhancing the competitiveness has been the major positive effect of ICT adoption in the Rajasthan carpet industry. Both the software creator and the government agencies played a catalyzing role in supporting the technology adoption process.

## **Key words**

ICT, Competitiveness, traditional industry, carpet weaving, computer aided design.

## **Biographical Notes:**

**Dr. B. Bowonder** is a Dean, Tata Management Training Centre, No.1, Mangaldas Road, PUNE – 411 001, India, Tel: 91-20-612 0141, E-Mail: bowonder@tata.com

**Mr. J Swamy** is a Project Associate , Administrative Staff College of India, Bella Vista, Hyderabad – 500 082, India. E-mail:

**Mr Nrupesh Mastakar** is a Research Associate, Tata Management Training Centre, No.1, Mangaldas Road, PUNE – 411 001, India, Tel: 91-20-612 0141. E-mail: nrupeshmastakar@hotmail.com

## **Introduction**

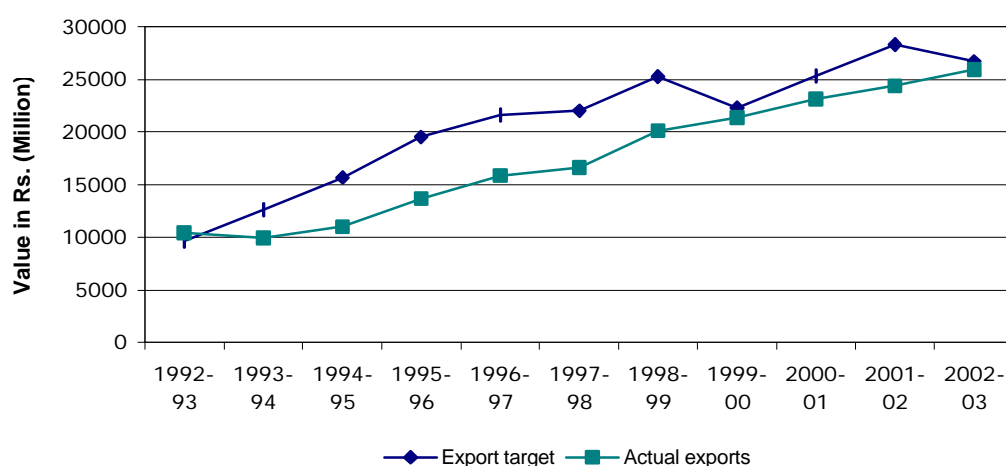
The carpet manufacturing as an art was brought into India by Mughals in 14<sup>th</sup> century. It enjoyed royal patronage and the Indian artisans imbibed the techniques of carpet weaving. Over the years, the craft got progressively indigenized depicting motifs from Indian paintings. In the nineteenth and early twentieth centuries, an extended belt of commercial production was established in the Mirzapur-Bhadohi belt of Uttar Pradesh, Jaipur and its adjacent areas of Rajasthan because of its close proximity to the Rajput and Mughal Kingdom.

The carpet manufacturing industry provides livelihood to more than three million artisans belonging to the rural areas of the country. It contributes to the national economy in several ways and provides employment to the rural poor and the economically backward sections of the society. A major portion of the weavers is belonging to the backward classes or other minority communities and almost all are living below the poverty line. The carpet industry is a de-centralized industry and is a generational craft where skills are passed on from one generation to another. Capital investment in this industry is meagre. But the returns are immense in terms of foreign exchange.

One of the key elements in determining the quality and price of the carpet is its design and the character of design. For 250 years, Indian design represented largely floral patterns, arabesques, rhomboids, and the occasional animal pattern, with varying degrees of stylization. Except for manufacturing of yarn, mechanization is very less thus the entire process is manual, hence the wage component is very high, to the tune of 40 % of the manufacturing cost, which is very rare in other industry. In other words, this handicraft industry plays a major role in solving unemployment problem in our country. Carpet Industry also provides the job right at the door step of the weavers as most of the weaving is done in their own houses and timing for work are flexible also work is done either by men, women, children or all the family members. This is a case study of application of information communication technology in the carpet industry, indicating that traditional technologies can be renewed by the use of ICT.

## An Overview of Indian Carpet Industry

The carpet industry in India has made significant strides in the recent past and exports of carpets from India touched a level of Rs. 25902 million in 2002-03. This growth is significant in view of the sluggish market conditions, stiff competition from other major carpet producing countries and other societal constraints. The Indian hand-made carpet industry is a significant contributor to the country's rural economy, which is an export-oriented industry and helps in providing employment. The strength of the industry is the small and medium sized exporters with tremendous export potential and the highly talented crafts persons who have been weaving intricate designs of exclusive floor coverings. In domestic market manufacturers of Bhadhoi (Mirzapur, UP), Panipat, Rajasthan, J&K, and Punjab are the major players who contribute noteworthy revenues. The exports trends of the Indian Carpet Industry are shown in **Fig 1**:



Source: Indian Carpet Export Council, New Delhi

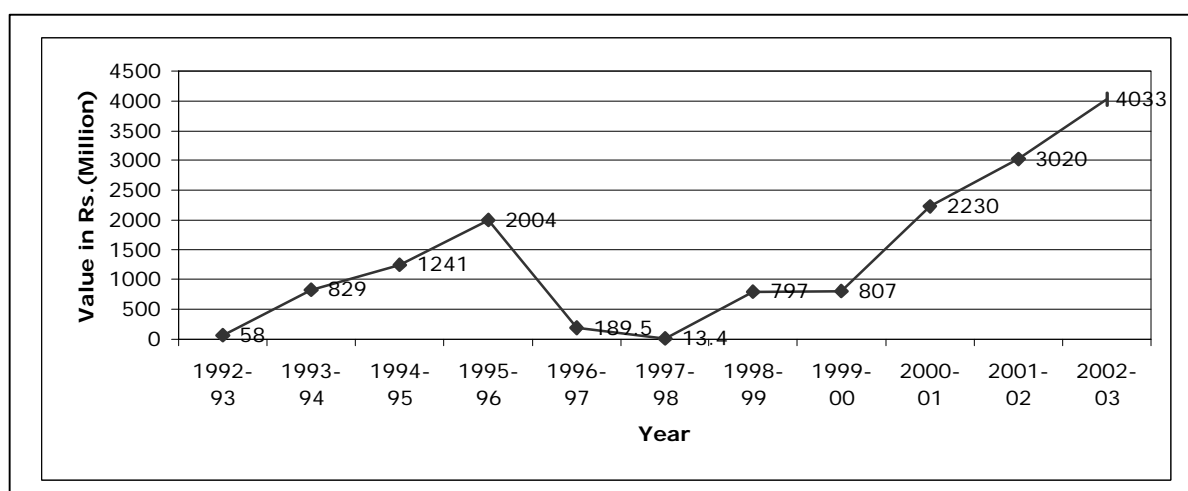
**Fig 1: Value of Exports of Handmade carpets from India**

## Rajasthan Carpet Industry

The carpet industry in Rajasthan is situated in Jaipur and its adjacent areas. It is famous for its superior quality and delicate designs depicting rich cultural heritage of Rajasthan. It also enjoyed royal patronage during the Rajput dynasty period. In the beginning of 20<sup>th</sup> Century limited number of carpets were exported. Today more than 6 million square feet of carpets are manufactured and exported from the State. The export figure of carpet industry from Rajasthan has been steadily increasing up to 1994-95 and had reached to Rs. 4020 million during the year 2001-2002.

In the beginning of 20<sup>th</sup> Century there were only a few skilled carpet weavers. Now, there are about 100,000 weavers in that industry. They are mostly from the backward classes and other minority communities. This industry provides livelihood to more than 150,000 people directly and indirectly in Rajasthan. This industry has thus taken the shape of a major labor oriented as well as exports oriented industry. The entire process of making the carpets is manual and the work is being carried on at the homes in rural areas of Jaipur, Tonk, Alwar, Dausa districts of Rajasthan. It is therefore, a handicraft and cottage industry in the real sense [1].

The export details of Carpets/Dhurries from the state of Rajasthan is shown in **Fig 2**:



Source: Rajasthan Carpet & Woolen Product Development Society

**Fig 2:** Value of Carpet Export from Rajasthan

The carpet industry witnessed a constant growth till 1994-95 and after 1994-95 the export declined due to competition with the other countries like China but during the year 1999-2000 the exports again grew to Rs. 2230 million which is an increase of 176.39 % over the previous year of 1998-99. The export figures have increased steadily from Rs.2976 to Rs.4020 million in the years 2000-01 and 2001-02 successively. The growth of carpet industry in Rajasthan has also contributed to the establishment of a number of ancillary industries like woolen yarn manufacturing and coloring & dyeing units in the state. As a result today about 30 woolen yarn manufacturing plants are operating in the state with full capacity [2].

### Traditional Carpet manufacturing process

Traditionally, all the designs that were used in the carpet were made manually. It was entirely dependent on the designers' creativity to produce a range of colorful designs. Design outline is prepared on white paper and then filled with appropriate colors to make them different from existing designs. The same design was used to be converted into different graph papers to enable weavers understand them clearly so that while interlocking of wool into cotton they could interpret the designs accurately. After the finalization of design a reduced graphical format of the complete design was prepared and given to weavers. The whole designing process used to take around 20-25 days depending on the compactness and size of the carpet.

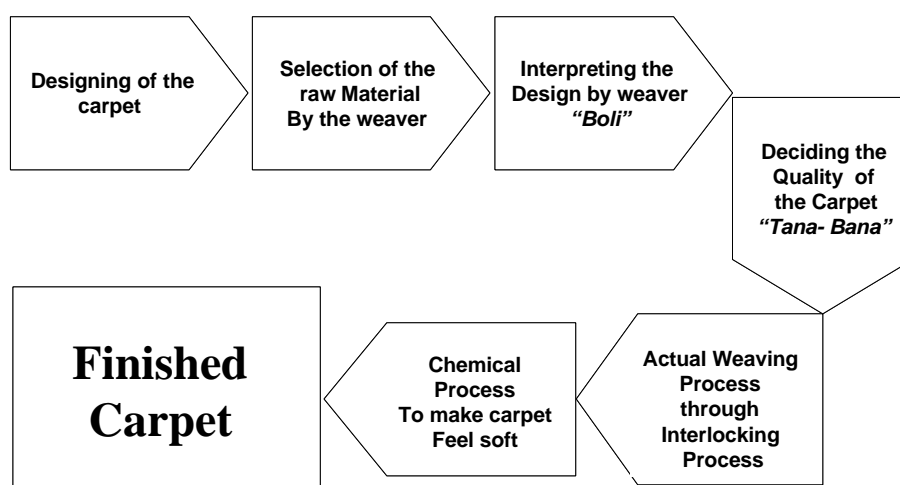


Fig 3: Traditional Carpet Manufacturing Process

While weaving one translates verbally the graphical design into their own weaving language called "*Boli*" and concurrently other person interlocks the woolen threads into a net of cotton threads called as "*Tana-Bana*". Time taken for interlocking the wool varies according to their knotting compactness. Thus the higher the compactness the greater is time spent by the weavers. At the end of the process a tough carpet made by weavers goes through several chemical processes and final product comes out as a soft and colorful floor covering.

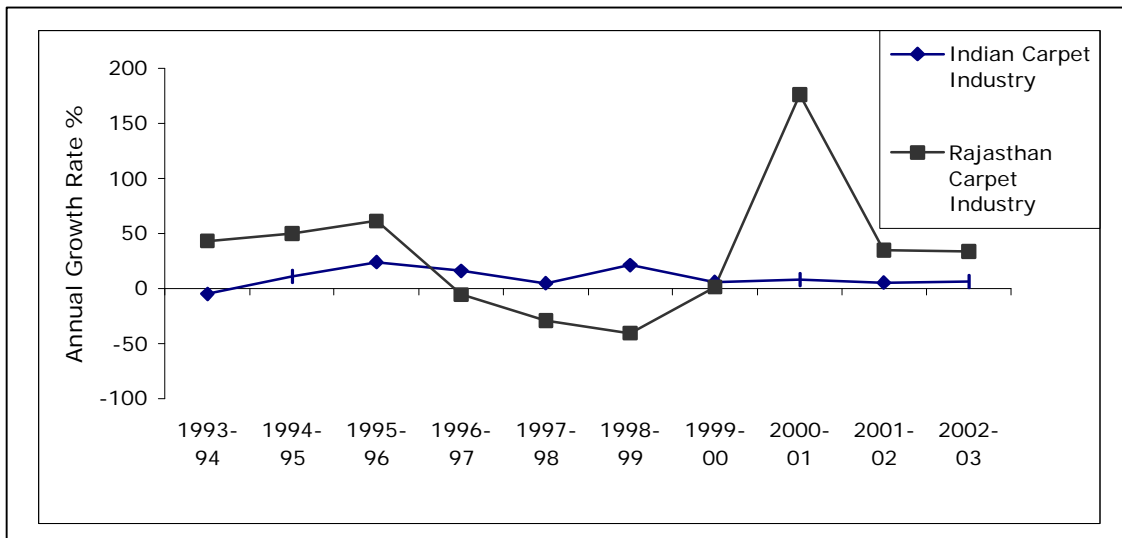
As indicated earlier, wages constitute the largest share in cost factor for making the carpet. The cost structure for manufacturing carpet is given below:

- Wages 40%
- Raw material 22%
- Designing process 10%
- Transportation 6%
- Wastage of Raw material 3-5% and
- Others Expenses 13-15%

### **Comparative scenario of Indian Carpet Industries**

The core competency of the Rajasthan carpet industry lies in its high quality design and comparatively lesser prices than the other manufacturing clusters in the country. Also the export growth rates are higher than the national average.

The comparative growth rates achieved by the Indian carpet industry and Rajasthan carpet industry shown in Fig 4: indicate that Rajasthan carpet industry experienced a higher growth over 1999.

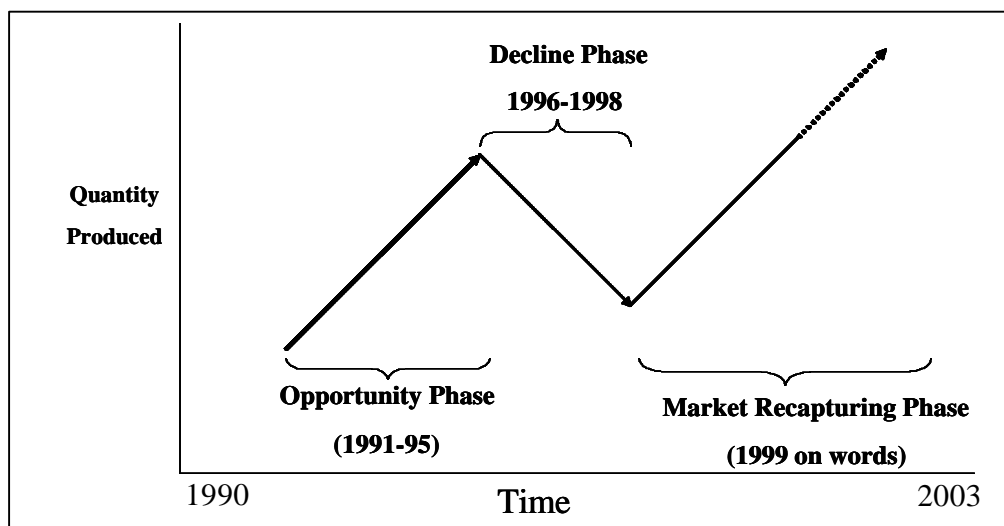


Sources: Rajasthan Carpet & Woolen Product Development Society, Jaipur & Carpet Promotion Centre, Delhi.

**Fig 4: Comparative growth Rates of Indian Carpet Industry & Rajasthan Carpet Industry**

If we look at the Rajasthan Carpet Industry there is three significant periods when growth rates moved drastically. The three phases encountered by the industry are shown in Fig.5.

**Opportunity Phase:** The market for Indian carpet industries moved upward after 1991-92 when export policies became liberal and global economy was growing. During this period there was overall increase in the market size.



**Fig 5: Growth Fluctuation in Rajasthan Carpet Industry**

**Decline Phase:** Rajasthan Carpet Industry encountered the decline phase during 1996 to 1998. This industry is highly quality sensitive. The designs were saturating and the productivity was declining. Hence other competitive clusters captured the export market and sales of the Rajasthan carpet industry declined.

**Market Recapturing Phase:** During late 1998, Rajasthan carpet industry realized the need for using modern computerized tools for widening the number of designs and for enhancing the skill sets of the weavers so as to enhance productivity. These initiatives helped the industry to recapture its share in exports. The main factor that contributed to the renewal of the carpet industry has been the use of information communication technology. The adoption of computer aided design helped in a high degree of flexibility. It facilitated rapid changes in design and enhanced customer acceptance. It also increased the productivity of the weavers.

The key reasons for changing from the traditional design process to computer-aided design have been the following:

- The manual design process had its own limitations and therefore the market got saturated with similar designs. Designers could modify color combinations, but market acceptability started dwindling. The designs could not be easily renewed. There was a need to introduce new range of designs to compete in the global market.
- Creation of designs with various color combinations is an important aspect of selling the product. But traditional methods are expensive when different colour combinations are to be used.
- There are no accurate methods for calculation of the raw material requirements. To avoid the problem of shades they used to dye more wool than their requirement. Hence 10-12% of raw material was getting wasted which accounted for 3-5% of the total cost. The possibility of reusing and recycling these waste raw materials are limited, as shades could not be easily mixed.

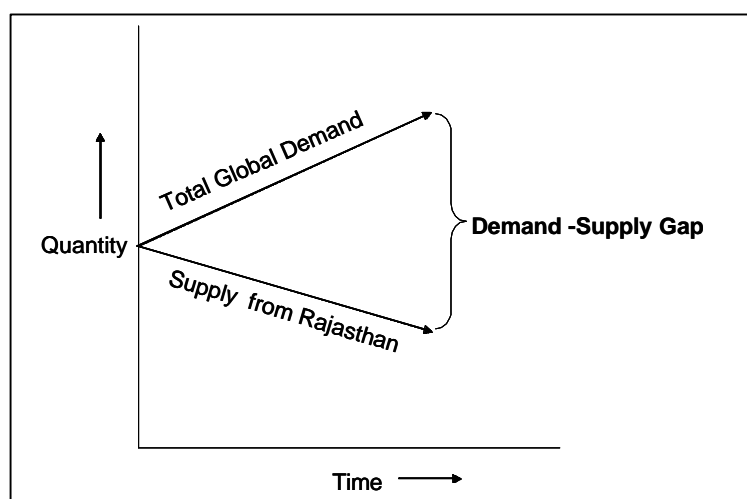


- The designs prepared on the graph paper when transferred for weaving on the carpet varied because of manual errors, resulting in poor customer acceptance.
- In the case of high knotting density carpets, graph papers are of rather limited use. Whereas, the market potential and demand was higher for high knotting density carpets. In the conventional carpet industry the acceptance rate of high knotting density carpets were low and the weavers were reluctant to produce high knotting density carpets. Also, in the case of high knotting density carpets market acceptance was low. Varieties were limited and acceptance was low. Varieties were limited and acceptance was low. In the traditional carpet technology there was no way one could make a variety of high knotting density carpets.
- There was no systematic method for varying designs, in the manual methods; hence designs were simply repeated. This also resulted in poor customer acceptance.
- Storage and handling of the graph paper based designs had its own problems as they degraded quickly. As a result the design had to be repeated afresh on a new graph paper, which is time-consuming and expensive.
- The intellectual property rights of the manual designs were rarely respected as a result the money, time and effort spent in acquiring a new design was rarely yielding benefits. Piracy of designs was a major systemic problem.

Time factor is also one of the major problems as the entire process is hand made and very cumbersome. Unavailability of the designs restricted the production when the sales did not move, weavers incurred heavy losses due to accumulated stocks and the weavers resorted to debts to reduce losses.

### First step towards computerization

During the last decade the demand for carpets increased drastically in the international and national market but Indian players could not penetrate the market globally because of higher costs and limited range of variety. Within a short span of 3-4 years a gap developed between total global demand and the supply from Rajasthan. The demand and supply gap created by the decreasing supply for Rajasthan paved way for the entry of players from China, Turkey and Iran to foray into the global market. Other Indian clusters also captured the market from the players in Rajasthan.



**Fig.6. Demand -Supply Gap**

It was evident that Rajasthan carpets cannot capture the global market without the induction of new technology. Also, without the use of new technology product acceptance will continue to be low even in the Indian market.

### Origin of Idea

Things had to be changed as it was becoming difficult for the weavers to survive. In a brainstorming meeting carpet traders and carpet promoters discussed the issue. Possible use of computer aided design cutting methods came up as the major solutions to recapture the market share. This was suggested by a few carpet exporters who had seen the use of computer aided design abroad. PLC consultation, a Delhi based software company was approached to provide a feasible solution for this problem. PLC Consulting company studied the problems faced by the

manufacturers. Application of ICT was considered as the solution to reduce costs and improve quality of the product. After assessing the carpet industry, PLC Consultation Pvt. Ltd introduced a series of software products titled as **AutoTex 2000** and another advanced version **AutoTex 5.6**. Autotex software brought about a revolution in the Rajasthan carpet industry. Things began to change indicating the power of the ICT platform to transform a traditional industry.

**Auto Tex design:** AutoTex Design is a CAD software tool for designers and is used to create a wide range of designs. By focusing on requirement of international market this software enables the creation of Persian, Tibetan, Nepalese or western designs apart from traditional Indian designs. The software reduced the design time and provided flexibility in the design process. Weavers could see the virtual design on computers, before they were added.

**ColorNet:** ColorNet supports selection and creation of color combinations by buyers, so that manufacturers can reach out to their customers and give them a wide range of options with respect to the colour combinations.

**AutoShow:** It is a visualization and presentation tool for designers, manufacturers, and end users.

**DyeTuft:** This tool has been prepared for accurate calculation of wool requirements for designs with their respective size so as to reduce wool wastage

**AutoFlo:** This tool catalogues the designs/products. This software helps them for management and marketing. They could use many designs given or their combinations. This increases the capability to increase the product variety.

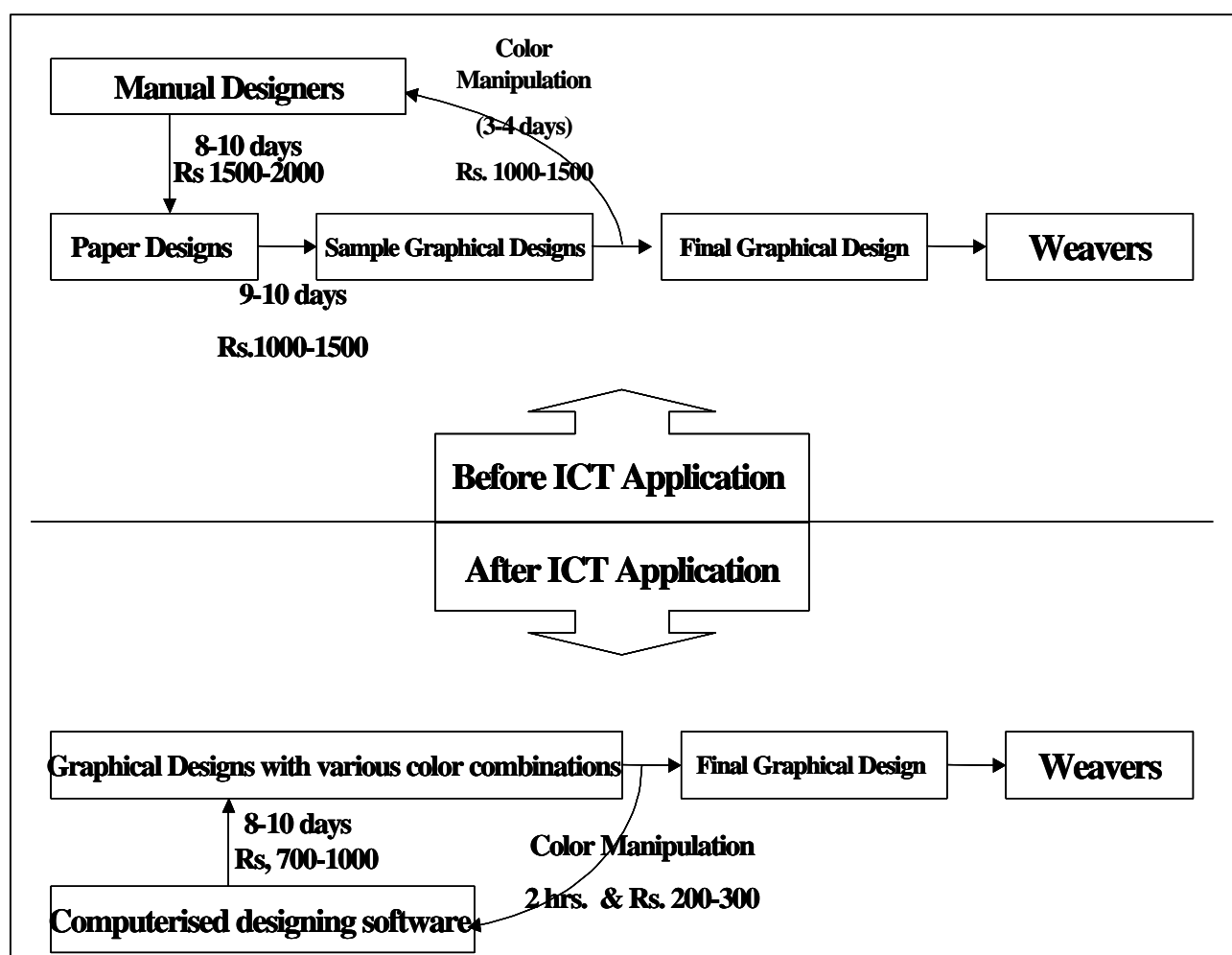
**Taleem:** This tool provides support to generate Taleem, the weaving language which is used for maintaining secrecy of new designs.

**Colorways:** The aim of this software is to help in creating a combination of colours and giving a wide range of options to buyers.

ICT platform helped in reducing design time, enhance product variety and helped in visualization of designs. These above-mentioned software takes care of all aspects of the value chain of the industry with respect to design, production, marketing, and presentation of designs. All these tools together act as an though the realization of economies of scope. It removed product design constraints and brought in capability to visualize design before they are made. It also helped in changing designs rapidly. The ICT platform helped in increasing the interactivity bringing in customer involvement in product design. Lastly, ICT platform enhanced the richness of design by allowing new colour combinations that was hither to not possible. ICT platform helped to realize collaborative design. Carpet dealers could come and examine potential designs. Digitization also helped in the reduction of cycle time and reduced the wastage of raw materials. Finally, the ICT platform enhanced simultaneously interactivity and market access.

### **Technical performance**

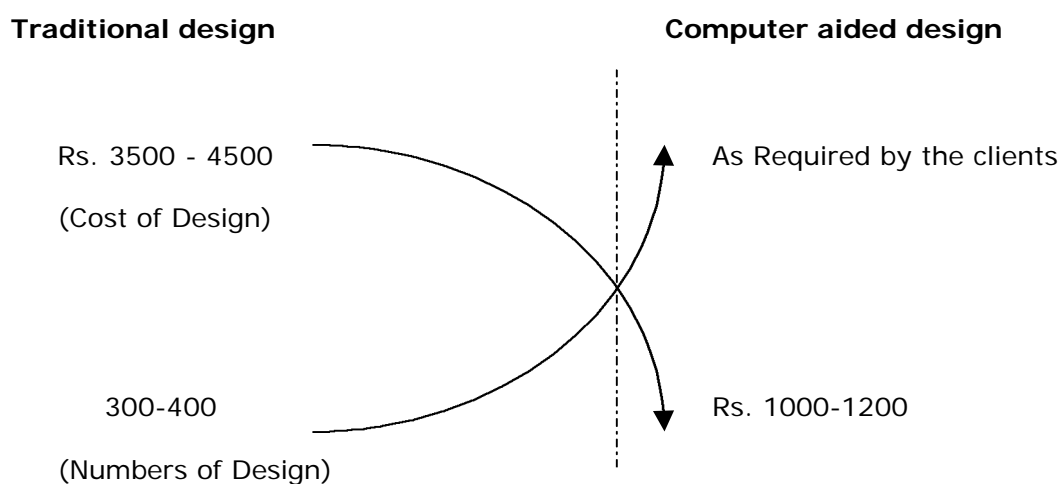
**Sarswati Carpets**, was the pioneer in implementing the computerized carpet-designing in Jaipur, and soon **K. P. & Company** also followed its footsteps. In a short span of time these units improved their performance. Multiple benefits accrued from the introduction of computer-aided designs. New designs were released by this traditional industrial sector and it quickly overcame some of the production and marketing problems. Some of the tangible and intangible benefits obtained through the adoption of ICT are shown in **Fig 7**.



**Fig. 7: Comparison of traditional and ICT based design process.**

By using IT application (*Autotex software*) a variety of designs can be created whereas earlier only 300-400 designs were available.

The cost of design came down by almost 50%. Given the capital cost involved in the procuring this software not all manufacturer were in a position to take benefits of this software. To overcome this limitation, *The Central Wool Development Board, Ministry of Textile, Govt. of India*, set up a designing unit at *Rajasthan Carpet and Woolen Product Development Society, Jaipur*. This centre started providing training and created designs for the small and medium manufacturers. This also facilitated the development of skills in the traditional weaving communities. As shown in **Fig 7** the costs of design reduced and even small manufacturers started using the new technology. Adoption of the ICT platform was facilitated by the skill development efforts of the Rajasthan carpet and Woolen Product Development Society.



**Fig. 8: Benefits of implementing Auto Tex design**

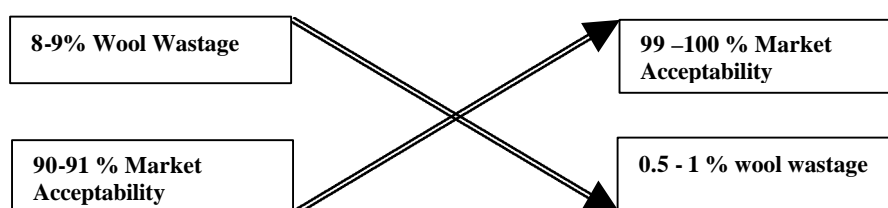
### **Benefits of ICT Adoption**

The computerized designing system helped in reducing the design preparation time from 25-30 days to 8-10 days. Cost was the other significant factor that could be reduced. The cost reduction was achieved through reducing the wastage of raw material inputs. Due to the delicate shading process wool had to be dyed in a single lot for different colors. A slight variation in color shades would cause rejection of order, due to dyeing shades variation us. Earlier the dyed wool remained unused because of different shading; usually 8-10 % raw material was unused which constituted 2-3 % of the total cost of a carpet.

DyeTuft, a part of AutoTex 2000 software solved the problem of wastage of raw material. Wool Waste quantity came down from 8-10 % to 1.0 %. DyeTuft, helped in estimating wool requirements for various designs created by the AutoTex Design. This software tool contributed not only for cost reduction but also increased the market acceptability by 8-9%. The rate of rejection has also come down drastically. In essence, the ICT platform endowed a variety of benefits there by facilitating the transformation of the traditional carpet industry.

**Before using the ICT Tools**

**After Using the ICT Tools**



**Fig. 9: Reduction in Wastage and increased acceptability**

### **Other Benefits Of Computer Aided Design**

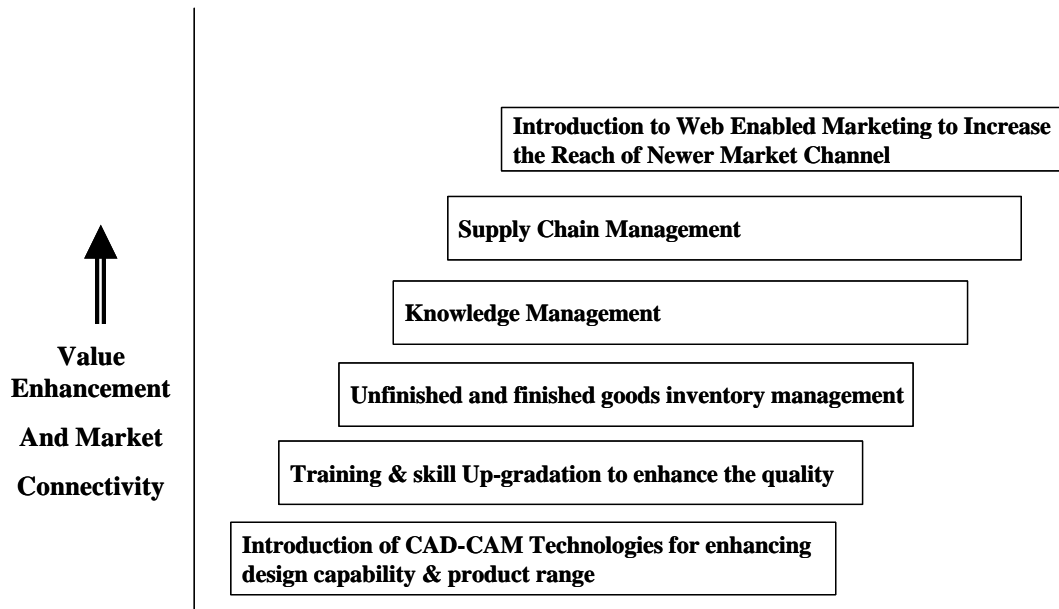
Apart from the above stated benefits one of the most important benefit seems to be to enhance the job opportunities for the skilled labor. In fact people involved in this profession don't have any additional skills apart from weaving the carpet. A growth in market created additional employment opportunity in this industry.

For instance, a village in *Tonk District* where in 1993 around 90 families with 550 working hands were involved in this profession. Today around 130 families with approximately 750 working hands are in the carpet industry. IT application enhanced the job opportunities creating a demand for skilled labor and also enhancing the average wages by 70-80% (from Rs.15-20/day to Rs.40-50/ day) in the last 5-6 years.

Considering the secrecy of the designs, designer can create the graph designs as well as printouts of "*Boli*" (A coding language) with the help of *Taleem software*. Only "*Boli*" is given to the weavers, thus middle man can't sell the designs as actual design can be seen only after the completion of carpet. Thus the secrecy of the designs is maintained.

Recently, an advanced concept was introduced to attract the foreign customers. This concept assists them to choose a couple of designs online and it also enables to make desirable changes according to their tradition/culture and color matching of the wall and that of the carpet. ColorNet and AutoShow are used for this purpose. ColorNet enables to make desirable changes in the basic design. With the help of

AutoShow can fit the carpet image into the scanned picture of a room and can help to have a virtual look of the carpet. This facilitates the matching process prior to real design.



**Fig 10: Evolution of learning in CAD use**

ICT platform adoption involves progressive learning as shown in **Fig 10**. Both the benefits are perceptible: value enhancement and improved market access. The ICT platform thus paved the way for the transformation of a tradition industry that was losing competitiveness because of global competition.

**ICT for designing:** Application of ICT in the form of computer-aided design has been the most needed input. The manufacturers used it to enhance the market share by broadening the design portfolio. The idea to customer cycle time was brought down dramatically. The visualization of design increased the customer acceptance. Designs could be easily changed at the click of a mouse. Storing and releasing paper based designs was completely eliminated.



**Skill enhancement and Training:** At the early stage, nontraditional designers used computers tools for designing purpose. But inputs of traditional designers were really required as most of designing patterns were conventional in nature. So skill enhancement and training to traditional designers had to be done. In a way, CAD tools enriched the design.

**Cost reduction and efficiency:** Cost reduction has been one of the major benefits. ICT has been implemented for raw material estimation. This has reduced 2 - 2.5% of total cost. ICT helped in inventory management and increasing the customer acceptance. Increased acceptance helped them to reduce stocks and processed goods.

**Knowledge management:** Designing and motifs created by the designers can be stored at a central location and the weavers can access such designs by paying a certain price. This facility can help significantly in time reduction and bringing down the price of the final product. The knowledge management can also help in solving the technical queries of weavers and assist them in improving his productivity. Training and interaction helped in enhancing the communication.

**Web Enabled selling:** Web enabled selling has come into vogue. This has helped the weavers to host their product on the Internet and gain access to the newer and untapped markets. These initiatives can be embarked if weavers come together and join hands, and promote joint selling of their products.

## SWOT Analysis

<b>Internal</b>	<b>Strength</b>	<b>Weakness</b>
	<ul style="list-style-type: none"> <li>• Rich in Quality</li> <li>• Comparative Lesser Price</li> <li>• Cheap labor</li> <li>• Skilled &amp; Traditional Labor</li> </ul>	<ul style="list-style-type: none"> <li>•Lack of Advanced Technology</li> <li>• Fragmented structure</li> <li>•Expensive Technology inputs</li> </ul>
<b>External</b>	<b>Opportunity</b>	<b>Threat</b>
	<ul style="list-style-type: none"> <li>• Increasing Global Demand</li> <li>• Use of ICT in Other marketing activities</li> <li>• Favoring WTO policies for Industrial export</li> </ul>	<ul style="list-style-type: none"> <li>•China and other competing countries like Iran and Turkey are entering the market</li> <li>• synthetic carpet Industries market are growing</li> </ul>

**Fig 11: SWOT analysis of Rajasthan Carpet Industry**

A major strength of the Rajasthan carpet industry is its rich quality that makes it different from others. If we compare price factor and quality Rajasthan carpets have become competitive. The SWOT analysis is given in **Fig 11**.

Rajasthan carpet industry is growing at a higher rate. But an internal assessment gives an idea about its major weaknesses as well. Though the new technologies at designing level have been introduced, still Rajasthan carpet industry used only low levels of advanced technologies. Its fragmented nature is also a weakness. If the cooperation between weavers is increased it can improve the overall competitiveness.

Increasing global demand and tariff reduction has opened up a new vista. On other hand, China and the other synthetic carpet manufacturers are increasing their share. Unless the traditional weaving industry uses new technology it will not be able to sustain its competitiveness.

## **Replication of the Technology Adoption Model**

ICT has been beneficial to a traditional industry, such as the carpet manufacturing. It has become significant in reviving a stagnant sector, which enjoyed royal patronage in the history. Given the unique nature of this industry, the designers and skilled workers are still very skeptical about utilizing the computerized tools [3].

The local government also had been slow in promoting the ICT in the traditional handicraft sector, fearing loss of employment at the grass root level. Also the penetration of IT industry in India is limited to the urban area where as rural industries have been untouched. There is a strong need to educate the traditional craftsmen and motivate them to use the computerized tools for increasing their productivity and to make the traditional craft carpet manufacturing competitive. Training is a crucial element of success in the implementation of ICT. This model could be replicated in other traditional industries as well [4].

## **Conclusions**

The carpet industry in Rajasthan is more than four centuries old and enjoyed the royal patronage in early stage. It is known mostly for its high quality carpet manufacturing and wider array of designs. This traditional industry has been faced with declining demand due to saturation of the qualitative output, the development and implementation of an ICT platform has enhanced the competitiveness. The use of ICT platform has the power to transform a traditional industry.

With the wider array of designs and productivity improvement process, the industry not only survived but also prospered. The share of export also increased. Given the current scenario of the carpet manufacturing industry In India, Rajasthan Carpet Industry has been facing stiff competition from other clusters such as Bhadhoi and Panipat, which are primarily mechanized and have a high domestic market share. Also, at the global level, the export markets are flooded with cheaper produce from China and synthetics. The domain specific ICT platform that can help in realizing a variety of the things simultaneously.

The ICT platform endowed a variety of benefits and transformed a number of business practices. The main benefits of use of the platform are:

- reduction in design time
- flexibility to increase colour combinations
- reduction in wastage of material
- interactivity to perform collaborative design involving both designers and users
- visualization of design prior to manufacturing
- ability to carryout online design
- increasing the number of designs and the ability to use other forms of styling and
- enhancing the market through online access.

The main facilitators of the ICT adoption have been:

- entrepreneurial motivation of the software provider and his ability to provide a comprehensive platform
- training of the grass root workers through a local society and
- close interaction between the software provider and the exporters.

The case study of Rajasthan carpet industry shows the power of ICT to transform a traditional industry and help it to regain the competitiveness. Many traditional industries are unable to face the pressure of competition. Only through adoption of new technology traditional industries can survive. While designing solutions, social, economic, organizational and technological aspects need to be considered. ICT platforms will be accepted if there are social and organizational readiness and economic viability built into the project concept.

### **References**

1. <http://www.rajasthanart.com/carpets/>
2. <http://www.indiastat.com>
3. D. B. Yoffie, Competing in the Age of Digital Convergence, California Management Review, Vol. 38, No. 4, 1996.
4. <http://www.india-carpets.com/> (Indian Carpet Export Promotion Council)