CHAPTER 1

INTRODUCTION

1.1 APPAREL INDUSTRY IN INDIA

The Apparel manufacturing industry has shown its potential as a leading sector in spurring economic development and has offered many new job opportunities in India for both men and women. The major markets for Indian made garments are United States, Canada, European Union, Japan and other developed countries (Lahiri and Samanta 2010). Recently, apparel selection has become a difficult task due to the availability of variety of garments. Moreover, managing and selecting proper clothes has long been a challenging problem especially in today’s world where people are always in a hurry and hence most of the time they end up choosing to wear the same style or the same piece of clothes. In addition, the people tend to stick with one or two dressing styles and buy new clothes that are very similar to the ones they already have. This usually results in a huge waste of time and money. Therefore, it is necessary to develop a decision support system which can provide suitable recommendations to the buyer, seller and manufacturer on the type of garments to be made and used. In addition, it is necessary to identify the key success parameters for successful manufacturing of garments and the requirements of customers with respect to fashion during that time. This helps to provide quality materials to the customers by analyzing the customer feedback in the manufacturing sector.
In India, strong production clusters for apparels like Tirupur and Ludhiana have led to the growth of industrial development in those areas. Moreover, the apparel industry in the past was focusing on domestic needs. However, due to the availability of recent technology and communication facilities, they started exporting the apparels to different countries. Now, they produce different varieties of garments and is one of the most competitive industry globally in terms of variety, unit prices and production quantity. Though cotton is the fibre of preference, man-made fibre (polysterfibre and polyster filament yarn) is also produced by about 100 large and medium size producers.

Exports of readymade garments are taking place in the recent years with heavy competition. In such a scenario, garments production is carried out largely in India with modern technology and automation is supported recently and hence it moves from small scale industry to large scale industry. The garments manufacturing and export activities in India are mainly located in Mumbai, Chennai, Tirupur, Bangalore, Visakhapatnam, Ahmedabad, Jaipur, Ludhiana and northern region namely New Delhi, Gurgaon and Noida. Moreover, the bulk of Indian garments export goes to United States of America and European Union and also to Australia, Canada, Norway, Middle East etc. Therefore, the garments sector has grown extensively and is made use of power looms fabrics and second hand machinery.

India’s garments/apparels sector is highly fragmented, comprising more than 8,000 units and employing some 5 million people. In the past, most of the apparel sector units were family businesses having 50-60 sewing machines. However, it is grown recently in to industries and hence targets the apparel wholesalers. New equipment’s are used for manufacturing apparels by replacing old production equipment and methods. Moreover, different varieties are manufactured for men, women and children. Exporters of ready-
made garments are classified as either manufacturer-exporters or merchant-exporters. However, the recent trend is separate manufacturing company and separate sales organizations.

Recent trends in the garment and apparel industry has reduced the fashion based approach with mass fashion based on mass production and mass sales. Currently, people want to have frequent changes, new models, cheaper rates and ease of maintenance. The new developments in the manufacture of variety in the garments have led to the formation of specialized groups to prefer separate types of garments. This is supported by the introduction of information technology into business activities and hence the production and sales department have to co-operate with each other to make suitable apparels which are in demand from time to time. Moreover, domestic and globalization of customers have gained importance and hence analysis must be performed not only on groups but also on individual customers. The manufacturer and sales executives must cooperate with each other to make a comparative study on supply and demand based on customers, items areas and price periodically. Due to the availability of online sales facilities, the advertisements and the recommendation methods followed earlier must be modified to suit the current requirements. Survey must be made on manufacturing side metrics, whole sale market and retail markets in addition to the customers. If the customer visits the shop directly, he is able to have a direct interaction with the marketing executives and hence they will get mutual benefit (Bozarth & Berry 1997, Choi & Kim 2013). However, due to business competition there is a need for studying the customer behaviour before manufacturing the garments. This can be done either through direct customer interaction or data analysis using past information. In data analysis, rules play an important role for decision making. Rules must be framed by consulting with domain experts. A system which is developed for a particular
domain in consultation with an expert in that domain is often called as an expert system.

Business expert systems are widely used by various business groups in different areas and time to improve the business strategy on the items sold. The Business Expert Systems are used by the clients and these systems attract the customers by producing sufficient details about the items needed by them which use rules. In this context, association rule mining is one of the most used data mining and analysis technique for predicting the sales patterns. The mining association rule is a data mining task that aims to discover relationships among items available in a transactional database (Agrawal & Srikant 1995, Surendren & Bhuvaneswari 2014, Witten et al. 2011). This research work proposes a new intelligent business expert system for predicting the sales patterns on the expected sales of new product or items using feature selection and association rule mining with time constraints. The proposed expert system uses the existing algorithms with time constraints to find the sales prediction over the transactions and products. Therefore, the apparel industry in India can be successful if it uses the current information technology. Moreover, the apparel industry should optimize the manufacturing cost in order to get success in the business. It needs the identification of key manufacturing parameters and the implementation of such key success factors during manufacturing in order to enhance the quality of items which are manufactured by the apparel industry.

1.2 Key Factors for Manufacturing

The apparel industry being highly labor intensive and with such a low technology, low skilled and high volume production moved out of the developed countries many years back and started concentrating in the developing countries where labour is cheaper and readily available (Zammuto & O’Connor 1992). Countries like China, Bangladesh, Vietnam, India,
Indonesia, Cambodia, Pakistan, Sri Lanka, and Thailand are the major production centers of garments in Asia. Though some production takes place in developed countries like Italy, Germany, France, Spain, Netherlands, Mexico, the majority of exports takes place from the above countries.

The developed nations which are primarily the market for consumption of huge volumes of apparel have become prohibitively costly for such labor intensive low-tech manufacturing and the labor available there is being used for more value added manufacturing like hi-tech precision engineering products, electronics goods and specialized products like arms and aircrafts, chemicals and similar products.

These factors forced the developed countries to stop production of apparels and made them dependent on third world developing countries. Almost entire production from the developing countries were targeted for exports to developed countries and created a very high competition among them for the price, flexibility in delivery and quality and economies of scale. Only the fittest countries that control the cost and manage all the critical parameters those are discussed here can compete and win orders in this competitive market and stay in business (Roth & Jackson 1995).

The recession has drastically reduced orders from these markets and put lot of pressure on apparel manufacturing countries. Many factories had to be closed as they become unviable and could not withstand the competition and open capacities. Only very few manufacturing companies survived this onslaught of the global recession. A detailed study needed to be done as to why many companies failed and some succeeded and what are the key parameters that can keep them survive and grow (Saim & Vijay 2014). This work attempts to bring out all such key parameters that are essential contributors for the success of an apparels/garments manufacturing unit.
Several studies have established the factors that affect the performance of Apparel Industry. The primary competency for any manufacturing comes from raw materials and other resources availability at competitive cost, technical knowledge, competence and skill availability and skilled labour potential. Other important factors that play a crucial role are appropriate technology, labour quality and productivity, absenteeism and attrition, logistics and transportation infrastructure, foreign exchange value fluctuation, government support and incentives, customers confidence and customer profile, competition in the market, tariff and non-tariff barriers, global economic condition and lean manufacturing concepts for continuous improvements for manufacturing and marketing operations (Stobaugh & Telesio 1983, Berry et al. 1991, Monczka & Trent 1991, Bozarth 1993, Ward et al. 1995a). All these key factors can be put into a configuration model in order to enhance the productivity in manufacturing and can provide suitable suggestions for enhancing the quality of manufacturing operations.

Quality is a relative term and hence is used to produce items which can compete in the market. The main aim of quality control and provision is to satisfy the customer with the product manufactured. In apparel industry, the competition is more and hence customers demand high with cheaper cost. Therefore, the manufacturers of apparels must provide consistent quality in the products made by them. The various steps that can be adopted by the manufacturer are effective market analysis, demand forecasting, new style design, configuration management, cost optimization and enhancing the quality of items.

The existing apparel industries make use of different parameters for judging the quality of the items manufactured by them. It includes inspections in fabric spreading, cutting, sewing, pressing and finishing. In addition, it has to perform quality control through sampling and statistical methods. In this
step, they have to maintain buyers specification standards, measurement checking, color checking and speed of manufacturing. They have to perform quality checking with respect to drill marks, height and width, length, pattern and production planning. In order to perform all these quality checking activities, a special quality control team is appointed. However, it is necessary to appoint an additional marketing team which can bring customer feedback and help the quality control team in providing guidelines for enhancing the manufacturing quality.

1.3 CONFIGURATIONS IN MANUFACTURING STRATEGY

Configuration models have generated a great deal of interest in the business strategy area (Meyer et al. 1993, Benningson 1996). Despite this, there has been no effort to examine the current state or future role of research in configuration modeling in the manufacturing strategy area (Maruchek et al. 1990, Mintzberg 1998). This work attempts to fill this gap. The proposed thesis discusses about how configuration models can play an important role in the study of dynamic manufacturing issues; specifically, the development, implementation, and change of manufacturing strategies. There are increasing numbers of complex factors that affect/influence the successful working of apparel manufacturing companies.

Once the survey is done and the prioritization and the varying impact levels of each factor is established through factor analysis of the responses from the target subjects, this work provides a comprehensive guide to Apparel industry for putting up a success formula. Moreover, when advice is received on purchase, the buyer utilizes the past interactions to judge the advice quality (Xinjuan et al. 2010). Furthermore, users would prefer to receive recommendations from people they trust. Hence, recommendations are made based on the ratings given by users who are either directly trusted by
the current user or indirectly trusted by another trusting user through trust propagation mechanism (Liu et al. 2012). A recommendation system can be made more accurate if it obtains feedback from customers in addition to the analysis of past data.

In the last decade, a strong interest in configuration modeling research in the business strategy area was developed by many researchers (Meyer et al. 1993). Therefore, the scholars made an attempt to examine the current state of the manufacturing industry with respect to apparel design and the future role of configuration models in the apparel manufacturing industry. There are many configuration models which are available in the apparel manufacturing industry. The reasons for this development are twofold. First, the vast majority of development works in the area of apparel design tend to focus on highly-specified products with known methods. Second, the quality related efforts were becoming famous in all types of manufacturing industry. Every sector wanted to manufacture items with zero defects. Hence, quality circles were formed to discuss about quality of products.

Due to the formation of quality circles and quality control groups, the competition among the manufacturer was increasing. Hence, every apparel industry wanted to carry out their manufacturing operations based on new configuration models. They wanted to use new classification techniques including taxonomical classification, statistical methods and decision trees. Analysis using multidimensional approach was proposed by many industries and they implemented to provide a new structural model. Therefore, configuration management has become an important component in the apparel manufacturing industry.

In the past, many efforts were made to develop suitable configuration models addressing strategic fit in apparel manufacturing. In other manufacturing sectors also configuration models were introduced.
Manufacturers can be classified into core manufacturers and secondary manufacturers. Core manufacturers carried out their work from scratch. On the other hand, secondary manufacturers manufactured some items and purchased others to make full set of garments. In this way, the apparel manufacturing industry explored all the possibilities to carry out research for enhancing the quality in manufacturing. This can be achieved by controlling quality in fabric spreading, cutting, sewing and finishing effectively.

In fabric spreading, requirement analysis must be taken care of by providing correct alignment with respect to length and width. Moreover, the number of fabric ply and ply direction are also important. In fabric cutting, cutting angle, accuracy, reduction of wastage, monitoring of drill holes and effective blade operations are to be monitored and ensured. In the sewing section, activities such as checking of input materials, cut panel and accessories, machine condition, thread count checking, needle size, stitching fault, seam fault and size checking must be carried out effectively. Finally, in the finishing section, proper inspection of the garments including measurement, spot, dirt, impurities and water spots must be checked seriously. It includes folding, closing, packet checking and drying activities.

1.4 **FEEDBACK FROM CUSTOMERS**

Globalization of markets and the international competition has made firms in the textile apparel industry to develop suitable recommendation systems to offer their customers with the best and most related services. These recommendation systems are helpful to textile industry for manufacturing the correct products which are having demand in the market. The use of soft computing techniques helps to make better recommendation systems. Moreover, and hence many companies are either sourcing their production to other components manufacturing unit is developing countries to reduce the labor cost. This challenge is complicated again by the increase in
unpredictability of the global garment market due to the fast changes in customer demand and also in styles. Therefore, the industry is with unpredictable demand, short product life cycles, quick response times, large product variety, and a volatile, inflexible, and complex supply chain structure (Fisher 1997). In day to day life, people seek advice from peers and they consider their past interaction history to locate the right peer. Moreover, when advice is received, they utilize the past interactions to judge the advice quality. Furthermore, users would prefer to receive recommendations of the trusted people. Hence, recommendations are made based on the ratings given by users who are either directly trusted by the current user or indirectly trusted by another trusting user through trust propagation mechanism (Foody & Mathur 2004).

Recent trends in the garment and apparel industry has reduced the fashion based approach with mass fashion based on mass production and mass sales which was the earlier taste of users. Currently, people want to have frequent changes, new models, cheaper rates and ease of maintenance models. The variety in the garments leads to specialized groups to prefer separate types of garments. This is supported by the introduction of information technologies into business activities and hence the production and sales department have to cooperate with each other to make suitable apparels which are in demand from time to time (Goldhar et al. 1991). Moreover, localization and globalization of customers have gained importance and hence analysis must be performed not only on groups but also on individual customers. The manufacturer and sales executives must cooperate with each other to make a comparative study on supply and demand based on customers, items areas and price periodically.
Due to the availability of online sales facilities, the advertisements and the recommendation methods followed earlier must be modified to suit the current requirements. Survey must be made on manufacturing side metrics, whole sale market and retail markets in addition to the customers. If the customer visits the shop he is able to have a direct interaction with the marketing executives and hence they will get mutual benefit (Seybold 1998). Therefore, a new recommendation system for apparel selection is necessary to provide effective guidance to the customer. For this purpose, two new questionnaires were designed and used for performing data collection. Moreover, survey was conducted from 1000 people from each city and was conducted in 10 different cities namely Chennai, Coimbatore, Kanchipuram, Mumbai, Bangalore, Hyderabad, Visakhapatnam, New Delhi, Kolkata and Varanasi. All the 10 cities are from India. By getting the feedback from customers, the qualities of the items were enhanced at the manufacturing side in order to get success in the competition. Moreover, a new recommendation system is proposed in this work which explains the features of the quality attributes used by the manufacturers so that the customer can select the best item with high quality.

1.5 SALES RECOMMENDATION SYSTEM

When the paradigm shifts from direct marketing to online marketing the recommendation systems must follow a reactive approach. They must develop reactive web services which can make a bridge between the membership segment, marketing segment and the customers. There are many recommendation systems which are using different techniques for decision making (Massa & Avesani 2007, Sarwar et al. 2002). Among them, Collaborative Filtering (CF) is the most important technique in which the opinion given by all the members are considered to make decisions. They can use public opinions, neighbor information and simulating measures to find the
suitable items. The use of ranking algorithms to find the top-10 or top-20 items present in the market. Schafer et al. (2007) introduced two nearest neighbor based CF algorithms in which predictions are based on similarities among preferences and item based algorithms. Past research (Song et al. 2011) shows that people like items which are liked by their friends and peers. Rashmi & Kirsten (2002) compared the quality of recommendations made using recommender systems and friends. It is found that the most people preferred recommendations from friends rather than recommendations made by out formatted recommender systems (Gallagher 2008). Above all these, style plays an important role in the selection of garments. In one time, loose fitting is preferred over tight fitting. The thicknesses of clothes also vary with respect to time, place and style preferences. Therefore, online shopping systems must provide a facility to perform style classification.

1.6 ONLINE SHOPPING USING STYLE CLASSIFICATION

A man without suitable clothes is treated as a half man. Therefore, the appearance of a person depends mostly on the type of clothes he/she is using on a particular day. Therefore, many important factors such as material type, color, cost, skin color, height, weight, climate and so on contribute to the selection of garments. In such a scenario, people with one style of cloth are treated as superior than people with another style of cloth. Therefore, the apparel is an important parameter for describing the human beings. Moreover, people are identified based on their clothes used on a particular time. For example, the man with black coat, the girl with green chudidhar and a man with white dhoti are examples of sentences used to identify people using their clothes.
The garment industry is responsible for producing different styles using patterns, materials, colors and cost on clothes. Younger people prefer one type of style and elder people prefer another type of style. Sports men prefer one type of style and priests prefer another type of style. Hence, style classification is an important guideline for manufacturing industry for producing garments. In addition, style classification helps to identify the most interesting cloth with required material and color for an individual, in the sales area.

Online shopping is different from direct shopping in many ways. In direct shopping, the customer can see the cloth directly, touch it and understand the texture properties. On the other hand, in online shopping the customer can see only the image of a cloth. Therefore, the customer needs more assistance from experts in the online business scenario. Hence, it is necessary to develop an automated system which can help the customers to select suitable garments.

1.7 TEMPORAL DATA ANALYSIS FOR BUSINESS SYSTEMS

Storage and retrieval of business data is an important activity in business systems. The business data can be effectively stored in databases. The existing relational database systems have been designed to maintain accurate, complete and consistent information pertaining to a business organization. In such databases, the most recent data (current data) are only stored. In such a scenario, when new data values are available through updates, the current data values are replaced with new values. Therefore, the database systems serve well in many business applications. A database management system that maintains past, present and future data is called a Temporal Data Base Management System and it supports both valid time and transaction time (Snodgrass & Ahn 1986). Valid time denotes the time at which an event took place in the real world. Transaction time, on the other
hand, refers to the time at which a transaction has been processed to update the database.

In the development of business systems, temporal databases can provide past and present data for effective analysis. There are many applications including sales monitoring, patient monitoring and forecasting in which the current database management systems cannot operate with either real world time or system time alone. In such a situation, temporal features must be taken care of by the application to perform effective decision making. Time is continuous in nature. There are two common views of time, Continuous and Discrete time. Continuous time is considered to be isomorphic to real numbers, whereas discrete time is considered to be isomorphic to natural numbers or a subset of real numbers. Both views assume that time is linearly ordered. Discrete interpretation of time has been adopted in temporal databases because of its simplicity and relative strategy of implementation.

Temporal reasoning involves a number of capabilities such as the provision of finding the dependencies between intervals and instants and prediction of the future using the past and present data. There are a number of applications such as weather forecasting, market trend analysis, health care management and banking systems which require the use of temporal reasoning in decision making, planning and to learn new rules. Temporal mining helps to perform temporal reasoning in an effective way, since it finds temporal patterns that can be used for analysis and prediction. Moreover, temporal reasoning on temporal data requires the use of temporal mining in order to provide the ability to handle dependencies among different temporal data using rules. Works on rule based systems have originated from logic programming communities. The integration of rule systems and business database systems can provide a reliable environment for business decision making.
Temporal data mining techniques allow for the possibility of computer driven, automatic exploration of the data and intelligent data analysis. Intelligent data analysis refers to all methods that are committed to automatically transform data into information exploiting the background knowledge on the domain (Hand 1997). The primary goal of intelligent data analysis is to provide methods that support data understanding. In most application areas that have been studied for data mining, the time at which an event has happened is recorded effectively. However, most data mining techniques treat data in temporal databases at best as data series in chronological order and ignore the time stamps.

1.8 PREDICTING SALES PATTERNS USING ASSOCIATION RULES

Time is an important component in day to day life since all our activities are depending on time. For example, trains and flights are scheduled based on time. Academic activities in a college, meetings in a business organization, deadline in a manufacturing industry are depending on time. For effective management of time, rules must be followed in every activity of the human life. Moreover, there are dependencies between one activity and the other activity. Therefore, it is possible to predict the next purchase by a customer based on his current and past purchases. Prediction of customer behaviour is an important area of research which is useful for business communities. Moreover, the rules used for prediction must be formed using scientific methods. Association rules are one type of rules which are formed by analyzing different transactions by a customer in an online business system. Such association rules can be used later on for making effective decisions in order to enhance the future business perspective.
Association rule mining finds interesting associations and/or correlation relationships among large set of data items. Association rules show attributes value conditions that occur frequently together in a given dataset. Association rules provide information of this type in the form of “if-then” statements. These rules are computed from the data and, unlike the if-then rules of logic, association rules are probabilistic in nature. In addition to the antecedent and the consequent, an association rule has two numbers that express the degree of uncertainty about the rule. In association analysis the antecedent and consequent are sets of items that are disjoint. The mining association rule is a data mining task that aims to discover relationships among items in a transactional database (Hu & Li 2011). This task has been studied widely in the literature for its benefit in many application domains, such as Web usage mining, recommender systems, and intrusion detection. The support is simply the number of transactions that include all items in the antecedent and consequent parts of the rule.

Confidence is the ratio of the number of transactions that include all items in the consequent as well as the antecedent to the number of transactions that include all items in the antecedent. Lift is nothing but the ratio of confidence to expected confidence. Lift is a value that gives us information about the increase in probability of the “then” (consequent) given the “if” (antecedent) part. Time is an important constraint over the sales (dynamic) data in this business environment. To improve the prediction accuracy on sales patterns, the combination of association rule mining and time is very important today. For this purpose, this work proposes a new intelligent business expert system for predicting the sales patterns on the expected sales of new product or items using feature selection and association rule mining with time constraints. This expert system uses the existing algorithms with temporal constraints to find the sales prediction over the transactions and products. Moreover, decision making using expert systems
will assist the customers for selecting cheap and best garments through online purchase.

1.9 BUSINESS DECISION SUPPORT FOR CUSTOMERS

Business expert systems are widely used by various business groups in different areas and time to improve the business strategy on the items sold. The Business Expert Systems are used by the clients and these systems attract the customers by producing sufficient details about the items needed by them. The various features that affect the consumer interest are categorized to form business rules. Since different individuals have different types of interests, it is necessary to make prediction on purchase of items. Expert systems, best known for their use in medical applications can be applied in business to provide suggestions. Modern business expert systems are facing challenges such as collection of data and analysis with rules to produce high-quality results. Though, already several statistical methods are available. Association rule mining is one of the most used data mining and analysis technique for predicting the sales patterns.

Rapid growth of user generated content in the form of reviews is directly proportional to the expansion of online shopping, according to a report about sales for 2010 (Gudigantala et al. 2008; Choi & Kim 2014). Current trend of business improvement is to provide sufficient facilities to the customers with low or free of cost for improving sales. Business systems are useful for making correct decisions on suitable purchase for their own interest based on experience and availability by providing more information about shopping.

Due to the sharing of information about products, it is necessary to satisfy the users during purchase decisions through online or offline purchase. Because of these, the proposed system helps the customers to perform online
purchase effectively by providing product information to become better buyers (Cheng et al. 2010). Moreover, it is difficult to deal with customers who do not have sufficient information about the products during their purchases (Iyengar et al. 2006). In this work, we introduced a new decision support system to simplify the business processing by providing suitable recommendations to the customers based on their interest to improve the sales. The proposed decision support system will provide feedback to the manufacturer on the type of styles liked by the people at that time. Therefore, the manufacturer must use this feedback to make changes in the current structures of the clothes. This type of configuration management will enable the manufacturer to provide garments with new structures which are liked by all communities and customers.

1.10 CONFIGURATION MANAGEMENT USING CUSTOMER FEEDBACK

Configuration management deals with decisions on structure of clothes and management of changes in the structure. For example, long shirts may be converted into short shirts, pants may be converted into trousers or smaller dresses may be made into bigger dresses. The major problems in configuration management include identification of changes required, communicating the required changes to the manufacturer, new modeling and correcting the deficiencies in the existing model. There are no books or guidelines which are available in the market for making change requests and their implementations. However, customer interaction and customer feedback can be used as a guideline for making new configurations.

Based on all these guidelines, a good configuration model can be derived by the manufacturer. These guidelines must be tested with the existing key parameters and a final set of parameters must be identified on the manufacturing side. Moreover, a correlation analysis between the demands of
the customer side and the facility provide by the customer side must be made. Based on these, a configuration management procedure must be identified. In this work, a new configuration management technique is proposed and implemented for effective manufacture of cloth items. For this purpose, the client accepts the queries and configuration requests in order to provide suitable services to the customers. When the key factors are finalized and are used in the business, the variation between the user requirements and the available configurations must be considered for next level decisions.

1.11 INTELLIGENT MANUFACTURING PARAMETERS USING KEY FACTORS AND SALES ANALYSIS

Several studies have established the factors that affect the performance Apparel Industry. The success of the Indian Apparel Industry lies in managing these parameters and by staying above the competition which is mainly from developing countries like Sri Lanka, Bangladesh, Pakistan, China, South East Asian countries like Indonesia, Thailand, Vietnam. Cambodia etc. However, this work provides intelligent decisions by combining key factors used in the manufacturer side and the user feedback and sales analysis from customer side for making effective manufacturing strategies. In this thesis, a new sales recommendation system along with intelligent decision support system is proposed for enhancing the business structure in many industries. Moreover, this recommendation system uses key factors and performs sales analysis on these patterns leading to the development of new garments with multiple designs.

1.12 NEED FOR THE STUDY

This study is more important to enhance the sales and to improve the manufacturing process. The main objectives of this thesis are to propose intelligent techniques for automation of manufacturing and business activities
of an apparel manufacturing industry. For this purpose, different techniques from Artificial Intelligence (AI), Electronic Commerce (e-commerce) and business management are necessary for effective decision making with respect to apparel industry.

The major objectives of this work are:

1. To propose a new algorithm for storing the business data in a database consisting of business datasets.

2. To identify the key management success parameters.

3. To use intelligent algorithms for feature selection with respect to garments.

4. To evaluate the use of key factors in manufacturing and its impact on research.

5. To enhance the quality of apparels made and to optimize the cost.

1.13 STATEMENT OF THE PROBLEM

The gap in the knowledge in the existing works include the lack of coordination between apparel manufacturing and sales areas. Therefore, it is necessary to provide continuous feedback obtained from the customers to the manufacturer. The specific problem to be addressed include the design of an apparel recommendation system, a feedback mechanism to reach the manufacturer and knowing the interest of people in various regions. In this work, a new intelligent apparel recommendation system is proposed for online shopping which can provide suitable feedback to the manufacturer also for manufacturing suitable garments using style classification. The proposed intelligent recommendation system uses an Intelligent Agent based Attribute
Selection Algorithm (IAASA) for selecting important features and an effective classification algorithm called Intelligent Agent based Enhanced Multiclass Support Vector Machine (IAEM SVM) (Ganapathy et al. 2012) for effective classification. This proposed system will be helpful to customers, who do not have detailed knowledge about the fashions in the real shop. However, when they want to perform online purchase, they use this software to select the items. The experimental results show that the proposed system helps to choose suitable clothes based on the taste of an individual customer. It makes recommendations of clothes based on past and present sales data on different styles. The system has also been validated using opinion from questionnaires and experts.

In addition, a new intelligent business expert system is proposed and implemented in this work for helping the seller by providing feedback on sales with respect to time for new products or items. For this purpose, this system uses Temporal Association Rule Mining Technique and business rules with time constraints to predict the sales patterns. This helps to provide feedback to the manufacturer and the sales persons on the quantity of items to be produced at each season of a year. In addition, we use a market transaction dataset having a large number of features for effective analysis. In order to make the inference faster, a feature selection algorithm called Intelligent Conditional Random Field based Feature Selection Algorithm (ICRFFSA) (Ganapathy et al. 2016) is used for selecting the optimal number of features. The experimental results obtained from this work show that the performance of the proposed expert system is more accurate and correlates with the survey obtained using a questionnaire from a large sample of customers who performed online shopping for ordering the products.

An intelligent business decision support system is also proposed in this work for apparel selection. The proposed system consists of two separate
modules namely apparel selection system and business expert system. The first module is the combination of Agent based Attribute Selection Algorithm (IAASA) and Intelligent Agent based Enhanced Multiclass Support Vector Machine (IAEMSV) for effective apparel selection. The second module consists of Intelligent Conditional Random Field based Feature Selection algorithm (ICRFFSA) and Temporal Apriori Algorithm (Somasundaram & Lakshmanan 2013) to provide inference on the type of garments to be made available to the customer. The experimental results obtained from this work show that the performance of the proposed intelligent business decision support system is more accurate with respect to garment recommendation.

Finally, a study on the correlation between manufacturer, seller and buyer is made. This study identifies the Key Success Parameters for a successful apparel manufacturing operation and to stay afloat and grow during such difficult times. This research work tries to list down and analyze the various factors contributing to the success or failure of the apparel manufacturing operations in the current socio economic environment. The main contribution of this work is the provision of manufacturing side analysis and corresponding sales analysis so that the qualities of manufactured apparels are taken care of by the proposed system.

1.14 OVERVIEW OF THE STUDY

This study is carried out in Indian cities for enhancing the sales and is limited to the garment and apparel industry in India. It considered different types of garments which are used in all parts of India namely North, South, West and East. This work has been carried out only using survey and data analysis and hence may vary in some areas. This work has been simulated using algorithms available in data mining tools and prediction was made based on benchmark datasets and real datasets collected from manufacturing industries and markets available in important cities in India.
1.15 METHODOLOGY OF RESEARCH

In this research work, a sampling and survey based research work is carried out to make a coordination between the manufacturer and the sales persons. For this purpose, a set of 1,45,718 images of garments were given to 10000 people from 10 different cities of India. The sampling techniques used for analysis include analysis based on mean and variance. It followed small sample analysis techniques and Chi-square test and t-test were used for analysis. For this purpose, Statistical Package for the Social Sciences (SPSS) was used to carry out the hypothesis testing and the weka tool has been used to find association rules and classification.

The limitations of the existing works include the lack of coordination between apparel manufacturing and sales areas. Therefore, the key success parameters must be applied on manufacturing apparels based on the feedback from apparel sales.

The major contributions of the thesis are as follows:

1. First, a study on the correlation between manufacturer, seller and buyer is made.

2. Second, a new configuration model for the manufacturing side of garment industry has been proposed in this work. It provides guidelines for effective change management.

3. In this work, a new intelligent apparel recommendation system is proposed for online shopping which can provide suitable feedback to the manufacturer also for manufacturing suitable garments using style classification using feature selection and classification.
4. This proposed system has been tested with customers, who do not have detailed knowledge about the fashions in the real shop.

5. A new intelligent business expert system is proposed and implemented in this work for helping the seller by providing feedback on sales with respect to time for new products or items.

6. In this work, an intelligent business decision support system is also proposed for apparel selection. The proposed system consists of two separate modules namely apparel selection system and business expert system and hence it helps the customer to make effective decisions.

7. In this work, suitable questionnaires are made for data collection. Therefore, the proposed techniques have been tested with questionnaire score and analysis score and found that they are positively correlated.

8. In this work, key success parameters and customer feedbacks are used as parameters for enhancing the quality of apparels provided by the manufacturers. This twofold analysis which focuses on both manufacturing and sales areas is helpful to perform accurate recommendations.

9. The proposed work focuses on enhancing the quality and at the same time provides cost and time optimization using rules and temporal constraints.
1.16 SIGNIFICANCE OF THE STUDY AND KEYWORDS

This study identifies the Key Success Parameters for a successful apparel manufacturing operation and to stay afloat and grow during such difficult times. Therefore, this research work provides a facility to analyze the various factors contributing to the success or failure of the apparel manufacturing operations in the current socio economic environment. This analysis is supported by using Temporal Association Rule Mining Technique and business rules with time constraints to predict the sales patterns. This system has helped the customers and also to provide feedback to the manufacturer and the sales persons on the quantity of items to be produced at each season of a year.


1.17 SCHEME OF REPORT

The scheme of this report is as follows:

Chapter 1 provides an introduction to the proposed study by introducing the manufacturing industry key parameters and its relationships to customers and sales analysis.
Chapter 2 discusses the related work in the area of apparel manufacturing, data mining approach for providing recommendation to select suitable apparels by customers.

Chapter 3 depicts the architecture of the system proposed in this research work.

Chapter 4 explains the identification of key success parameters and Configuration management for manufacturing.

Chapter 5 details the techniques used for apparel recommendation using feature selection and classification. It also provides the details and features of the business expert system proposed in this research work. Finally, it depicts the techniques used for developing a new business decision support system proposed in this work.

Chapter 6 gives conclusion on this work and suggests some future work.

The plan of the study is the collection of literature survey, literature study, problem formulation, data collection, identification of key manufacturing factors, descriptive statistical analysis, testing of hypothesis, inferential analysis, application of data mining methods, derivation of association rules, classification of data using rules, statistical analysis on classified results and providing feedback to the manufacturer.