2.1 INTRODUCTION

The history of textiles and garments use in India has started from 3000 BC. Therefore, India is an important country with respect to garment industry and apparel manufacturing in the world. The diversity of fibers available in India, the complex weaving techniques used in manual handlooms and its organic dyes attracted the buyers from many countries all over the world. After independence, India has developed many new textile industries mainly in Bombay, Coimbatore and Ahmadabad Regions. Therefore, India developed new capabilities in apparel industry with its diversification of its product base.

Today, the textile and garment sector has employed more than 35 million people in India. Hence, the apparel industry contributes 4% to the gross domestic products thereby making it as one of the largest industrial sectors of India. Moreover, the apparel industry economy is more than 40 billion dollars. Its global market share is more than 6% in the recent years. The industry growing with a constant rate and provide consistent employment opportunities to many Indians. It is estimated that more than 50000 apparel industries are available in India. In the peninsular India, apparel industry is the most important industry and produces more than 20% of India’s total income.
The value of Indian garments including Sarees, Dhoties, Salwars and Kurtas are around Rs.200–250 Crores. Moreover, nearly 40% of the raw materials for garment production are obtained through imports.

In many towns of India, a number of people are employed in apparel industry. Three different technologies are used in the apparel sector namely handlooms, power looms and knitting machines. Moreover, they produced different types of clothes with different values. For example, Sarees made from Kanchipuram in Tamil Nadu and Varanasi in Uttar Pradesh has high values and is exported to different countries. Therefore, many researchers proposed many techniques for quality improvement for manufacturing success.

In the past, new web service systems were created for information integration in apparel supply chain. In such systems, apparel supply chain is a network which includes the activities namely clothing fabric, accessories supply, apparel manufacturing, apparel distribution, apparel sales and trading. In this scenario, the necessary materials and products are acquired, transformed and then they are delivered to consumers in markets. It needs effective communication and coordination between all the stack holders including manufacturer and buyer. Hence, the efficiency of apparel supply chain can be improved through proper coordination. This can be done if the information is passed from the upstream fabric supplier to downstream consumers step by step accurately. Moreover, the information integrating and sharing will not be efficient if the product can’t satisfy or the market demand.

The reasons for failure of projects in apparel manufacturing industry can be identified using the critical success factors by investigating and identifying possible reasons for the failure of improvement methodologies. The critical success factor required for successful implementation has been tested in the past using different industries through
various cases in different sectors of the manufacturing industry. Finally, a method for continuous improvement in manufacturing is necessary. The research methodology employed in existing systems is exploratory and comparative in nature using case studies. The conceptual model of the literature survey is shown in Figure 2.1.

![Conceptual Model of Literature Survey](image)

**Figure 2.1 Conceptual Model of Literature Survey**

### 2.2 STRATEGIES AND METRICS FOR MANUFACTURING

In the past, there was a strong interest in configuration management research in the business strategy area by many researchers (Porter 1980, Dess & Beard 1984, Miller 1986, Hinings & Greenwood 1988, Adam & Swami Dass 1989, Flynn et al. 1990, Meyer et al. 1993, Miller 1996). However, there is no new and efficient technique to examine the current state or future role of configuration models in the manufacturing management. Therefore, it is necessary to provide a comprehensive review on the current status of configuration management research with respect to manufacturing strategy in apparel industry.
From the literature, it is observed that most of the current configurations models in the manufacturing strategies are lighter in nature. The reasons for this are twofold. First, majority of works in this area focus on highly-specified relationship between a few key parameters, such as quality-related and organization related parameters (Benson et al. 1991). While most of the current works provide the essential building blocks needed to create classification of parameters they do not provide multidimensional descriptions of the parameters. Second, most of the reviews perform classification based on taxonomy and decision trees. Therefore, it is necessary to focus on manufacturing based configurations in order to identify trends, areas of overlap, and potential directions for future research.

Wheelwright & Hayes (1985) made early attempts to develop configuration models addressing strategic fit in manufacturing. Moreover, this work of Wheelwright and Hayes is unique in that it is the only configuration model that focuses on the manufacturing strategy process. The authors classified the manufacturers into four types based on the method used to manufacture and process the manufactured items. Miller & Roth (1994) clustering of 164 large American manufacturers across eleven competitive priorities revealed three main manufacturing strategy types namely caretakers, marketers and innovators. The authors compared these strategies in order to provide improvements which will lead to reduction in manufacturing time and to enhance the quality of manufacture items.

Richardson et al. (1985) proposed and empirically tested a new methodology describing the fit between the manufacturing task, corporate mission, and performance. Their work focuses on six distinct corporate mission profiles and four manufacturing task profiles using thirteen and nine dimensions, respectively. Richardson et al.(1985) measured the cooperate focus and plant focus as the deviation between the respondent’s expressed
importance scores and those of the closest fitting mission or task. Kotha & Orne (1989) presented a typology which attempts to link conceptually business strategies and manufacturing strategies, using concepts first proposed by Porter (1980). Their model proposes eight generic manufacturing strategies based on high/low combinations of process structure complexity, product line complexity, and organizational structure.

Another manufacturing strategy typology addressing environmental fit is provided by (Ward et al. 1995a, Ward et al. 1995b, Kotha & Vadlamani 1995, Doty & Glick 1994, Doty et al. 1993, Mintzberg 1984, Arnold 1982). Their model attempts to describe commonly used paths to competitive advantage for manufacturers, and is notable for its deliberate integration of models and measurements from the business strategy and organization theory literature. Specifically, their configuration model describes manufacturing organizations across four areas namely competitive strategy, environment, structure and strategic manufacturing capabilities. Miles & Snow (1978), Dess & Beard (1984), the authors used the work of on organizational task environments to define the competitive strategy and environmental dimensions, and also the model of Miller on organizational structure to define the structural dimensions.

In the history of the garment industry, the focus has shifted from a production point of view to other phenomena such as workers availability, handicraft and readymade garments which are manufactured massively on different sizes with different prices. Moreover, they are exported to different countries and hence it is globalized with respect to market. Moreover, exports are made to different European countries and 90% of clothing which are distributed in Germany is imported from Asian production countries such as India, Pakistan and Bangladesh. Due to globalization, the prices are fixed at the international levels and standards.
In the case of raw material production, new cultures are introduced were cotton, polisters and silk are introduced. In the processing of raw materials to get clothes, different types of chemicals are used to provide colors and to perform smoothening of the fibres. Moreover, most of the readymade garments are low priced due to market competition. Most of the clothes are made manually and working hours are increased for laborers. Later on, automated systems have been introduced for garment manufacturing (BMZ 2014). Due to increase in labors new associations were formed by workers to take care of their welfare. However, whenever there is a collapse in market, laborers were affected seriously. Therefore, insurance and compensation methods are introduced recently.

Another issue is to reduce the environmental issues which will lead to social harm (Katz & Kahn 1978). Therefore, Corporate Social Responsibility (CSR) was introduced to address the environmental, social and economic challenges in the apparel manufacture industry. The literature review on apparel manufacturing shows that there are many publications which discuss about CSR. Moreover, many researchers investigated about CSR along with supply chain management in the apparel industry. Many reports investigated thoroughly on the financial aspects of business performance based on CSR.

The selection of the different approaches for laborer management reflects the various levels of understandings and possibilities of working with CSR. Hence, many researchers discussed about the role of CSR for sustainable development.

2.3 CONFIGURATION MANAGEMENT

Configuration management is an important activity in the manufacturing process. To understand the usefulness of configurations, it is
first necessary to review the concepts of strategic fit and equality. In the past, many researchers have proposed configuration management methodologies which are fit for manufacturing (Miller 1992, Lawrence & Lorsch 1967, Thompson 1967).

According to (Miller 1992, Stobugh & Telesio 1983), the concept of environmental fit “demands that organizations match their structures and processes to their external settings”, while internal fit centers on the development of organizational structures and processes that are “internal complementarities”. Both environmental and internal fit are seen as central to organizational effectiveness, yet they can conflict with one another, as when efforts to maintain environmental fit prevent or destroy internal complementarities, or when the emphasis on internal consistency detracts managers from changes outside the organization. The distinction between environmental fit and internal fit is shared, if not explicitly, by the manufacturing strategy literature, with works addressing environmental fit (Skinner 1969, Schroeder et al. 1986, Kotha & Orne 1989, Beckman et al. 1990, Miller & Roth 1994, Skinner 1974, Hill & Duke-Woolley 1983, Schmenner 1983, Schmenner 1990). All these strategies are helpful to perform configuration management effectively.

2.4 CONSUMER BEHAVIOUR WITH RESPECT TO APPAREL PURCHASE

Gupta (2004) explained the factors which are influencing the choice of labels in departmental stores for two product categories namely processed food items and toiletries. McKinney et al. (2004) made a study to examine the influence of some social factors on the apparel purchasing behaviour patterns with respect to college level customers in United States of America (USA) universities. Their work was surveyed with a group of people and found that there is no difference between different groups in USA with respect to
purchase of garments. Mohamadou et al. (2005) identified the sources of demand growth for apparels in the US market. This work was carried out on different customers with different profiles. Moreover, Memon (2006) performed a study for tracing the use of private level brands on retail garment business by considering two retail brands namely Westside and Pantaloons in Ahmedabad city. Based on this study, the author proved that people are ready to switch over to new brands whenever they are made available.

In another study on apparel purchase by Nam et al. (2007), it is proved that independent living residents of America were interested in buying apparels with new fashion. Moreover, Radha Krishna & Shylajan (2007) proposed a new model for customer behaviour with respect to their purchase patterns and found that the geographical locations influence the purchasing behaviour of branded garments. The authors identified other factors also for change in customer behaviour. Cowart & Goldsmith (2007) investigated the motivations required for online apparel shopping with respect to the purchase behaviour of customers. Lee et al. (2008) conducted surveys on the effect of global consumer variables.

Lahiri & Samanta (2010) identified the factors which influence the consumers purchase behaviour with respect to retail business of apparels. Krishna (2011) explained that Indian retail business is expanding continuously and becomes third bigger market after food and groceries market. They also discussed about the competition among different private manufacturers and their brands in apparel industry. They have concluded that private brands are liked by most people very recently. Kaushal (2013) examined the behaviour of teenagers with respect to fashion and apparel purchase. They found that teenagers were interested in buying variety of apparels in comparison with other works which are released by them. Sullivan
et al. (2012) explained the role of customers generation in the decision making process of apparel market.

2.5 WORKS ON SALES RECOMMENDATION SYSTEMS

Many works have been carried out by the various researchers on recommendation systems during the past decade. Among them, Gohary & Hanzae (2014) investigated the impact of consumer behaviors on online shopping and motivations. They conducted t-test to find the differences between male and female personalities. Their investigation is useful for managers to set a goal and choose suitable customer on products. Saim & Vijay (2014) explored whether family firms reveal unique purchase behavior and whether their unique behavior in turn helps them outperform non-family firms during periods of economic contraction in their study. Asem et al. (2008) introduced a method to design an improved and well-structured website design for an E-shop in the design phase with the help of Association Rule Mining. Moreover, they have a physical grocery store which has no website, but it has a dataset that records the transactions of its customers. Association Rule Mining techniques are applied on this dataset. The extracted interesting Association Rules from the transactions dataset of the grocery store are taken into account in the process of designing a website for the grocery store. The extracted Association Rules are invested to support the website design from the beginning (i.e. in the design phase). Many improvements and modifications are done to the website’s design, such as adding/modifying links, and/or creating index pages. They introduced a technique to evaluate our method by comparing the navigation efficiency among different website designs.

Surendren & Bhuvaneswari (2014) introduced a framework for Recommender System incorporating cognitive dissonance, a psychological factor. The recommender system is designed as a hybrid system which
combines both content and collaborative concepts using association rule mining concept a data mining technique. Hu & Li (2011) proposed a method which divides the customer acts data into browsing, evaluation, selection and purchasing four act data, and combines these data to the goods data, thus it can provides managers the results that more close to actual acts of the relevant rules. Karim et al. (2012) proposed a complete solution of predicting e-shopper’s purchase rules by using maximal frequent patterns and sequence close level. Their experimental results indicates their proposed approach can give more accurate measurement in discovering e-shoppers purchase rules and useful fore-marketers to make marketing decisions.

Somasundaram & Lakshmanan (2013) proposed a new intrusion detection system using the temporal association rules for effective classification. Ganapathy et al. (2014) proposed a new pattern classification system by combining Temporal features with Fuzzy Min–Max (TFMM) neural network based classifier for effective decision support in medical diagnosis. Intelligent fuzzy rules are extracted from the temporal features with Fuzzy Min–Max neural network based classifier, and then Particle Swarm Optimization (PSO) rule extractor is also used to minimize the number of features in the extracted rules. Choi et al. (2013) implemented a recommendation system, which are suitable for products showing repetitive purchase pattern and this system recommends three sets of products, by applying user-based Collaborative Filtering approach, item-based Collaborative Filtering approach, and by finding Associate Products that are frequently bought at the same time. Finds Associate Products for each user and analyze to consider baskets for each user, or consider baskets for similar user groups respectively. Deng & Wang (2009) presented a recommendation method which is based on rank correlated association rules in which this
method’s recommendation quality is measured by recall rate, and is better than that of the traditional strategy.

Item-based CF recommendation algorithm proposed by Karypis (2001) determine the similarities between the various items, and use them to identify the set of items to be recommended. One of the methods for computing the item-to-item similarity models the items as vectors in the user space and uses the cosine function to measure the similarity. Another method is to use a measure that is based on the conditional probability of purchasing one of the items given that the other items has already been purchased. Choi et al. (2013) implemented Recommendation algorithms for periodically repetitive purchasing shopping malls. Once a new purchase occurs, the recommendation system in (Choi et al. 2013) updated “purchase frequency” of the corresponding product by off-line, followed by re-calculating a “Favorite-Items Set” per user, and re-calculate “user similarity” based on the Favorite-Items Set. The Favorite-Items Set was defined as frequently purchased products per user. Whenever a user logged in, products in Favorite-Items Sets of other users who have similar purchase patterns were recommended using a user-based Collaborative Filtering method.

2.6 WORKS ON ASSOCIATION RULE MINING IN BUSINESS

Association Rule Mining is a data mining method which is used for uncovering the relations between data items (Ian H et al. 2009). For example, a typical application of association rule mining is the market-basket analysis, in which the buying behavior of the customer can be analyzed to find the associations among different items that customer place in his/her shopping baskets. These associations are often used by business application by the retail sales community in order to identify items that are frequently purchased together in a transaction or frequent in an itemsets.
Agrawal et al. (1993) proposed the first work on Association Rule Mining (ARM) which is an efficient algorithm for generating all significant association rules between data items available in the database. The significant contribution of their algorithm is that it incorporates not only buffer management techniques but also new estimation and pruning techniques. After the introduction of ARM the Apriori algorithm later on was extended by Agrawal & Srikanth (1994). So that it can find frequent itemsets which follow the closure property. Using the closure and the Apriori properties, this Apriori algorithm works mainly in two steps called joining and pruning. Therefore, the first pass of this algorithm counts the number of single item occurrences to find the frequent itemsets with one item. Each subsequent pass, k, consists of two phases where the frequent itemsets \( L_{k-1} \) are found in the (k-1) the pass and the same are used to generate the candidate itemsets \( C_k \), using the Apriori candidate generation algorithm. In the next step, the database is scanned to find the support of the candidates in \( C_k \) which ensures that \( C_k \) itemsets are frequent itemsets.

Agrawal & Srikanth (1994) explained the method of discovering association rules between items in large database of transactions on sales. They presented two new rule mining algorithms that are fundamentally different from the existing association rule mining algorithms. Another framework for discovering temporal patterns in sequential data is the mining of frequent episodes proposed by Mannila et al. (1994). In this framework, the data items are given in a single long sequence of events. Here, the task is to discover the frequent episodes in the sequence and is later used to generate episode rules. Agrawal & Srikanth (1995) introduced the techniques for mining generalized association rules. Given a large database of transactions, where each transaction consists of a set of items, and taxonomy on the items. Moreover, they found the associations between items at any level of the taxonomy. Savasere et al. (1995) presented an efficient algorithm for mining
association rules. Their algorithm not only reduces the I/O overhead significantly but also has lower Central Processing Unit (CPU) overhead for most cases. Park et al. (1995) examined the issue of mining association rules among items in a large database consisting of sales transactions.

Zaki (2000) proposed an efficient algorithm for the discovery of frequent itemsets which is the computation intensive phase of the task. This algorithm utilizes the structural properties of frequent itemsets to facilitate fast discovery. Lin et al. (2009) proposed a new algorithm that combines both the bottom-up and the top-down for the discovery of association rules. The primary search direction is still bottom-up, but a restricted search is also conducted in the top-down direction. Wang et al. (2003) proposed a new framework for frequent itemset mining in the presence of support constraints. Their approach pushes the support constraints into the Apriori item set generation so that the “best” minimum support is determined for each itemset at runtime to preserve the essence of Apriori. This strategy is called Adaptive Apriori.

Tung et al. (2003) extended the scope to include multi-dimensional, inter-transaction associations. In a database of stock price information, an example of such an association is “if (company) A’s stock goes up on day one, B’s stock will go down on day two but go up on day four”. Moreover, they introduced the notion of inter-transaction association rule and develop an efficient algorithm for mining inter-transaction associations, which adopts two major ideas namely an inter-transaction frequent item-set contains only the frequent item-sets of its corresponding intra-transaction counterpart; and a special data structure is built among intra-transaction frequent item-sets for efficient mining of inter-transaction frequent item-sets.

Moustakides & Verykios (2008) proposed a new algorithmic approach for sanitizing raw data from sensitive knowledge in the context of
mining of association rules. Their approach relies on the max-min criterion which is a method in decision theory for maximizing the minimum gain. Moreover, it builds upon the border theory of frequent item-sets. Ribeiro et al. (2008) proposed a new method based on association rule-mining to enhance the diagnosis of medical images. It not only combines low-level features which are automatically extracted from images but also the high-level knowledge from specialists to search for patterns. Tan et al. (2014) provide a comprehensive coverage of important data mining techniques including classification (Nowicki 2009), clustering (Ketchen & Shook 1996, Punj& Stewart 1983), and pattern mining. Lia & Chen (2009) suggested that, how to mine non-derivable frequent item-sets in an incremental fashion. They designed a compact data structure to efficiently maintain a dynamically selected set of item-sets. According to the authors, rare association rule is an association rule consisting of rare items. It is difficult to mine rare association rules with a single minimum support constraint because low minimum support can result in generating too many rules in which some of them can be uninteresting. However, that model still extracts un-interesting rules if the items frequencies in a dataset vary widely.

Weng & Chen (2010) proposed a new representation scheme for handling uncertain data. This representation schema is based on the possibility theory which establishes a close connection between the concepts of similarity and uncertainty and providing thus an excellent framework for handling uncertain data. Webb (2010) proposed effective tests for statistically sound discovery of self-sufficient item-sets. They also suggested some computational techniques that allow those tests to be applied as a post-processing step for any item-set discovery algorithm. Saquer & Jitender(2010) proposed a new approach for generating representative association rules which uses only a subset of the set of frequent item-sets called frequent closed item-sets. Mining frequent item-sets from transactional datasets is a
challenging problem having good algorithmic solutions. In the case of uncertain data, however, several new techniques were proposed in the past. Unfortunately, most of these proposals suffer when a lot of items occur with many different probabilities.

Ma et al. (2011) proposed a new method based on fuzzy logic to formulate association rules. It uses fuzzy logic to group members as strong or weak and thus provides much more flexibility than traditional methods to discover some potentially more interesting association rules. Since, association rule mining generates large quantities of rules, they need more memory. In order to find the genuine useful knowledge for decision making from the association rules Zhang et al. (2010) proposed an intelligent knowledge discovery model which is a new purpose-oriented approach based on a second order mining from association rules.

Aouad et al. (2010) proposed a new distributed Apriori-based frequent item-sets mining algorithm. They provide a new distributed approach which takes into account inherent characteristics of this algorithm. They explained the distribution aspect of the rule mining algorithm and made a comparison of the proposed approach with a classical Apriori-like distributed algorithm, based on both analytical and experimental studies. Abdullah et al. (2010) proposed a scalable trie-based algorithm for generating association rules. Their algorithm generates the significant patterns using interval support and determines its correlation. In their model, a set of association rules is called representative if it is a minimal set of rules from which all association rules can be generated. Most of the existing algorithms for generating representative association rules use the frequent item-sets as input. Therefore, most applications rely on finding the frequent items and the implementations are in use in large scale industrial systems. However, there has not been much comparison of the different methods under uniform experimental conditions.
Cormode & Hadjieleftheriou (2010) developed a comparison model for the most important algorithms in association rule mining.

Tremblay et al. (2010) proposed a new methodology for association rule mining by combining a number of Knowledge Discovery and Data Mining techniques. Their work used association rule mining, to discover patterns in related attribute values that help to characterize the bias patterns. Wang & Zhong (2011) proposed a new Apriori association rule algorithm to perform the analysis of college students’ performance. In their framework, the data were processed first and then the relations which affect the students’ performance were identified out and the association rules have been generated. This can be applied in guiding the studies and teaching. Ramasubba Reddy et al. (2011) proposed a new algorithm for mining indirect negative associations. Their method can discover all positive and negative indirect association between item-sets.

Abdullah et al. (2011) proposed a new metric called Weighted Support Association Rules (WSAR) metric to validate the significant association rules. According to these authors, indirect association is a new kind of infrequent pattern that provides a new way for interpreting the value of infrequent patterns. This method is useful to reduce the number of uninteresting infrequent patterns. The concept of identifying association is to find two “indirectly” connected items called co-occurred items using a frequent item-set called mediator. It appropriately utilized, it is useful to identify the real interesting infrequent item-pairs from databases. Indirect association rule is said to be positive or negative if mediator set contains presence or absence of items. Most of the existing indirect association mining methods mine positive mediator sets.

In this work, several different approaches to association rule mining are surveyed, starting from traditional approaches, followed by multi-level
and cross-level approaches. All those works focused on the proposal of different types of algorithms for Association Rule Mining. However, the focus of recent research is on applying them for business analysis and decision making. Therefore, suitable algorithms have been used in this research work to form association rules and to make effective decisions on manufacturing and sales.

2.7 RELATED WORK ON SALES ANALYSIS AND PREDICTION

There are many works on apparel selection and business intelligence which are available in the literature. Among them, Sekozawa et al. (2011) proposed an apparel online shopping system for fashion adviser through internet. Their system analyzes the customer’s choices on dresses using past data and suggests dresses suitable to the customers. Xinjuan et al. (2010) proposed an intelligent apparel selection model for providing personalized apparel recommendations on dresses using rules as well as the corresponding customer personal information which are used for reasoning effectively.

Surendren & Bhuvaneswari (2014) introduced a new Recommender System which combines content and collaborative concepts and forms association rules for decision making. Vinodhini & Chandrasekaran (2012) proposed a hybrid machine learning approach for classifying the customer’s opinion into positive or negative review. Kim et al. (2014) proposed a supervised learning approach based on Support Vector Machine (SVM) to classify products according to their attributes. Dalal & Zaveri (2014) provided a model using fuzzy functions for sentiment classification on user’s reviews.

A time series analysis consists of two steps namely the building of a model which represents a time series and then using the proposed model to
predict future values. If a time series analysis model provides a regular pattern, then the value of the series should be obtained by using a function of the previous known values. In time series prediction, many works focus on prediction using curve fitting. The most important curve fitting method available in statistics is least square method. In time series prediction, two components are very important. They are namely historical data and the algorithm used to perform prediction using temporal patterns.

According to Li & Biswas (2000), the time series data can be represented as either linear or nonlinear model. In such a scenario, the measurement of Temporal Sequence is usually performed by measuring the temporal characteristic of elements based on the similarity of the members of the temporal sequence.

Many works are available on prediction using time series and temporal data. Among them, Allen (1983) proposed a new algebra for binary intervals by representing qualitative temporal information and addressed the problem of temporal reasoning about such information and focused on prediction. An automated decision model called proof procedure method which is used for decision making by applying linear temporal prepositional logic was proposed by Cavalli & Fariñas del Cerro (1984). In another model called model theoretic approach, the author Lundberg has described a new temporal logic for temporal reasoning in which the author has regarded time points as being like all other entities in temporal databases.

Yin et al. (2010) proposed a new model for mining temporal patterns from time series databases using temporal association rules. Mörchen & Fradkin (2010) proposed a new temporal mining algorithm which considers the dependencies among temporal intervals and semi-temporal intervals to perform temporal reasoning. Using this algorithm, it is possible to predict the future data by applying temporal rules on past data and present data. Another
advantage of this algorithm is that, it not only works with complete data but also with incomplete information. Gharib et al (2010) proposed a temporal mining algorithm using association rule mining on temporal data. Their work was tested with temporal databases and found that it was suitable for prediction. Chen et al (2011) proposed a temporal mining algorithm using association rules for deriving new fuzzy temporal associations. This algorithm transforms each quantitative value into qualitative membership.

2.8 WORKS ON INTELLIGENT CLASSIFICATION TECHNIQUES


Hongle et al. (2009) proposed an improved form of Fuzzy Support Vector Machine (FSVM) which introduces new memberships to each data point. The authors reformulated the algorithm in such a way that different input points can make different contributions to the decision hyperplane. In order to verify the performance of this algorithm the authors applied it to intrusion detection applications. Zhou & Fang (2009) proposed a neuro-fuzzy classification algorithm in which the principal component analysis neural network has been used to reduce the input data space. Moreover, an enhanced fuzzy C-Means clustering algorithm has been applied by them to create and
extract fuzzy rules. Particularly, the adaptive neural fuzzy inference system has been utilized repeatedly in their model and the system was optimized by applying genetic algorithms. The main advantages of their work are the capability to classifying the patterns more accurately. Moreover, the proposed method has higher speed and better performance.

A novel neuro-fuzzy network for pattern classification problem has been proposed by Guo & Li (2011). Their classification model was used in calculating the initial weights from the training data. Though many classification techniques are available in the literature the classification accuracy of the existing classification techniques are not upto the expectation requirements. Hence, it is necessary to use new classification techniques which can increase the classification accuracy.

In the past, many works have been proposed and implemented for analysis using classification techniques. Among them Zhou et al. (2003) proposed the discovery of classification rules by using gene expression programming with linear representation. In their model, the antecedent of discovered rules can involve many different combinations of attributes. Hence, their approach is also noise tolerant and is able to deal with both numeric and nominal attributes.

A novel approach for classification based on applying a modern Meta heuristic Gene Expression Programming (Jaroslaw & Francizek 2009; Jaroslaw et al. 2010). They used genetic algorithms to reduce the search space effectively. Loh & Subramanian (2010) introduced fuzzy classification metrics for validating the performance of classification algorithms based on soft computing techniques. These metrics help to derive a level of assurance that supports management decisions and to enhance effective remediation efforts and thus serve as good design metrics. In their work, the decision
problem is transformed into classification problem, where the objective is to classify user based on their behavior.

Sarkar & Yegnanarayana (1998) proposed a new classifier by modifying the K-Nearest Neighbor (K-NN) algorithms. Moreover, the authors have tested their approach using real and benchmark datasets. Fuzzy rough sets are used by the authors along with rough set theory to handle the fuzziness and vagueness in data. In their model, fuzzy rough sets are largely used for handling approximation operators. In the past, many attempts have been made by many researchers on classification using fuzzy rough sets. Among them, Tsang & Kwong (2005) proposed a new approach for feature classification using fuzzy rough sets. Their work was able to handle uncertainty and classification effectively.

Nowicki (2009) presented a new approach to carry out fuzzy classification under uncertainty. They used the rough set theory with fuzzy logic in order to enhance the classification accuracy. They used the generalization ability of Artificial Neural Networks to provide an attractive automatic way of determining a near-optimal architecture. Many works are available in the literature on the use of neural networks for classification. For example, Islam et al. (2009) proposed a new classification algorithm which was used to determine neural network architectures mechanically. Moreover, their algorithm is useful since it finds the number of hidden layers in a neural network and also the number of neurons in each hidden layer. Such algorithms are more effective for decision making. The Fuzzy Rough Set is a very powerful method available to handle the discernibility and fuzziness features. Zhao et al. (2005) proposed a rule-based classifier using generalized form of Fuzzy Rough Set to perform effective classification. They have taken care of thresholding and noising during classification. Therefore, their
classification algorithm produced better classification accuracy. Han & Qiao (2010) projected a novel growing-and-pruning approach which optimizes the structure of fuzzy neural networks. This work uses radial basis function neurons for effective classification.

Iwata et al. (2011) proposed a new classification algorithm which provides a comparative analysis with other algorithms and hence is suitable for enhancing the classification accuracy. Gui & Qiao (2012) proposed a brand new learning algorithm for nonlinear modeling and classification by suggesting the use of radial basis function based neural networks. Their technique is useful to simplify the neural network learning by applying an adaptive computation algorithm.

2.9 WORKS ON ONLINE SHOPPING AND STYLE CLASSIFICATION

There are many works that have been done in this direction by various researchers in the past. Among them, Sekozawa et al. (2011) introduced an apparel online shopping application with a fashion adviser over the internet. The fashion adviser must have detailed knowledge about the fashions and coordinates the dresses of the customer’s choice. The fashion advisor may help to the customer whoever not having detailed knowledge of fashion. Those customers were not able to choose the best quality dresses through online shopping. They created a system that analyzes the customer’s choices over the dresses by new techniques and by forming a cluster by correlation of clothes, and analyzed the market basket. Finally, their system manages dresses suitable to the choice of each customer and it is also makes recommendations of other dresses based on past sales data, Xinjuan et al. (2010) proposed an intelligent apparel on-line recommendation platform for providing personalized apparel recommendation over online business. Here,
the apparel design knowledge model that includes both the apparel dressing rules as well as the corresponding customer personal information used for reasoning.

Bossard et al. (2012) introduced a complete channel for recognizing and classifying people’s clothing in natural scenes. It has several interesting applications, including e-commerce, event and activity recognition, online advertising, etc. The stages of the channel combine a number of state-of-the-art building blocks such as upper body detectors, various feature channels and visual attributes. The main aim of their method consists of a multi-class learner based on a Random Forest and SVM for that uses strong discriminative learners as decision nodes. Limaksornkul et al. (2014) introduced an Android application called smart cloth selection application. This application helps to the people for coordinating dress selection in their budget. This application introduces a statistical based recommendation engine that learns user’s favorite dressing styles based on the past activity of people and recommended the best dresses. Ngai et al. (2014) provides a comprehensive review of research articles related to the application of decision support and intelligent systems over dresses. Jakhar (2015) introduced a supply chain performance measures and also proposes a partner selection and a decision making model for flow allocation. This system helps to take decision by the decision makers, managers, and practitioners to achieve economic growth, societal development, and environmental protection. They illustrated the uses of their proposed model for partner selection and flow allocation decision making, real-time data from an apparel manufacturer are presented.

Apparel classification is an important part of classifying scenes in apparel recommendation systems, and it is also related to detecting and
describing persons in images. Specifically, in the past there has been little work on classifying clothing. Moreover, Wang & Ai (2011) also investigated segmentation of upper bodies, where the individuals occlude each other. Retrieving similar clothes given a query image was addressed by Liu et al. (2012) and Wang & Zhang (2011). In the latter work, the authors use attribute classifiers for re-ranking the search results. Song et al. (2011) predict people’s occupation incorporating information on their clothing. Information extracted from clothing has also been used successfully to improve face recognition results (Gallagher 2008). Very recently, detection and classification of apparel has gained some momentum in the computer vision community.

2.10 SUMMARY

The summary of this literature survey is that most of the techniques used for manufacturing management focus on the technical aspects such as length, width, finishing and cutting. On the other hand, the work proposed in this thesis identifies key success parameters for manufacturing using quality metrics. Therefore, this work is more suitable for maintaining quality in the manufacturing process. Second, most of the existing works on configuration management focused only on configuration items. However, the change management process is more important than the configuration items. In this thesis, new techniques are proposed for performing effective configuration management by introducing a step wise configuration management process.

Third, most of the existing works focus only on either manufacturing side or sales side. However, the manufacturer and the market are highly related and hence coordination between these two sides is an important criterion for success. This proposed work considers the quality parameters for both manufacturing side and marketing side. Fourth, most of the existing systems do not identify styles. However, identification and
classification of styles is an important management activity. Hence, this proposed work performs style classification using suitable classifiers. Fifth, feature selection is an important activity for providing the relevant attributes for classification. On the other hand, most of the existing systems do not focus on feature selection. However, the proposed work not only focuses on feature selection but also it focuses on feature reduction. Sixth, most of the existing systems depend on the sales executives for matching the demand and supply and to enhance the quality of manufacturing.

However, the proposed systems considers both manufacturer and buyer and forecasts the future demands and request the manufacturer to manufacture more garments during demand seasons. Finally, the proposed system provides a recommendation system which is capable of analyzing the user needs and firing suitable rules for advertizing the current scenario. This is helpful for selecting necessary items using automated tools. Hence, the proposed work is more robust and reliable.