CHAPTER 1

INTRODUCTION

1.1 SUPPLY CHAIN MANAGEMENT

In business transaction, there is a supplier and there are customers. The processes and operations that connect these suppliers and customers are named supply chains. Supply chains vary considerably in complexity and size but their basic principles can be used to all operations, regardless of the size of the company. Supply chain consists of a set of processes and activities that move the material by the supply chain from initial supplier to final customers. Therefore, supply chain includes the internal divisions of the company as well as external partners such as suppliers. The supplier for a certain company has his own suppliers. Supply chain is basically a network that links all these suppliers until the last customer. Another definition as "Supply chain is the network of organizations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services in the hands of the ultimate consumer" (Martin, 1992). Figure 1.1 illustrates well this supply chain network and its complexity.
The globalization has been more powerful. The companies now focus on their core function and outsource for the rest of the production. Thus, the supply chain has become more difficult and wider. It can pass thorough a lot of variety countries and cultures. It is dispersed around the world and is working in widely different conditions. One example is the supply chain of the Apple Inc. This company has several sources/suppliers, such as China, Taiwan, United States, Singapore and many others spread on different continents. The components are assembled in China and sent to the main Warehouse in Elk Grove, USA or to another intermediate before they are sent for final distribution. Due to the increase in size and complexity of the supply chains, companies have started to realize the necessity to have a broader view of the movement through all related organizations that constitute the supply chain and manage this chain as one integrated organization.

Although in the last fourdecades, the industry and academic community have increasingly used the term supply chain Management; there is still no consistent definition of this term. As a outcome, there is still a lack of consistency, which can generate discrepancy in understanding within the chain. Although many managers focus on supply chain analyses only through...
their own organizations, it is also important to manage the conjunction of all integrated supply chains, once companies are strongly connected and any impact on one organization brings consequences to the following organizations. Supply chain Management exists to overcome the lack of communications among different partners within a supply chain until the last costumer (Water, 2011). Supply chain management is the management of materials, information, and finances as they move from dissimilar variety to the manufacturer, wholesaler and/or retailer until they reach the final consumer. Supply chain management, then, is the energetic management and coordination of supply chain activities to increase customer worth and attain a competitive advantage. It describe a combined effort put in by the supply chain partners to develop and operate the supply chains in the most effective and efficient manner. Figure 2 describes the supply chain network and the complication in its design.

Figure 1.2 Strategic supply chain network (Samson, 2010)

Klemencic (2006) suggested on the basics significant of the coordination and integration of actions among variety partners in the supply
chain. This network coordination is a win-win connection and it can minimize the inventory level, maximize profit through developing customer service and by attaining lot of added profits. Consequently, supply chain management is concerned with the efficient integration of operations, suppliers, warehouses and stores, in order to create and issue the correct goods, at the correct time and location and for the correct price.

The basics, method and logic support systems are detailed to successfully run the supply chain. In supply chain, a set of methods are utilised to effectively combine suppliers, manufacturers, stores, and warehouses, therefore that merchandise shaped and issued are in the correct levels, to the correct places, and at the correct duration, in order to reduce the structure wise costs while agreeable service level needs. This definition gives direction to a number of remarks.

**Figure 1.3 Supply Chain Management**

Consideration of each facility shown as significant impact on money and acting a significant role in producing and issuing the good to the consumer from supplier and manufacturing facilities through warehouses and distribution centres to retailers and stores as shown in figure 1.3. Indeed, in some supply chain examination, it is need to account for the suppliers’
suppliers and the customers’ customers for the reason that they have an impact on supply chain performance.

1.2 SUPPLY CHAIN TRENDS

Supply chain is examining fastly and is no longer an afterthought for CEOs, investors and managers. In the previous four decades, several papers have been attempt, and several industries have maximized the concentration to supply chain and logistics. Managers are under constant stress to determine enhanced behaviors and develop the actions and processes. The internet and the intensification of usage of computers have made possible a revolution on every company’s activities. Advanced methods will maintain, as it has over the previous decades, drive adjust in supply chain management.

Waters (2011) outlined some of these trends mentioned below:

- Integration of supply chains- Managers stopped to divide the actions within the business and begin to implement combined measures.
- Cost Reduction.
- Agile Logistics- Activities should be flexible and act in response fastly to modifying constrains.
- E-business
- Globalization- The chains are becoming longer and are getting spread in diverse continents.
- Outsourcing- Industries concentration on their foundation activities. They influence on the supply chain shape and difficulty.
- Increasing of environmental concerns
• Concentration of ownership- With a few overall companies dominating the market.

• Postponement measures

1.3 METHODS TO MANAGE SUPPLY CHAIN

1. Developing more than one supply chain for attaining a goal. For instance, maintaining prepare extra machines to take care of any breakdown in the machineries. Setting up alternateways in transportation of material so that release time is met with few changes.

2. Receiving information continuously from machines, labourers, transportations characteristics which can maintaining the supply chain managers careful to choose any alternateresult in the event of uncomfortable incidents.

3. Subcontracts should be given by considering suppleness in the delivery process so that the existing supply chain can be managed.

4. Various risk managing methods to be implemented for the period of the time of supply chain improvement.

1.4 SUPPLY CHAIN NETWORK DESIGN

Network design problem used to finding the elements, numbers, positions and physical flow quantities which have a strategic significant for Supply Chain Network (SCN). The term of supply chain implies that there is only one player for every stage. Though in practice, it is possible for a manufacturer to supply material from variety industries and work with different distributors. For this reason, actually most of the supply chains are networks (Chopra & Meindl, 2004). A SCN is a complicated whole that contains suppliers, manufacturers, distribution centers, retailers and the
systems, sub systems, operations and activities that develop the supply chain and the relations between them (Shapiro, 2001). SCN is a continuous processes and levels, which begin with the material/informationsuppliers and finish with the customer (Tsiakis et al. 2001). Each middle stage is the consumer of the second stage and supplier of the previous stage. This means that the participants have variety roles in the network; however the basic connection is seen among suppliers and the customers (Wang, 2009). The SCN seems different from the various views of the industries, since each industry incase itself at the center and thinks about the structure and the participants of the network from the view of its own vision. However it is greatly significant for the industry managers to recognize the roles and the views of the remaining industries along the SCN, so each industry is the participant of the second SCN. The cause at the back is that the combination and the management of the job operations in an organization will be doing well when they are all significant from each organization’s view (Lambert & Cooper, 2000).

The SCN design is one of the largest logic decision based problems applied for well-organized extended processes in the whole SC, and therefore it required optimization. The design outlined the numbers, capacity, arrangement and classification of the industries, inventory and supply centres. Further it fix the distribution channels and calculates the quantity of materials which will be consumed in the production process, the quantity of materials which will be transported from suppliers to customers, and the quantity of materials which will be produced. The SC is divided into several stages to bear with the complexity of the designing and calculation problems. The number of the stages can be found due to the balance between the complexity and the integration of the problem.
Basically, the SC network design is realized at three stages. The first stage contains which give the supply chain operations which are competently adjusted. There are three significant reasons in the first stage: (1) emphasizing the suppliers which give direct input to this chain, (2) converting this combined design to a trending business application, and (3) taking activity through cause of processes logics which are being affected by the suppliers directly. Second stage implements the design by comparing supply and demand at each demand points. In the second stage, the input from suppliers is transformed into final product or service. The third stage of the SCN design includes operational functions which consists of optimal source and plans for all the network points in a minimum cost assignment problem.

1.5 SIGNIFICANCE OF SUPPLY CHAIN DISRUPTION

In order to attain victory in the trending world of production, companies, it is crucial to take on modern producing measures and technologies. The enterprises should be flexible as much as necessary to cater to the varying needs of the global market. At the current situation, it is uncomfortable and violate global markets; disruption has been measured as a basic point of a supply chain needed for today. To attain the competitive edge, industries should align with suppliers and consumers to pipeline processes, as well as agility beyond individual industries. With an increasing global competition, at the beginning of the 21st century, industries have evidence important improvement in the market, such as higher degree of marketplace explosive nature, shortened lifecycles, uncertain demand and unreliable supply. Mass markets are continuing to fragment as customers demands and outlook rise. These improvements have caused a foremost modification of business priorities and planned revelation. The need to respond to volatile environment has been addressed in previous years by the basics of supply chain disruption.
1.5.1 Role of Supply Chain Disruption

A supply chain disruption is an occurrence that takes place at one point in the chain and it can harmfully influence the performance of one or more elements positioned elsewhere in the supply chain and the usual flow of products and materials within the supply chain (Craighead et al. 2007). The supply chain risk is the expected exposure of a supply chain to the potential shock of disruptions which are usually characterized by the likelihood of a disruption and the impact of disruption if it occurs (Zsidisin et al. 2005). By considering a supply chain as a network, a disruption can occur in any node or link of the chain. The source of disruption may originate inside or outside the chain.

A disruption may impact numerous performance indicators in a supply chain. The performance of a supply chain is commonly characterized in terms of customer service level, financial aspects or a combination of both (Beamon 1999). The impact of disruption, however, is not at all times immediate. It occasionally takes time for the irregularity to represent its complete impact on the system performance. Besides, the disruption may have a long-term impact on the company. For instance, if customer relationship or company reputation is damaged, the impact of disruption can be long-lasting and difficult to recover (Sheffi 2005).

Handling disruptions in supply chains can take variety forms and include variety classification of actions. From a time view, all these actions can be classified into two types: Pre-Disruption vs. Post-Disruption. The two distinctive views on handling disruptions are also called prevention vs. Response. Another classification used for similar purpose is Proactive (predictive) vs. Reactive (Dani & Deep 2010). In this classification, proactive
risk management refers to taking precautionary measures to tackle the risk of disruptive events while reactive refers to reacting once the event materializes.

Even though varietytypes, controlling supply chain disruptions should be supported through methodical tools to:

(i) find the potential disruptions and recognize/invest in the resources necessary to control them in advance and

(ii) apply the existing resources to control disruptions when it occurs.

The previous is largely accepted as Supply chain risk management (Finch 2004) or Supply chain risk analysis (Sinha et al 2004) which first deal with pre-disruption such as identification, assessment and mitigation of potential disruptions. The second is commonly named supply chain disruption management (Blackhurst et al 2005) and focuses on the necessary support in handling an actual disruption after it has materialized.

1.5.2 Supply Chain Conflicts

Conflict is defined as the behaviours of interdependent parties in response to potential or actual obstructions that impede one or more of the parties achieving their goals (Gaski 1984). Conflict occurs in situations where two or more interdependent parties (either individuals or groups) have interests, outcomes, and/or goals that are incompatible in some manner. Conflict can occur both in cooperative and competitive contexts, as well as in mixed motive contexts that are marked by a combination of competitive and cooperative features.
While collaboration can result in significant mutual benefits, many collaborative efforts often produce less than desired outcomes. Many of these short comings surface from conflicts inherent in supply chains. Corbett (2001) stated that different parties in the supply chain can have conflicts stemming from the fact that each party is working towards differing objectives that are often in conflict across the supply chain. In different domain contexts, conflicts may arise in distributed operations. For instance, Kim et al (2010) presented hospital bed reservations applying a simulation model that control conflict among surgeons and intensive care unit physicians. Chung et al (2004) describes supply chain conflicts linked to worldwide sourcing and developed a business model background on a combined network to enhance the performance.

1.5.2.1 Impact of Conflicts in Supply Chains

More newly, supply chain conflicts have gathered gradually improved concentration from supply chain managers by the potentially detrimental impact they can have on the performance of supply chains. A single disruption reasoned through a conflict can halt the flow of material in supply chain by shocking not only on the tier of the supply chain where the disruption produces but also all the way to the end customer. Hendricks & Singhal (2005) showed that the impact of these disruptions which can affect shareholders wealth (to drop off wealth by 10% in the small term and 40% over the extended term) and supply chain operational performance (disruptions in publicly traded firms, on average, associated with a 107% drop in operating income, a 114% drop in return on sales and a 93% drop in return on assets).

Studies focusing on transportation delays and port stoppages (Christopher & Lee 2004), accidents and natural disasters, poor communication, parts shortage, and quality issues, operational issues (Chopra
& Sodhi 2004) and terrorism (Sheffi 2001) have documented the impacts of conflicts on supply chains in nearly every industry and market segment. Several researches, including (Fawcett et al 1996), and Swafford et al (2006) found that businesses characterized through more flexibility are more capable of responding to unexpected events such as disruption in a more doing well manner compared to their non-flexible counterparts.

The study of risk, interdependence and the associated impact of conflicts strive to minimize the businesses risk of disruption. Managerial efforts to combat the effects of disruption are nearly as plentiful, but a few are researched beyond their day-to-day applications. Although the number of studies into supply chain conflicts is growing, there is still a limited amount of progression towards scientific theory-building, as well as very limited researches on descriptive/prescriptive in order for managers (Craighead et al 2006).

1.5.2.2 **Necessity of Conflict Detection and Analysis**

Conflicts in supply chain structure put a business’s supply chain at risk and by this means, gradually improve its rank of weakness. These conflicts can disrupt the operation of a supply chain and affect customer metrics such as on time delivery and quality. Due to their potential for conflict in supply chains, practitioners have spent important effort and cost to apply governing mechanisms such as expediting orders, frequent checking of order status and buffer inventories. Forever, blanket safety strategies can reason increased inventories all the way through the supply chain directing to obsolescence and increased costs. For that reason, a approaches to determine and examine conflicts in a supply chain previous to they happen would be of advantage to practitioners. Though, this is a complexity task because the size,
difficulty, distributed nature and shortage of inputs and aim distribution in supply chains.

1.6 MEASURE OF PERFORMANCES

Supply chain disruptions are commonly examined by total quantities that involve information about every machines, resulting in congestion performance measures.

Cost minimization: It is reduced in manufacturing environment as given by equation.

\[
\text{Manufacturing cost is } \alpha = \frac{1}{1 + \text{Machine idle time}} + \frac{1}{1 + \text{Over time}} \quad (1.1)
\]

\[
\text{Machine idle time} = \begin{cases} 
0 & \text{cost is minimum} \\
> 0 & \text{cost increases}
\end{cases} 
\quad (1.2)
\]

\[
\text{Overtime} = \begin{cases} 
0 & \text{cost is minimum} \\
> 0 & \text{cost increases}
\end{cases} 
\quad (1.3)
\]

\[
\text{Machine working condition} = \begin{cases} 
0 & \text{not working} \\
1 & \text{working}
\end{cases} 
\quad (1.4)
\]

\[
\text{Machine working on daily basis} = \begin{cases} 
\leq 0.5 & \text{not suitable, for manufacturing, maintenance is required} \\
> 0.5 & \text{performance of machine is not good} \\
1 & \text{machine is in good working}
\end{cases}
\quad (1.5)
\]

\[
\text{Amount of material available on daily basis} = \begin{cases} 
< 1 & \text{insufficient material} \\
1 & \text{sufficient material}
\end{cases}
\quad (1.6)
\]
Minimize the transportation cost

\[
\text{Minimum } Z = \sum_{i=1}^{n} \sum_{j=1}^{m} t_i (1/d_j) \quad (1.8)
\]

1.7 THE OBJECTIVES OF THIS RESEARCH

The current research is focused on supply chain disruption problems present in supply chain network with combined objective functions by applying neural network tools. The software codes have been developed by using ‘Matlab® 2015’ language. The research work carried out encompasses the following objectives are minimizing the manufacturing cost, predicting supply chain disruption and reducing in time for delivery of finished products to the customers, reducing the cost of the product, transportation cost and increasing the profit. The research scheme is depicted in Figure 1.4.

1.8 ORGANIZATION OF THE THESIS

The thesis is structured as follows:

Chapter 1 presents the supply chain network applied in general, trends, significance of supply chain disruption, conflicts, manage, performance measures and objectives of the supply chain. It also addresses the research scheme of this thesis.
Chapter 2 describes the Literature Review. From the details of previous literature review, the research gaps are identified. It is followed by outlining the required for research in supply chain disruption problems.

Chapter 3 presents the proposed methodology and describes the details of fuzzy algorithms used in solving supply chain disruption problems with different environments. It also deals with Fuzzy Inference System with neural network algorithms are used in this research.

Chapter 4 addresses the fuzzy formulation as well as result and discussion of supply chain disruption problem from real fastener industry data. The results obtained by the fuzzy algorithms are compared.

Chapter 5 addresses the fuzzy formulation as well as result and discussion of supply chain disruption problem from automobile industry data. It describes the real-life case study problem in automobile industry. The results obtained through the fuzzy algorithms are compared.

Chapter 6 provides fuzzy formulation as well as results and discussions of the supply chain disruption problem from paper industry, in the real case study problems. The supply chain disruption problem has been solved and compared with Fuzzy interference system based neuro fuzzy algorithms.

Chapter 7 provides facility location formulation of the supply chain network in the hypothetical problem. The facility location problem has been solved and compared by fuzzy algorithms.

Chapter 8 is the conclusion of the research. It contains the outcome of this Research, limitations of this Research Work and future research scope.
Design and development of neuro-fuzzy system and its application to supply chain management

- Literature Review
- Identify the Research Gap
- Need for this research

Proposed Fuzzy Inference System – BPA, RBF, ESNN and CMAC Algorithms

- Real case study problem
  - Fastners Industry
  - Automobile Industry
  - Paper Industry
- Hypothetical Problem
  - Randomly generated Data

Minimize supply chain disruption
Minimize the transportation cost

Result and Discussion

Conclusion and Future Scope

**Figure 1.4  Research scheme**