Chapter 3

Research Questions, Aims, Scopes and Objectives of the Research Work

In the last section of the Chapter 2, it is noticed during gap analysis that some of the issues in their past work are overlooked/not addressed by the earlier researchers. Literature review also indicated that due course of time; supply chain dynamics has become more complex. Under this perspective, the rule of thumb is that the complexity of the organization has to match with the complexity of the environments to increase the possibilities of survival. This philosophy reminds the Ashby’s Law of “Only variety can absorb variety”. Those limitations of the past work and the urge to develop state-of-the-art, act as stimulation to the author to take up the research work in that direction further to minimize those gaps. These limitations/gaps provide the base under which this research work is set to enquire about some specific research questions to formulate the problems discussion as seen in the upcoming section 3.1. At the onset of the research work, it is also paramount to state the aims, scopes and objectives of impending research work unequivocally to the academic fraternity (section 3.2 to 3.4).

3.1 Research Questions

Extensive literature survey focused on strategic warehousing decisions under supply chain perspective. Physical distribution network design and warehouse management are extensively studied in the literature where warehousing decisions are highlighted as a part of the distribution network design (Chopra and Meindl, 2001). The focus in literature has been on the competitive business scenario, customer needs and product characteristics as a basis for supply chain design (Fisher, 1997; Christopher, 2005). The literature survey also covered the strategic fit of supply chain strategy with the competitive strategy as well as the importance of alignment between different strategies.
and decisions levels. It is recognized that supply strategies at operational levels should correspond to the decisions made at higher levels (Nollet et al., 2005). Distribution and warehousing concept have got sufficient attention by the academic and practitioners’ community stressing their importance in achieving operational excellence. However, warehousing decisions are seldom made considering holistic supply chain perspective (Baker, 2004). The concept of warehousing theory and SCM has not been fully integrated into warehouse network design. Even information regarding at which level warehousing decisions are made are limited. Today’s warehousing decision promotes a complete supply chain solution. Hence in this regard, it attracts the academic fraternity to study the importance of warehousing decisions in a supply chain design. Consequently, the thesis aims at developing a decision support framework for warehousing decisions under supply chain perspective.

Firms used to design their warehouse strategy to minimize costs and taking advantages of economies of scale (Melachrinoudis and Min, 2007). Decisions and design of nodes and links in a warehousing network is a long term one and would impact a company for a considerable time. Therefore managements need to consider both strategic and operational needs for the warehouse network design in a supply chain (Christopher and Towill, 2002). Warehousing design can affect product availability. Adequate and best practices, right technologies and material handling equipments help the firms to serve the customer properly. Supply chain coordination through effective integration among its linkages especially through appropriate warehouse design could effectively be enhanced, leads to improvement in firm’s overall performance. To sustain and augment supply chain performance, managers need a decision support framework tailor made to the specific company (Fisher, 1997). To develop a decision support framework (DSF), it is essential to go through past literatures. The literature survey focused on relevant research work on available decision support systems for warehousing strategies in a supply chain. To address the gaps found in the literature and illuminate what will be done in the thesis, few research questions were developed. In order to establish the research problem it is necessary to ask the familiar ‘who’, ‘what’, ‘where’, ‘how’ and ‘why’ questions (Yin 2003). Research question makes a research more precise and accurate; it serves as a guide for the researchers towards the right direction (Bryman, 2012).
The research questions for this thesis is presented as,

- What are the justifications of taking this research initiative?
- Why to develop warehousing decision support framework in a supply chain?
- Where to specifically limit the domain of this present research work?
- What is state-of-the-art for this domain?
- How to develop appropriate warehousing decisions support frameworks in a supply chain?

The above mentioned research questions investigate the decision process so that an appropriate warehousing decision support framework may be determined. The theoretical framework and the research questions developed are built on the limitations found during literature survey. Consequentially, those above mentioned problem statements are clearly and justifiably stated in the upcoming sections of aims, scopes and objectives of the research work. All these research questions altogether help the researcher to remain focus on the fulfillment of the research questions.

3.2 Aims of the present Research Work

In the history of mankind, civilizations are built primarily on the foundation of fulfilling basic needs. To achieve that target within the competitive environment, many wars have been fought among its inhabitant. The results heavily depended upon the capacity of warriors group to continue the timely supply according to their demand. Many war veterans candidly agreed the same. The battle of Panipat (1526) and Pallasey (1757) where the winner won due to their competitive advantages and the loser lost as they were unable to meet the supply-demand chain. The same philosophy rightly got its recognition in the shape of supply chain management (SCM) in the modern business environment. Supply chain philosophy basically thrives to achieve industrial excellence by coordinating and synchronizing the smooth flow of materials and information. Industrial excellence in terms of competitive advantages might be the reduction in manufacturing cost with higher value addition, increased product quality, quicker delivery, reliable and prompt service to the consumers. These competitive advantages result in greater customer satisfaction,
earning higher revenues and in turn more profitability and higher productivity. These competitive edges can only be achieved by properly aligning the competitive strategy of the organization with its own supply chain core strategy.

Competitive strategy basically depends upon the company’s policies towards its customer’s priorities in terms of the product cost, product delivery, quality and its availability. Supply chain strategy primarily looks after the procurement of raw materials, manufacturing of the products, distributions and delivery to the customers with the promise of prompt service. Decisions regarding inventory, transportation, facilities and enabling information technologies inside an organization comes under supply chain strategies. The fundamental goal of any supply chain manager is to align those two strategies to achieve strategic fit so as to get competitive advantages and enhance overall supply chain performance capabilities. Supply chain facility design decision has a large impact on the overall design of the network as it affects the other major drivers e.g. inventory, transportation and information. The location of the facility would make the supply chain strategy either responsive or efficient one. The design of a supply chain network has a strong impact on the overall profitability and success of an organization. To achieve optimized supply chain network, facilities such as manufacturing plants, ware housings, wholesale distribution centers (DCs) and local retail outlets should be strategically located (Coyle et al., 2003; Simchi-Levi et al., 2003). Appropriate warehouse location assists the management to respond quickly to the demand of the end users. It reduces the supply chain risk and uncertainty, lowers the prices of a better product and improves the customer service. All these strengths and weakness indicate the strategic significance of warehouse location selection that deserve the attention and interest of the academic fraternity.

Appropriate decision support system (DSS) can sustain and augment those advantages in a real industrial environment. DSS is a manager- computer interactive information system which is capable of making accurate and effective warehouse design decisions within or outside the organization in a given situation. Supply chain managers nowadays are always in search of an effective warehouse decision making aid to survive in a highly competitive and volatile business scenario. The aim of the research work is set to position the warehouses in such locations within a supply chain in line with the
competitive strategy of the organization. The decisions on the nature, capacity, and role of the warehouses have a large impact on the performance of the company. Warehouse design has a significant role to make the operations quickly, effectively and accurately. Application of the right decision support frameworks help to achieve that. Right warehouse design decisions are instrumental to ensure the following achievements.

**1. To thrive for greater customer satisfaction**

Customers delight is the ultimate goal of any organization. This research work aims to exceed the customers delight by providing them the exact valued items of their specific requirement at the right time by suitably positioning the warehouse(s) in a supply chain. Apart from picking and shipping point, warehouse used to provide service by pre-sorting, pre-labeling, packaging and in actual customization of outbound product to increase customer satisfaction level.

**2. To obtain competitive advantages**

The research work aims to assist business organizations to achieve competitive edge over their rivals in the market. The desired competitive advantages can be obtained through suitable positioning and designing the warehouses to serve the customer base in a better way. Adhering appropriate decision support aids by the supply chain managers could help in achieving the target.

**3. To accelerate acquiring global leadership**

Better warehousing solution as a core competencies of the organization result in competitive advantages in relation to its immediate competitors available in the said domain. True competitive edges of the national level organization with world class warehousing infrastructure have the potential to compete with the global leaders and sustain it.

**4. To increase reputation of the organization**

A recognized global leader in warehousing domain is poised to increase the reputation of the organization and their brand name would be respected and benchmarked by others.
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5. To improve productivity

Effective utilization of storage space, human resources and material handling equipments within a warehouse help in increased productivity of the overall supply chain. Productivity is one of the major indicators of overall health of the organization.

6. To increase Profitability

Strategic location of warehouses within a supply chain is designed for maximized value generation to each product or service. Value of a product may be defined as the worthiness of its intended function to the ultimate customers. These values are some specific features inbuilt into the product and can be tipped as real prime mover by which the customers are attracted towards the same product and hence the revenue earning. Higher the values of the product, more the revenue and hence increase in profit of a supply chain.

7. Capacity Planning/Utilization

The research work also aims for proper planning and utilization of its available resources to its rated capacity. An appropriate evaluation, selection and implementation of various warehousing decisions may significantly increase the capacity utilization of its resources of an organization.

8. To Improve Working Environment

The research work aims to improve the working environment of the warehouse operations with seamless flow of material and information to achieve coordination and synchronization within /outside a chain to ensure the safety to the workers, material and equipment, and foolproof operation. It may reduce employee turnover, employee training and replacement.

9. To reduce green house effect

The research work also contributes significantly by strictly adhering to the environmental norms and regulations. Warehousing decision support frameworks must consider some evaluation criteria that directly have the positive effect on the environment
and climate of the surroundings. “Grow being Green” would be one of the fundamental theme of this research work.

3.3 Scope of the present Study

One of the important needs of human beings is to move physical finished products from place of manufacturing to place of consumption at right quantity and quality at the right time. This necessity of supply-demand fulfillment is being achieved by proper alignment of facility design in a supply chain. Traditionally, a warehouse within a supply chain plays three different roles of storage, consolidation and postponement of inventory. The relative significance of warehousing roles to the complete network may vary from one warehouse to another due to specific competitive strategy shifts in the firm’s business environments. Due to the dynamic changing scenario in supplier and customer segments, government legislation, distribution center networks, economy of scales, corporate mergers/acquisition, warehouse design decisions are made accordingly. Centralization of warehouses would fit for proficient supply chain whereas an agile supply chain would require more number of decentralized warehouses to satisfy customer needs. The warehouse strategic decisions mainly depend upon the role/profile of the concerned firm’s business strategy.

Facilities within a supply chain scrupulously manage demand and supply within and across companies. It started from generation of demand, acquisition of raw materials/parts/components, inventory operations, manufacturing of semi-finished/finished products, accumulate in a warehouse, and ultimately deliver it to the customers via various downstream linkages. With the advent of liberalization, privatization and globalization (LPG), business and commodities are global, product produced in one country is assembled and packed in other and consumed by another country. Warehouses as facility providers are the backbone of today’s global supply chain. Due to the entry of global retailers and big industry leaders, the importance of the warehousing industry has got a big boost.

Warehouses are positioned strategically within a global supply chain that involved critically in day to day life starting from mobile phones and lap top of electronic industry
to daily household agricultural retail product. Warehouses are required in chemical industry, steel industry, railway industry, telecom industry and petrochemical industry etc. Effective warehousing is vital in e-commerce industry to manufacturing plant to courier companies. A mind set up is required to improve efficiency and effectiveness of real life warehouse operations towards fulfilling the aims of the organization.

Warehousing decision support systems to the supply chain managers permits them in consistent decision making. Barriers to effective decision making can be reduced a lot by DSS. Even beyond the reach of human capacity, intelligent DSS can analyze the primary data and offer recommendations for relatively accurate decisions. Warehousing decision support framework (DSF) acts as an aid to the supply chain managers and helps them to achieve the overall success of the organization. The scope of the current research work is involved in all the upstream, midstream and downstream of a chain of any organization and can be extended to any of the below mentioned sectors to its logical conclusion.

**Automotive**: The automobile industry in India has attracted much attention due to the sharp increase in the sales of automobiles in the country. The concentration of the auto manufacturing activity in a certain places has led the auto manufacturers to design warehouses in strategic locations, which serves as distribution and collection centers of finished and semi-finished products including auto parts. The government has also established Special Economic Zones (SEZs) especially for auto manufacturers, contributed to the growth of the warehousing sector. SEZs are usually close to the ports, to cater to the growing demand in the automobile sector. Manufacturing is the major sector of industry where managers make strategic, tactical and operational level decisions for the selection of facility locations. Therefore manufacturing industry certainly is one of the most important areas of application for the present research work.

**Agriculture**: Inefficient agriculture supply chain in India suffers heavy losses of grains throughout the country due to improper storage and poor transportation facilities. It is estimated that about 20% of the food grains are wasted annually due to poor warehousing. The huge gap between the demand and supply of logistics services, which
was left unattended due to the un-organized nature of the market and poor handling by the Govt. agencies, has opened up many opportunities for organized sector. Nowadays, the business leaders apply appropriate warehousing decision making aid in agriculture/agro-based industry for the evaluation and selection of site location, modern seeds, fertilizers and appropriate material handling equipment for increasing the productivity of the agriculture sector. Therefore agro-based industry may be one of the most imperative areas of application for the present research work.

**Retailing sector:** As per report published in the survey of US consulting group AT Kearney in June 2010, India, the third ranker in retail market among the 30 largest emerging retail markets. Huge industrial and IT investments in south India push the demand for modern warehouse space. To ensure continuous supply of a wide range of products in required quantities across a widely spread operational network, warehouses need to be suitably positioned. This translates to a high level of control on logistics. The change in food habits and consumption patterns along with fast-changing demographics is noticed all over India. For perishable food products, temperature-sensitive warehousing and transport services arises. Decision support aids are largely utilized in retail sector industry for the evaluation and selection of distributor centers, building site selection, customer service satisfaction level etc.

**Pharmaceutical:** Lowering operation costs and increasing supply chain efficiency is the challenge to most pharmaceutical companies for its sustained growth. They require extremely reliable and secure storage spaces as they are temperature-sensitive and require an environment where temperature range can be pre-defined to accommodate the special requirements of the vehicle. Decision support aids are largely utilized in pharmaceutical sector for the evaluation and selection of cold chain warehouses and required transportation facilities. Decision support frameworks (DSFs) of the research works find its major application in

- Processing industry and
- Chemical/petro-chemical Industry.

Apart from all the above mentioned sectors, the research work also finds its applications in other important sectors. The sectors are:

- Power Plant (Thermal, hydro and nuclear plant);
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- Aircraft and space industry;
- Transportation (rail, automobiles, and logistics);
- Machine Tool manufacturing industry;
- Manufacturing unit of automobile industry;
- Building and construction Project (large scale construction and house-building);
- Information and telecommunications technology (consumer electronics, telecommunications).

The present research work is not primarily intended to be an exhaustive analysis of each of these sectors but tries to highlight the vast domain of warehousing decisions from a supply chain perspective and its potential applications. Focus is put on identifying important warehouse evaluation criteria, its weight determination technique and variables associated with warehousing strategy while developing a decision support framework. Layout, allocation and individual distribution centre operations such as receiving, put away, storage, order picking and shipping will not be explained thoroughly since the scope of the thesis is warehouse network strategy. This current research work intends to carry out few real case studies in chemical industry, retail sector, manufacturing industry, automobile sector and processing industry in Eastern Indian companies.

3.4 Objectives of the present Research Work

Extensive past literature review highlights various classical as well as fuzzy multi criteria decision making approaches and its application on warehouse performance evaluation under supply chain perspective. Most of the time, conventional decision support systems lack broad-viewed programmed structures for ill structured warehouse performance evaluation. Classical approaches have the limitations to solve real life complex warehouse problems and frequently led to make confusing and complex rather than alleviating and solving problems. The techniques adopted by most of the above mentioned previous researchers are complex, time consuming and have some limitations. These limitations encourage us to propose some novel, simplified, effective and largely stable MCDM algorithm to solve strategic warehouse location problems in different
linkages of a supply chain. Considering both the aforementioned points and the predestined aims of the work in view, a set of research objectives are designed to assist and guide decision makers in making appropriate decision making framework in solving warehouse decision problems under supply chain perspectives. The objectives of the research work are:

1. To provide a **scientific basis as a decision support framework** to the supply chain managers of an organization for solving problems involving warehouse performance evaluation, ranking and selection.
2. To evaluate performance of various warehouse alternatives for industrial purpose.
3. To propose an appropriate weight measuring technique for the decision support system framework.
4. To identify important relevant criteria for performance evaluation of respective decision alternatives and to quantify their relative importance weights.
5. To construct a novel, precise and accurate MCDM technique equipped with a modified weight concept in order to mitigate rank reversal phenomenon.
6. To develop robust FMCDM techniques for warehouse performance evaluation under subjective and objective environments in a supply chain.
7. To establish interactive experts based homogeneous/heterogeneous MCDM techniques capable of assessing realistic weight measurement for improved decision support framework.
8. To carry out real case studies on warehouse performance evaluation to revalidate the proposed decision support frameworks in rapidly changing industrial scenarios.

Graphical visualization of the objectives of the research work is shown through Fig. 3.1(Developmental explanation provided in Appendix A).
As the objectives of the research work is spelled out clearly, it is obvious to describe the actual research work undertaken to the upcoming chapters. In line with the aims, scopes and objectives of the research work, it is worthwhile to mention some innovative work carried out in developing unique decision support frameworks for warehouse performance evaluation in a supply chain. The proposed four novel decision making approaches individually have a principal role as the heart of the decision support framework. The decision support frameworks in actual research undertaken used to answer
the research questions and to discover the context within which warehousing decisions are made in a supply chain. These decision support frameworks and their illustrations, result analysis, validations and revalidations are described in detail in the upcoming Chapter 4 to Chapter 8.