“AN IN-DEPTH INVESTIGATION ON LOGISTICS PRACTICES FOR FLUID MILK AND MILK PRODUCTS IN CO-OPERATIVE DAIRIES IN GUJARAT”

A Thesis

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Preface

Logistics is one of the most important aspects of fluid milk and milk products in co-operative dairies in Gujarat. The increasingly levels of product variety and customization, the ability to respond to customer orders in a timely fashion can provide a critical competitive advantage, which requires the flexibility in logistics system for fluid milk and milk products. The milk procurement in Gujarat is one of the highest among states in India. The per capita milk availability is also higher than the most other states in India. The co-operative dairies in organised market are on a high growth level in Gujarat and captures higher share in total milk production and varieties of other dairy products.

The vast and complex supply chain of co-operative dairies in Gujarat stretches from small suppliers to large fragmented markets. Given the large number of organizations and entities in the supply chain and decentralized responsibility for various activities, effective coordination is critical for efficiency and cost control. A hierarchical network of cooperatives increases the complexities to match supply and demand through logistics system. The sustained growth for the long term depends on matching supply and demand, which requires heavy investment in the logistics infrastructure at supply and distribution levels. The constraints in terms of lack of cold chain network in supply and distribution phases results in low supply of milk due to sourage and loss during transport and lack of efficient distribution of varieties of fluid milk and milk products in different regions of Gujarat. The distribution of varieties of fluid milk and milk products become more difficult because the different product requires different temperature to be preserved for a long time. Again, the customers demand the same product with different pack size and characteristics.

Chapter 1 of Introduction describes the evolution of logistics concept, its importance in food products and vital issues in it. In chapter 2 of Scenario of Co-operative Dairies in Gujarat, the detailed discussion of growth of Gujarat economy, the development of dairy
sector with special focus on co-operative dairies and various issues in logistics management of various fluid milk and milk products have been done.

The most important features of fluid milk and milk products are variety, perishability and customization, high inventory cost and strict traceability requirement. The ability to procure milk from various primary co-operative societies and varieties of materials from other suppliers and take them to district dairy co-operatives, processing of various fluid milk and milk products and distribute them in customized manner, demand flexibility in logistics system throughout supply chain. The significant growth of economy of Gujarat and the flourishing development of co-operative network of fluid milk and milk products demand perfect synchronization of supply of various fluid milk and milk products with market opportunities. This issue is equally vital and critical for all manufacturers (co-operative dairies) and marketer (GCMMF) of fluid milk and milk products irrespective of their scale of productions and operations. The usage of third party logistics service providers can help co-operative dairies to achieve substantial results, both in terms of customer satisfaction and logistics cost reduction as a major source of competitive advantages. Therefore, it is also important to study the benefits of using third party logistics service providers that significantly affect the logistics flexibility of co-operative dairies in Gujarat. Use of information technology can create business value by linking firms together in logistics networks, as separate business enterprises are connected through a shared information and communication system aiming to achieve superior co-ordination and efficiency in their logistics operations. So, it becomes imperative to study the important features of information technology that significantly affect the logistics flexibility of co-operative dairies in Gujarat.

In chapter 3 of Literature Review, the detail discussion of concept of logistics flexibility, its various components, and the various issues in managing third party logistics service providers and information technology in logistics system has been included.

Chapter 4 of Research Methodology includes the rationale of the study and research design followed for primary research. This study used a descriptive research design to determine the relationships among various components of logistics flexibility and
interrelationships among them. It also intends to study the impact of use of information technology and third party logistics service providers on maintaining logistics flexibility. The data was collected from managers of different departments at various supply chain levels of co-operative dairies in Gujarat like procurement and purchasing, processing and marketing and distribution.

In Chapter 5 of Data Analysis and Discussion, the data analysis includes the descriptive statistics, reliability statistics and multiple regression analysis. The Cronbach Alpha was used to check the reliability of the various dimensions included in the research questionnaire and in all cases, the reliabilities were found satisfactory. Multiple regression analysis was used to explore the relationships among various dimensions. The data analysis confirmed that flexible logistics competence supports the flexible logistics capability, which ultimately enhances customer satisfaction for fluid milk and milk products in co-operative dairies in Gujarat. The results of regression analysis have shown that the logistics information system capabilities can greatly enhance overall flexibility of logistics operation and planning competence. The results have also shown that use of third party logistics service provider in logistics system can significantly improve logistics flexibility. The major findings of this study have been described in detail in Chapter 6 of Major Findings and Recommendations.

Chapter 7 brings the conclusion and implications of this study. This research helps managers of co-operative dairies in Gujarat to understand that the co-operative dairies can achieve customer satisfaction by developing logistics flexibility, which enable quick replenishment of incoming materials, fast production of various products and rapid delivery of finished products to customers in cost-effective manner. The investment in advance information technology is a key to enhance logistics flexibility. The coordination of different types of information flow along a supply chain is a key to faster response to customer demands, lower inventories and lower cost associated with operations. The use of third party logistic service provider firms in logistics system of fluid milk and milk products greatly enhances the effectiveness and accuracy of logistics system for fluid milk and milk products.
This study has opened frontiers for defining the dairy specific as well as product specific logistics system flexibility and relationships among various components of it. The future research can also be extended towards finding out factors affecting the integration of third party logistic service providers, management of these relationships with logistics system of co-operative dairies in Gujarat. The future research can also be directed toward application of specific information technology and its impact on maintaining flexibility, efficiency and effectiveness of logistics system in co-operative dairies in Gujarat.
Acknowledgements

It would not have been possible to write this doctoral thesis without the help and support of the kind people around me, to only some of whom it is possible to give particular mention here.

I owe my deepest gratitude to my guide, Prof. (Dr.) Mahendra Sharma, for his encouragement, guidance and support from the preliminary to the concluding level as well as sharing his extraordinary experiences throughout the work, which enabled me to develop an understanding of the subject. I am also heartily thankful to him for giving his valuable advice and critical comments during research work. He has a constant oasis of ideas and passions in management, which exceptionally inspire and enrich my growth as a research student.

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I am also thankful to the Management of IIM, Ahmedabad library and Institute of Rural Management, Anand library for grating me the permission to use their library resources in terms of getting required research papers and books starting from initial stage to concluding stage of my thesis work.

I devote my sincere gratitude towards the managing directors of various co-operative dairies included in the research for granting me the permission to interact with senior managers and employees, which proved very helpful to me in understanding the basic concept and problems lie in the subject of this thesis. I am also very much thankful to managers of various departments of co-operative dairies in Gujarat for imparting the basic understanding of the subject and filling up the questionnaire and sharing their experiences.

Last but not the least, I would like to thank my wife for her personal support and great patience at all times. My parents have given me their unequivocal support throughout, as always, for which my mere expression of thanks likewise does not suffice.

It is a pleasure to thank those who made this thesis possible. I offer my regards and blessings to all of those who supported me in any respect during completion of the project.
CERTIFICATE OF GUIDE

Certified that work incorporated in this thesis entitled “AN IN-DEPTH INVESTIGATION ON LOGISTICS PRACTICES FOR FLUID MILK AND MILK PRODUCTS IN CO-OPERATIVE DAIRIES IN GUJARAT” submitted by Shah Tejas Rajeshbhai (Ref. No. MM/001/009/08), at Faculty of Management Studies, Ganpat University, Mehsana, comprises the result of independent and original investigation carried out by the candidate under my supervision. The material that has been obtained (and used) from other sources has been duly acknowledged in the thesis.

Date:

Place: Ganpat University

(Prof. (Dr.) Mahendra Sharma)
DECLARATION BY CANDIDATE

This thesis titled “AN IN-DEPTH INVESTIGATION ON LOGISTICS PRACTICES FOR FLUID MILK AND MILK PRODUCTS IN CO-OPERATIVE DAIRIES IN GUJARAT” is submitted in fulfillment of the requirements for the award of the degree of Doctor of Philosophy (Ph.D.) in Management to Ganpat University, Mehsana. I also declare, to the best of my knowledge and belief, this thesis contains no material previously published or written by any other person except where due reference is made in the text of the thesis.

Date:

Place: Ganpat University (Shah Tejas Rajeshbhai)
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Chapter 1: Introduction

1.1 Conceptual Evolution of Logistics Thought

Three aspects of the evolution of logistics thought emerge from the literature. The first is the time frame. Logistics thought as first documented in the early 1900s and clearly continues today. The second is the roots of logistics thought, which originated in early writing about farm-to-market economics. The third is the distribution between the logistics domain and the overall body of knowledge, which began in 1960s. (Kent and Flint, 1997)

The evolution of logistics thought can be divided into six eras (Kent and Flint, 1997):

Table 1.1 Conceptual Evolution of logistics Thought

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<td>• Physical Distribution</td>
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(Source: Kent and Flint, 1997)

**Era 1 - Farm to Market:** Until World War II, agriculture economics had a great deal of influence, where the attention centered on transporting products from the farm to the
point of sale. Logistics was treated as economics oriented, borrowing from economics, geography, transportation economics, etc.

**Era 2 – Segmented Functions:** The second era consists of two sectors: business and military. World War II marks the beginning of this period, and the late 1950 mark its end, where the military requirements of troops and supply movement during the war apparently gave birth to transport engineering and efficient physical distribution, which led to the thought of engineering focus of logistics. The primary focus was on the functions that comprise the distribution of goods, including efficient warehousing, efficient transportation and then efficient inventory management and customer service.

**Era 3 – Integrated Functions:** This era is marked by a system approach or total cost perspective. In the beginning of early 1960s, there was a shift from physical distribution as the main focus of logistics to an entire system of activities working with and relying on one another, which led to development of total cost or system approach to logistics management. Industrial economics appears to have had a good deal of influence on the developing concepts and business logistics as a separate function came into existence. The consolidation of management for both in-bound and out-bound transportation, warehousing, inventory control and materials handling began to gain importance.

**Era 4 – Customer Focus:** In the early 1970s, the customer was regarded as the primary focus of the firm. In this era, operations management and management science had a strong influence. Here, the logistics was considered a mean to maximize profits and satisfying the customers.

**Era 5 – Logistics as Differentiator:** In the early 1980s, logistics started to be considered a key means of differentiation for the firm. Logistics is viewed as a critical component in the strategy of the firm. The concepts emerging are integrated supply chain management, logistics channel management, inter organizational efficiency, environmental logistics, reverse logistics and a heightened awareness of globalization. Information technology and strategy concepts have had a significant influence.
Era 6 – Behavioral and Boundary Spanning: The recent trend in the logistics research is a deeper understanding of behavioral issues, specifically, customer perceptions of a firm’s logistics systems and their related behaviors. Other area to focus on includes interfunctional cooperation and coordination and theory building to develop specific solutions for specific problems.

1.2 Logistics Management

The logistics management has been defined as the management of all inbound and outbound materials, parts, supplies and finished goods. Logistics comprises of integrated management of purchasing, transportation and storage on a functional basis. On a channel basis, logistics comprises of the management of the pre-production, in-production and post-production channels. Logistics is defined as “the process of strategically managing the acquisition, movement and storage of materials, parts and finished inventory (and the related information flows) through the organisation and its marketing channel in such a way that current and future profitability is maximized through the cost effective fulfillment of orders” (Gattorna et al., 1991). Logistics is all-encompassing throughout the organization. It includes everything from the moment a product or service needs to be made, through to incoming raw materials management, production, finished goods storage, delivery to the customer and after-sales service (Pollitt, 1998). Logistics is almost synonymous with strategy. Logistics is more than an operational mode. It is a way of unifying and mobilizing all the activities in the organisation which impinge on the process from product (or service) conception to ultimate consumption (Gattorna et al., 1991). Logistics operations are responsible for the efficient and effective handling of a firm’s goods and services with the ultimate aim to minimize any costs, to improve customer service and to create a competitive advantage.
Today, the logistics concept suggests that instead of marketing, production, distribution, finance and purchasing, all working away of the others' involvement in the flows of materials and information and all attempting to optimize their own particular set of logistics activities, all should work together and all of the individual functional areas to operate sub-optimally in order for the whole logistics system to be more effective. The integrated systems-based approach which characterizes the logistics concept implies a recognition that an inter-relationship exists between the parts of the whole such that action affecting one part may affect all the others. Any action, therefore, must be considered in the light of its effect on all parts of the business and on the objectives of the company. Thus, the company can be viewed as a number of inter-linked subsystems which must somehow be united if effectiveness is to be maximized. The firm must be concerned with the flow of materials and information through the whole business process, from raw materials through to the finished goods arriving at the customer's premises; from conception to consumption. (Gattorna et al., 1991)

1.3 Concept of Logistics Mix

Logistics management is concerned with the analysis, planning and control of that level of product availability appropriate to the needs of the marketplace and the resources of the company (Tracey, 1998).

Customers not only want products to be physically available in the marketplace, they also want them in the right unit, sizes, in good condition and at the appropriate time. To meet these requirements the manager has to consider individually and then to co-ordinate the seven key decision areas which together constitute what has been termed the "Logistics Mix". These seven elements are (Byrne and Markham, 1991 and Holcomb, 1994):

1.3.1 Inventory: Efficient inventory management is central to logistics management. Some of the vital issues in inventory management are how much inventory should be held, where the inventory should be held, in what quantities and with what
frequency inventory should be replenished. Stock levels have a direct bearing on the customer service that can be offered and, at the same time, are the prime determinants of inventory holding costs. Holding stock is costly, it ties up working capital and can perish or become obsolete if sales are not made according to plan. The management task is, therefore, to determine a level of stock at which its associated costs are balanced by the benefits for customer service.

1.3.2 **Facilities:** To hold inventory, storage facilities are required. The number, location, size and special facilities as per requirements of the products are vital issues in management of warehouses.

1.3.3 **Communications:** Effective communications system in the logistics management brings capability of providing satisfactory customer service at acceptable cost. The implementation of communication system in order-processing system, the invoicing system, the demand-forecasting system, etc. brings efficiency and effectiveness in logistics management at operational as well as planning stage.

1.3.4 **Unitization:** This refers to the size of the packages in which goods are originally packed and to the accumulation of these packs into larger unit sizes. The unit loads used can have a major bearing on economics. For example, the ability to stack goods on a pallet which then becomes the unit load for movement and storage can lead to considerable cost savings in terms of handling and warehousing.

1.3.5 **Transport:** Transportation management is one of the most important issues in logistics management. The main decisions concern such issues as what mode or modes of transport we should use, whether vehicles should be owned or hired, how frequently deliveries should be made to different customers and how these deliveries should be scheduled.
1.3.6 **Materials Management:** No product can be made or delivered to the right standards without effective management of inbound purchasing, transport and storage.

1.3.7 **Production Scheduling:** The rise of concepts such as "just-in-time" has increased the importance attached to inventory control and responsiveness in production scheduling. This activity can have significant impact on inventory management.

### 1.4 Impact of Logistics on Customer Service

Customer service refers to identifying and responding to buyers’ needs with customized, high-quality products and services at reasonable price. Flexibility in regular logistics management is very importance in customer service management, which is defined as the ability of a firm to be proactive in adapting to changing customer requirements. The capability of a firm to provide accurate customer service is largely depended upon efficiency and flexibility in logistics management at supply, production and distribution levels.

Logistics Management affects the following aspects of Customer Service (Gattorna et al., 1999):

1.4.1 **Price Offered:** It refers to the manufacturer’s ability to offer competitive prices and/or command premium prices is influenced by the logistics expense incurred across the supply chain and the level of accompanying logistical service it is able to offer.

1.4.2 **Quality Product:** The quality of a manufacturer’s products is influenced significantly by the caliber of incoming materials and how well output is packed, stored and transported.
1.4.3 **Product Variety:** Customers expect an assortment of products and features that satisfy their individual requirements. This necessitates a logistics system able to supply the required materials and finished goods as needed without the occurrence of exorbitant costs.

1.4.4 **Fill Rates:** It can be described as providing a sufficient completeness for routine and emergency shipments without an increase in price requires an efficient logistics system.

1.4.5 **Cycle Time:** Shortening the time to bring a product from concept to market and also post introduction order cycle time requires excellent logistics.

1.4.6 **Order Information:** Customers desire meaningful information when they place an order pertaining to inventory availability, projected shipping date and projected delivery date. The ability to transmit accurate data in these areas is dependent in large part on the effectiveness of the logistics network.

1.4.7 **Delivery Frequency:** Customers today expect frequent shipments, and the capacity to fulfill this request while incurring reasonable expense is impacted by the proficiency of the manufacturer’s logistics system.

### 1.5 Logistics in Food Products

There is some time lag between production and consumption of food products, so it is necessary to preserve the food from its production until its consumption. The quality of the final product depends on how the transportation and storage of the products are done. There are number of issues that need to be addressed in order to keep the food products’ quality (Pimenta, 2010):
a. The product must be transported as fast as possible from its harvest/production to its storage place or plant to prevent losses due to climatic conditions. Highly perishable products such as milk must arrive quickly at the consumer or plant, vegetables and fruit must also arrive early at the distribution centers.

b. The quantity and quality of storage places are very poor and leads to losses. There are several proposals to avoid this loss; however it would be much more efficient to increase the food availability and its quality through better storage and transportation systems than increasing production.

The logistics of perishable products is more complicated due to products deteriorating over the time. Perishable products are affected by temperature variation, humidity, other environmental conditions and transportation time. Therefore, it is extremely important that transportation time, handling, storage and other requirements are well planned in order to maintain the product characteristics till they reach to the customers.

Transportation costs are always a significant component of logistics cost, especially for companies where the movement of raw material or product is required. These costs are even more important when transportation of perishable product is involved and special handling is required (Butler et al., 2005). In the past, most perishable products had to be consumed around the area where they were manufactured or collected due to the lack of transportation and storage equipment. It was almost impossible to reach long distance and keep perishable product with acceptable quality. However, the improvements of logistics facilities have made it possible to reach other areas, regions and markets around the globe (Huttner, 2005).

The market for fresh and perishable products is increasingly guided by demands regarding freshness, inherent quality and minimum food safety requirements. Therefore there are some regulations for production, handling, processing and transportation that need to be followed in order to guarantee and ensure safety and quality of products and meet the customers’ standards. The logistics of food products require special treatment
for their storage and transportation. Transportation temperatures play a considerable role in keeping the quality of the final products by avoiding the growth of bacteria, mould and yeast which consequently extends the shelf life that is not very long in this type of product. Therefore, it is important that refrigerated vehicles, containers and shipping spaces have been pre-cooled before any product is loaded, especially when dealing with fresh products. In addition, the unloading process into the shipping spaces or cold stores must be done as quickly as possible to avoid any increase in the product temperature which can affect the quality of final product (Pimenta, 2010).

1.6 Logistics in Fluid Milk and Milk Products

Milk is a highly perishable product. It must be processed within few hours after product, unless kept at low temperatures at which it can be stored for 2 or 3 days before processing. The key process of milk logistics is during its collection and cool storage. The capacity of dairy co-operatives to keep themselves competitive in a market is based on their ability to manage the production cost at an acceptable level (Butler et al., 2005).

Significant logistics problems arise both in collection of the milk from farms and the distribution of varieties of fluid milk and milk products to retailers and customers. The requirements of quality and productivity in the process of milk production have stimulated improvements in the logistics of the milk collection into dairy co-operatives, which make possible the reduction of collection routes and the increase in the amount of milk carried by truck, resulting in significant economy in the logistics cost and increase in profits (Butler et al., 2005).

Dairy co-operatives must avoid the increase in logistics cost as it will affect the price paid for the milk collected from their farmers. The cost of milk has two components: the cost of logistics and the cost of paying the farmers for the milk. The dairy co-operatives are
always trying to find ways of reducing the milk collection cost by applying an efficient logistics system which allows a higher milk price paid to the farmers (Butler et al., 2005).

In the older days, dairy co-operatives were small and milk production was not high, the milk was supplied to nearby farms and collected daily therefore did not spend too much time on its way to the plant. It was also easier to keep the bacteria growth in the milk under control using minimum of refrigeration conditions. Nowadays, the situation is significantly different. Milk production is now much higher, the concern about the quality has increased and the distance travelled is also greater. Basically, the logistics of milk logistics encompasses three parts under co-operative structure:

- 1<sup>st</sup> part: From the farms to the milk collection stations called primary co-operative society
- 2<sup>nd</sup> part: From primary co-operative societies to the dairy co-operative plants
- 3<sup>rd</sup> part: From dairy co-operatives to the retailers and customers

The detailed discussion of co-operative structure and various issues involved in it has been done in chapter 2.

### 1.7 Vital Issues and Recent Trends in Logistics Management

#### 1.7.1 Flexibility in Logistics Management

1.7.1.1 In market conditions, increasingly levels of product variety and customization, the ability to respond to customer orders in a timely fashion can provide a critical competitive advantage (Reichhart and Holweg, 2007). Companies are indicating that responsiveness and flexibility are the keys to responding to markets, which are rapidly changing and where customers are requiring a range of products and
services (Cunningham, 1996). To succeed in an increasingly uncertain environment, firms must respond to changing customer needs in terms of special treatment in design, production, and delivery, which require firms to view flexibility from a supply chain perspective rather than an equipment or process perspective (Day, 1994).

1.7.1.2 The flexible logistics system results in increasing the range of products available, improving the firm’s ability to respond quickly, and achieving good performance over a wide range of products (Upton, 1994). The flexible logistic system strengthen the ability of a firm to respond quickly and efficiently to changing customer needs in inbound and outbound delivery, support, and services (Day, 1994; Davis, 1993; Perry, 1991). Firms can achieve customer satisfaction by developing logistics flexibility, which enable quick replenishment of incoming materials and rapid delivery of finished product to customers. To enhance customer satisfaction, logistics should be organized in the manner that enables customer responsive and cost competitive operations.

1.7.2 Information Technology in Logistics Management

1.7.2.1 Many authors have promoted information technology as a means to enhance logistics competitiveness (Closs et al., 1997). Information technology (IT) is one of the few productivity tools that is both increasing in capability and decreasing in cost simultaneously. Adoption and successful implementation of IT is said to be prerequisite for logistics success.

1.7.2.2 Introna (1991) explains that while the logistical system converts materials into products, creating value for customers, the information system converts data into information to facilitate managerial decision making. Information is a resource to be utilized for decision making that subsequently enhances logistical effectiveness, efficiency, and flexibility. Information technology applications are also gaining importance at the operational level in logistics. The advent of
powerful microcomputers and advanced software applications has initiated significant discussion regarding how data can be cheaply and easily provided to those who actually use them (Martland and Waters, 1984). Information as a substitute for inventory is another common theme in the literature. The concept arises out of the advantages inherent with data transmission speed, accuracy, and low cost. Stock (1990) discusses the successful “marriage” of computers, communications systems and information systems in a warehousing context where information serves as a substitute for inventory.

1.7.2.3 Information technology contributes to the Porter’s three generic strategies of cost leadership, product differentiation, and niche marketing. The benefits of using information system like cost minimization, value-added maximization, and control/flexibility enhancement reflects the importance of information system in logistics operations. Bowersox et al. (1989) found that firm’s ability and willingness to invest in state-of-the-art information technologies leads to successful logistics operation. Daugherty et al. (1995) examine the relationships between information, integration, and customer response. They found that higher levels of shared information and communications with supply chain partners lead to integration and greater responsiveness. The development of information systems in logistics organization creates the followings benefits (Schary and Coakley, 1991): It increases the capacity to communicate complex messages. It leads to more information-intensive organizational structures. It reduces the cost of market transactions. Standardize data and images accessible to decision makers who control physical product flow is another advantage.

1.7.2.4 The concept of logistics information system can be considered as a pyramid on a base of transaction flow through the organization from customer to supplier. Data from market transactions are used for operations and management planning. The logistics information system plays crucial role in shaping the direction of logistics management. The ability of information system to process transactions,
monitor operations and perform complex analysis has extended the ability to manage complex process (Schary and Coakley, 1991).

1.7.2.5 Malone et al. (1987) presented the transaction cost economics view to use of information system in logistics transactions. The observed that the impact of information systems is to lower the cost and increase the capacity to transmit information. Child (1987) expanded this view by observing that information technology expansion is more useful to external transactions with suppliers and customers.

1.7.2.6 Advanced information technology such as the Internet provides real-time information, which enables logistics flexibility and precise order information. The information exchange offered by logistics systems that are flexible force extensive coordination among organizational entities engaged in the production and delivery of a product. Under these circumstances, information is a substitute for inventory and thus information flow is a complement for material flow (Closs et al., 1997). The coordination of different types of information flow such as demand, capacity, inventory, and scheduling along a supply chain is a key to faster response to customer demands, lower inventories, and lower cost associated with expediting shipment/production. Thus, investing in cost-effective information technology is a key to increasing logistics flexibility and improving customer service. (Zhang et al., 2005)

1.7.3 Outsourcing in Logistics Management

1.7.3.1 In an era, where logistics becomes more sophisticated and the gap between what companies want to accomplish and what they can do in-house continues to grow, the rational for outsourcing to third parties increases (Bolumole, 2003). The trend toward corporate downsizing and diversification and the need to focus on core, value-adding operations is also increasing the rate of logistics outsourcing as organizations realize the effectiveness of logistics as competitive tool. The
logistics function has been shown to be core to achieving customer value added. The basic philosophy behind outsourcing the logistics function is that the most researches acknowledge that an expert in a field is able to do the job better and more economically than doing it in-house.

1.7.3.2 Logistics outsourcing is contractual relationship with third-party based on certain specified performance criteria. Third party logistics service providers can offer certain advantages to the client firms like logistics expertise, cost advantage, no need to tie up unnecessary capital in logistics related equipment such as warehouse, trucks and sortation equipment, etc., advantage of economies of scale, etc. (Bolumole, 2003)

1.7.3.3 The major drivers of the outsourcing decisions and strategy include:

- Complex supply chain due to fragmented supply base
- Increasing volume of product variety and quantity
- The need to compete through improved service levels

In addition, the operational reasons for outsourcing include the need to achieve the following:

- Complementary product volume through consolidation
- Access to existing skills and facilities base
- Enable a wider spread of risk through risk sharing over a wider base of market
- Simplification of complex logistics processes
- Operational efficiency, such as consistent delivery times, efficiency and flexibility
- Reduced overheads

1.7.3.4 Regarding logistics role of third party logistics service provider, organizations that outsource for operational and cost based reasons will tend to restrict third party logistics service provider involvement to basic logistics functions. Those organizations that are motivated to outsource for the purpose of facilitating the
integration of supply chain members tend to perceive the third party logistics service provider function as an integral part of that supply chain strategy. Four factors are very important that influence the role of third party logistics service providers in logistics management (Bolumole, 2001): the strategic orientation of the outsourcing organization, the nature of the resultant relationship, the client’s perception of service provider’s role within the logistics strategy and the extent to which the logistics process is outsourced.

1.7.3.4.1 The strategic orientation refers to the focus of organization’s competitive strategies and the effect of it on the nature of the logistics strategy. The firm’s strategic orientation refers to the focus of their corporate objectives and motives for outsourcing, which influences the firm’s perception of and the nature of the relationship. It may be conceptualized as internal or cost based focus (Bolumole, 2001) and/or an external supply chain improvement focus (Evans et al., 1993). In case of co-operative dairies, they have an internal strategic orientation and motive for outsourcing tends to outsource for the primary purpose of reducing logistics costs and improving supply chain efficiency was subsidiary cause of outsourcing.

1.7.3.4.2 The nature of relationship between client and third party logistics service provider depends on the outsourcing contract and how the ensuing relationship progresses (Bolumole, 2001). These relationship ranges from adversarial arm’s length relationships to fully collaborative partnerships. Social exchange theory suggests that the exchange process evolves over time as organizations mutually and sequentially demonstrate greater levels of trust. But, the fear of the loss of strategic control tends to be an important barrier to increased level of interaction. Basically the nature of logistics outsourcing relationship is largely a consequence of the characteristics of organization’s logistics strategies.

1.7.3.4.3 The firm’s outsourcing decision is influenced by its perception of third party logistics service provider’s abilities. It refers to the way in which third party logistics service provider’s job functions are defined and their capabilities are
perceived, based on the retailer’s underlying reasons for outsourcing (Bolumole, 2001). The nature of the outsourcing contract and firm’s perception of third party logistics service provider’s role is largely driven by the underlying factors which influence the original decision to outsource. When the strategic objectives are aimed at internalizing logistics control, outsourcing is perceived as a means of gaining operational control through resource acquisition (Arend, 1998). When the cost based rationale is used, outsourcing is viewed as a means of avoiding internal transaction costs and third party logistics service providers are regarded as alternative and cheaper mechanism to in-house logistics operations (Ellarm and Maltz, 1995).

1.7.3.4.4 The extent of logistics outsourcing can be conceptualized at three levels: operational, tactical and strategic, representing an increasing extent of logistics outsourcing (Bolumole, 2001). In case of co-operative dairies, one of the reasons for limiting the extent of outsourcing the tactical and strategic level activities is the firm’s perception of the risks of outsourcing and the increased dependence on service providers. Another major risk limiting outsourcing to operational levels is the risk of third party logistics service provider’s access to crucial company information, which may be used to competitors’ benefits. The risk of the loss of control over the outsourced activity and the impact it has on critical business aspects such as customer service and customer relationships is also the vital issue influencing the extent of logistics outsourcing decision.

1.7.3.5 The decision to outsource can be linked to two basic management theories: the resource based view of the firm and transaction cost economics.

1.7.3.5.1 The underlying assumptions of the resource based view are that resources are both heterogeneously distributed among competitors and are not perfectly mobile. For many firms, the logistics is not part of core competencies or competitive advantage, so it is to be outsourced logically. The resource based view strategy explains that both the outsourcing user and the outsourcing provider must guard against wandering from their core competencies in
directions that detract from their ability to create value. The provider must also strive to provide only those services that are within their core competencies and promote a competitive advantage. The provider must evaluate their customers’ requests with their own competencies and resources in mind. Resource based view results in synergy between the user and provider to maximize their profits and attain service goals.

1.3.7.5.2 The transaction cost economics theory focuses on transactions rather than commodities or technology, explaining that it is transactions that mainly determine the efficacy of outsourcing function. The make or buy decision is made using transaction cost economics theory to economize on transaction costs. These two theories can guide the firms in evaluating the outsourcing decision. First, the firm should evaluate the ability of the provider to use its core competencies to serve the user and determine if synergies exist with existing operations. If the provider fits into firm’s preferred profile and can provide the firm requires, then the transaction costs should evaluated. Transaction cost economics includes assessing transaction costs, which include: asset specificity and investment needs, levels of uncertainty and the opportunities to develop economies of scale and scope.

1.8 Brief about Chapters included in Thesis

Chapter 1: This chapter includes introduction about evolution of logistics management, its conceptualization, the concept of logistics mix and its importance to customer service. This chapter also brings the importance of logistic management for food products, especially, milk and milk products. In the end, some vital issues and recent trends of logistics management is discussed.

Chapter 2: This chapter contains the discussion about scenario of milk and milk products in co-operative dairies in Gujarat region. The chapter includes introduction to
The economy, it’s demographic, economic and infrastructure conditions are. It also discusses about the milk and milk products’ scenario with special focus on co-operative dairies operating in Gujarat region. The chapter ends with the co-operative dairy structure in Gujarat and its various issues.

Chapter 3: In this chapter, a comprehensive literature review has been done. The literature review is divided into three parts. The first part includes the conceptualization of logistics flexibility, its characteristics and various components. It has also brought out the competence and capability view of logistics flexibility. The second part contains literature review regarding the impact of information system in maintaining logistics flexibility of co-operative dairies in Gujarat. The third part discusses about the outsourcing of logistics function to third party logistics service provider firm and various issues involved in it. This part basically discusses about the benefits of using third party logistics service providers in logistics management of a firm.

Chapter 4: This chapter discusses about the importance and objectives of this study. This chapter also includes the details of research design in terms of sampling procedure, questionnaire design, data collection procedure and scope of the study.

Chapter 5: This chapter relates to the data analysis. In first part, Regression analysis is used to find out the degree of impact of various dimensions of logistics flexibility model for fluid milk and milk products in co-operative dairies in Gujarat. In second part, regression analysis is used to find out the important benefits of logistics information operating system and planning system, which have the significant impact on logistics flexibility for fluid milk and milk products in co-operative dairies in Gujarat. In third part, regression analysis is used to find out the important benefits of using third party logistics service providers in logistics activities, which have the significant impact on logistics flexibility for fluid milk and milk products in co-operative dairies in Gujarat.
Chapter 6: This chapter reveals the major findings of the study based on primary survey and data analysis. Based on major findings, recommendations are also made to enhance logistics flexibility of co-operative dairies in Gujarat.

Chapter 7: This chapter describes the conclusion drawn from the study and its implications in general.
1.9 References


Chapter 2: Scenario of Co-operative Dairies in Gujarat

2.1 Introduction to Gujarat

Gujarat is covered under the area of 1,96,024 sq. km (six per cent of India), with the population of 5,06,71,017 (five per cent of India), increased at the growth rate of 22.66 percent during 1991-2001 (Gujarat Fact File, n.d.). It is located on the western coast of India and has the longest coastline of 1,600 km. The state currently has 26 districts, 231 talukas, 18,539 villages (18,066 inhabited villages and 472 un-habited villages) and 242 towns (State Profile, n.d.). The density of Gujarat was 258 persons per sq km as opposed to 325 persons per sq km in India in 2001. The decadal growth rate of the decade 1991-2001 has increased in comparison to 1981-1991 from 21.19 percent to 22.66 percent. The sex ratio of Gujarat comes out to be 920 per thousand male population. Gujarat consists of 4.96 percent of total male population and 4.89 percent of total female population of India (Demography, n.d.).

2.1.1 Literacy rate: The literacy rate in Gujarat has been higher than India during the period 1901-2001. The literacy rate of population has increased from 21.82 percent to 69.14 percent in Gujarat as against from 18.33 percent to 64.84 percent in India during 1951-2001. The literacy rate among male members has been higher than female members in Gujarat. The literacy rate among male members was 79.66 percent, while it was only 57.80 percent among female members in Gujarat during 2001. The literacy rate among urban population has increased from 60.31 percent to 81.84 percent, while among rural population it has increased from 36.20 percent to 61.29 percent during 1981-2001 (Vital Statistics, 2001 and Socio-Economic Review, 2007-08).

According to the National Sample Survey data, the net enrolment rate of children in elementary school in the state has increased marginally, from 69.56 percent in 1993-94 to
72.66 percent in 1999-00, implying an increase of 3.1 percent while that of girls increased by 4.98 percent. Gujarat’s rank has moved from 4th in 1993-94 to 6th in 1999-00 with respect to net enrolment of children (6-14 years). Gujarat’s rank in the literacy rate has declined during the 1990s: it is ranked sixth among the 15 large states in India in 2001 as against the fourth in 1991; in female literacy, it is ranked sixth in 2001, down from fifth position in 1991 and in male literacy the state has maintained its fourth position. The state is sixth among 15 large states in India with regard to overall ST literacy rate, sixth in ST female literacy rate and fifth in the ST male literacy rate. The state stands third in overall SC literacy and third in SC female literacy and first in SC male literacy in 2001. (Hirway and Mahadevia, 2005)

2.1.2 Gross State Domestic Product: According to quick estimates of Gross State Domestic Product (GSDP) of Gujarat State at factor cost at constant (1990-00) prices in 2006-07(Q) has been estimated at Rs. 185802 crore as against Rs. 170200 crore in 2005-06(P) registering a growth of 9.17 percent over the previous year. At current prices, GSDP at factor cost in 2006-07(Q) has been estimated at Rs. 254533 crore as against Rs. 219780 crore in 2005-06(P) showing an increase of 15.81 percent over the previous year. (Socio-Economic Review, 2007-08)

2.1.3 Per capital income: Gujarat ranked 4th in terms of per capita income among major states of India as per census 2001. Per Capita Income (i.e. Per Capita NSDP at factor cost) at constant (1999-00) prices has been estimated at Rs. 27027 in 2006-07(Q) as against Rs. 25487 in 2005-06(P), registering a growth of 6.04 percent over the previous year. The Per Capita Income at current prices, has been estimated at Rs. 37532 in2006-07(Q) as against Rs. 32991 crore in 2005-06(P), showing an increase of 13.76 percent over the previous year (Socio-Economic Review, 2007-08). The per capita income from the primary sector in Gujarat varies from Rs. 792 in 1980-81 to Rs. 729 in 1990-91 to Rs. 896 in 1994-95 and Rs. 491 in 200-01 (Hirway and Mahadevia, 2005).

2.1.4 Employment in Gujarat: Out of the total population of 506.71 lakh in the state, the total workers consisted of around 214 lakh, which consisted of 5.28 percent of total workers in India (Economic survey 2007-08). Out of total workers in Gujarat,
170.25 lakh (33.60 per cent) were main workers, 42.30 lakh (8.35 per cent) were marginal workers and 294.15 lakh (58.05 per cent) were non-workers (Demography, n.d.).

About 15.52 percent of the state income comes from agriculture sector and about 52.05 percent of the workforce is engaged in this sector. It also indicates a low level of productivity and incomes of the people engaged in the primary sector. The manufacturing sector contributes around 32.6 percent of the state income and employs about 16 percent of the workforce. It indicates that this sector has a relatively high share in the state income and its workforce enjoys higher productivity. (Hirway and Mahadevia, 2005)

In Gujarat, 41.95 percent of the total population was working in the year 2001. There was a marginal increase in the male working population from 52.91 percent to 54.87 percent (3.70 percent growth rate as against from 20.66 percent to 27.91 percent (35.09 percent growth rate) during the period 1981-2001. (National Human Development Report, 2001)

The unemployment rate in Gujarat was 5.79 percent in Gujarat, while it was 6.09 percent in India in the year 1987-88. It has decreased to 5.73 percent in 1993-94 in Gujarat as against 6.03 percent in India. There was a further decreased in unemployment rate in 1999-00 in Gujarat, i.e., 4.63 percent, while there was an increase in unemployment rate in India to 7.39 percent. (Hirway and Mahadevia, 2005)

The share of organized sector in total employment in the state has declined from 11 percent in 1983 to 10.1 percent in 1993-94 to 8.3 percent in 2001. About 92 percent of the total workforce is employed in the unorganized sector in 2001. There has been a decline in the rate of growth of employment in organized industries, from 1.8 percent during 1983-94 to 0.2 percent in 1994-2001. (Hirway and Mahadevia, 2005)

2.1.5 Poverty in Gujarat: Out of the total population in Gujarat, 16.80 percent were below poverty line. In rural area, 19.10 percent of the population was below poverty line while in urban area, 13 percent of the total population was below poverty line (Economic Review, 2007-08). Gujarat had the fifth rank in rural poverty as well as urban poverty among major states in India. (Hirway and Mahadevia, 2005)
2.1.6 Prosperity in Gujarat: Gujarat accounts for 25.8 percent of the country's total investment and 10 percent of country's expenditure. The state contributes 15.59 percent to the total value of output in general and 14.0 percent of the total value of output added by manufacturing sector of the country. The proportion of the population involved in running owned business in Gujarat is the highest among all states in India. Gujarat is among the six states with Andhra Pradesh, Arunachal Pradesh, Goa and Rajasthan, having grown at a higher rate than 9 percent for five consecutive years during the period 1980-2004 (Dholakia, 2009). Gujarat contributed almost one third of the national growth acceleration during the period 1991-92 to 2003-04.

2.1.7 Sectors in Gujarat: Gujarat economy basically consists of three sectors: Agriculture (Primary), Industry (Secondary) and Service (tertiary). Agriculture sector accounted for around 18.22 percent of the State's GSDP against 18.5 percent of the GDP in India in the year 2006-07. The secondary sector accounted for 37.78 percent of the State's GSDP against 19.7 percent of the GDP in India in the year 2006-07. The services sector contributed 44.00 percent to the State's GSDP against 61.8 percent of the GDP in India in the year 2006-07 (Dholakia, 2009). Gujarat is the only state reporting a negative growth rate in agriculture and allied sectors in the 1990s (1993-2001). Gujarat’s advantage is mainly in the industrial sector (3rd rank) and to an extent in the tertiary sector (5th rank) (Hirway and Mahadevia, 2005).

Gujarat has 9.5 percent of the total employees working in the country. The number of factories is 10 percent of that of total factories in India. Investment in Gujarat counts a major share in India’s Investment ratio. In last five years, Gujarat’s Development share is 10.30 percent and as per RBI survey (2008). Fixed capital investment in Gujarat consists of 17 percent of the total fixed capital investment in India. In exports, Gujarat has 21 percent share in India’s exports. Gujarat contributes 30 percent of the total stock market capitalization in India.

2.1.8 Urbanization: The urbanization has increased from 27.23 percent to 37.36 percent (37.20 percent growth rate) in Gujarat during 1951-2001. The total urban population of Gujarat consists of 6.62 percent of total urban population of India and 4.27
percent of total rural population of India. Out of the total population in Gujarat, 62.24 percent has been living in rural area (Urban population, n.d.).

2.1.9 **Households in Gujarat:** In 2001, 65.9 percent of the total number of houses in Gujarat had the electricity; while in India 42.4 percent of the houses had the electricity. Out of the total houses in Gujarat, 56.9 percent were pucca houses, 39 percent were semi-pucca houses and 4 percent were kutcha houses, as against 41.6 percent, 31 percent and 27.3 percent in India respectively. The household development in Gujarat is high due to a high rate of investment in infrastructure development and urbanization in Gujarat. (Hirway and Mahadevia, 2005)

2.1.10 **Health scenario in Gujarat:** As per Sample Registration System as on March, 2005, the estimated Birth Rate, Death rate and Infant Mortality Rate per 1000 persons, worked out to 23.7 persons, 7.1 persons, & 54 persons respectively (Health, Gujarat). The birth rate was 23.5 per 1000 persons and death rate was 7.3 persons per thousand in 2006 (Demography, n.d.). The life expectancy at birth for male was estimated to be 67.2 years in Gujarat as against 65.8 years in India for the year 2006-10, while it was 71 years for female in Gujarat as against 68.1 years in India for the same period.

As of November 2007 the total number of primary health centers, Community health centers & Sub-Centers in the state were 1072 (4.73 percent of India, Socio economic review 2007-08), 273 (6.98 percent of India, Socio economic review 2007-08) & 7274 (5.02 percent of India, Socio economic review 2007-08) respectively. The average number of villages served by Primary health Center, Community Health Center and sub-center were 16.85, 66.18 & 2.48 respectively as against 26.19, 151.85 and 4.10 in India respectively. In 2001, there were 52.80 doctors per lakh population in Gujarat, while in India there were 46.99 doctors per lakh population. (Hirway and Mahadevia, 2005)

Irrespective of the developments in Gujarat, the position of Gujarat in terms of human development among other states in India has been reduced. In 1981, Gujarat ranked 4th as per Human Development Report, which was dropped down to 6th in 1991 and remained stable in 2001. The state ranks 6th in terms of per capita income, 2nd in industrialization
and third in urbanization level in 2001. So, the state has poor performance in terms of per capita income due to poor performance of agriculture sector in terms of per capita income. In 2001, Gujarat state has achieved 48 percent of the goals set for human development. Gujarat ranks 2nd in terms of housing development, 6th in terms of education index, 4th in terms of income index and 9th in terms of health index. But, the state has poor performance in terms of participation rate of workers, where it stands at 12th rank. The state has lower rank in terms of health index due to poor health sector expenditure. The health sector expenditure, which includes expenditure on health and family welfare, social welfare and nutrition show a consistent decline. The has not met any of the norms set by UNDP with regard to social sector and public expenditure ratios with regard to social sector and public expenditure ratios. (Hirway and Mahadevia, 2005)

In terms of gender development, the state ranks 6th, same as human development index. In gender development index, Gujarat is at 8th position in 2001, which implies that the performance of the state is worse in gender equality than in gender development. In terms of regional equality index, Gujarat ranks at 9th position. In the basic service index, Gujarat ranks at 2nd position. (Hirway and Mahadevia, 2005)

### 2.1.11 Infrastructure in Gujarat

#### 2.1.11.1 Roadways

The total length of roads (except municipal roads) in the State is 74038 km. in 2005-06. The village roads consist of 28.52 percent in the year 2005-06, while state highway consists of 25.26 percent and national highway consists of 3.87 percent of total roads in Gujarat. Out of this, the length of the surfaced roads is 70688 km (that is, 95.48 per cent). The density of road is 37.77 km. per 100 square kilometer and 146 km. per lakh population in Gujarat, against 43 km. per 100 square kilometer and 126 km. per lakh population in India respectively. Besides, the total number of vehicles registered in the State are 65.08 lakh and vehicles density i.e. number of vehicles per sq. km is 33. Roads in transport sector account for nearly 17.05 percent of the total planned
investment amount to Rs. 19951 crore for the periods up to 2010 of “Gujarat Infrastructure Agenda – Vision 2010” prepared by GIDB (Infrastructure, n.d.).

2.1.11.2 Railways: The rail traffic in Gujarat mainly falls under the following divisions of Western railway, namely: Vadodara, Rajkot, Bhavnagar, Mumbai and Ahmedabad. The total length of railway lines in the State is 5171 Km, consisting of around 8.25 percent of total rail length in India. Railways line in Gujarat comprising 2409 km of broad gauge; 1886 km of meter gauge; and 876 km of narrow gauge lines. The State of Gujarat is connected to the rest of India by railways at six points - three towards Rajasthan, one towards Madhya Pradesh and two towards Maharashtra. Northern Saurashtra, central and eastern Gujarat are well connected through broad gauge lines, while Southern Saurashtra and Kutch Region do not have direct connectivity to the rest of the country by broad gauge lines (Infrastructure, n.d.).

2.1.11.3 Ports: Gujarat has one major port of Kandla and 40 minor and intermediate ports, geographically dispersed across South Gujarat (13 ports), Saurashtra (23 ports) and Kachchh region (4 ports). Ports in Gujarat accounted for 20 percent of the total cargo handled by total ports in country. Among the maritime States, Gujarat is the first to set up a maritime board to oversee the privatization of minor ports. It is also the first State to announce a separate port policy, which integrates the development of ports with industrial development, power generation and infrastructure development (Infrastructure, n.d.).

2.1.11.4 Power: The total installed capacity of power in Gujarat is 13556 MW, which is third highest among all the states in India after Maharashtra and Tamil Nadu. The per capita availability of power in Gujarat is 1354 units, which is almost doubled the national average of 665 units (Infrastructure, n.d.).
2.2 Milch animals in Gujarat

2.2.1 Livestock sector in the state has made positive impact on the lives of rural people mainly small farmers, marginal farmers and agricultural landless labourers by raising their living standards considerably. The gross value of output from livestock sector in Gujarat has increased at an annual compound growth rate of nearly 12 percent from Rs. 5724 crore in 1999-00 to Rs. 14734 crore in 2007-08. The contribution of gross value of output from agriculture and allied sectors is about 25 percent (Sharma and Thaker, 2010). Therefore, livestock plays an important role at household level and significantly contributes to the state economy.

2.2.2 As per census 2003, total livestock in Gujarat is 234.48 lakhs. The various species of animals are as follows: cows: 79.69 lakhs, buffaloes: 87.60 lakhs, Sheep and Goat: 65.84 lakhs. The total breedable population consists of 37.55 lakhs of total cows and 51.41 lakhs of total buffaloes (Live stock census, 2007). Though the total number of milk producing animals is higher in Gujarat, the per capita milk producing capacity is very low, except crossbreed cows. The indigenous cows in Gujarat can produce on an average of 2.84 kg. per day as compared to 3.80 kg. per day for buffaloes. The crossbreed cows can produce very high per capita production at around 7.96 kg per day.

2.2.3 In Gujarat, the buffaloes carry higher share than cows in terms of total milk production. Buffalo is accounting for about 63 percent of total milch animals in Gujarat. The buffalo population has increased at the rate of 22.7 percent from 1992 to 2007, while the population of indigenous cows has remained stable and the population of high-yielding crossbred cows has increased more than 3 times from 1.8 lakh in 1997 to 5.7 lakh in 2007. The share of crossbreed cow population has increased from 7.6 percent to 20.3 percent during the same period. (Sharma and Thaker, 2010)
2.2.4 There has been a considerable improvement in milk yield of local cows and buffaloes during 2001 to 2007. The total expenditure of government on animal husbandry and dairy development has increased from Rs. 8093 lakh in ninth five year plan to Rs. 13449 lakh in tenth five year plan and actual expenditure during the first two years of eleventh five year plan was Rs. 16796 crore, higher than total expenditure during the tenth five year plan. The number of total artificial insemination done in the state has increased from 25.4 million in 2001-02 to 40.6 million in 2007-08. The share of artificial insemination in cows has increased from 34.8 percent to 43.3 percent during the same period, which is reflected in the increased population of crossbred cows. The number of vaccinations has also increased from 20.5 million in 2001-02 to 29.1 million in 2007-08. So, overall there has been a significant increase in provision of livestock inputs and services to farmers and investment in the sector. (Sharma and Thaker, 2010)
2.3 Milk and Milk Products in Gujarat

2.3.1 Milk Production in Gujarat

Gujarat is one of the important states in India in terms of fluid milk and milk products production. The total milk procurement in India it was 10,84,63,000 tonnes, while in Gujarat it was 83,86,000 tonnes, which constitutes around 7.73 percent of total milk production in India. The Gujarat is ranked 5th among the states producing milk in India (NBBD, n.d.). Gujarat witnessed acceleration in growth in milk production from 4.6 percent to 5.1 percent in 2000s. The per capital availability of milk in Gujarat is 403 grams per day in the year 2008-09 as against the 258 grams per day in India. However, the present level of per capita availability of milk in Gujarat is much higher than the world average of 285 grams per day and also above the per capita availability of milk of 220 grams per day as recommended by ICMR (Sharma and Thaker, 2010). Per capita availability of milk has increased at an about 4 percent annual compound growth rate as against less than 2 percent growth in national average during the year 2000-01 to 2008-09 (Sharma and Thaker, 2010). The Gujarat is ranked 3rd in terms of per capita availability of milk in India. The per capita consumption of food in Gujarat is around Rs 4975, which is higher than per capita milk consumption of Rs 4016 in India (NBBD, n.d.). Per capita monthly expenditure on Food in Gujarat is higher than that of India. The per capita monthly expenditure on food in Gujarat was 54.3 percent in rural area and 39.6 percent in urban area as against 52.3 percent in rural area and 39.4 percent in urban area in India for the year 2006-07 (Sharma and Thaker, 2010). Per capita monthly expenditure on milk and milk products in Gujarat is higher than India. The per capita monthly expenditure on milk and milk products in Gujarat was 22.7 percent in rural area and 25.3 percent in urban area as against 15.5 percent in rural area and 18.8 percent in urban area in India for the year 2006-07 (Sharma and Thaker, 2010). The wholesale price index is 196 for milk and 217.4 for dairy products in the year 2006-07 (Base year 1993-94).
2.3.2 Co-operatives Dairies in Gujarat

In Gujarat, there are 13646 organised District co-operative societies (DCS) centers in the year 2008-09, constituting 2839000 farmer members out of which 784000 women members. Dairy co-operatives have played an important role in the development of the dairy industry by linking smallholder dairy producers with the markets and providing fair-cost and quality inputs and services to the producers. Co-operatives procure about 14 percent of the national marketable surplus and nearly 8 percent of total rural milk producing households. As against the national average of 8 percent, the share of milk procured by co-operatives in Gujarat is much higher at 39 percent and has decreased significantly during 2000s. The share of Gujarat in total milk procurement by co-operative sector in India is the highest at 32.90 percent, followed by Karnataka (13.2 percent) and Maharashtra (13.1 percent) during the year 2008-09. Gujarat has increased its share from 27.6 percent in the 2001-02 to 32.9 percent in 2008-09. (Sharma and Thaker, 2010)

Banaskantha is the largest milk producing district in the state with an estimated production of 752 thousand tonnes during the year 2007-08 accounting for about 10 percent of the total production in Gujarat. Sabarkantha is the second largest producer of milk with an estimated share of 8.9 percent, followed by Mehsana (8.3 percent) and Surat (5.9 percent). Nearly one-third of the districts increased their share in total milk production while 11 districts lost share in total milk production. (Sharma and Thaker, 2010 and NDDB, n.d.)

Table 2.1 Classification of districts according to changes in share to total milk production in Gujarat between 2002-03 to 2007-08

<table>
<thead>
<tr>
<th>Changes in share</th>
<th>Districts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase in share</td>
<td>Banaskantha (10/1 percent), Sabarkantha (8.9 percent), Surat (5.9 percent), Panchamahal (4.3 percent), Gandhinagar (3.6 percent), Navasari (2.2 percent), Valsad (1.7 percent), Dang (0.1 percent)</td>
</tr>
<tr>
<td>Decline in share</td>
<td>Kheda (5 percent), Junagadh (4.9 percent), Ananad (4.4 percent), Bhavnagar (4.3 percent), Vadodara (4.2 percent), Patan (4.1 percent), Ahmedabad (3.6 percent), Amreli (2.9 percent), Dahod (2.2 percent), Bharuch (1.6 percent) and Porbandar (1.5 percent)</td>
</tr>
<tr>
<td>No change</td>
<td>Mehsana (8.3 percent), Rajkot (5.1 percent), Kachchh (3.7 percent), Jamnagar (3.3 percent), Surendranagar (3.2 percent) and Narmada (0.7 percent)</td>
</tr>
</tbody>
</table>

(Source: Sharma and Thaker, 2010)

Table 2.2 Classification of districts according to growth rate in milk production in Gujarat during 2002-03 to 2007-08

<table>
<thead>
<tr>
<th>CAGR (percent)</th>
<th>Districts</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 5 percent</td>
<td>Dang, Gandhinagar, Navsari, Valsad, Panchmahal, Banaskantha, Sabarkantha, Surendranagar, Porbandar, Kachchh, Kheda, Narmada and Surat</td>
</tr>
<tr>
<td>3-5 percent</td>
<td>Jamnagar, Rajkot, Bhavnagar, Junagadh, Anand, Ahmedabad, Amreli, Vadodara and Mehsana</td>
</tr>
<tr>
<td>&lt; 3 percent</td>
<td>Patan and Bharuch</td>
</tr>
<tr>
<td>Negative</td>
<td>Dahod</td>
</tr>
</tbody>
</table>

(Source: Sharma and Thaker, 2010)

2.3.3 GCMMF – Introduction

GCMMF is the apex body of all the co-operative dairies in Gujarat. Under GCMMF, 13 co-operative dairies are operating with 19 dairy plants in Gujarat. Total milk procurement by GCMMF has been 30,50,000 tonnes in the year 2008-09, which constitutes 36.37 percent approximately of the total milk production in Gujarat. The total average
daily milk handling capacity of GCMMF stood at 11220 tonnes, while the total daily milk collection has been 8400 tonnes for the year 2008-09. GCMMF is operating with 13328 co-operative societies with around 2.79 million producer members (Source: GCMMF official website).

**Figure 2.1 The Demand – Supply Linkages in Logistics of Co-operative dairies**

![Diagram showing supply chain and linkages](image)

<table>
<thead>
<tr>
<th>Entities in Supply Chain</th>
<th>Coordination and Planning activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suppliers</td>
<td>3P Services</td>
</tr>
<tr>
<td>Milk</td>
<td>GCMMF</td>
</tr>
<tr>
<td>Supply</td>
<td>VDCS</td>
</tr>
<tr>
<td>Unions</td>
<td>3PIL</td>
</tr>
<tr>
<td>Material flow of Milk and Dairy Products</td>
<td>3POL - Third party in-bound logistics</td>
</tr>
<tr>
<td>Support Services</td>
<td>3POL - Third party out-bound logistics</td>
</tr>
<tr>
<td>Primary/Major influencing factors</td>
<td></td>
</tr>
</tbody>
</table>

(Source: Chandra and Tirupati, 2002)
A schematic description of the business model showing the demand-supply linkages is presented in above figure. In addition to material flows, the figure shows major decisions, support services, and planning and coordination activities. For example, procurement prices set by Unions are a major determinant of milk supply. Similarly, GCMMF’s pricing strategy for dairy products has a strong influence on consumer demand. As shown in the figure, the Unions and GCMMF share coordination activities. In addition to outbound logistics, GCMMF takes responsibility for coordinating with the distributors to assure adequate and timely supply of products. It also works with the Unions in determining product mix, product allocations and in developing production plans. The Unions, on the other hand, coordinate collection logistics and support services to the member-farmers. In what follows we elaborate on these aspects in more detail and provide a rationale for the model and strategies adopted by GCMMF. (Chandra and Tirupati, 2002)

The co-operative structure aims at following features: (1) Decentralized milk production by the small milk producers; (2) Milk procurement by the village-level dairy cooperative societies; (3) Centralized milk processing by the district-level unions; and (4) Marketing of milk and milk products by the state-level federation. (Source: GCMMF official Website)

2.3.4 The Three-tier Co-operative Structure in Gujarat

The GCMMF Model is a three-tier cooperative structure. This structure consists of a Dairy Cooperative Society at the village level affiliated to a Milk Union at the District level which in turn is further federated into a Milk Federation at the State level. The above three-tier structure was set-up in order to delegate the various functions; milk collection is done at the Village Dairy Society, Milk Procurement & Processing at the District Milk Union and Milk & Milk Products Marketing at the State Milk Federation. This helps in eliminating not only internal competition but also ensuring that economies of scale can be achieved (GCMMF Model, Wikipedia).
2.3.4.1 Primary Village Dairy Cooperative Society (VDCS)

The milk producers of a village, having surplus milk after own consumption, come together and form a Primary Village Dairy Cooperative Society (VDCS). The Primary Village Dairy Cooperative is the primary society under the three-tier structure. It has membership of milk producers of the village and is governed by an elected Management Committee consisting of 9 to 12 elected representatives of the milk producers based on the principle of one member, one vote. The village society further appoints a Secretary (a paid employee and member secretary of the Management Committee) for management of the day-to-day functions. It also employs various people for assisting the secretary in accomplishing his / her daily duties. The main functions of the VDCS are as follows:

a. Collection of surplus milk from the milk producers of the village & payment based on quality & quantity
b. Providing support services to the members like Veterinary First Aid, Artificial Insemination services, cattle-feed sales, mineral mixture sales, fodder & fodder seed sales, conducting training on Animal Husbandry & Dairying, etc.
c. Selling liquid milk for local consumers of the village

d. Supplying milk to the District Milk Union

2.3.4.2 District Cooperative Milk Producers’ Union (Milk Union)

The Village Societies of a District (ranging from 75 to 1653 per Milk Union in Gujarat) having surplus milk after local sales come together and form a District Milk Union. The Milk Union is the second tier under the three-tier structure. It has membership of Village Dairy Societies of the District and is governed by a Board of Directors consisting of 9 to 18 elected representatives of the Village Societies. The Milk Union further appoints a professional Managing Director (paid employee and member secretary of the Board) for management of the day-to-day functions. It also employs various people for assisting the Managing Director in accomplishing his / her daily duties. The main functions of the Milk Union are as follows:

a. Procurement of milk from the Village Dairy Societies of the District
b. Arranging transportation of raw milk from the VDCS to the Milk Union.
c. Providing input services to the producers like Veterinary Care, Artificial Insemination services, cattle-feed sales, mineral mixture sales, fodder & fodder seed sales, etc.
d. Conducting training on Cooperative Development, Animal Husbandry & Dairying for milk producers and conducting specialised skill development & Leadership Development training for VDCS staff & Management Committee members.
e. Providing management support to the VDCS along with regular supervision of its activities.
f. Establish Chilling Centres & Dairy Plants for processing the milk received from the villages.
g. Selling liquid milk & milk products within the District
h. Process milk into various milk & milk products as per the requirement of State Marketing Federation and decide on the prices of milk to be paid to milk producers as well on the prices of support services provided to members.
2.3.4.3 State Cooperative Milk Federation (Federation)

The Milk Unions of a State are federated into a State Cooperative Milk Federation. The Federation is the apex tier under the three-tier structure. It has membership of all the cooperative Milk Unions of the State and is governed by a Board of Directors consisting of one elected representative of each Milk Union. The State Federation further appoints a Managing Director (paid employee and member secretary of the Board) for management of the day-to-day functions. It also employs various people for assisting the Managing Director in accomplishing his daily duties. The main functions of the Federation are as follows:

a. Marketing of milk & milk products processed / manufactured by Milk Unions.

b. Establish distribution network for marketing of milk & milk products and arranging transportation of milk & milk products from the Milk Unions to the market.

c. Creating & maintaining a brand for marketing of milk & milk products (brand building).

d. Providing support services to the Milk Unions & members like Technical Inputs, management support & advisory services.

e. Pooling surplus milk from the Milk Unions and supplying it to deficit Milk Unions.

f. Establish feeder-balancing Dairy Plants for processing the surplus milk of the Milk Unions.

g. Arranging for common purchase of raw materials used in manufacture / packaging of milk products.

h. Decide on the prices of milk & milk products to be paid to Milk Unions.

i. Decide on the products to be manufactured at various Milk Unions (product-mix) and capacity required for the same.

j. Conduct long-term Milk Production, Procurement & Processing as well as Marketing Planning.

k. Arranging Finance for the Milk Unions and providing them technical know-how.

l. Conflict Resolution & keeping the entire structure intact.
Figure 2.3 Supply Chain and Logistics Flow of Milk and Milk Products under Co-operative System

Milk Producers

Village Dairy Cooperative Societies

Bulk Milk Cooler

Distict Milk Union

Chilling Center

Bulk Milk Cooler

Milk Producers

Village Dairy Cooperative Societies

Bulk Milk Cooler

Chilling Center

District Milk Union

Chilling Center

NCMMF

Mother Dairy

Export Agent

Export to other Countries

Exports Agent

Wholesale Distributor

Local Retailers

Consumers

Exports to other Countries

Wholesale Distributor

Local Retailers

Consumers

Gandhinagar Retail Depot

Amul Retail

Consumers

Distributors

Retailers

Consumers

Flow of Material

Flow of Money

Institutional Sales

Defense Service

National Depot

C&F Agent

Retailers

Consumers

Local and other districts’ Sales

Distributors

Retailers

Consumers

Exports to other Countries

Exports to other Countries

Exports to other Countries

Gandhinagar Retail Depot

Amul Retail

Consumers

Distributors

Retailers

Consumers

Local Depot

Local Retailers

Consumers

National Depot

C&F Agent

Retailers

Consumers

Exports to other Countries

Exports to other Countries

Exports to other Countries

Gandhinagar Retail Depot

Amul Retail

Consumers

Flow of Material

Flow of Money
2.4 Information Technology implementation in Co-operative dairies in Gujarat

The implementation of Information and Communication Technology systems covers the following aspects (Bowonder, Prasad and Kotla, 2002):

a. The milk collection centers at villages co-operative societies, were first automated
b. The enterprise wide integration was taken up next.
c. Application and utilization of GIS
d. Data analysis software utilization for milk production estimation and increasing productivity.
e. VSAT network between all the levels of distribution network and GCMMF.
f. WEB initiatives-“.coop” domain name, to become the first five Indian companies that went for web and cyber stores.

The rural IT empowerment project started by GCMMF had the following objectives:

a. To build transparency among the farmers towards cooperative society
b. Training the rural people towards the quality supply of milk
c. Getting the whole activity chain of GCMMF under uninterrupted information flow network
d. To reduce the pilferage
e. To remove the complexity associated with the village cooperative society milk collection process
f. Empowering the rural masses towards self-development activities
g. To build the competencies in the area of it
h. To build the transparency and trust amongst the rural people towards the cooperative system
i. To face the global competition by effective decision-making.
2.4.1 Automatic Milk Collection Centers

Milk is collected at the co-operative milk collection centers located within 5-10 km of the villages supplying the milk. The number of farmers selling milk to these centers varies from 100 to 1000. The daily milk collection varies from 100 to 10,000 litres. Each farmer is given plastic identity card. At the counter he drops the card into a box that reads it electronically and transmits the identification number to the PC. The milk is emptied into a steel can kept over the weighing scale. Instantly the weight of the milk is displayed to the farmer and communicated to a PC. The can is connected by tube to a big can, which transports milk to the dairy. One operator is required to fill the can. Another operator sitting next to the can takes a 5-ml, sample of milk and holds it up to a tube of an Electronic Milk-tester. The fat content is displayed to the farmer and communicated to the PC, which calculates the amount to be paid to the farmer based on the fat content of the milk. The total value of the milk is printed on a pay slip and given to the farmer who collects the payment from the adjoining window. The payment is automatically rounded to the nearest rupee and the balance due to the farmer is stored so it can be added to the farmer’s payout for the next day. (Chakravarty, n.d.)

2.4.1.1 Advantages of the system

The main benefits of the automatic milk collection systems as compared to the conventional methods are as follows:

a. Immediate payment for the milk delivered;
b. Accurate information about the fat content, quantity of milk and the payment due to the farmer is displayed;
c. Accuracy in weighing the milk on the MWS as against the manual process where milk was weighed using measuring containers which very often led to a financial loss to farmers;
d. Immediate testing of the quality of milk as against testing after 2 to 3 hours of collection;
e. The card reader unit ensures speed of operation and an error-free entry of identification number of the farmer; and
f. The elimination of manual registers for all kinds of information and data storage.

2.4.2 Dairy Information System Kiosk (DISK)

The E-Governance Centre of the Indian Institute of Management (IIMA) has worked to extend the benefits of this application by developing Diary Information System Kiosk (DISK) software which will replace the existing application at the milk collection centers. It has two major components - an application with enhanced database and reporting running at the society level and connectivity to a Dairy Portal serving transactional and information needs of all members and staff at various levels in the district co-operative structure. (Bhatnagar, 2000)

The DISK project was conceived with two components; 1) an application running at the society level that could be provided Internet connectivity and, 2) a Dairy Portal at the district level serving transactional and information needs of all members and staff in the district co-operative structure. The software used at the society level was developed to provide:

a. Data analysis and decision support to help a rural milk collection society in improving its performance i.e. increasing milk collection.

b. Data analysis to improve productivity and yield of milch cattle.

c. Farmers with facilities to place orders for goods and services offered by different agencies in the co-operative sector and seek information on subjects of interest.

The DISK database includes a complete history of all milch cattle owned by the farmers. The basic details of breed and a history of disease, inoculations, artificial insemination and pregnancy are maintained in the system. Longitudinal data on milk production by individual farmers is also available in the database. Decision support systems have been developed to forecast milk collection, and provide feedback to the farmers.
The services to be offered by DISK would include (Monika, 2000):

a. Delivery of information related to dairying, including best practices in breeding and rearing milch cattle, scheduling of government and other private sector agency services, and collecting feedback on the quality of service provided to the catchments area

b. Access to a multimedia database on innovations captured by SRISHTI (an NGO working with IIMA) from hundreds of villages, covering agricultural practices, medicinal plants, home remedies, tools and implements, etc., and a multimedia format that has captured the description of the innovations provided by innovators and a visual presentation of the innovations

c. Use as a communication centre offering services like email, fax and Internet telephony (if Internet telephony is permitted).

d. Internet Banking Services and Automated Teller Machines (ATMs), which will enable the milk societies to credit payments directly to sellers’ bank accounts. (The sellers already have plastic card identifiers. The card identifier may have to be upgraded to smart cards carrying biometric identification. The cards can be used to withdraw cash from ATMs). Farmers may now receive immediate payment for their milk, rather than waiting ten days as under the previous system. Moreover, queues at the milk collection centers are short, saving farmers considerable time.

e. A way for farmers to download Government Forms, receive documents (from a Government site) and order supplies and agricultural inputs from manufacturers

f. Means of communicating with farmers via the automatic printing process of daily payment slips.

2.4.2.1 Obstacles to the Growth of Rural Kiosks: Need to involve developmental agencies (Monika, 2000)

a. If the Internet can be accessed from rural areas, useful information and government and other institutions' services can be delivered to the rural population via information kiosks. Several state governments are planning to
establish kiosks in rural areas. To set up rural Internet kiosks it is imperative that a communication service (cable, fixed line telephone, mobile phone) reaches rural India. Telecommunication investors, financial institutions that provide telecom loans, urban telecom operators, and telecom equipment vendors are generally reluctant to get involved in rural operations because they perceive telecom ventures in rural areas, especially those in developing countries and emerging markets, as high-risk, troublesome, or not worth significant effort.

b. Part of the investment can come from users provided that they can be shown the value of the information and services that kiosks can deliver. Building useful content in local language is absolutely necessary. In the dairy sector the district unions will spend because they stand to gain as the system increases the efficiency and effectiveness of the services delivered to the rural farmers. Organizations like Grameen Bank (which has already invested) or other NGOs can also invest in rural kiosks. This will come from areas with a reasonable level of economic activity. Subsidies will be needed in areas inhabited by the poorest of the poor.

c. For rural kiosks to become a reality, partnerships will be required between development organizations, telecom companies, small IT service companies and government agencies. The role of the committed volunteer (in this case the office bearer of the society) who intermediates between the computer screen and the rural farmer is also important. Most of the current success of rural kiosks has been built around the enthusiasm of this intermediary.

d. Extensive training is required to operate the software, which requires training and development expenses. After installation, regular maintenance of the software is also required, which might increase the cost.

2.4.3 Enterprise-wide integrated application system

Accordingly, GCMMF assigned the ERP software development project named as Enterprise-wide integrated application system (EIAS), on a turnkey basis to Tata Consultancy Services. At present, the EIAS system covers a plethora of operations like market planning, advertising and promotion, distribution network planning, stock control,
sales and accounting, budgetary control, quality control management and co-operative service management. GCMMF has also connected all its zonal offices, regional offices and members dairies through VSATs for seamless exchange of information.

Each of GCMMF’s offices is connected by e-mail and all of them send a daily report on sales and inventory to the main system at Anand. Also, sales offices, C&F points and wholesale distributors of GCMMF have been connected through the Internet for timely exchange of information. The customized ERP EIAS is designed in such a way that it can be plugged into various points of the supply chain and external system. Moreover, the software is platform independent and can work on any operating system. GCMMF is also in the process of Web-enabling the entire supply chain so that it can capture key information at the source, and use the same for decision-making. This would include the likes of transporters, member-manufacturing units, oil packing stations, suppliers, depots and the entire field force. (Srikanth, 2002)

2.4.4 Geographic information systems

In addition to the EIAS, GCMMF has also been using Geographic Information Systems (GIS) in an innovative way. The company uses GIS in its head office and key marketing offices. Using the Indian map in GIS, the company is in a position to plot zone/depot boundary as well as a pointer for zone, depot and distributor locations, which are superimposed by product-wise sales data. This data is then used for sales and distribution planning according to the various zones. The unique thing about GCMMF’s GIS is that it is used for business planning activity at the collection level as it captures the farmer-member census information, which includes animal census data. This has enabled GCMMF to decipher information regarding milk production and productivity of animals, region wise in Gujarat. This ultimately helps in forecasting milk production according to the region and suggests remedies, if any, for a region that has a lower milk production rate. The same GIS system can also be used for monitoring veterinary health and controlling the outbreak of diseases. (Srikanth, 2002)
2.5 Problems for Milk and Milk Products in Gujarat

2.5.1 Critical issues and challenges in supply chain of Milk and Milk Products

Table 2.3 Issues and Challenges in supply chain of milk and milk products

<table>
<thead>
<tr>
<th>Stage</th>
<th>Priority</th>
<th>Agent</th>
<th>Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>Policy environment</td>
<td>Developing livestock policy</td>
<td>Dept. of Animal Husbandry, Dairying</td>
<td>• Lack of a coherent livestock development policy</td>
</tr>
<tr>
<td></td>
<td>Breed development</td>
<td></td>
<td>• Ineffective implementation of policy and projects due to lack of clarity in roles of different agencies</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Lack of resources</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Lack of clarity between roles of different departments</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Lack of regulation for quality of feed and medicines</td>
</tr>
<tr>
<td>Services</td>
<td>Disease control/health/breeding/extension services</td>
<td>Dept. of Animal Husbandry, Dairying and Fisheries, Cooperatives NGOs</td>
<td>• Inadequate coverage of veterinarian and breeding services</td>
</tr>
<tr>
<td></td>
<td>Support to dairy farmer organizations/women’s self-help groups</td>
<td></td>
<td>• Non-existent extension services</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Scope to enhance activities of NGOs in these areas</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Lack of private sector involvement in dairy development services and activities</td>
</tr>
<tr>
<td>Formal credit for animal purchase</td>
<td>Banks/financial institution Co-operatives Self-help group</td>
<td>• Very poor access to formal credit at the farm level</td>
<td></td>
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<tr>
<td>----------------------------------</td>
<td>----------------------------------------------------------</td>
<td>--------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Informal loans for animal purchase or other dairy needs</td>
<td>Trader Private company agent</td>
<td>• Very high rate of interest; farmer has to sell milk at low price to the trader if he/she has borrowed money from the trader</td>
<td></td>
</tr>
<tr>
<td><strong>Production</strong></td>
<td>Dairy farming Selling milk cooperatives/traders/private dairy agents</td>
<td>Farmers</td>
<td>• Poor management and feeding practices because of lack of information in the absence of extension activities. • Low per capita productivity of animals because of poor feeding and management practices, poor access to health and breeding services, lack of good-quality animals.</td>
</tr>
<tr>
<td><strong>Purchase &amp; Processing</strong></td>
<td>Collection of milk from farmers through village society, processing</td>
<td>Cooperative Unions Trader</td>
<td>• Lack of coverage of villages • Lack of proper cold chain infrastructure • Lack of milk and milk products’ production facilities • Maintaining quality of milk processing infrastructure • Unhygienic conditions for milk processing</td>
</tr>
</tbody>
</table>
Adulteration and quality of milk and milk products

<table>
<thead>
<tr>
<th>Marketing &amp; Distribution</th>
<th>Selling of milk and milk products processed by cooperatives</th>
<th>Federation and Co-operative unions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>• Large areas to be covered for distribution with limited cost</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Maintaining cold chain network in distribution of fluid milk and milk products</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Delivering varieties of products as per requirements</td>
</tr>
</tbody>
</table>

(Source: www.foa.org)

The major factors, which contributed to unprofitable milk production, were high cost of feeds and fodder and non-remunerative prices of milk paid by the dairy co-operatives. Limited resources, lacks of skilled and trained manpower are others challenges of the co-operative organizations. High establishment cost and low margin, absence of professional management, prevalent administrative inefficiency, illiteracy etc are other weakness of the co-operative organizations in India (Karki, 2005). Despite large volume of milk production, the average productivity of milch animals is quite low due to low genetic potential for milk production, poor nutrition and poor management and care of the milch animals (Jain et al. 1996). Proper feeding of the animals is essential for improving their productive potential. Most of the small-scale dairy farmers’ animals survive on crop residues and natural herbage (grass, tree leaves etc.) which do not provide adequate nutrients to the animals for improving their growth and exploiting their productive potential.

2.5.2 Problems in Policy Environment

The key pillars of Institutional structure providing services in Animal Husbandry and Dairy Sector are; i) Government, ii) Private Sector, iii). Producer Institution, iv) Autonomous Bodies and v) NGOs. These institutions do not have a well defined role and their functions overlap each other making assessment of their performance difficult.
There is a need to define the role of various institutions to make them more effective. For example, the Livestock Department is within the Department of Agriculture and thus the resources are biased towards agriculture. There is need to emphasize the importance of dairying to smallholder incomes to direct more resources towards dairy development. (Report of Planning Commission, 2007-12)

The Department of Animal Husbandry and Dairying is managing large infrastructure of livestock farms and fodder production stations. Many of the infrastructures are out dated and have not kept pace with the development of science and technology. The veterinary officers operate from their veterinary dispensaries to treat animals rather than approach farmers to educate and inform them about feed, fodder and animal health. There is no separate livestock production extension service. The Government of India maintains large infrastructure which is not fully utilized because of financial and bureaucratic procedure followed by these institutions. Many of the infrastructures are out dated and have not kept pace with the development in science and technology. Presently, standards and specifications for several feed ingredients and compounded feeds for livestock and poultry are available under the Bureau of Indian Standards. However, there is no control or regulatory mechanism available for imposing these standards as mandatory. (Report of Planning Commission, 2007-12)

The State Animal Husbandry Departments are the main provider of services such as livestock breeding, vaccination, primary veterinary treatment, etc. However, due to limited resources, lack of human resources, inadequate technological back-up and non-availability of superior quality inputs, these services are not available at the doorsteps of the farmers. It is generally observed that there are instances of lack of commitment, initiative and appreciation of the food safety problems in the organised the sector. There are also instances where HACCP accreditation does not necessarily translate into good food safety practices and standards. (Report of Planning Commission, 2007-12)
2.5.3 Problems in providing Livestock Services

Green fodder cultivation is very limited in Gujarat and restricted to farmers having access to irrigation facilities in the winter season. Supplementary feed in the form of concentrates is offered to milk-producing or working animals. Concentrates (compound feeds, produced commercially by cooperative and private feed factories) are available where milk cooperatives are well established, i.e., in the middle and the south of Gujarat. In some areas, limited quantities of a mix of home-made (mix of damaged grains and broken pulses) and compound feeds are offered. In general, quantity and quality of available feed resources are inadequate to meet the animal feed requirements. These widening gaps in feed availability force farmers to feed animals with poor quality materials.

Most of the farmers owning livestock do not have adequate fodder and feed resources to nurture their animals. As a result, the animals are not able to exhibit their genetic potentials. Inadequate health care further affected the production capabilities. The type of breeding programme that one can develop and the rate of genetic progress that can be achieved in a target population primarily depend on the extent of artificial insemination infrastructure available in the population. For a long time, most of the rural people were unaware of the merits of artificial insemination technology and the advantages of crossbreeding, while others who were aware about this programme had lost trust in the technology due to repeated failures. There is skepticism about crossbreeding, in spite of its proven benefits. (BAIF, n.d.) Large numbers of livestock farms are managed for the purpose of (a) production of breeding bulls and (b) preservation of various breeds of different species. These programmes are neither cost effective nor have been able to achieve their objectives. (Report of Planning Commission, 2007-12) It was stated that most of the States failed to operationalize the breeding policy due to inefficient breeding network, non-availability of quality bulls and poor economics of indigenous breeds. The presentation noted that there were large gaps in targets and achievements with regard to quality semen production, which the artificial insemination services needed to fill. The most artificial insemination service providing agencies have not given enough attention to monitor artificial insemination performance on an individual animal basis and help
farmers improve productive and reproductive performance of their animals. There is no coordination, amongst various agencies involved in breed improvement and for monitoring performance of genetic improvement programmes and artificial insemination service providing organizations.

Livestock extension service assists livestock farmers through educational process, to improve livestock farming methods and techniques, increase production efficiency and income, better levels of living, and lift the social and educational standards of rural life through livestock enterprise. But, the livestock extension policy has not received its due importance. (Nutrition Foundation of India, n.d.)

Veterinary services throughout India have traditionally been rendered by the public sector, leaving few areas where cooperatives and other NGOs provide the service. Most of the government dispensaries, hospitals and artificial insemination centers are stationary. An estimated 85 per cent of the annual non-plan state budgets are spent on salaries and other establishment cost, leaving little for drugs and vaccines. All curative as well as artificial insemination services are considered a private good and ideally be paid by the beneficiary. At present the focus of the state veterinary services is curative. At the same time, there is need to take measures related to disease prevention, control, quarantine, epidemiology, monitoring and surveillance by the state which cannot be done efficiently due to shortage of manpower. There is a need to encourage participation of private sector and NGOs in the delivery of artificial insemination services at the farmers’ doorstep. (Nutrition Foundation of India, n.d.)

The M&MPO provides for information to be filed by all registered units, but there is hardly any information available, especially on the private sector. It is important that information returns should be filed by all registered units through a single central window. However, this is not possible since both the Central Government and the State Governments are Registering Authorities. It may be pertinent to examine all registering authority to be vested centrally and making suitable budgetary provisions to provide for expenditure on this vital requirement. (Report of Planning Commission 2007-11)
2.5.4 Problems in providing Financial Services

Lack of credit for livestock production has been a major problem. Though several efforts have been made to increase the flow of institutional credit for agricultural and rural lending, there have been mismatches in credit requirement and its availability due to absence of effective local level planning.

Public sector lending is abysmally very low. The commercial banks are not favourably disposed to providing credit to livestock farmers and the cooperative credit system is very weak. The perception of bankers is that the financing of livestock activities is a risky proposition and many loans are likely to become bad. Consequently the sector does not receive credit for production activities. No short-term credit normally is given for meeting the recurring expenditure of milch cattle sheep or goat units.

Loss of livestock due to deaths caused by diseases and/or calamities gives a great setback to the poor livestock farmers. Lack of access to formal coping mechanism, such as protective cover through insurance, become a critical gap for the poor to face the situation. It is imperative to improve coverage of animals under cattle insurance, which indicates that the present coverage is abysmally low for both scheme and non-scheme animals. The reasons observed are several that include lack of awareness, affordability, lack of delivery channels that provide access at the doorsteps, problem in claims settlements, etc. from the view points of livestock holders and high cost of transaction and service from the view points of the insurance industry (Report of Planning Commission 2007-11).
2.6 Importance of Logistics Management for Milk and Milk Products in Gujarat

2.6.1 The vast and complex supply chain of co-operative dairies in Gujarat stretches from small suppliers to large fragmented markets. Managing supply chain efficiently is critical as GCMMF's competitive position, which is driven by low consumer prices supported by a low cost system. Given the large number of organizations and entities in the supply chain and decentralized responsibility for various activities, effective coordination is critical for efficiency and cost control. GCMMF and the unions play a major role in this process and jointly achieve the desired degree of control. (Chandra and Tirupati, 2002)

2.6.2 The sustained growth for the long term would depend on matching supply and demand. It would need heavy investment in the simultaneous development of suppliers and consumers. A hierarchical network of cooperatives forms the robust supply chain behind co-operative dairies’ endeavors. Management of this network is made more complex by the fact that GCMMF and other co-operative unions is directly responsible only for a small part of the chain, with a number of third party players (distributors, retailers and logistics support providers) playing large roles (Chandra and Tirupati, 2002). The unions’ core activity lay in milk processing and the production of varieties of dairy products. Accordingly, marketing efforts (including brand development) are performed by GCMMF. All other activities were entrusted to third party service providers. These include logistics of milk collection, distribution of dairy products, sale of products through dealers and retail stores, provision of animal feed, and veterinary services thereby taking advantage of the local, small and medium enterprises. In such cases large network is built by forging linkages with these third party firms thereby reducing the operational risk while providing a credible source of understanding the behaviour of the consumer through the experience of these firms. It also provides operational flexibility and makes the network responsive to changes within and outside. It requires the decision-making be decentralized to the extent possible, with
appropriate coordination mechanisms to ensure consistency in the logistics system throughout supply chain. (Chandra and Tirupati, 2002)

2.6.3 Standardization is one of the critical factors in management of logistics of milk and milk products’ supply chain. There are two kinds of standards to be maintained: the first one is the food standard that concerns itself about the content and the manufacturing process and the packaging, etc. and the second standard concerns regarding the logistics and IT systems like standardization of cartons, pallets and IT software so that seamless transfer of goods and information is possible. Standards enable partners across the supply chain to enjoy increased productivity and economies of scale due to better compatibility and interoperability of their systems and processes.

2.6.4 The temperature controlled during supply chains or cold chains are a significant proportion of the milk and milk products’ market. There are several food temperature levels to suit different types of milk and milk products. Failure to maintain appropriate temperature regimes throughout the product life cycle may shorten the product life or adversely affect its fitness for consumption. So, the logistics challenge is formidable in milk and milk products, which is cost conscious industry. It is important to note that a number of third parties managing logistics of varieties of milk and milk products are not in the organized sector and many are not professionally managed with little regard for quality and service. This is a particularly critical issue in the logistics and transport of perishable milk and milk products.

2.7 Summary

The co-operative dairies operating under GCCMF holds the dominant position in production and sales of fluid milk and milk production in Gujarat. The flourishing growth of Gujarat in terms of increasing literacy rate, per capita income, urbanization and development of infrastructure creates opportunity for escalation in growth of co-operative
dairies. The higher productivity and good quality of milch animals in Gujarat adds into better growth of milk production in Gujarat. A hierarchical network of cooperatives increases the complexities to match supply and demand through logistics system. The various issues involved in logistics management and use of third party logistics service providers and information technology in logistics management under co-operative structure have been described in detail in this chapter.
2.8 References


11. www.amul.com/


Chapter 3: Literature Review

3.1 Logistics Management

3.1.1 Introduction

The Indian industry spends 14 per cent of its gross domestic products on logistics (Sahay and Mohan, 2006). The Indian logistics environment comprises road transport companies, railways, airfreight companies, inter-modal transport providers, ports and shipping companies, as well as 3PL companies.

3.1.2 Defining Logistics

Various terms have been used to define logistics, over the years, like business logistics, physical distribution, material logistics and total distribution. Marketing logistics refers to that part of logistics, which deals with the finished goods (kapoor and Kansal, 2003). The field of logistics is early as old as man himself. Its activities were carried out when man first began forming more goods than could be consumed at the point of manufacturing to the point of consumption, logistics was born (Heskett, 1973).

A logistics management system comprises a variety of components: corporate headquarters; retail stores; distribution centers (DCs); suppliers; manufacturers; distributors; carriers; networks; information service providers; insurers; and bankers. According to Raghuramang and Rangarajan (2000), out of total logistics cost, 45% is spent on transportation, 25% on inventories, 6% on losses, 30% on packing, material handling and warehousing operations and 6% on customers’ shopping.
Bowersox (1990) defined logistics as “a single minded logic to guide the process of planning, allocating and controlling financial and human resources committed to physical distribution, manufacturing, support and purchasing organizations.

Novack et. al (1995) defined logistics as an “activity involving the creation of time, place, form and possession utilities within and among firms and individuals through strategic management with the goal of creating products/services that satisfy customers through attainment of value.

3.1.3 Logistics and Physical Distribution

In 1948, AMA formulated a set of definitions, which included one for physical distribution (logistics): The movement and handling of goods from the point of production to the point of consumption of use (Definition committee of AMA, 1948). National Council of Physical Distribution Management (now known as Council of Logistics) had adopted a restrictive definition: “physical distribution is the term employed in manufacturing and commerce to describe the broad range of activities concerned with efficient movement of finished products from the end of production line to the consumer and in some cases includes the movement of raw material from the source of supply to the beginning of the production line”. The activities include freight transportation, warehousing, material handling, protective packaging, inventory control, plant and warehouse site selection, order processing, marketing forecasting and customer service (Kapoor and Kansal, 2003).

The terms physical distribution and logistics were used interchangeably until the late 1980s. But, the two terms are different because the view that logistics and physical distribution are the same seriously underestimates the cost of moving and storing semi-finished goods and altogether ignores the expense of necessary planning and computer systems. It further obscures the reasons for poor delivery, high finished goods inventory and rising transport costs.
In 1986, Council of Logistics Management modified its 1976 definition of physical distribution and defined logistics as: “The process of planning, implementing, and controlling the efficient, cost-effective flow and storage of raw materials, in-process inventory, finished goods and related information from point of origin to point of consumption for the purpose of conforming to customer requirements.” This definition implies that there exist four flows in a logistics system: material flow, merchandise flow, money flow, and information flow (Cooper et al., 1997).

Logistics is larger in terms of scope than physical distribution. Physical distribution is only concerned with creation of time and place utilities, while logistics is concerned with creation of time, place, form and possession utilities. Physical distribution includes only outbound logistics, while logistics include inbound, processing as well as outbound logistics (Kapoor and Kansal, 2009)

### 3.1.4 Logistics and Supply Chain Management

The 1986 Council of Logistics Management definition of logistics has been augmented to include services along with goods and information movement. From a comparison of the understanding of integrated logistics management and the characteristics of SCM as described by most authors, it is unclear what specific characteristics differentiate the two disciplines. For many, the contemporary understanding of SCM is not appreciably different from the understanding of integrated logistics management, however broadly logistics is defined (Lambert et. al, 1998). But, the CLM definition makes it clear that logistics was always intended to be from dirt-to-dirt. Other view of SCM includes more functions than logistics being integrated across firm boundaries. Lambert et al (1998) found a need for the integration of business operations in the supply chain that goes beyond logistics.

Scott and Wrestbrook (1991) defined SCM as the chain, linking element of the manufacturing and supply process from raw material through to the end user,
encompassing several organizational boundaries and treating all organizations within the value chain as a unified virtual business entity.

Stock (2001) defined logistics as an important part of supply chain management and corporate strategy and an activity that can create not only cost savings and efficiencies, but also competitive advantage in the marketplace.

Competitive Excellence (1994) defined SCM as: “the integration of business processes from end user through original suppliers that provides products, services and information that add value for customers”. A conceptual framework is proposed, which considers SCM as a broader discipline than just integrated logistics management properly implemented. Logistics seeks to create a single plan for flow of product and information through business, it is planning oriented. While SCM not only seeks to create single plan for flow of goods and information through business, but also aims to achieve linkages and co-ordination between process of other entities in the chain, like supplier, customers and other members (Kapoor and Kansal, 2009).

SCM was viewed as logistics outside the firm to indicate customers and suppliers. Logistics as defined by the CLM always represented a supply chain orientation, “from point-of-origin to point-of-consumption”. It is probably due to the fact that logistics is a functional silo within companies and is also a bigger concept that deals with the management of materials and information flows across the supply chain. The understanding of SCM has been re-conceptualized from integrating logistics across the supply chain to the current understanding of integrating and managing key business processes across the supply chain. The modified definition explicitly declares CLM’s position that logistics management is only a part of SCM. (Lambert et. al, 1998)
3.1.5 Functional Areas of Logistics

Logistics covers the following functional areas, called Logistics Mix (Sople, 2004):

1. Information flow
   - Order registration
   - Order checking and editing
   - Order processing
   - Coordination

2. Warehousing
   - Material storage
   - Load unitizing and material handling
   - Site selection and network planning
   - Order picking and filling
   - Dispatch documentation

3. Inventory control
   - Material requirement planning
   - Inventory level decisions for customer service objectives

4. Packaging
   - For handling and damage prevention
   - For communication
   - For inter-modal transportation

5. Transportation
   - Route planning
   - Mode selection
   - Vehicle scheduling
Logistics delivers value to the customer through three logistical phases:

1. Inbound logistics: It precedes the manufacturing operations. This includes movement of raw materials and components for processing from suppliers.

2. Process logistics: It is directly related to the processing of the manufacturing the final product. This includes storage and movement of raw materials and components within the manufacturing premises as per manufacturing schedules and the inventory management of stored materials and in-process goods.

3. Outbound logistics: It follows the actual manufacturing process. It includes the warehousing, transportation and inventory management of finished products.

Kapoor and Kansal (2009) described the most comprehensive list of various functions involved in logistics. Logistics activities include the following functions:

- Procurement
- Plant and warehouse selection
- Demand forecasting
- Customer service
- Order processing
- Traffic and transportation
- Inventory control
- Warehousing and storage
- Packaging
- Material handling
- Distribution communication
- Handling of returned goods
- Parts and service support
- Salvage and scrap disposal
3.2 Logistics Flexibility

3.2.1 Introduction

In market conditions, increasingly levels of product variety and customization, the ability to respond to customer orders in a timely fashion can provide a critical competitive advantage (Reichhart and Holweg, 2007). Companies are indicating that responsiveness and flexibility are the keys to responding to markets, which are rapidly changing and where customers are requiring a range of products and services. (Cunningham, 1996). To succeed in an increasingly uncertain environment, firms must respond to changing customer needs in terms of special treatment in design, production, and delivery, which require firms to view flexibility from a supply chain perspective rather than an equipment or process perspective (Day, 1994).

It is not clear in literature whether flexibility, responsiveness and agility are synonymous or distinct concept. Bernardes and Hanna (2009) described that the flexibility could be subsumed within agility and both these may be subsumed within responsiveness. Hence, it suggests that a manufacturing firm could develop competence for flexing, within agile capability to reconfigure as and when needed, within a strategic vision of responsiveness.

3.2.2 Defining Flexibility

3.2.2.1 A great deal of research into defining various types of flexibilities in manufacturing has occurred over the last two decades (Kumar et. al, 2006). Despite this, there is no general agreement on how to define flexibility. The early definitions of manufacturing flexibility are concerned with the ability to effectively adapt to changing circumstances, but they failed to define what ability means. The modified definition of flexibility is the reactive capability of the management to the uncertainty faced by an organization. The coordination of sourcing, making and distribution enhances the company’s ability to respond to
market changes by eliminating redundant activities and reducing response time. Logistics flexibility includes many activities such as organizing inbound and outbound shipments, providing manufacturing support, and supplying information to coordinate these efforts.

3.2.2.2 Gerwin (1987) defined flexibility as an ability to respond effectively to changing circumstances. Cox (1989) defined it as the quickness and ease with which plants can respond to changes in market conditions. Sethi and Sethi (1990) defined it as the adaptability of a system to a wide range of possible environments that it may encounter. Ramesesh and Maliyakal (1991) described flexibility as the ability of a manufacturing system to generate high net revenues consistently across all conceivable states of the nature in which it may be called to function. Gupta and Somers (1992) were of the view that flexibility is the ability to cope with changing circumstances or instability caused by the environment. Nagarur (1992) described it as the ability of the system to quickly adjust to any change in relevant factors like product, process, loads, and machine failure. Newman et al. (1993) simply described flexibility as a response to external uncertainty. Day (1994) defined flexibility as ability of a firm to respond quickly and efficiently to changing customer needs in inbound and outbound delivery, support, and services. Upton (1994, 1995b) defined it as the ability of a manufacturing system to change states across an increasing range of volume and/or variety, while adhering to stringent time and cost metrics. Small and Chen (1997) described it as the ability to respond quickly to changing customer needs at reasonable price. Vokurka and Fliedner (1998) described flexibility as the capability of an organization to move from one task to another quickly and as a routine procedure. Das (2001) described it as the ability of a manufacturing system to change states across an increasing range of volume and/or variety, while adhering to stringent time and cost metrics. Zhang et al. (2002) defined flexibility as the organization’s ability to meet an increasing variety of customer expectations without excessive costs, time, organizational disruptions or performance losses. Holweg (2005) defined it as a generic ability to adapt to internal and/or external influences.
3.2.3 Types of Flexibility

3.2.3.1 Flexibility can be reactive or proactive or adaptive or redefined (Bernardes and Hanna, 2009). A number of classifications have been developed to describe flexibility. Slack (1983) identified five types of flexibility which are more at a manufacturing system level: product performance, product mix, quality, volume and delivery and two dimensions for each type of flexibility, which are range and response (mobility). Expanding on Slack’s framework, Upton (1995a) identified a third dimension of flexibility called uniformity. The significance of uncertainty in the understanding of flexibility is used by Gerwin (1987), to link different types of uncertainty with seven distinct elements of what could be regarded as operational level flexibility: Mix flexibility, Changeover flexibility, modification flexibility, rerouting flexibility, volume flexibility, material flexibility and sequencing flexibility. Sethi and Sethi (1990) presented an augmented set of 11 types, which are grouped into basic flexibilities (machine, material handling, and operation), system flexibilities (process, routing, product, volume, expansion) and aggregate flexibilities (programme, production, market). Two broad interpretations can be put on the inter relationships between these. Basic flexibilities influence those at the system level, which determine aggregate flexibility. Alternatively manufacturing strategy should indicate the required aggregate flexibilities, which determine the necessary system flexibility and themselves establish the necessary basic flexibilities.

3.2.3.2 Vickery et al. (1999) defined five supply chain flexibilities, which include product flexibility, volume flexibility, new product flexibility, distribution flexibility and responsiveness flexibility. Koste and Malhotra (1999) also conducted a comprehensive review of the manufacturing flexibilities and proposed four elements of flexibility: range-numbers, range-heterogeneity, mobility and uniformity. Duclos et al. (2003) explored six components of supply chain flexibility: operations system flexibility, marketing flexibility, logistics flexibility, supply flexibility, organizational flexibility and information system flexibility.
Pujawan (2004) presented a framework for assessing flexibility of a supply chain. Four main dimensions of flexibility are delivery flexibility, production flexibility, product development and sourcing flexibility. Kumar et al. (2006) considered five dimensions of supply chain flexibility, which are sourcing, developing new products, product customization, responsiveness and delivering the finished products.

3.2.3.3 From the literature it is difficult to see a totally consistent view concerning the types of dimensions of flexibility. The conceptual literature indicates that the domain of any type of flexibility is defined by four building blocks of range-number, range-variety, mobility and uniformity (Bernardes and Hanna, 2009). There is a need explore specific types of flexibility in relation to the particular settings of each chain to fully exploit the competitive potential (Holweg, 2005).

3.2.4 Components and Attributes of Logistics Flexibility

3.2.4.1 Basically, Logistics flexibility includes internal competences means what the firm can do and control but customers cannot see, and external capabilities, that customers see and value (Zhang et al., 2002). Upton (1995a/b) described two types of logistics flexibility, internal flexibility that focuses on internal competence and external flexibility that focuses on market responsiveness. He found that internal flexibility is the internal means by which external flexibility can be achieved. A capability is a customer desired and visible strength that depends on other strengths within the firm. The internal strengths are called competence (Zhang et al., 2002). Capabilities are complex bundles of skills and accumulated knowledge, exercised through organizational processes that enable firms to coordinate activities and make use of their assets (Day, 1994). Competence and capability correspond to secondary and primary flexibility respectively. Flexible capability can be viewed as a linkage among corporate, marketing and manufacturing strategy. Flexible competence provides the
processes and infrastructure that enable the firm to achieve the desired levels of capability.

3.2.4.2 The logistics competence and capability make disproportionate contribution to the provision of superior customer value as defined from the customer's perspective or permits the business to deliver value to customers in an appreciably more cost-effective way. Logistics competence and capabilities contribute to a firm’s competitiveness through creating economic (cost leadership) and market-based (differentiation) values. In this respect, a distinctive capability functions like a key success factor. Initiatives to enhance market sensing and customer linking capabilities are integral to broader efforts to build a market-driven organization. Strategies that emphasize creating customer value depend on building distinctive market-sensing and customer-linking capabilities and using these capabilities to guide the internal competence (Day, 1994).

3.2.4.3 Customers are unlikely to be aware of or interested in the underlying processes that yield the superior value they receive. Thus, one of the critical management tasks is to decide which capabilities to emphasize, which is dictated by how they choose to compete (Day, 1994). It is the ability of the business to use inside-out capabilities to exploit external possibilities that matters, but there has to be a matching "outside-in" capability to sense these possibilities and decide how best to serve them. (Day, 1994) The goal of logistics, both inside and outside a firm within a supply chain, is to enhance end-customer value.

3.2.4.4 Capabilities can be usefully sorted into three categories, depending on the orientation and focus of the defining processes (Day, 1994). At one end of the spectrum are those that are deployed from the inside out and activated by market requirements, competitive challenges, and external opportunities. Examples are manufacturing and other transformation activities, logistics, and human resource management, including recruiting, training, and motivating employees. At the other end of the spectrum are those capabilities whose focal point is almost
exclusively outside the organization. The purpose of these outside-in capabilities is to connect the processes that define the other organizational capabilities to the external environment and enable the business to compete by anticipating market requirements ahead of competitors and creating durable relationships with customers, channel members, and suppliers. Finally, spanning capabilities are needed to integrate the inside-out and outside-in capabilities. Strategy development, new product/service development, price setting, purchasing, and customer order fulfillment are critical activities that must be informed by both external (outside-in) and internal (inside-out) analysis.

3.2.4.5 The concept of logistics flexibility is confounded because the attributes of flexibility (i.e., range, mobility and uniformity) and the components of flexibility (e.g. purchasing flexibility and demand management flexibility) are often mingled (Zhang et al., 2005).

3.2.4.6 The attributes of flexibility involve increasing the range of products available, improving the firm’s ability to respond quickly and achieving good performance across these products. Flexibility seeks to increase range/variety, improve mobility/responsive and achieve uniform performance (Zhang et al., 2005). Range is the firm’s ability to design, make and distribute different products (Slack, 1983). Mobility is the speed at which a firm can change from one product to another (Slack, 1983). Uniformity is the ability to maintain performance standards as a firm switches among products, which implies the ability to maintain high quality as per changes in products (Upton, 1995).

3.2.4.7 Logistics flexibility has four components (Zhang et al., 2005): physical supply flexibility and purchasing flexibility, which are competences and physical distribution flexibility and demand management flexibility, which are capabilities.

1. Physical Supply Flexibility: The ability of a firm to provide a variety of inbound materials and supplies for production, quickly and effectively.
2. **Purchasing Flexibility**: The ability of a firm to make agreements to buy a variety of materials and supplies, quickly and effectively.

3. **Physical Distribution Flexibility**: The ability of a firm to adjust the inventory, packaging, warehousing and transportation of physical products to meet customer needs, quickly and effectively.

4. **Demand Management Flexibility**: The ability of a firm to respond to the variety of customer needs for service, delivery time and price, quickly and effectively.

3.2.4.8 Customers value the visible capabilities, physical distribution flexibility and demand management flexibility rather than the supply side competences Physical Supply Flexibility and Purchasing Flexibility because customers see how capabilities are deployed to meet their needs. Physical Distribution Flexibility and Demand Management Flexibility cannot be achieved without flexible logistics competences that support the manufacturing process. This dichotomy of flexible logistics competence and capability enables managers to develop a comprehensive view of flexibility.

<table>
<thead>
<tr>
<th>Logistics flexibility</th>
<th>Range</th>
<th>Mobility</th>
<th>Uniformity</th>
<th>Competence or Capability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Supply Flexibility</td>
<td>Variety or materials and number of inbound transport modes</td>
<td>Time &amp; efficiency of different materials moved</td>
<td>Quality and supply dependability across various materials</td>
<td>Indirectly impacts customer by supplying materials quickly and efficiently</td>
</tr>
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</table>
3.2.4.9 Logistics flexibility enables firms to customize product and service offerings without increasing stock levels (Zhang et al., 2005). While functional products with predictable demand benefit most from “physically efficient processes”, innovative products demand “market responsive” processes that focus on speed and flexibility rather than on cost (Storey et al., 2005). With flexible logistics competence/capability, bundles of services such as adding product features or providing specific packaging, labeling and product configuration can be aligned with individual customer needs. The internal competences and customer-facing capabilities that comprise logistics flexibility should be explained and the relationships between them should be examined (Zhang et al., 2005).

3.2.5 Importance of Manufacturing Flexibility

3.2.5.1 The business is facing change pressure that call for efforts to reinforce production efficiency while also improving flexibility and responsiveness to specific
customer requirements (Juga, 1996). In recent years, manufacturing industry has experienced an unprecedented degree of change, changes in management, process technology and customer expectations, supplier attitudes, competitive behavior and many more aspects. Together these changes have come to represent a fundamental shift in the way companies view, manage and conduct their business. Today, manufacturing flexibility is defined as the ability of the manufacturing system to produce wide variety of final products, without intervention from outside to change the system (Kumar et al., 2006). A major project being undertaken to examine issues associated with the ability of manufacturing companies to adapt at a strategic level to their changing environment, which has been referred to as the strategic flexibility of a company (Beach et al., 2000).

3.2.5.2 The issue of manufacturing flexibility is assuming increasing importance in production management (Zhang et al., 2006). The need for manufacturing flexibility is growing due to the changing nature of competition which is based more than ever on constantly improving the technical characteristics of products and being responsive to differing customer requirements (Gerwin, 1987). In manufacturing, the flexibility is typically defined in terms of range, mobility and uniformity, i.e., the various states a system can adopt, the ability to move form making one product to making another product and the ability to perform comparably well when making any product within a specified range. (Stevenson and Spring, 2007) So, the manufacturing activities should be included in the research, which is an interface between physical supply flexibility and purchasing flexibility on one side and physical distribution flexibility and demand management flexibility on the other (Zhang et al., 2005).

3.2.5.3 Two forces shape the organization of logistics flexibility management (Zhang et al., 2005). One is centripetal, gathering functional activities into one organizational unit. The number and types of functions included within the organization under this concept become a measure of the logistics sophistication of the organization. The opposing force is centrifugal, characterized by
outsourcing, partnerships and alliances. This is part of a larger trend within business to shift functional activities which are not part of the core business of the organization and which do not contribute unique value to the organization to outside parties (Schary and Coakley, 1991). Logistics is often technology driven (Mentzer et al., 2004). Advance information technology such as the internet provides real-time information, which enables logistics flexibility and precise order information. The most effective logistics systems do not automatically mean more automated and sophisticated procedures and machines, but seem to rely on a more flexible logistics strategy (Cunningham, 1996).
3.3 Third Party Logistics Service Providers

3.3.1 Introduction

3.3.1.1 In recent years, there has been growing trend of outsourcing of logistics activities in a wide variety of industrial sectors. As a result, there has been an emergence of large companies that have the capabilities to offer sophisticated logistics solutions, known as logistics service providers.

3.3.1.2 Various terms have been used interchangeably to describe the organizational practice of contracting out part of or all logistics activities like logistics outsourcing, logistics alliances, third party logistics, contract logistics and contract distribution (Berglund et al. 1999, Aertsen, 1993, Bagchi and Virum, 1996, Bowersox, 1990). Third party logistics is usually associated with the offering of multiple, bundled services, rather than just isolated transport or warehousing functions. 3PL activities are based on formal contractual relations.

3.3.1.3 Virum (1993) put forward the “Nordic” definition of third-party logistics as: The services offered by a middleman in the logistics channel that has specialized in providing, by contract, for a given time period, all or a considerable number of logistics activities for other firms. Langley et al. (1999) defined third-party service provider as: A company that provides multiple logistics services for its customers, whereby the Third-party logistics provider is external to the customer company and is compensated for its services. Berglund et al. (1999) defined third-party logistics as “activities carried out by a logistics service provider on behalf of a shipper and consisting of atleast management and execution of transportation and warehousing. The third party normally takes the possession of goods but does not take title and provides its services for a price. (McGinnis et al., 1995) The major reasons cited for usage of 3PL services include – cost reduction (27 per
cent), strategic reasons (26 per cent), process effectiveness (24 per cent), and lack of internal capability (11 per cent) (Sahay and Mohan, 2006).

3.3.1.4 The level of analysis of 3PL research can be studied at three levels: the firm, the dyad and the network. The majority of the studies focus on the firm level (67%), examining issues from either shipper’s or the Logistics Service Provider’s viewpoint. Regarding the dyadic level, the literature concentrates on different aspects of the Logistics Service Provider - client relationship (contracting). Very few studies (6%) exist at the network level (triads) (Selviaridis and Spring, 2007).

3.3.2 **Decision to outsource Logistics Function**

3.3.2.1 The decision to outsource logistics activities depends on number of internal and external considerations. Several factors such as centrality of logistics function, risk and control, cost/service trade-offs, information technologies and relationships with Logistics Service Providers affect the outsourcing decision. Product related (e.g. special handling needs), process related (e.g. cycle times) and network related (e.g. locations served) drivers are believed to have an indirect influence in the outsourcing decision (Rao and Young 1994). McGinnis et al. (1995) found that the logistics strategy is affected by competitive responsiveness, external environmental hostility and environmental dynamism. The factors like changes in business environment, increased competition, pressure for cost reduction and the resulting need to restructure supply chains have led to use of Logistics Service Providers (Bagchi and Virum, 1996 and Van Laarhoven and Sharman, 1994).

3.3.2.2 Van Damme and pools van Amstel (1996) explained that the do or buy decision is affected by evaluation of cost/service trade-offs. Cost associated with performing logistics activities in-house and investment in capital assets is traded-off against service provider fees. But, the cost is not the single most important decision variable and logistics service issues are also considered. Generally third-party
logistics decision considers the subject from a shipper’s point of view, but relatively little has been written about outsourcing from the provider’s point of view (Berglund et. al, 1999). Hong (2004) discuss determinants of outsourcing in terms of shipper firm’s characteristics. Daugherty and Droge (1997) linked the logistics outsourcing decision with the shipper’s organizational structure. Organizations that have decentralized line activities at the business level are expected to outsource more in comparison to shippers that organize theirs centrally.

3.3.2.3 Logan (2000) suggested three strategic theories to evaluate outsourcing decision: RBV (Resource Based View), TCE (Transaction Cost Economies) and AT (Agency theory). RBV evaluates the ability of the provider to use its core competencies to service the user. TCE theory shows that high asset specificity coupled with difficulties in performance measurement should lead to in-house distribution (Aertsen, 1993). The high asset specificity is associated with in-house warehousing, whereas high transaction frequency leads to outsourcing. But, 3PL providers must be used in the case of medium specific assets or in case of high asset specificity, but, low uncertainty. As per AT, there must be a synergy between service providers and users in terms of their goals, values and behaviors.

3.3.3 Benefits and Costs of using Third party Logistics Service provider

3.3.3.1 The decision process of outsourcing is based on an evaluation of the costs and benefits of outsourcing (Hong, 2004). The principle behind 3PL (third party logistics) is to concentrate on core activities and rely on experts (third party logistics service providers) for other critical activities (La Londe and Maltz, 1992). In doing so, companies can direct scarce resources for developing core competence and outsource critical activities like logistics on expert third party providers for whom logistics is the core activity (Bagchi and Virum, 1996). The relationship with third party logistics service providers increases efficiency and

3.3.3.2 Three kinds of benefits can occur using third party logistics: strategy, finance and operations related (Selviaridis and Spring, 2007). Outsourcing of non-strategic activities enables organizations to focus on core competence and exploit external logistical expertise (Sink and Langley, 1997). Logistics outsourcing provides many cost-related advantages such as reduction in asset investment, labour and equipment maintenance cost (Bardi and Tracey, 1991). Postponement can be another benefit, which enhances the ability of the firm to compete on time while remaining cost competitive (Bhatnagar and Vishwanathan, 2000) The multiple customers can be approached, which spreads logistics costs among wide number of customers, which provides the benefit of economies of scale. third party logistics users can enhance their flexibility with regard to market (investment) and demand (volume Flexibility). In an era of increased competition, globalization and the need for reduced order cycle time and inventory levels, the firms can be more responsive to market situations based on effective logistics alliances (Bolumole, 2001). Other benefits include reduction in inventory levels, order cycle time, lead-times and improvement in customer service (Bhatnagar and Vishwanathan, 2000). The contract logisticians convert a fixed cost in to variable cost for users. (Razzaque and Sheng, 1998)

3.3.3.3 One of the reasons given for limiting the extent of outsourcing the strategic level activities is the retailers’ perception of the risks of outsourcing, the most commonly cited was the increased dependence on service providers (Bolumole, 2001). One of the most obvious risks associated with using third party logistics is loss of control over the logistics function and loss of in-house capability and customer contact (Ellram and Cooper, 1990). So generally companies employ mixed strategy regarding logistics and retain important logistics activities (e.g. order management) in-house (Wilding and Juriado, 2004). The lack of responsiveness to customer needs is also one of the important problems in logistics outsourcing (van damme and ploos van amstel, 1996). The cost reduction
is not clearly found out due to unrealistic fee structures of service providers (Ackerman, 1996). Cost saving evaluation can be difficult due to the shipper’s lack of awareness of internal logistics costs. Other problems associated with 3PL are inferior service performance, disruption to inbound flows, inadequate provider expertise, inadequate employee quality, sustained time and effort spent on logistics, loss of customer feedback and inability of third party logistics providers to deal with special product needs and emergency circumstances (Ellram and Cooper, 1990; Gibson and Cook, 2001; Sink and Langley, 1997 and Svenssson, 2001). Certain difficulties like lack of understanding of client’s supply chain needs, lack of adequate expertise in specific products and markets, unrealistic customer expectations, inadequate description of services and service levels, lack of logistics cost awareness by the client and lack of third party logistics innovation are impediments for designing and implementing third party logistics (Ackerman, 1996; Ellram and Cooper, 1990). Gibson and Cook (2001) identified that the most significant problem faced by third party logistics firms is finding qualified people.

3.3.3.4 There is a mismatch between demand and supply for logistics services (Murphy and Poist, 1998). Logistics Service Providers expand their offerings to include information systems, consulting, contact manufacturing and even purchasing and financial services, there is a low demand of such services and buyers prefer to outsource transport and warehouse related functions (Lieb and Randall, 1999). The majority of the studies focus on demand side of third party logistics such as services used, usage rate, contract renewal rates, outsourcing costs and geographical spread of services. Overall, there is eminence of transport, warehouse and administration related services and validate the continuing growth of logistics outsourcing (Murphy and Poist, 1998). There is a weak demand for value added solutions such as information systems, fourth party logistics and manufacturing related services. The bulk of logistics services bought still remain in the areas of transportation and warehousing.
<table>
<thead>
<tr>
<th>Variables</th>
<th>Description</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct Delivery</td>
<td>Ability to deliver products at the right destination</td>
<td>McGinnis et al. (1995), Razzaque and Sheng (1998)</td>
</tr>
<tr>
<td>Inventory Accuracy</td>
<td>Ability to maintain accurate inventory records and follow up</td>
<td>Bolumole (2001), Bhatnagar and Vishwanathan (2000), Bardi and Tracy (1991), Selviaridis and Spring (2007)</td>
</tr>
<tr>
<td>Quality of Services</td>
<td>Ability to provide services as per predefined standards effectively</td>
<td>La Londe and Maltz (1992), Menon et al. (1998), Daugherty and Droge (1999), Sarel and Zinn (1992), Selviaridis and Spring (2007)</td>
</tr>
<tr>
<td>Customization</td>
<td>Ability to customize the products and services as</td>
<td>Rao and Young (1994), Bardi and Tracy (1991), Razzaque and</td>
</tr>
<tr>
<td>Category</td>
<td>Description</td>
<td>Sources</td>
</tr>
<tr>
<td>---------------------------------------</td>
<td>----------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Shipments in terms of Value/Volume</td>
<td>Ability to handle large shipments in terms of value/volume</td>
<td>Bhatnagar et al. (1999), Selviaridis and Spring (2007), Sahay and Mohan (2006)</td>
</tr>
<tr>
<td>Communication System</td>
<td>Ability to communicate error free, timely and cost effective manner</td>
<td>Stank (1996), Bienstock (2002), Daugherty and Droge (1999)</td>
</tr>
<tr>
<td>Sensitive Information Sharing</td>
<td>Ability to share common information effectively with customers and organization</td>
<td>Bardi and Tracy (1991)</td>
</tr>
<tr>
<td>Quick Response</td>
<td>Ability to respond to organization and retailers or customers when and where required</td>
<td>Mcginnis et al. (1995), Bolumole (2001), Sarel and Zinn (1992)</td>
</tr>
<tr>
<td>Customer Complaint</td>
<td>Ability to solve complaints of retailers/customers or communicated it to the organization</td>
<td>Bhatnagar et al. (1999), Selviaridis and Spring (2007)</td>
</tr>
<tr>
<td>Total Order Cycle Time</td>
<td>Ability to respond quickly (with minimum time to the customer orders</td>
<td>Rao and Young (1994), Bolumole (2001), Bhatnagar and Vishwanathan (2000),</td>
</tr>
<tr>
<td>Fill Rate</td>
<td>Proportion of orders that can be met by available inventory</td>
<td>Bhatnagar et al. (1999)</td>
</tr>
<tr>
<td>Use of Technology</td>
<td>Extent to which technology is used in operation</td>
<td>Rao and Young (1994), Sauvage (2003), Bardi and Tracy (1991)</td>
</tr>
</tbody>
</table>
3.3.4 Selection of Third Party Service Provider Firm

3.3.4.1 Purchasing framework: The definition of service requirements appear to be more difficult, criteria for third party logistics selection extend far beyond price considerations and contracts are much more detailed when buying advanced logistics solutions (Andersson and Norman, 2002). Sink and Langley (1997) focused on process issues such as need identification, top management commitment, formation of cross-functional buying team, development of selection criteria and service implementation. Bagchi and Virum (1998) also focused on process but they also included dealing with post-contracting issues such as performance measurement and goal redefinition. So, in all, they have emphasized the need awareness as the starting point of the process.

3.3.4.2 Selection criteria for third party logistics service providers: Logistics outsourcing represents a specifically defined contractual relationship, which is dependent on third party logistics’ meeting specified performance criteria set by the outsourcing organizations (Bolumole, 2001). Many organizations now argue for selective or smart sourcing as an approach to balance efficiency and effectiveness in logistics services. Several criteria for logistics service provider choice have been discussed in the literature, which include cost, service quality and reliability, flexibility, responsiveness to requests and financial stability. Some studies have given importance to cost, while others have given importance to service performance and quality requirements (La Londe and Maltz, 1992 and Menon et al., 1998). Qualitative factors such as supplier reputation, references from clients and response to information requests are used for initial screening (Sink and Langley, 1997). So, the criteria seem to apply to all third party logistics purchasing circumstances, irrespective of buyer characteristics and special requirements.

3.3.4.3 The rise in use of third party logistics service is due to several factors like reduction in asset intensity, reduction in labour costs and restructuring of
distribution, industry deregulation and declining profit margins in basic services (Berglund et al., 1999). First, many transportation and warehousing firms have developed into third party logistics providers. Then firms that specialize in express parcel deliveries entered the market. And recently, companies originally specializing in financial services, IT services and management consulting entered the market by developing competences in information systems and supply chain planning (Anderson consulting). (Berglund et al., 1999 and Hertz and Alfredsson, 2003)

3.3.4.4 Today IT services are being used to offer real-time information to clients and enhance their visibility for supply network members (Piplani et al., 2004). Concepts such as fourth party logistics and lead logistics providers (LLP) have also been introduced for integrated management of supply chain (Skjoett-Larsen, 2004). Various classifications of logistics service providers have been proposed between asset based and non asset based logistics service providers (Razzaque and Sheng, 1998 and Sheffi, 1990). Asset based providers own physical assets such as truck fleets and warehousing and focus on the management and execution of transport and warehouse-related activities. Non-asset based firms rely on human expertise and information systems and offer management oriented services, sub-contracting physical distribution activities to asset based companies. There is a gradual shift from asset based to system (non-asset) based providers and distinguished between service and solution (Berglund et al., 1999).

3.3.4.5 The nature of third party logistics relationships is a function of service offering composition, contract duration and the client’s motivation for outsourcing. The four main factors have been identified that substantially influence the role of third party logistics service providers in logistics function: the client organization’s strategic orientation, its reasons for outsourcing and subsequent perception of third party logistics service providers’ function within the logistics strategy, the nature of the resultant client- third party logistics service provider
relationship and the extent to which the logistics process is outsourced (Bolumole, 2001)

3.3.4.6 The partnerships between logistics service providers and the manufacturers develop gradually, as the number of outsourced activities increases over time (Bhatnagar & Vishwanathan, 2000 and Bowersox, 1990). The buyers are looking forward towards specific solutions initially to check the provider’s capabilities. Over the time, the scope of the relationship increases and the offering expands to include more value-added or complete packages of services and customized solutions (Persson and Virum, 2001). The relationship between buyer and seller of logistics function is on a continuous scale going from single transaction to integrated service agreements (Skjott-Larsen, 2004). He identified four stages from simple use of logistics service providers to highly integrated logistics service provider: Market exchange, Customized logistics solutions, Joint logistics solutions and In-house logistics solutions. Social exchange theory suggests that the exchange process evolves over time as organizations mutually and sequentially demonstrate greater levels of trust and commitment. In other words, relationship partners move gradually from episodes of social exchange to the development of trust and cooperation to commitments built in the form of tangible adaptations or investments (Bolumole, 2001). In long run the interdependence of shipper and logistics service providers increases, this leads to higher level of commitment towards each other. The role of logistics service providers is limited to operational issues when shipper focuses on cost function, the third party logistics service provider is seen as a strategic partner when outsourcing decision is made due to resource considerations (Bolumole, 2001). But, the major challenges in establishing third party logistics service provider relationship are trust and confidence in service providers (Logan, 2000).
3.3.5 Management of Third Party Logistics Service Provider

3.3.5.1 Contacts: A typical third party logistics service provider contract includes contract term, costs per activity, service and activities description, service levels, bonus payment for excellent performance, penalty clauses for services failures, allocation of roles and responsibilities, risks and insurance costs and contract termination clause (Andersson and Norman, 2002; Boyson et al. 1999).

3.3.5.2 Information exchange: The information sharing between the client and logistics service provider is important both at pre contracting and post contracting period (Stank et al., 1996; Bienstock, 2002). Communication channels in multiple organizational levels are established in order to cover the strategic as well as operational information needs.

3.3.5.3 Performance Measurement: The establishment of continuous monitoring of key performance indicators related to logistics services allows users to compare achieved with expected service levels. Performance matrix can be used to benchmarking purposes. Additional practices for management and control of third party logistics service provider relations include carrying customer satisfaction surveys, gaining access to logistics service provider information systems, jointly planning and implementing performance improvement projects and organizing third party logistics service provider forums to share logistics strategy objectives (Boyson et al., 1999).

3.3.5.4 Success Factors: The following factors are important in the wider inter-firm partnership and strategic alliances:

- Common goals and compatible interests;
- Compatibility of information systems
- Compatibility of organisational culture and routines;
- Customer orientation;
• Expert knowledge in specific markets/products/processes;
• Financial stability of service provider
• Frequent communications and information exchange:
• Joint investment for achieving relationship objectives;
• Joint planning, management and control of 3PL relationship;
• Mechanisms for dispute resolution;
• Power balance between contracting parties;
• Provider ability to stay updated with respect to new technologies;
• Risk and reward sharing;
• Service level improvement/reduction of distribution costs;
• Service provider flexibility and responsiveness;
• Top management support; and
• Understanding client’s supply chain needs.

3.3.5.5 Logistics partnership Model: Various partnership models have been proposed in the previous studies. Bagchi and Virum (1998) identified three phases namely need awareness phase, planning phase and evaluation phase. The need awareness is the seed that started the changes leading to outsourcing of logistics services (Bagchi and Virum, 1998). Gardner et al. (1994) presented key stages in the 3PL partnership building process, including partner selection and relationship design and evaluation. Lambert et al. (1999) emphasized the main drivers for relationship formation, facilitating factors, main partnership components as well as outcomes. High asset specificity and environmental capacity have a positive effect on the formation of collaborative relations, whereas high transaction volume and high industry concentration are negatively related to third party logistics service provider partnership (Stank and Daugherty, 1997). Sankaran et al. (2002) mentioned the five steps in logistics outsourcing: identify need to outsource logistics, develop feasible alternatives, evaluate and select supplier, implement service and conduct ongoing service assessment.
3.3.5.6 Current research focuses on dyadic logistics service provider-client interactions. Much has been written about relationships in logistics, primarily between the shipper and the receiver of the goods, not least within the marketing research area as well as within the logistics research area (Olsen and Ellram, 1997; Bagchi and Virum, 1998). However, the relations in the common triad setup, between the shipper and the carrier and between the receiver and the carrier, have rarely been covered (Gentry, 1996; Larson and Gammelgaard, 2001; Skjoett-Larsen et al. 2003). But, due to boundary spanning role of logistics and the importance of customer service requires to study this relationship beyond dyad to consider larger network (Mentzer et al., 2004). Larsson and Gammelgaard (2001) defined the logistics triad as: A logistics triad is a cooperative, three-way relationship between a buyer of goods, the supplier of those goods and a logistics service provider moving and/or storing the goods between buyer and supplier.

3.3.5.7 The parties taking over these activities are third-party service providers, carriers providing transportation service or logistics service providers providing transportation and warehousing services. In recent years these logistics service providers have been extending their service portfolio, with more complex activities than ever before and serving more customers than previously (Lieb and Kendrick, 2003; Lieb and Bentz, 2004).

3.3.5.8 Maltz and Ellram (1997) argued that there are two important interfaces that need to be assessed before outsourcing the logistics function: the logistics service provider-client and the logistics service provider-final customer interface. The logistics service provider is positioned between the client and its customers, potentially having a crucial role in handling end-customer information and feedback. In this sense, the relevant unit of analysis becomes the inter-firm triad, rather than the dyad. In line with McGinnis et al. (1995), the third party logistics service provider represents the third party to a transaction (the first and second being the buyer and the seller) and fulfils part or all of the logistical needs related to that transaction in a way that a triad of exchange relations is formed.
There are a few studies that explicitly discuss the formation of logistics outsourcing triads. The term third party logistics service provider implies a triadic link among suppliers, their customers and LSPs. Larson and Gammelgaard (2001) investigated the preconditions, benefits and barriers to the formation of collaborative relations among buyers, sellers and 3PL providers. Carter and Ferrin (1995) illustrated the impact of trilateral collaboration on the reduction of transport costs. Moreover, Gentry (1996) studied the role of carriers in strategic buyer-supplier alliances and concluded that logistic service providers mainly have operational responsibilities and are not involved in strategic planning of the supplier-customer alliance.

### 3.3.6 Future Trend

Various forms of sub-contracting are also considered in today’s environment. In particular, the design of fourth party logistics solutions entails that the logistics service provider acts as a single point of contact within the client’s supply chain. The concept of a fourth party logistics service provider was introduced a few years ago by Andersen Consulting (now: Accenture). The definition given by Andersen Consulting is: An integrator that assembles the resources, capabilities and technology of its own organization and other organizations to design, build and run comprehensive supply chain solutions.

Most fourth party logistics service provider companies have no assets like warehouse facilities, own fleet, etc. and they provide services to the customers in the form of responsibility and knowledge of how to fulfill the customer requirements. The physical movement of the goods is outsourced to other third-party service providers. To simplify the terminology in this work, the term logistics service information is used for operators that provide only administrative services to their customers, such as fourth party logistics service provider, forwarders, web-marketplaces, etc. (Stefansson, 2006)
The fourth party logistics service provider is often regarded as a non asset-based company which makes use of its supply chain design/planning capabilities and IT solutions and acts as a single interface between the client and multiple (asset-based) logistics service providers (Skjoett-Larsen, 1999). Logistics providers also develop horizontal networks in order to gain access to complementary resources and capabilities (Lemoine and Dagnaes, 2003).

Empirical research should be directed towards finding out factors affecting the growth of third party logistics service provider and fourth party logistics service provider, its costs and benefits with reference to specific industry, contractual practices and the development of performance measurement systems in third party logistics service provider.
3.4 Logistics Information System

3.4.1 Introduction

Information is a valuable logistics resource in today’s environment. Information Technology is a mean to enhance logistics competitiveness. It has been forwarded as means of achieving competitive advantage and as a valuable tool used to ensure that the logistics objective of providing target service at the least total cost is accomplished. The council of logistics management has integrated the flow of information with the flows of raw materials, work-in-process and finished goods. While the logistical system converts materials into products, creating value for customers, the information system converts data into information to facilitate managerial decision making. Information as a substitute for inventory is a common theme in the literature due to its speed, accuracy and low cost. The advent of the internet and electronic communications has enabled companies to be more responsive to their customers (Williams et al., 2002). The information system contributes to the porter’s three generic strategies of cost leadership, product differentiation and niche marketing. Information system has the potential to be a strategic weapon in four ways: (1) to gain competitive advantage, (2) to improve productivity and performance, (3) to enable new ways of managing and organizing and (4) to develop new businesses (Narsimhan and Kim, 2001). The ability and willingness to invest in information technologies is one of the most important differentiators for leading edge logistics functions. The world class logistics research at Michigan State University determined that information technology is one of seven capabilities that combine for logistics process integration and better performance. Adoption and successful implementation of information technology is said to be prerequisites for logistics success.
3.4.2 Scope of Information System

3.4.2.1 The scope of information technology is classified into following four categories (Earl 1989): (1) Information technology that automates or improves the physical aspect of every activity, (2) Information technology used for physically connecting each value activity or controlling those activities at the connecting point, (3) Information systems that facilitate the implementation, support and management of value activities and (4) Information systems that optimize or adjust the connection of each value activity.

Table 3.3: Difference between Traditional Logistics and E-Logistics

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Traditional Logistics</th>
<th>E-Logistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orders</td>
<td>Predictable</td>
<td>Variable, Small lots</td>
</tr>
<tr>
<td>Order Cycle Time</td>
<td>Weekly</td>
<td>Short OTD/daily or hourly</td>
</tr>
<tr>
<td>Customer</td>
<td>Strategic</td>
<td>Broader base</td>
</tr>
<tr>
<td>Customer Service</td>
<td>Reactive, Rigid</td>
<td>Responsive, flexible</td>
</tr>
<tr>
<td>Replenishment</td>
<td>Scheduled</td>
<td>Real time</td>
</tr>
<tr>
<td>Distribution Model</td>
<td>Supply driven (Push)</td>
<td>Demand driven (Pull)</td>
</tr>
<tr>
<td>Demand</td>
<td>Stable, Consistent</td>
<td>More cyclical</td>
</tr>
<tr>
<td>Shipment Type</td>
<td>Bulk</td>
<td>Smaller lots</td>
</tr>
<tr>
<td>Destinations</td>
<td>Concentrated</td>
<td>More dispersion</td>
</tr>
<tr>
<td>Warehouse Reconfiguration</td>
<td>Weekly, Monthly</td>
<td>Continual, rules-based</td>
</tr>
<tr>
<td>International Trade</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compliance</td>
<td>Manual</td>
<td>Automated</td>
</tr>
</tbody>
</table>

(Source: Coyle et al., 2008)
3.4.3 Classification of Logistics Information System

3.4.3.1 Closs et al. (1994) defined logistics information system as “that combines hardware and software to manage, control and measure logistics activities”. Coyle et al. (2008) defined Logistics Information System as “An interacting structure of people, equipment and procedures that together make relevant information available to the logistics manager for the purpose of planning, implementation and control.” The logistics information system (LIS) can be divided into two parts: (a) logistics operating system (LOS), which includes transactional applications such as an order entry, order processing, warehousing and transportation and (b) logistics planning system (LPS), which include coordinating applications such as forecasting, inventory management and distribution requirement planning (Closs et al., 1997).

Coyle et al. (2008) divided the logistics information system in to four sub systems: planning, execution, research and intelligence and reports and outputs. Planning system could be related to network design, demand planning and forecasting, strategic sourcing, production planning and scheduling and distribution planning, while Logistics execution system might be responsible for the short-term, day-to-day functioning of the logistics system and manages activities in the areas like warehousing, transportation, inventory, order processing and order management processes.

Technology implementations are from both sides, operational and strategic perspectives (Benjamin et al. 1990 and Malone et al. 1987). Logistics information is required for operation planning and control, system development and also for strategic decision making process. Operation planning covers customer order registration, order processing, procurement actions, storage, order picking, packing and transportation. Inventory management provides coordination between logistics operations, procurement and manufacturing.
3.4.4 Benefits of use of Information Technology

3.4.4.1 The free flow of information is imperative for integration (Gustin, 1994). The higher levels of shared information and communications with supply chain partners lead to integration, greater responsiveness and improvements in operational performance. But, information technology includes high technology cost (Gustin, 1994), risk of organizational damage during implementation and lack of demonstrated effectiveness. Other reasons include the expected obsolescence of hardware and software, application redundancy and irrelevance of applications to a firm’s particular industry and information needs (Dawe, 1994) and inability or unwillingness of managers to invest in it (Bowersox et al., 1995).

3.4.4.2 Closs et al. (1997) explained the various benefits of using Logistics Information System from operation and planning point of views in logistics management, which are as follows:

Table 3.4: Benefits of using Logistics Information System

<table>
<thead>
<tr>
<th>Evaluation Criteria</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timeliness</td>
<td>Available information is current relative to the situation</td>
</tr>
<tr>
<td>Accuracy</td>
<td>Available information is error free</td>
</tr>
<tr>
<td>Availability</td>
<td>Information can be accessed when and where desirable</td>
</tr>
<tr>
<td>Exception basis</td>
<td>Information is organized in a form that focuses decision makers’ attention on situations requiring action</td>
</tr>
<tr>
<td>Formatted</td>
<td>Information layout is designed to bring together data items which are used concurrently</td>
</tr>
<tr>
<td>Formatted to facilitate usage</td>
<td>Information sharing</td>
</tr>
<tr>
<td>Flexibility</td>
<td>Ability to exchange information effectively across managerial areas within the firm</td>
</tr>
<tr>
<td>-------------</td>
<td>----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Internal Validity</td>
<td>Ability to exchange information effectively across managerial areas within the firm</td>
</tr>
<tr>
<td>External Connectivity</td>
<td>Ability to exchange information effectively with next destination customers and/or suppliers</td>
</tr>
</tbody>
</table>

(Source: Closs et al., 1994)

3.4.4.3 Logistics capacity and capability planning and network design require allocations and commitment of resources. These fall under the purview of strategic planning, wherein the information needs are quite different from what is required for operational planning. There is a high degree of risk in the strategic planning exercise, which can be minimized by designing a proper logistics information system using the latest technology and ensuring speed and reliability in information availability, processing and movement. (Sople, 2004)

3.4.4.4 Logistics deals with information from sources outside the firm as well as within the firm. Logistics information system includes an external information system and an internal information system. The external information system refers to the communication between the firm and its customers and suppliers. The internal information system provides for an exchange of information between functional departments within the organization and for the processing, storage, retrieval and manipulation of the information pertaining to logistics for purpose of analysis, decision-making and compilation of status reports and decision reports. (Khanna, 1998)
3.4.5 Major Types of Information System used in Logistics Management

Five major information technologies which have become increasingly common in practice are: point of sale systems (POS), barcoding or RFID, electronic data interchange (EDI), Value added networks (VANs) and electronic ordering systems (EOSs) (Chiu, 1995).

3.4.5.1 EDI

1. Electronic data interchange can be defined as “the computer-to-computer exchange of business information electronically, in a structured format, between business trading partners” (Murphy and Daley, 1998). EDI systems are used to share data between suppliers and customers in standardized formats over value-added computer networks (Bhatt, 2001). The major focus of EDI is transmission and processing of necessary data with minimal human intervention (Benerjee and Sriram 1995). To achieve the goal of paperless transactions, the exigent needs for a common standard for recognizing interflow information is encouraging. The document forms that trading partners send each other, such as purchase orders, order confirmations, bills of lading, invoices, advance shipment notices and remittance advices, are formatted and converted to standard messages during the transaction process. The standard messages can be interpreted, processed and transmitted directly, using the same data communication protocols via a communications network, usually a direct link network or third-party network, to the destination without incurring the delay of mail delivery. So, about 15% of logistics expenses were derived from order processing, administrative and related costs, which can be saved using EDI in business (Chiu, 1995). EDI system spans across a company’s boundaries, so it demands continual support and encouragement from suppliers and buyers. When a firm makes it mandatory that its suppliers and distributors adopt EDI systems, it usually provides EDI software free to its suppliers to encourage adoption (Bhatt, 2001). EDI benefits include quick access to information (Millen, 1992), flexibility (O’Callaghan et al. 1992)
and customization (Crum and Allen 1997), better customer service (Johnson et al. 1992 and Crum and Allen 1997) and responsiveness (Walton and Lewis 1995), reduced paperwork (Crum et al. 1996), better communications (Crum and Allen 1997), increased productivity (Crum et al. 1996), improved tracing and expediting (Walton and Lewis 1995 and Murphy et al. 1998), cost efficiency (Millen, 1992), ahead of competitors, accuracy (Walton and Lewis 1995) and improved billing (Murphy et al. 1998). The various barriers to EDI includes high set up cost (Crum and Allen 1997), incompatibility of hardware/software (Murphy et al. 1998), lack of standard formats (Johnson et al. 1992, Benerjee and Gohlar 1993, Crum et al. 1996 and Murphy et al. 1998), lack of customer sophistication and technical expertise (Crum et al. 1996 and Murphy et al. 1998), lack of awareness of EDI benefits (Murphy et al. 1998), lack of customer education/training (Murphy et al. 1998), lack of trust between customers and suppliers (Czinkota and Kotabe, 1992) customer resistance and corporate culture (Walton and Lewis 1995). EDI system has a direct and significant impact on business process improvement factors (Bhatt, 2001).

2. EDI formats differ substantially from industry to industry and among firms in the same industry. A variety of industry specific standards have been developed like UCS (Uniform Communication Standards) for retailing industry, WINS (Warehouse Information Network Standards) for warehousing industry, TDCC (Transportation data coordinating Committee) for transportation industry, CIDX (Chemical Industry Data Exchange) for chemical industry, VICS (voluntary inter-industry communication standard) for general merchandisers and EDX (electronic data exchange) for the electrical industry. (Chiu, 1995)

3. EDI is expected to promote the concept of an “electronic marketplace”, which will ultimately reduce the cost of negotiating and consummating deals. This in turn may make it more beneficial for many companies to outsource rather than manufacture. This will make vertical integration less appealing to many companies (Chiu, 1995).
3.4.5.2 POS

1. POS is defined as the in-store entering and accessing of product and/or customer information in order to facilitate product sale to the customer (Weber and Kantamneni, 2002). Frequently cited benefits of POS include reduced check-out time and error, improvements in inventory management through reduced stock-outs, inventory levels, shrinkage and forced markdowns and an ability to track costs directly to specific products. Frequently cited barriers include a lack of sufficient resources and the supplier/retailer’s technological capability, a lack of management commitment to technology adoption and a lack of trust between retailer and supplier (Czinkota and Kotabe, 1992).

2. Two types of POS terminals are used in retail store, front POS (FPOS) and rear POS (RPOS). Almost all the sales information can be gathered by the FPOS system in a more timely and accurate way. The RPOS system analyses sales information from the FPOS system and manages the goods by product and places electronic orders. In addition, the RPOS system handles merchandise receiving and inspection, inventory control, physical counting, accounting and vendor management (Chiu, 1995)

3.4.5.3 RFID

1. Radio Frequency Identification (RFID) has brought in a paradigm shift in the way logistics and supply chains are managed. With the usage of RFID, there is a sea change in managing inventory, logistics, manufacturing, supply chain and also retail. RFID is a technology that helps in automatic identification and capturing of remotely retrieved data. There are two types of RFID tags: active and passive. Active RFID tags have an internal source to power them. They have longer range and larger memory relative to passive tags. They can also emit information in the form of radio signals. These tags perform better in harsh environments and are more reliable in harsh environment than passive tags. On the contrary, passive
tags have no internal source to power them. Power is induced in the antenna while receiving radio signals, which helps the tag transmit messages. They are cheaper than active tags and more widely used.

2. RFID can be characterized as primarily an attempt to reduce uncertainty that results from incomplete or missing information regarding what is where in the logistics flow (Cannon, Reyes and Prater, 2008). RFID typically rests on three distinctions between it and current coordination/control technologies such as bar codes. First, RFID can facilitate increased traceability for items, whether they are components, finished goods, containers or other equipments (Reyes et. al, 2007 and Dutta et. al, 2007). Secondly, because RFID tagged items can be scanned, real time inventory control becomes possible; item locations or quantities are much more easily updated, often without the need to bring the items into close proximity with a reader (Srivastava, 2004). Third, because tagged items will be more traceable and information about their status will be available almost constantly, this information could be shared by buyers and suppliers and lead to greater collaboration across a supply chain (Karkkainen and Holmstorm, 2002; Delen et al, 2007).

3. RFID has several advantages over bar codes. Bar codes require line-of-sight to be read, while RFID tags can be read through an obstacle (Prater et al, 2005). Comparatively, bar codes contain less information. Information storage is limited to name and price, while RFID can store other information like location, expiry date, the product ID and other details (Prater et al, 2005). Further, read/white tags can be reused, thus saving costs of repeated bar coding. Unlike RFID tags, barcodes cannot survive harsh environment.

4. RFID makes data acquisition and identification more efficient and makes possible more intensive information exchange among supply chain partners (Cannon, Reyes and Prater, 2008). Other benefits of RFID include the managers can track how many units of the product have been sold at various points thus giving store
managers accurate data for further allocation (Dutta et. al, 2007). RFID helps to reduce the cost of retailers by allowing them to track the goods which, in turn, can reduce the costs significantly, especially in FMCG sector. RFID also enables product security and authentication. Companies can benefit by enabling customers reach the products on the shelves, either by providing the information online or offline. This ensures effective customer relationship Management (CRM). It also reduces logistics and supply chain cost by improving efficiency, accuracy and security of material and information flows (Cannon, Reyes and Prater, 2008) (Smaros and Holmstorm, 2003; Delen et al., 2007 and Reyes and Frazier, 2007). It can also help prevent pilferage and ensure the quality of the product. RFID helps in managing the inventory at the retail outlet (Dutta et. al, 2007). It can track purchases made by customers and check this data against the stock availability at the store, the exact location of the item and trigger actions for continuous replenishment and vendor managed inventory. When the logistics operations are outsourced; the customization and handling problems as well as information sharing problems can be solved with wireless product identification and item level supply chain management (Karkkainena and Holmstorm, 2002). Demand forecasting can be made more accurate through analyzing information stored in RFID (Prater et al, 2005).

3.4.5.3.1 Benefits of RFID in Retailing

1. **Data Forecasting:** RFID’s ability to provide accurate and real-time data helps in better forecasting. This helps in taking effective decisions to manage warehouse inventories and withdrawals, replenishing inventories and product replacements. Retailers using RFID technology can provide accurate data to suppliers as they arrive and leave their warehouses, stores and retail points.

2. **On shelf availability:** Out-of-stock situation in retail is a common feature. This is primarily due to inadequate order processing. RFID can be useful in tackling out-of-stock issues in its non-food goods.
3. **Enhanced product security:** By placing RFID tags on products, movements can be tracked. This is of greater significance in product categories that face the risk of counterfeiting. This can also be useful in product recalls as the current location of the product can be identified and disposal of damages and out-of-date products can be possible immediately.

4. **Customizing offering:** RFID opens the doors for several innovations at the retail front. Shoppers can experience customized product or service offerings. For repeat customers, the retail store can address them by first name and make announcements about a new product or a new design.

5. **Integrated forward logistics and supply chain management:** Some products that are time or application sensitive require tagging, allowing suppliers to manage customer inventories without waiting for order placements. This can help the company to maintain a competitive edge in market.

### 3.4.5.3.2 Challenges in adoption of RFID in the retail sector

1. Though RFID has several benefits, it is not cost-effective in all situations. RFID tags cost about 50 cents. So it proves very costly to use RFID in FMCG sector where the unit cost is very low. An RFID reader costs between $100 to $3000 depending upon the frequency and range. Hundreds of such readers have to be installed across a company’s factories, warehouses and retail stores. Integration of RFID with existing IT system requires costly and difficult customization efforts (Dutta et. al, 2007). As there is no consensus on a standard frequency, a store might end up having several readers of various frequencies which will further increase the cost. Where item tagging is expensive, manufacturers can consider case-level tagging or blended level tagging. Though retailers and distributors gain significantly, it is the suppliers who incur huge costs because of
the capital expenditure. This disparity in financial gains and investments across players in the supply chain needs to be reduced. Efforts to bring in equitable incentives to all players need to be initiated. Another issue that has acted as an impediment to RFID in retail is the concern expressed by consumers related to security and privacy. Consumers are unaware of how the technology will be used and its impact on them, which may invade their privacy. The information on location and personal data can pose threat to the use of RFID. When it comes to information to travel through multiple organizations, the issue of standardization of data formats can become a challenge (Dutta et al., 2007). The lack of convergence creates uncertainties for vendors and end users, and poses a barrier to more aggressive adoption of the RFID by organizations.

2. The challenge against the use of RFID is increased uncertainty resulting from RFID’s potential effects on firm’s relationships with buyers, supplier and competitors. Central to this uncertainty are risks accompanying adoption that can be grouped into two broad categories – uncertainty with regard to the requirements and capabilities of the technology itself and uncertainty with regard to the effects of the technology on interorganizational relationships (Cannon et al., 2008).

3. RFID implementation requires organizations to re-invent their core activities (Cannon, Reyes and Prater, 2008). RFID technology needs to coexist with barcode technology for quite some time. The existing systems will need to be updated to accept and process data collected through RFID technology, since the existing systems have been designed to store and process barcode data, which has its own standards for structure and transmission. Given the complexity of existing system, making these changes is a nontrivial task (Dutta et al., 2007).
3.5 Summary

The Logistics Management has been defined differently by different researchers. The Council of Logistics Management has given the most comprehensive definition of Logistics Management. Based on literature review, it can be inferred that Physical Distribution is a part of Logistics Management, while Logistics Management is a part of Supply Chain Management. The attributes of Logistics Flexibility has been defined in terms of range, mobility and uniformity, while its components includes Physical Supply Flexibility, Purchasing Flexibility, Manufacturing Flexibility, which are described as competence and Physical Distribution Flexibility and Demand Management Flexibility, which are described as capability. The relationship between competence and capability and its impact on customer satisfaction has been discussed in detail. The rationale behind the use of third party logistics service provider is to concentrate on core activities and rely on experts (third party logistics service providers) for other critical activities. During literature review, it was found that logistics service providers are expanding their offerings to include information systems, consulting, contact manufacturing and even purchasing and financial services, there is a low demand of such services and buyers prefer to outsource transport and warehouse related functions. The majority of the studies focus on demand side of third party logistics service providers such as services used, usage rate, contract renewal rates, outsourcing costs and geographical spread of services. Overall, there is an eminence of transport, warehouse and administration related services. But, basically, the decision process of outsourcing is based on an evaluation of the costs and benefits of outsourcing. The various benefits of use of third party logistics service providers in logistics management are described in detail in this chapter. The advent of the internet and electronic communications has enabled companies to be more responsive to their customers. The impact of logistics information system can be described in two ways: Operational such as an order entry, order processing, warehousing and transportation and Planning such as forecasting, inventory management and distribution requirement planning. The detailed description of Operational and Planning system of Logistics Information System and their benefits have been discussed in detail during literature review.
3.6 References


Chapter 4: Research Methodology

4.1 Significance of the Study

4.1.1 Flexibility is a complex and multidimensional. The confusion and ambiguity about flexibility seriously inhibits its effective implementation. The concept of logistics flexibility is confounded because the attributes of flexibility and the components of flexibility are often combined. In addition, logistics flexibility is difficult to understand and achieve because distinction between internal competences that organization controls but customers cannot see, and external capabilities, that customer see and value, are often unclear.

The logistics flexibility plays crucial role in supply chain of fluid milk and milk products. It is more crucial and critical due to the high number of product variants, strict traceability requirements, shorter shelf life of products and larger volume of the goods to be handled. Out of all product categories of fast moving consumer goods sector; the fluid milk and milk products segment has the lowest shelf life, higher inventory carrying cost and logistics cost and disposal of outdated products are vital issues. The significant growth of economy of Gujarat and the flourishing development of co-operative network of fluid milk and milk products demand perfect synchronization of supply of various fluid milk and milk products with market opportunities. This issue is equally vital and critical for all manufacturers (co-operative dairies) and marketer (GCMMF) of Fluid Milk and Milk products irrespective of their scale of productions and operations.

In co-operative dairies, the logistics of supply of raw milk is handled by procurement managers, while the logistics of purchase of other materials is handled by purchase managers. In distribution front, the logistics and distribution of various fluid milk and milk products are handled by marketing manager only. So, no separate authority has been assigned to specifically focus on logistics
aspects in supply as well as distribution of various materials and fluid milk and milk products in co-operative dairies in Gujarat. This creates problem in co-ordination at various levels of supply chain.

Therefore, it becomes important to examine the relationships between internal competences and customer perceptible capabilities that comprise logistics flexibility to develop appropriate relationships to describe logistics flexibility at supply chain level with reference to co-operative dairies in Gujarat.

4.1.2 Information technology represents a major shift in the co-operative dairies’ ability to gain, store, process and disseminate information and can be viewed as a source of value creation and competitive advantage. Use of information technology can create business value by linking firms together in logistics networks, as separate business enterprises are connected through a shared information and communication system aiming to achieve superior co-ordination and efficiency in their logistics operations. So, it becomes imperative to study the important features of information technology that significantly affect the logistics flexibility of co-operative dairies in Gujarat.

4.1.3 Good logistics performance requires a tradeoff between the need to reduce overall supply chain inventory and lead times, while simultaneously capturing economies of scale and improving customer service to enhance business performance. With growing pressure to reduce cost and provide better services, co-operative dairies can consider outsourcing as an option to improve both efficiency and effectiveness. The usage of third party logistics service providers can help co-operative dairies to achieve substantial results, both in terms of customer satisfaction and logistics cost reduction as a major source of competitive advantage. Therefore, it is also important to study the benefits of using third party logistics service providers that significantly affect the logistics flexibility of co-operative dairies in Gujarat.
4.2 Objectives of the study

1) To develop the concept of logistics flexibility in terms of identifying its various components and interrelationships among them for fluid milk and milk products in co-operative dairies in Gujarat.

2) To study the structure of logistics system for fluid milk and milk products in co-operative dairies in Gujarat.

3) To study the macro and micro factors affecting logistics network of the fluid milk and milk products in co-operative dairies in Gujarat.

4) To study the role and the scope of information technology in optimizing the performance of logistics network for fluid milk and milk products in co-operative dairies in Gujarat.

5) To study the role and scope of third party logistics service provider firms in enhancing logistics flexibility for fluid milk and milk and milk products in co-operative dairies in Gujarat.

4.3 Sampling Procedure

This study used a descriptive research design to determine the relationships among various components of logistics flexibility and interrelationships among them. It also intends to study the impact of use of information technology and third party logistics service providers on maintaining logistics flexibility. The non-probability quota sampling method was used for data collection. The managers of different departments at various supply chain levels of co-operative dairies in Gujarat like procurement and purchasing, processing and marketing and distribution were considered as sample universe for sampling procedure. The inbound logistics of raw milk and other materials, like value added ingredients, packaging, etc. were handled by procurement and purchase managers. The production managers were responsible for processing of various fluid milk and milk products. While the marketing, distribution and logistics of various fluid milk and milk products were handled by Marketing and Distribution Managers.
Based on the primary discussion with senior managers of some of the co-operative dairies in Gujarat, the researcher observed that the various departmental managers of each co-operative dairy meet once or twice a week to discuss relevant issues. The manager of each department had to work in co-ordination with other departments throughout supply chain, which was the primitive requirement of all co-operative dairies to maintain accuracy in logistics management at each and every stage of supply chain. All the co-operative dairies in organised sector operating under GCMMF in Gujarat were included in the sample. In total, the researcher contacted ninety senior managers of procurement and purchase department, processing department and marketing and distribution department of fifteen co-operative dairies in Gujarat, out of which, eighty two completely filled questionnaires were received. The sample unit includes the senior managers of procurement and purchase department (25 nos.), production department (33 nos.) and marketing department (24 nos.) of various co-operative dairies in Gujarat.

4.4 Questionnaire Design

The final questionnaire contains three parts:

✔ The first part contains the statements regarding Logistics Flexibility, which includes six factors containing thirty five statements in total.

✔ The second part contains eight variables regarding benefits of using Logistics Information System in logistics management of co-operative dairies in Gujarat, which is divided into two sub section; one is of Logistics Operating System and second is Logistics Planning System.

✔ The third part contains the variables regarding benefits of using Third Party Logistics Service Provider Firm, which contains fifteen variables that describe the benefits of using third party logistics service providers in logistics management of co-operative dairies in Gujarat.

All the questions in final questionnaires are close-ended in nature. The detail discussion of each part of the final questionnaire is as follows:
4.4.1 Logistics Flexibility

To identify an initial set of components to measure logistics flexibility, an extensive literature review is completed. Based on the findings of Zhang et al (2005), four dimensions of logistics flexibility at supply chain level named physical supply flexibility, purchasing flexibility, physical distribution flexibility and demand management flexibility creating significant impact customer satisfaction dimension were identified. The reliability and validity of these five factors have been proved in the previous study conducted by Zhang et al. (2005).

In this study, a further reliability of these five factors has been checked to confirm the consistency and accuracy of results using these factors.

The manufacturing flexibility is included in the list of components of logistics flexibility, which is the interface between Physical Supply Flexibility and Purchasing Flexibility on one hand and Physical Distribution Flexibility and Demand Management Flexibility on the other hand. The most comprehensive list of various characteristics of manufacturing flexibility from supply chain point of view developed by Stevenson and Spring (2007) is considered to include in this research. A pilot survey of twenty eight senior executives of procurement and purchasing, production and marketing and distribution departments of co-operative dairies in Gujarat are surveyed to rate the importance of various aspects of manufacturing flexibility having significant impact on maintaining logistics flexibility from supply chain point of view. The variables are rated on the basis of Likert scale with 1 = most unimportant, 2 = unimportant, 3 = neutral, 4 = important and 5 = most important. Out of 15 variables of manufacturing flexibility developed by Stevenson and Spring (2007), six variables are selected to be included in the research on the basis of highest ratings given by senior executives of various co-operative dairies. These variables are material handling flexibility, automation, volume flexibility, delivery flexibility, production flexibility and market flexibility. The reliability of these six variables consisting manufacturing flexibility has been checked in this study to confirm the consistency and accuracy of results using these variables.
The final part contains the five components of logistics flexibility with total of six factors, which include physical Supply Flexibility, Purchasing Flexibility, Manufacturing Flexibility, Physical Distribution Flexibility, Demand Management Flexibility and Customer Satisfaction. These six factors contain 35 statements. All 35 statements are rated using Likert scale with 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree and 5 = strongly agree. The managers are asked to rate each question in terms of the strength of their agreeableness or disagreeableness with respect to Logistics Flexibility for fluid milk and milk products in co-operative dairies in Gujarat.

### 4.4.2 Logistics Information System

The second part contains the variables derived from the scale developed by Closs et al. (1997), which includes the variables regarding benefits of using Logistics Information System in maintain accuracy of Logistics Flexibility for Fluid Milk and Milk Products in Co-Operative Dairies in Gujarat. The Logistics Information System is divided into two parts: Logistics Information Operating System and Logistics Information Planning System. The benefits of using Logistics Information System include eight variables. The managers are asked to rate the same eight variables from point of view of Logistics Operating System and Logistics Planning System in terms of the extent of their agreeableness or disagreeableness with respect to benefits of using Logistics Information System in maintaining Logistics Flexibility for various fluid milk and milk products of co-operative dairies in Gujarat, which follows the same methodology as used by Closs et al. (1997). The variables were rated on five point Likert scale with 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree and 5 = strongly agree.

The reliability of these eight variables consisting Logistics Information System has been checked in this study to confirm the consistency and accuracy of results using these variables.
4.4.3 Third Party Logistics Service Provider

The third part contains the variables regarding benefits of using Third Party Logistics Service Providers in maintaining Logistics Flexibility for Fluid Milk and Milk Products in Co-Operatives Dairies in Gujarat. Initially, seventeen variables are derived with respect to benefits of using third party logistics service provider in logistics management of organization. A pilot survey of twenty eight senior executives of procurement and purchasing, production and marketing and distribution departments of co-operative dairies in Gujarat are surveyed to rate the importance of benefits of using third party logistics service provider and its impact on maintaining logistics flexibility. The variables are rated on the basis of Likert scale with 1 = most unimportant, 2 = unimportant, 3 = neutral, 4 = important and 5 = most important. Out of 17 variables, fifteen variables are selected to be included in the research on the basis of ratings given by senior executives of various co-operative dairies. In final questionnaire, the variables are rated on five point Likert scale with 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree and 5 = strongly agree. The managers were asked to rate 15 variables in terms of extend of their agreeableness or disagreeableness with respect to benefits of using third party logistics service providers in maintaining Logistics Flexibility for fluid milk and milk products in co-operative dairies in Gujarat. The reliability of these fifteen variables consisting benefits of using Third party Logistics Service Providers has been checked in this study to confirm the consistency and accuracy of results using these variables.

4.5 Data Collection Procedure

During the primary discussion with senior managers of some of the co-operative dairies in Gujarat, the researcher found that some of the senior managers of co-operative dairies in Gujarat did not possess proficiency in English language. So, the final questionnaire was developed in English as well as Gujarati languages and sent to the senior managers of co-operative dairies as per their preference. A care was taken while converting the
questions from English language to Gujarati language so that the meanings of questions remained the same.

The questionnaires along with copy of introductory letter and permission letter from the director of my institute were sent to the senior managers of various co-operative dairies in advance of actual personal contact made. The questionnaire were sent to the managers in advance so that they could study it well in advance and provide them time to understand the technicality of various terminologies used in questionnaire. The personal contact method was used for final discussion and filling up the questionnaire by the managers of various co-operative dairies in Gujarat. During personal discussion with senior managers, the respondents’ doubts were clarified, which has improved the accuracy of responses given by them. It provided them the chance to study the questionnaires in detail and clarify the doubts during the personal discussion with the researcher. The managers were asked to fill the questionnaire in the presence of the researcher only, which could increase the accuracy of ratings of questionnaires given by managers.

4.6 Scope of the Study

This study is limited to the co-operative dairies in Gujarat region only. The scope and definitions flexibility and its various components are dependent on the explanation given in literature. The interrelationships among different variables are applicable for Logistics System of Fluid Milk and Milk products in co-operative dairies in Gujarat only. This study includes the literature review, which has been developed till year 2010-11.
4.7 Summary

This study used a descriptive research design to determine the relationships among various components of Logistics Flexibility and interrelationships among them, use of Logistics Information System and its impact on Logistics Flexibility and use of Third Party Logistics Service Providers and its impact on Logistics Flexibility. The non-probability convenience sampling method was used for data collection from sampling universe, consisting of the managers of different departments at various supply chain levels in co-operative dairies operating under GCMMF in Gujarat. The sample unit includes managers of procurement and purchasing, processing and marketing and distribution department. The questionnaire was finalized based on primary discussion with twenty eight managers of co-operative dairies in Gujarat. The final questionnaire contains three parts: Logistics Flexibility, benefits of using Logistics Information System and benefits of using Third Party Logistics Service Providers. The reliability of various factors included in the final questionnaire has been checked in this study to confirm the consistency and accuracy of results using these factors. The managers were asked to rate each variable in the questionnaire based on Likert Scale in terms of the strength of their agreeableness or disagreeableness for fluid milk and milk products in co-operative dairies in Gujarat. The personal contact method was used for final discussion and filling up the questionnaire.
Chapter 5: Data Analysis & Discussion

5.1 Introduction

The descriptive statistics like maximum ratings, minimum ratings, mean and standard deviation have been used to describe the data. The regression analysis method has been used for analysis of data for all three parts of the questionnaires. The analysis is done using 95% confidence level. In addition to regression analysis, Pearson correlation and variance inflation factor (VIF) statistics were used to assess both pair wise and multiple collinearity among independent variables in regression analysis. The Durbin-Watson test is also used to assess the degree of autocorrelations among various variables in regression equation. In first part, Regression analysis is used to find out the degree of impact of various dimensions of logistics flexibility model for fluid milk and milk products in co-operative dairies in Gujarat. In second part, regression analysis is used to find out the important benefits of logistics information operating system and planning system, which have the significant impact on logistics flexibility for fluid milk and milk products in co-operative dairies in Gujarat. In third part, regression analysis is used to find out the important benefits of using third party logistics service providers in logistics activities, which have the significant impact on logistics flexibility for fluid milk and milk products in co-operative dairies in Gujarat.

5.1.1 Multiple Regression Analysis

Multiple regression analysis is a multivariate statistical technique used to examine the relationship between a single dependent variable and several independent variables. The objective of multiple regression analysis is to use the independent variables whose values are known to predict the single dependent value selected by the researcher. Each
independent variable is weighted by the regression analysis procedure to ensure maximal prediction from the set of independent variables. The weights denote the relative contribution of the independent variables to the overall prediction and facilitate interpretation as to the influence of each variable in making the prediction. The set of weighted independent variables forms the regression variate, a linear combination of the independent variables that best predicts the dependent variable (Hair et al., 2009).

5.1.2 Usefulness of Multiple Regression Analysis

1. Multiple regression provides a means of objectively assessing the degree and character of the relationship between dependent and independent variables by forming the variate of independent variables. Here, the contribution of independent variable in overall contribution of all variables can also be known.
2. Regression analysis provides a means of objectively assessing the magnitude and direction (positive or negative) of each independent variable’s relationship with dependent variable.
3. Regression analysis provides diagnostic analyses to determine relationship among independent factors that will be useful to find out the real power of each independent variable on dependent variable.

5.1.3 Measurements used in Multiple Regression Analysis

1. **Regression Co-efficient**: It is standardized regression co-efficient that allows for a direct comparison between coefficients as to their relative explanatory power of the dependent variable (Malhotra and Dash, 2010).

2. **Coefficient of Determination** ($R^2$): It is a measure of the proportion of the variance of the dependent variable about its mean that is explained by the independent or predictor variables. The strength of association is measured by the coefficient of determination. Its value varies from 0 to 1. The researcher can infer
that the higher the value of $R^2$, the greater the explanatory power of the regression equation and therefore the better the prediction of the dependent variable (Malhotra and Dash, 2010).

**Adjusted $R^2$:** It is the modified measure of the coefficient of determination that takes into account the number of independent variables included in the regression equation and the sample size. It explains whether or not the inclusion of additional independent variables in regression equation may increase or reduce the overall coefficient of determination. (Malhotra and Dash, 2010 and Kutner et al., 2005)

3. **ANOVA (F-test):** The F-test is used to test the significance of the overall regression equation. It is used to test that the coefficient of multiple determination in the population is non zero. (Malhotra and Dash, 2010).

4. **Multicollinearity:** Collinearity is an expression of the relationship between two (Collinearity) or more (Multicollinearity) independent variables. Multicollinearity occurs when any single independent variable is highly correlated with a set of other independent variables (Hair et al., 2009). Keith (2006) finds that Multicollinearity occurs when several independent variables correlate at an excessively high level with one another or when one independent variable is a near linear combination of other independent variables. Multicollinearity can result in misleading and sometimes bizarre regression results. Multicollinearity suggests that the researcher is trying to use two variables in a prediction that overlap completely or almost with one another.

The simplest and most obvious means of identifying Collinearity is an examination of the correlation matrix of independent variables. The presence of high correlations (generally .70 or more) is an indication of substantial Collinearity. (Hair et al., 2009)
A formal method of detecting the presence of Multicollinearity is Variance Inflation Factors (VIF). These factors measure how much the variances of the estimated regression coefficients are inflated over that with uncorrelated independent variables (Keith, 2006) as compared to when the predictor variables are not linearly related (Kutner et al., 2005). The larger values for VIF signal the presence of Multicollinearity. The common rule of thumb for a large value of VIF is 10 as described by Keith (2006). If the VIF value is near to 10 (Keith, 2006) or more than 10 (Kutner et al., 2005), then it signifies high level of Multicollinearity among independent factors.

The mean of the VIF values also provides information about the severity of the Multicollinearity in terms of how far the estimated standardized regression coefficients are from the true values. If VIF value of each independent variable is not centering around mean of VIF values of all independent variables, it results larger differences between the estimated and true standardized regression coefficients. (Kutner et al., 2005)

5. **Autocorrelation:** Autocorrelation exists when there is high correlation among the error terms of one independent variable with error terms of one or more other independent variable/s (Menard, 1991 and Lewis-Beck, 1980). The autocorrelation among independent variables results in inefficient regression coefficients and invalidates the significance tests and confidence intervals considered for regression analysis (Kutner et al., 2005 and Lewis-Beck, 1980).

Durbin-Watson test is one of the methods of detecting existence of autocorrelations among independent variables. The Durbin –Watson test for autocorrelation assumes the linear autoregressive error, with values of the predictor variable fixed. The test determines whether or not the autocorrelation among independent variables in regression equation is zero. The test can also determine whether or not either positive or negative autocorrelation exists among independent variables. (Kutner et al., 2005)
5.1.4 Major Hypothesis

**H_{LF0}:** The relationships among various components of Logistics Flexibility are not significant for Fluid Milk and Milk Products in Co-Operative Dairies in Gujarat.

**H_{LF1}:** The relationships among various components of Logistics Flexibility are significant for Fluid Milk and Milk Products in Co-Operative Dairies in Gujarat.

**H_{LIS0}:** There is no significant impact of use of Logistics Information System on maintaining Logistics Flexibility for Fluid Milk and Milk Products in Co-Operative Dairies in Gujarat.

**H_{LIS1}:** There is a significant impact of use of Logistics Information System on maintaining Logistics Flexibility for Fluid Milk and Milk Products in Co-Operative Dairies in Gujarat.

**H_{TP0}:** There is no significant impact of use of Third Party Logistics Service Providers on maintaining Logistics Flexibility for Fluid Milk and Milk Products in Co-Operative Dairies in Gujarat.

**H_{TP1}:** There is a significant impact of use of Third Party Logistics Service Providers on maintaining Logistics Flexibility for Fluid Milk and Milk Products in Co-Operative Dairies in Gujarat.
5.2 Analysis of Logistics Flexibility Model

5.2.1 Reliability Analysis

Reliability analysis is done to check whether the variables used to study logistics flexibility will produce consistent results. The Cronbach Alpha is used to check the reliability. The results are shown in the table 5.2.1 below:

<table>
<thead>
<tr>
<th>Variables</th>
<th>Cronbach Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Supply Flexibility</td>
<td>0.788</td>
</tr>
<tr>
<td>Purchasing Flexibility</td>
<td>0.802</td>
</tr>
<tr>
<td>Manufacturing Flexibility</td>
<td>0.705</td>
</tr>
<tr>
<td>Physical Distribution Flexibility</td>
<td>0.734</td>
</tr>
<tr>
<td>Demand Management Flexibility</td>
<td>0.711</td>
</tr>
<tr>
<td>Customer Satisfaction</td>
<td>0.800</td>
</tr>
<tr>
<td>Logistics Flexibility Factors</td>
<td>0.709</td>
</tr>
</tbody>
</table>

As shown in the above table, the calculated Cronbach Alphas for all the variables are well ahead of the cut off rate of 0.70 to prove good reliability (Hair et al., 2009). So, it can be concluded that all the factors used to measures the logistics flexibility for fluid milk and milk products in Co-operative dairies in Gujarat are found to be reliable. It means these factors will produce consistent results irrespective of time period.
5.2.2 Regression of Physical Supply Flexibility (PSF) and Purchasing Flexibility (PF) on Manufacturing Flexibility (MF)

Hypothesis:

\( H_{(PSF)0} \): There is no significant impact of Physical Supply Flexibility on Manufacturing Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

\( H_{(PSF)1} \): There is a significant impact of Physical Supply Flexibility on Manufacturing Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

\( H_{(PF)0} \): There is no significant impact of Purchasing Flexibility on Manufacturing Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

\( H_{(PF)1} \): There is a significant impact of Purchasing Flexibility on Manufacturing Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

5.2.2.1 The regression co-efficient of the independent variables with their respective direction, values and significance level are given in the table 5.2.2.1 below:

Table 5.2.2.1

Regression coefficients of Physical Supply Flexibility and Purchasing Flexibility

<table>
<thead>
<tr>
<th></th>
<th>Regression Co-efficients</th>
<th>t-value</th>
<th>Significance Level</th>
<th>VIF Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Direction</td>
<td>Value</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>-</td>
<td>0.303</td>
<td>-3.103</td>
<td>0.003</td>
</tr>
<tr>
<td>PSF</td>
<td>+</td>
<td>0.494</td>
<td>18.819</td>
<td>0.000</td>
</tr>
<tr>
<td>PF</td>
<td>+</td>
<td>0.633</td>
<td>24.093</td>
<td>0.000</td>
</tr>
</tbody>
</table>
Dependent Variable: MF \[ R^2 = 0.958 \]
Independent Variables: PSF, PF \[ N = 82 \text{ numbers} \]
Durbin-Watson = 2.240

5.2.2.1.a The table 5.2.2.1 shows that Physical Supply Flexibility (PSF) has positive relationship with Manufacturing Flexibility (MF); as the regression co-efficient is + 0.494. The significance level of 0.000 indicates that this regression co-efficient is statistically very significant. So, null hypothesis \( H_{(PSF)} \) is rejected and alternate hypothesis \( H_{(PSF)} \) is accepted that there is a significant impact of Physical Supply Flexibility on Manufacturing Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat. This means Physical Supply Flexibility (PSF) exerts significant influence over Manufacturing Flexibility (MF). An increase in Physical Supply Flexibility (PSF) will bring about a significant increase in Manufacturing Flexibility (MF) by number of times the value of regression co-efficient.

5.2.2.1.b Purchasing Flexibility (PF) has positive relationship with Manufacturing Flexibility (MF); as the regression co-efficient is + 0.633. The significance level of 0.000 indicates that this regression co-efficient is statistically very significant. So, null hypothesis \( H_{(PF)} \) is rejected and alternate hypothesis \( H_{(PF)} \) is accepted that there is a significant impact of Purchasing Flexibility on Manufacturing Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat. This means Purchasing Flexibility (PF) exerts significant influence over Manufacturing Flexibility (MF). An increase in Purchasing Flexibility (PF) will bring about a significant increase in Manufacturing Flexibility (MF) by number of times the value of regression co-efficient.
Table 5.2.2

Variance Analysis of Physical Supply Flexibility and Purchasing Flexibility

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>Df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>17.84</td>
<td>2</td>
<td>8.92</td>
<td>932.044</td>
<td>0.000</td>
</tr>
<tr>
<td>Residual</td>
<td>0.756</td>
<td>79</td>
<td>0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>18.596</td>
<td>81</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5.2.2.2 The variance analysis given in table 5.2.2 above shows F = 932.044 at a significance level of 0.000 with df (2, 79), which indicates that all regression coefficients will be non zero.

5.2.2.3 The emerging Multiple Regression Equation is as under:

\[ MF = -0.303 + 0.494 \times \text{PSF} + 0.633 \times \text{PF} \]

The adjusted \( R^2 \), i.e. the co-efficient of determination stands at 0.958 indicating that the equation can explain 95.8% variations in Manufacturing Flexibility (MF). For remaining variations, i.e. unexplained variations, some other variables are responsible.

Table 5.2.3

Co-efficient Correlations of Physical Supply Flexibility and Purchasing Flexibility

<table>
<thead>
<tr>
<th></th>
<th>PSF</th>
<th>PF</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSF</td>
<td>1.000</td>
<td>0.504</td>
</tr>
<tr>
<td>PF</td>
<td>0.504</td>
<td>1.000</td>
</tr>
</tbody>
</table>
5.2.2.4 The co-efficients of correlation amongst all variables are depicted in the table 5.2.2.3 above. It is revealed that the two independent variables (Physical Supply Flexibility and Purchasing Flexibility) have the co-efficient of correlation 0.504. The VIF statistics in table 5.2.2.1 also depicts the value of 1.340 for Physical Supply Flexibility and 1.340 for Purchasing Flexibility, which are very much far from cut off rate of 10 for VIF statistics. Hence there is no cause of concern from viewpoint of multicollinearity among the independent variables. The D (Durbin-Watson) statistic stands at 2.240. The corresponding table values for D statistic stand at 1.61 for lower limit (D_L) and 1.66 for upper limit (D_U). As a result D (2.240) is greater than D_U (1.66) and 4 – D (1.76) is greater than D_L (1.61). Hence it can be concluded that either positive or negative autocorrelation does not exist.

Table 5.2.2.4

Descriptive Statistics of Physical Supply Flexibility, Purchasing Flexibility and Manufacturing Flexibility

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSF</td>
<td>3.00</td>
<td>4.83</td>
<td>3.81</td>
<td>0.45</td>
</tr>
<tr>
<td>PF</td>
<td>2.33</td>
<td>4.67</td>
<td>3.79</td>
<td>0.56</td>
</tr>
<tr>
<td>MF</td>
<td>2.33</td>
<td>4.67</td>
<td>3.75</td>
<td>0.48</td>
</tr>
</tbody>
</table>

5.2.2.5 The descriptive statistics pertinent to the multiple regression equation are depicted in table 5.2.2.4 above. For Physical Supply Flexibility, the minimum value rated is 3 and maximum value rated is 4.83, with mean 3.81 and standard deviation 0.45. For Purchasing Flexibility, the minimum value rated is 2.33 and maximum value rated is 4.67, with mean 3.79 and standard deviation 0.56. For Manufacturing Flexibility, the minimum value rated is 2.33 and maximum value rated is 4.67, with mean 3.75 and standard deviation 0.48.
5.2.3 Regression of Physical Supply Flexibility (PSF) and Purchasing Flexibility (PF) on Physical Distribution Flexibility (PDF)

Hypothesis:

\( H_{PSF0} \): There is no significant impact of Physical Supply Flexibility on Physical Distribution Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

\( H_{PSF1} \): There is a significant impact of Physical Supply Flexibility on Physical Distribution Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat

\( H_{PF0} \): There is no significant impact of Purchasing Flexibility on Physical Distribution Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

\( H_{PF1} \): There is a significant impact of Purchasing Flexibility on Physical Distribution Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

5.2.3.1 The regression co-efficient of the independent variables with their respective direction, values and significance level are given in the table 5.2.3.1 below:

**Table 5.2.3.1**

<p>| Regression Co- | Direction | Value | t-value | Significance Level | VIF Statistic |</p>
<table>
<thead>
<tr>
<th>coefficients</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>+</td>
<td>0.102</td>
<td>0.480</td>
<td>0.633</td>
<td></td>
</tr>
<tr>
<td>PSF</td>
<td>+</td>
<td>0.752</td>
<td>13.035</td>
<td>0.000</td>
<td>1.340</td>
</tr>
<tr>
<td>PF</td>
<td>+</td>
<td>0.238</td>
<td>4.127</td>
<td>0.000</td>
<td>1.340</td>
</tr>
</tbody>
</table>
Dependent Variable: PDF  \( R^2 = 0.799 \)

Independent Variables: PSF, PF  \( N = 82 \) numbers

Durbin-Watson = 2.091

5.2.3.1.a The table 5.2.3.1 shows that Physical Supply Flexibility (PSF) has positive relationship with Physical Distribution Flexibility (PDF); as the regression coefficient is + 0.752. The significance level of 0.000 indicates that this regression coefficient is statistically very significant. So, null hypothesis \( H_{(PSF)0} \) is rejected and alternate hypothesis \( H_{(PSF)1} \) is accepted that there is a significant impact of Physical Supply Flexibility on Physical Distribution Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat. This means Physical Supply Flexibility (PSF) exerts significant influence over Physical Distribution Flexibility (PDF). An increase in Physical Supply Flexibility (PSF) will bring about a significant increase in Physical Distribution Flexibility (PDF) by number of times the value of regression coefficient.

5.2.3.1.b Purchasing Flexibility (PF) has positive relationship with Physical Distribution Flexibility (PDF); as the regression coefficient is + 0.238. The significance level of 0.000 indicates that this regression coefficient is statistically very significant. So, null hypothesis \( H_{(PF)0} \) is rejected and alternate hypothesis \( H_{(PF)1} \) is accepted that there is a significant impact of Purchasing Flexibility on Physical Distribution Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat. This means Purchasing Flexibility (PF) exerts significant influence over Physical Distribution Flexibility (PDF). An increase in Purchasing Flexibility (PF) will bring about a significant increase in Physical Distribution Flexibility (PDF) by number of times the value of regression coefficient.
### Table 5.2.3.2

Variance Analysis of Physical Supply Flexibility and Purchasing Flexibility

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>Df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>14.676</td>
<td>2</td>
<td>7.338</td>
<td>161.528</td>
<td>0.000</td>
</tr>
<tr>
<td>Residual</td>
<td>3.589</td>
<td>79</td>
<td>0.045</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>18.265</td>
<td>81</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5.2.3.2 The variance analysis given in table 5.2.3.2 above shows $F = 161.528$ at a significance level of 0.000 with df (2, 79), which indicates that all regression coefficients will be non zero.

5.2.3.3 The emerging Multiple Regression Equation is as under:

$$PDF = + 0.102 + 0.752 \times (PSF) + 0.238 \times (PF)$$

The adjusted $R^2$, i.e. the co-efficient of determination stands at 0.958 indicating that the equation can explain 79.9% variations in Physical Distribution Flexibility (PDF). For remaining variations, i.e. unexplained variations, some other variables are responsible.

### Table 5.2.3.3

Co-efficient Correlations of Physical Supply Flexibility and Purchasing Flexibility

<table>
<thead>
<tr>
<th></th>
<th>PSF</th>
<th>PF</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSF</td>
<td>1.000</td>
<td>0.504</td>
</tr>
<tr>
<td>PF</td>
<td>0.504</td>
<td>1.000</td>
</tr>
</tbody>
</table>

5.2.3.4 The co-efficients of correlation amongst all variables are depicted in the table 5.2.3.3 above. It is revealed that the two independent variables (Physical Supply Flexibility and Purchasing Flexibility) have the co-efficient of correlation 0.504.
The VIF statistics in table 5.2.3.1 also depicts the value of 1.340 for Physical Supply Flexibility and 1.340 for Purchasing Flexibility, which are very much far from cut off rate of 10 for VIF statistics. Hence there is no cause of concern from viewpoint of multicollinearity among the independent variables. The D (Durbin-Watson) statistic stands at 2.091. The corresponding table values for D statistic stand at 1.61 for lower limit (D_U) and 1.66 for upper limit (D_L). As a result D (2.091) is greater than D_U (1.66) and 4 – D (1.909) is greater than D_L (1.61). Hence it can be concluded that either positive or negative autocorrelation does not exist.

Table 5.2.3.4

Descriptive Statistics of Physical Supply Flexibility, Purchasing Flexibility and Physical Distribution Flexibility

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSF</td>
<td>3.00</td>
<td>4.83</td>
<td>3.81</td>
<td>0.45</td>
</tr>
<tr>
<td>PF</td>
<td>2.33</td>
<td>4.67</td>
<td>3.79</td>
<td>0.56</td>
</tr>
<tr>
<td>PDF</td>
<td>3.00</td>
<td>4.83</td>
<td>3.88</td>
<td>0.47</td>
</tr>
</tbody>
</table>

5.2.3.5 The descriptive statistics pertinent to the multiple regression equation are depicted in table 5.2.3.4 above. For Physical Supply Flexibility, the minimum value rated is 3 and maximum value rated is 4.83, with mean 3.81 and standard deviation 0.45. For Purchasing Flexibility, the minimum value rated is 2.33 and maximum value rated is 4.67, with mean 3.79 and standard deviation 0.56. For Physical Distributed Flexibility, the minimum value rated is 3.00 and maximum value rated is 4.83, with mean 3.88 and standard deviation 0.47.
5.2.4 Regression of Physical Supply Flexibility (PSF) and Purchasing Flexibility (PF) on Demand Management Flexibility (DMF)

**Hypothesis:**

\[ H_{(PSF)0} \]: There is no significant impact of Physical Supply Flexibility on Demand Management Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

\[ H_{(PSF)1} \]: There is a significant impact of Physical Supply Flexibility on Demand Management Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

\[ H_{(PF)0} \]: There is no significant impact of Purchasing Flexibility on Demand Management Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

\[ H_{(PF)1} \]: There is a significant impact of Purchasing Flexibility on Demand Management Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

5.2.4.1 The regression co-efficient of the independent variables with their respective direction, values and significance level are given in the table 5.2.4.1 below:

**Table 5.2.4.1**

Regression coefficients of Physical Supply Flexibility and Purchasing Flexibility

<table>
<thead>
<tr>
<th></th>
<th>Regression Co-efficients</th>
<th>t-value</th>
<th>Significance Level</th>
<th>VIF Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Direction</td>
<td>Value</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Constant</strong></td>
<td>+</td>
<td>0.397</td>
<td>1.299</td>
<td>0.198</td>
</tr>
<tr>
<td><strong>PSF</strong></td>
<td>+</td>
<td>0.396</td>
<td>4.902</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>PF</strong></td>
<td>+</td>
<td>0.506</td>
<td>6.270</td>
<td>0.000</td>
</tr>
</tbody>
</table>
Dependent Variable: DMF  \[ R^2 = 0.606 \]
Independent Variables: PSF, PF  \[ N = 82 \text{ numbers} \]
Durbin-Watson = 1.937

5.2.4.1.a The table 5.2.4.1 shows that Physical Supply Flexibility (PSF) has positive relationship with Demand Management Flexibility (DMF); as the regression co-efficient is + 0.396. The significance level of 0.000 indicates that this regression co-efficient is statistically very significant. So, null hypothesis \( H_{(PSF)0} \) is rejected and alternate hypothesis \( H_{(PSF)1} \) is accepted that that there is a significant impact of Physical Supply Flexibility on Demand Management Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat. This means Physical Supply Flexibility (PSF) exerts significant influence over Demand Management Flexibility (DMF). An increase in Physical Supply Flexibility (PSF) will bring about a significant increase in Demand Management Flexibility (DMF) by number of times the value of regression co-efficient.

5.2.4.1.b Purchasing Flexibility (PF) has positive relationship with Demand Management Flexibility (DMF); as the regression co-efficient is + 0.506. The significance level of 0.000 indicates that this regression co-efficient is statistically very significant. So, null hypothesis \( H_{(PF)0} \) is rejected and alternate hypothesis \( H_{(PF)1} \) is accepted that that there is a significant impact of Purchasing Flexibility on Demand Management Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat. This means Purchasing Flexibility (PF) exerts significant influence over Demand Management Flexibility (DMF). An increase in Purchasing Flexibility (PF) will bring about a significant increase in Demand Management Flexibility (DMF) by number of times the value of regression co-efficient.
Table 5.2.4.2

Variance Analysis of Physical Supply Flexibility and Purchasing Flexibility

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>Df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>11.850</td>
<td>2</td>
<td>5.925</td>
<td>63.177</td>
<td>0.000*</td>
</tr>
<tr>
<td>Residual</td>
<td>7.409</td>
<td>79</td>
<td>0.094</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>19.259</td>
<td>81</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(* Significant at 0.05 level of significance)

5.2.4.2 The variance analysis given in table 5.2.4.2 above shows \( F = 63.177 \) at a significance level of 0.000 with df (2, 79), which indicates that all regression coefficients will be non zero.

5.2.4.3 The emerging Multiple Regression Equation is as under:

\[
DMF = + 0.397 + 0.396 \text{ (PSF)} + 0.506 \text{ (PF)}
\]

The adjusted \( R^2 \), i.e. the co-efficient of determination stands at 0.606 indicating that the equation can explain 60.6% variations in Demand Management Flexibility (DMF). For remaining variations, i.e. unexplained variations, some other variables are responsible.

Table 5.2.4.3

Co-efficient Correlations of Physical Supply Flexibility and Purchasing Flexibility

<table>
<thead>
<tr>
<th></th>
<th>PSF</th>
<th>PF</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSF</td>
<td>1.000</td>
<td>0.504</td>
</tr>
<tr>
<td>PF</td>
<td>0.504</td>
<td>1.000</td>
</tr>
</tbody>
</table>

5.2.4.4 The co-efficients of correlation amongst all variables are depicted in the table 5.2.4.3 above. It is revealed that the two independent variables (Physical Supply
Flexibility and Purchasing Flexibility) have the co-efficient of correlation 0.504. The VIF statistics in table 5.2.4.1 also depicts the value of 1.340 for Physical Supply Flexibility and 1.340 for Purchasing Flexibility, which are very much far from cut off rate of 10 for VIF statistics. Hence there is no cause of concern from viewpoint of multicollinearity among the independent variables. The D (Durbin-Watson) statistic stands at 1.937. The corresponding table values for D statistic stand at 1.61 for lower limit (D_L) and 1.66 for upper limit (D_U). As a result D (1.937) is greater than D_U (1.66) and 4 – D (2.063) is greater than D_L (1.61). Hence it can be concluded that either positive or negative autocorrelation does not exist.

Table 5.2.4.4
Descriptive Statistics of Physical Supply Flexibility, Purchasing Flexibility and Demand Management Flexibility

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSF</td>
<td>3.00</td>
<td>4.83</td>
<td>3.81</td>
<td>0.45</td>
</tr>
<tr>
<td>PF</td>
<td>2.33</td>
<td>4.67</td>
<td>3.79</td>
<td>0.56</td>
</tr>
<tr>
<td>DMF</td>
<td>2.40</td>
<td>4.80</td>
<td>3.80</td>
<td>0.49</td>
</tr>
</tbody>
</table>

5.2.4.5 The descriptive statistics pertinent to the multiple regression equation are depicted in table 5.2.4.4 above. For Physical Supply Flexibility, the minimum value rated is 3 and maximum value rated is 4.83, with mean 3.81 and standard deviation 0.45. For Purchasing Flexibility, the minimum value rated is 2.33 and maximum value rated is 4.67, with mean 3.79 and standard deviation 0.56. For Demand Management Flexibility, the minimum value rated is 2.40 and maximum value rated is 4.80, with mean 3.80 and standard deviation 0.49.
5.2.5 Regression of Manufacturing Flexibility (MF) on Physical Supply Flexibility (PSF)

**Hypothesis:**

$H_{(MF)}$: There is no significant impact of Manufacturing Flexibility (MF) on Physical Supply Flexibility (PSF) for fluid milk and milk products in Co-Operative Dairies in Gujarat.

$H_{(MF)}$: There is a significant impact of Manufacturing Flexibility (MF) on Physical Supply Flexibility (PSF) for fluid milk and milk products in Co-Operative Dairies in Gujarat.

5.2.5.1 The regression co-efficient of the independent variable with its direction, values and significance level are given in the table 5.2.5.1 below:

<table>
<thead>
<tr>
<th>Regression Co-efficients</th>
<th>Significance Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direction</td>
<td>Value</td>
</tr>
<tr>
<td>Constant</td>
<td>+</td>
</tr>
<tr>
<td>MF</td>
<td>+</td>
</tr>
</tbody>
</table>

Dependent Variable: PSF $R^2= 0.697$

Independent Variables: MF $N = 82$ numbers

5.2.5.1.a The table 5.2.5.1 shows that Manufacturing Flexibility (MF) has positive relationship with Physical Supply Flexibility (PSF); as the regression co-efficient is $+ 0.830$. The significance level of $0.000$ indicates that this regression
co-efficient is statistically very significant. So, null hypothesis $H_{(MF0)}$ is rejected and alternate hypothesis $H_{(MF1)}$ is accepted that there is a significant impact of Manufacturing Flexibility on Physical Supply Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat. This means Manufacturing Flexibility (MF) exerts significant influence over Physical Supply Flexibility (PSF). An increase in Manufacturing Flexibility (MF) will bring about a significant increase in Physical Supply Flexibility (PSF) by number of times the value of regression co-efficient.

Table 5.2.5.2

Variance Analysis of Manufacturing Flexibility

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>Df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>12.805</td>
<td>1</td>
<td>12.805</td>
<td>187.631</td>
<td>0.000</td>
</tr>
<tr>
<td>Residual</td>
<td>5.460</td>
<td>80</td>
<td>0.068</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>18.265</td>
<td>81</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5.2.5.2 The variance analysis given in table 5.2.5.2 above shows $F = 187.631$ at a significance level of 0.000 with df (1, 80), which indicates that all regression co-efficients will be non zero.

5.2.5.3 The emerging Multiple Regression Equation is as under:

$$PSF = + 0.770 + 0.830 \times (MF)$$

The adjusted $R^2$, i.e. the co-efficient of determination stands at 0.697 indicating that the equation can explain 69.7% variations in Physical Supply Flexibility (PSF). For remaining variations, i.e. unexplained variations, some other variables are responsible.
Table 5.2.5.3

Descriptive Statistics of Manufacturing Flexibility and Physical Supply Flexibility

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>MF</td>
<td>2.33</td>
<td>4.67</td>
<td>3.75</td>
<td>0.48</td>
</tr>
<tr>
<td>PSF</td>
<td>3.00</td>
<td>4.83</td>
<td>3.81</td>
<td>0.45</td>
</tr>
</tbody>
</table>

5.2.5.4 The descriptive statistics pertinent to the regression equation are depicted in table 5.2.5.3 above. For Manufacturing Flexibility, the minimum value rated is 2.33 and maximum value rated is 4.67, with mean 3.75 and standard deviation 0.48. For Physical Supply Flexibility, the minimum value rated is 3 and maximum value rated is 4.83, with mean 3.81 and standard deviation 0.56.

5.2.6 Regression of Manufacturing Flexibility (MF) on Demand Management Flexibility (DMF)

Hypothesis:

\[ H_{(MF)}^0: \] There is no significant impact of Manufacturing Flexibility (MF) on Demand Management Flexibility (DMF) for fluid milk and milk products in Co-Operative Dairies in Gujarat.

\[ H_{(MF)}^1: \] There is a significant impact of Manufacturing Flexibility (MF) on Demand Management Flexibility (DMF) for fluid milk and milk products in Co-Operative Dairies in Gujarat.

5.2.6.1 The regression co-efficient of the independent variable with its direction, values and significance level are given in the table 5.2.6.1 below:
Table 5.2.6.1

Regression coefficient of Manufacturing Flexibility

<table>
<thead>
<tr>
<th>Direction</th>
<th>Value</th>
<th>t-value</th>
<th>Significance Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>+</td>
<td>0.618</td>
<td>2.438</td>
</tr>
<tr>
<td>MF</td>
<td>+</td>
<td>0.822</td>
<td>12.254</td>
</tr>
</tbody>
</table>

Dependent Variable: DMF

Independent Variables: MF

N = 82 numbers

5.2.6.1.a The table 5.2.6.1 shows that Manufacturing Flexibility (MF) has a positive relationship with Demand Management Flexibility (DMF); as the regression coefficient is +0.822. The significance level of 0.000 indicates that this regression coefficient is statistically very significant. So null hypothesis $H_{(MF)_0}$ is rejected and alternate hypothesis $H_{(MF)_1}$ is accepted that there is a significant impact of Manufacturing Flexibility on Demand Management Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat. This means Manufacturing Flexibility (MF) exerts significant influence over Demand Management Flexibility (DMF). An increase in Manufacturing Flexibility (MF) will bring about a significant increase in Demand Management Flexibility (DMF) by number of times the value of regression coefficient.

Table 5.2.6.2

Variance Analysis of Manufacturing Flexibility

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>Df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>12.565</td>
<td>1</td>
<td>12.565</td>
<td>150.163</td>
<td>0.000</td>
</tr>
<tr>
<td>Residual</td>
<td>6.694</td>
<td>80</td>
<td>0.084</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>19.259</td>
<td>81</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5.2.6.2 The variance analysis given in table 5.2.6.2 above shows $F = 150.163$ at a significance level of 0.000 with df (1, 80), which indicates that all regression coefficients will be non zero.

5.2.6.3 The emerging Multiple Regression Equation is as under:

$$\text{PSF} = + 0.618 + 0.822 \times (\text{MF})$$

The adjusted $R^2$, i.e. the co-efficient of determination stands at 0.648 indicating that the equation can explain 64.8% variations in Demand Management Flexibility (DMF). For remaining variations, i.e. unexplained variations, some other variables are responsible.

Table 5.2.6.3

Descriptive Statistics of Manufacturing Flexibility and Demand Management Flexibility

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>MF</td>
<td>2.33</td>
<td>4.67</td>
<td>3.75</td>
<td>0.48</td>
</tr>
<tr>
<td>DMF</td>
<td>2.40</td>
<td>4.80</td>
<td>3.80</td>
<td>0.49</td>
</tr>
</tbody>
</table>

5.2.6.4 The descriptive statistics pertinent to the regression equation are depicted in table 5.2.6.3 above. For Manufacturing Flexibility, the minimum value rated is 2.33 and maximum value rated is 4.67, with mean 3.75 and standard deviation 0.48. For Demand Management Flexibility, the minimum value rated is 2.40 and maximum value rated is 4.80, with mean 3.80 and standard deviation 0.49.
5.2.7 Regression of Physical Distribution Flexibility (PDF) and Demand Management Flexibility (DMF) on Customer Satisfaction (CS)

Hypothesis:

\( H_{(PDF)^0} \): There is no significant impact of Physical Distribution Flexibility (PDF) on Customer Satisfaction (CS) for fluid milk and milk products in Co-Operative Dairies in Gujarat.

\( H_{(PDF)^1} \): There is a significant impact of Physical Distribution Flexibility (PDF) and Demand on Customer Satisfaction (CS) for fluid milk and milk products in Co-Operative Dairies in Gujarat.

\( H_{(DMF)^0} \): There is no significant impact of Demand Management Flexibility (DMF) on Customer Satisfaction (CS) for fluid milk and milk products in Co-Operative Dairies in Gujarat.

\( H_{(DMF)^1} \): There is a significant impact of Demand Management Flexibility (DMF) on Customer Satisfaction (CS) for fluid milk and milk products in Co-Operative Dairies in Gujarat.

5.2.7.1 The regression co-efficient of the independent variables with their respective direction, values and significance level are given in the table 5.2.7.1 below:

**Table 5.2.7.1**

| Regression Co-efficients of Physical Distribution Flexibility and Demand Management Flexibility |
|---|---|---|---|
| **Directions** | **Value** | **t-value** | **Significance Level** | **VIF Statistic** |
| **Constant** | + | 0.142 | 0.066 | 0.947 |
| **PDF** | + | 0.639 | 14.070 | 0.000 | 1.698 |
| **DMF** | + | 0.405 | 8.922 | 0.000 | 1.698 |
Dependent Variable: CS  \[ R^2 = 0.902 \]

Independent Variables: PDF, DMF  \[ N = 82 \text{ numbers} \]

Durbin-Watson = 1.883

5.2.7.1.a The table 5.2.7.1 shows that Physical Distribution Flexibility (PDF) has positive relationship with Customer Satisfaction (CS); as the regression co-efficient is + 0.693. The significance level of 0.000 indicates that this regression co-efficient is statistically very significant. So, null hypothesis \( H_{(PDF)_0} \) is rejected and alternate hypothesis \( H_{(PDF)_1} \) is accepted that there is a significant impact of Physical Distribution Flexibility on Customer Satisfaction for fluid milk and milk products in Co-Operative Dairies in Gujarat. This means Physical Distribution Flexibility (PDF) exerts significant influence over Customer Satisfaction (CS). An increase in Physical Supply Flexibility (PSF) will bring about an increase in Customer Satisfaction (CS) by number of times the value of regression co-efficient.

5.2.7.1.b Demand Management Flexibility (DMF) has positive relationship with Customer Satisfaction (CS); as the regression co-efficient is + 0.405. The significance level of 0.000 indicates that this regression co-efficient is statistically very significant. So, null hypothesis \( H_{(DMF)_0} \) is rejected and alternate hypothesis \( H_{(DMF)_1} \) is accepted that there is a significant impact of Demand Management Flexibility on Customer Satisfaction for fluid milk and milk products in Co-Operative Dairies in Gujarat. This means Demand Management Flexibility (DMF) exerts significant influence over Customer Satisfaction (CS). An increase in Demand Management Flexibility (DMF) will bring about an increase in Customer Satisfaction (CS) by number of times the value of regression co-efficient.
Table 5.2.7.2

Variance Analysis of Physical Distribution Flexibility and Demand Management Flexibility

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>Df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>15.768</td>
<td>2</td>
<td>7.884</td>
<td>372.440</td>
<td>0.000</td>
</tr>
<tr>
<td>Residual</td>
<td>1.672</td>
<td>79</td>
<td>0.021</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>17.441</td>
<td>81</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5.2.7.2 The variance analysis given in table 5.2.7.2 above shows $F = 372.440$ at a significance level of 0.000 with df (2, 79), which indicates that all regression coefficients will be non zero.

5.2.7.3 The emerging Multiple Regression Equation is as under:

$$CS = + 0.142 + 0.639 \text{ (PDF)} + 0.405 \text{ (DMF)}$$

The adjusted $R^2$, i.e. the co-efficient of determination stands at 0.902 indicating that the equation can explain 90.2% variations in Customer Satisfaction (CS). For remaining variations, i.e. unexplained variations, some other variables are responsible.

Table 5.2.7.3

Co-efficient Correlations of Physical Distribution Flexibility and Demand Management Flexibility

<table>
<thead>
<tr>
<th></th>
<th>PDF</th>
<th>DMF</th>
</tr>
</thead>
<tbody>
<tr>
<td>PDF</td>
<td>1.000</td>
<td>0.641</td>
</tr>
<tr>
<td>DMF</td>
<td>0.641</td>
<td>1.000</td>
</tr>
</tbody>
</table>
5.2.7.4 The co-efficients of correlation amongst all variables are depicted in the table 5.2.7.3 above. It is revealed that the two independent variables (Physical Distribution Flexibility and Demand Management Flexibility) have the co-efficient of correlation 0.641. The VIF statistics in table 5.2.7.1 also depicts the value of 1.698 for Physical Distribution Flexibility and 1.698 for Demand Management Flexibility, which are very much far from cut off rate of 10 for VIF statistics. Hence there is no cause of concern from viewpoint of multicollinearity among the independent variables. The D (Durbin-Watson) statistic stands at 1.883. The corresponding table values for D statistic stand at 1.61 for lower limit (D_L) and 1.66 for upper limit (D_U). As a result D (1.883) is greater than D_U (1.66) and 4 – D (2.117) is greater than D_L (1.61). Hence it can be concluded that either positive or negative autocorrelation does not exist.

Table 5.2.7.4

Descriptive Statistics of Physical Distribution Flexibility, Demand Management Flexibility and Customer Satisfaction

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>PDF</td>
<td>3.00</td>
<td>4.83</td>
<td>3.88</td>
<td>0.47</td>
</tr>
<tr>
<td>DMF</td>
<td>2.40</td>
<td>4.80</td>
<td>3.80</td>
<td>0.49</td>
</tr>
<tr>
<td>CS</td>
<td>2.33</td>
<td>4.83</td>
<td>3.86</td>
<td>0.46</td>
</tr>
</tbody>
</table>

5.2.7.5 The descriptive statistics pertinent to the multiple regression equation are depicted in table 5.2.7.4 above. For Physical Distribution Flexibility, the minimum value rated is 3 and maximum value rated is 4.83, with mean 3.88 and standard deviation 0.47. For Demand Management Flexibility, the minimum value rated is 2.40 and maximum value rated is 4.80, with mean 3.80 and standard deviation 0.49. For Customer Satisfaction, the minimum value rated is 2.33 and maximum value rated is 4.83, with mean 3.86 and standard deviation 0.46.
Figure 5.1 Relationships among various dimensions of Logistics Flexibility Model for Fluid Milk and Milk Products in Gujarat

(* Significant at 0.05 level of significance)

(Indicates impact of independent factor on dependent factor)
5.2.8 Discussion regarding Logistics Flexibility Model

This section aims to find out the importance of various dimensions of logistics flexibility throughout supply chain and relationships among them. The flexibility is defined in terms of three attributes called range, mobility and uniformity. Six dimensions, i.e. Physical Supply Flexibility, Purchasing Flexibility, Manufacturing Flexibility, Physical Distribution Flexibility, Demand Management Flexibility and Customer Satisfaction, are used to measure logistics flexibility for fluid milk and milk products in Co-operative dairies in Gujarat. Physical Supply Flexibility, Purchasing Flexibility and Manufacturing Flexibility are treated as competence and Physical Distribution Flexibility and Demand Management Flexibility are treated as capability. It was hypothesized that the competence creates capability, which leads to customer satisfaction. Regression analysis was done to check the hypothesized relationships among various dimensions of logistics flexibility.

5.2.8.1 Regression of Physical Supply Flexibility (PSF) and Purchasing Flexibility (PF) on Manufacturing Flexibility (MF)

a. It is hypothesized the Physical Supply Flexibility and Purchasing Flexibility exert significant impact on Manufacturing Flexibility for fluid milk and milk products in co-operative dairies in Gujarat. The regression co-efficient $R^2$ shows the value of 0.958, which proves that the Physical Supply Flexibility and Purchasing Flexibility, both together, creates significant positive impact on Manufacturing Flexibility for fluid milk and milk products in co-operative dairies in Gujarat. The $\beta$ co-efficient are +0.494 for Physical Supply Flexibility and +0.633 for Purchasing Flexibility and the significance level of 0.000 for both the independent variables show that both the variables are exerting significant positive impact on Manufacturing Flexibility. It is found that Purchasing Flexibility exerts more positive impact than Physical Supply Flexibility on Manufacturing Flexibility.
b. Physical Supply Flexibility exerts significant positive impact on Manufacturing Flexibility due to following reasons: (1) Delivering multiple kinds of material (range) in response to operations requirements brings flexibility in producing different products (range) as per requirements. (2) On time and quick delivery (mobility) of required materials to production department brings accuracy in terms of producing range of products as per planning (mobility). (3) The ability to pick and assemble multiple materials accurately (uniformity) and quickly (mobility), delivering varieties of materials to production location on time (range and mobility) and maintaining accurate records of required materials and location (range and uniformity) in physical supply function brings flexibility in manufacturing function in terms of ability to respond to changes in delivery request (range and mobility), producing varieties of products cost effectively (mobility) and adapt changes in response to market environment (range and uniformity). So, the better management Physical Supply Flexibility leads to more flexibility in manufacturing of fluid milk and milk products in co-operative dairies in Gujarat.

c. Purchasing Flexibility exerts significant positive impact on Manufacturing Flexibility because of following reasons: (1) The ability to obtain multiple kinds of materials that meet specification (range, mobility and uniformity) brings ability in manufacturing system to respond to changes in delivery request in terms of production of varieties of products (range and uniformity). (2) The ability to obtaining multiple batch sizes of materials from suppliers quickly (mobility) brings ability in manufacturing system to cost effectively produce multiple products at certain range of output levels (mobility). (3) The ability to maintain accurate update of purchasing and production orders, close communication and co-ordination with suppliers for bringing required materials (uniformity) leads to in house ability in manufacturing system to response to changes in multiple production orders (range and uniformity) and market environment at large.
5.2.8.2 Regression of Physical Supply Flexibility (PSF) and Purchasing Flexibility (PF) on Physical Distribution Flexibility (PDF)

a. It is hypothesized that Physical Supply Flexibility and Purchasing Flexibility exert significant impact on Physical Distribution Flexibility for fluid milk and milk products in co-operative dairies in Gujarat. The regression co-efficient $R^2$ shows the value of 0.799, which proves that the Physical Supply Flexibility and Purchasing Flexibility, both together, creates significant positive impact on Manufacturing Flexibility for fluid milk and milk products in co-operative dairies in Gujarat. The $\beta$ co-efficient are +0.752 for Physical Supply Flexibility and +0.238 for Purchasing Flexibility and the significance level of 0.000 for both the independent variables shows that both the variables are exerting significant positive impact on Physical Distribution Flexibility. It is found that Physical Supply Flexibility exerts more positive impact than Purchasing Flexibility on Manufacturing Flexibility.

b. Physical Supply Flexibility exerts significant positive impact on Physical Distribution Flexibility because of following reasons: (1) Delivering multiple kinds of material (range) in response to operations requirements on time (mobility) creates positive impact on Physical Distribution Flexibility in terms of distributing varieties of fluid milk and milk products in different pack sizes on time (range and mobility). (2) On time and quick delivery (mobility) of required materials to manufacturing department brings accuracy in terms of producing range of products as per planning (mobility), which in turn develops the ability to deliver varieties of products at the required time (range and mobility) to retailers and customers. So, more flexibility in Physical Supply creates more ability to maintain flexibility in Physical Distribution of fluid milk and milk products in co-operative dairies of Gujarat.

c. Purchasing Flexibility exerts significant positive impact on Physical Distribution Flexibility because of following reasons: (1) The ability to obtain multiple kinds of materials that meet specification (range, mobility and uniformity) brings ability to distribute varieties of fluid milk and milk products with specification (range
and uniformity). (2) The ability to fill multiple materials orders quickly (mobility) leads to more accurate distribution of various products on time (mobility). (3) The co-ordination and close communication with suppliers in terms of specification of required materials (range and uniformity) leads to more accurate physical distribution of varieties of fluid milk and milk products as per specifications (range and uniformity).

5.2.8.3 Regression of Physical Supply Flexibility (PSF) and Purchasing Flexibility (PF) on Demand Management Flexibility (DMF)

a. It is hypothesized that Physical Supply Flexibility and Purchasing Flexibility exert significant impact on Demand Management Flexibility for fluid milk and milk products in co-operative dairies in Gujarat. The regression co-efficient $R^2$ shows the value of 0.606, which proves that the Physical Supply Flexibility and Purchasing Flexibility, both together, creates significant positive impact on Manufacturing Flexibility for fluid milk and milk products in co-operative dairies in Gujarat. The $\beta$ co-efficient are +0.396 for Physical Supply Flexibility and +0.506 for Purchasing Flexibility and the significance level of 0.000 for both the independent variables shows that both the variables are exerting significant positive impact on Physical Distribution Flexibility. It is found that Purchasing Flexibility exerts more positive impact than Physical Distribution Flexibility on Demand Management Flexibility.

b. Physical Supply Flexibility exerts significant positive impact on Demand Management Flexibility because of following reasons: (1) The ability to deliver multiple kinds of materials in terms of requirements as per specifications (range and uniformity) creates ability to respond to multiple retailers’ and customers’ requirements in terms of specifications (range and uniformity). (2) The ability to pick and assemble multiple kind of materials (range) and delivering it with accurate transport system on time (mobility) leads to respond to multiple delivery requests of retailers and customers quickly and on time (range and mobility).
c. Purchasing Flexibility exerts significant positive impact on Demand Management Flexibility because of following reasons: (1) It is important to maintain co-ordination among the various members throughout supply chain so that the customers’ and retailers’ feedback and requirements can be known not only to organization, but also to suppliers of organization. So, ability to maintain close communication and co-ordination with suppliers in terms of specifications of required materials creates ability to respond to feedback and specifications from retailers and consumers (uniformity) quickly. (2) The ability to fill multiple purchasing requests quickly (mobility) with specifications (range and uniformity) leads to flexibility in terms of delivering varieties of required products at required time period (range and uniformity).

5.2.8.4 Regression of Manufacturing Flexibility (MF) on Physical Distribution Flexibility (PDF)

a. It is hypothesized that Manufacturing Flexibility exerts significant impact on Physical Distribution Flexibility for fluid milk and milk products in co-operative dairies in Gujarat. The regression co-efficient $R^2$ shows the value of 0.697, which proves that Manufacturing Flexibility exerts significant positive impact on Physical Distribution Flexibility for fluid milk and milk products in co-operative dairies in Gujarat. The $\beta$ co-efficient of +0.830 for Manufacturing Flexibility, shows that Manufacturing Flexibility exerts significant positive impact on Physical Distribution Flexibility.

b. Manufacturing Flexibility exerts significant positive impact on Physical Distribution Flexibility due to following reasons: (1) The ability to produce varieties of products (range) creates flexibility in terms of responding to varieties of products’ delivery requests (range) from customers and retailers. (2) The use of automated manufacturing technologies in production process improves the flexibility in production of varieties of products (range) quickly (mobility) in terms of ability to respond to delivery changes in delivery requests in terms of
producing varieties of products, packaging and labeling; which in turn brings ability to deliver varieties of products (range) at required time (mobility).

5.2.8.5 Regression of Manufacturing Flexibility (MF) on Demand Management Flexibility (DMF)

a. It is hypothesized that Manufacturing Flexibility exerts significant impact on Demand Management Flexibility for fluid milk and milk products in co-operative dairies in Gujarat. The regression co-efficient $R^2$ shows the value of 0.648, which proves that Manufacturing Flexibility exerts significant positive impact on Physical Distribution Flexibility for fluid milk and milk products in co-operative dairies in Gujarat. The $\beta$ co-efficient of +0.822 for Manufacturing Flexibility, shows that Manufacturing Flexibility exerts significant positive impact on Demand Management Flexibility.

b. Manufacturing Flexibility exerts significant positive impact on Demand Management Flexibility due to following reasons: (1) The ability to produce varieties of products (range) by respective dairies proves significant in terms of responding to varieties of products (range) demanded by customers and retailers. (2) The ability to produce varieties of products (range) with automated technologies quickly (range) proves significant in terms of responding to customers’ and retailers’ delivery time requirements (range). (3) The in-house flexibility and ability to make changes in production of varieties of products as per customers’ and retailers’ feedback and specifications (uniformity) brings flexibility in terms of demand management in market.

c. It is observed that though Manufacturing Flexibility exerts significant positive impact on Physical Distribution Flexibility and Demand Management Flexibility, the value of R2 showing the variation in Physical Distribution Flexibility and Demand Management Flexibility exerted by Manufacturing Flexibility is only 0.697 and 0.648 respectively. It means that manufacturing flexibility exerts 69.7%
variations in Physical Distribution Flexibility and 64.8% variations in Demand Management Flexibility.

d. The flexibility is depended upon the supply of raw milk and demand for fluid milk and milk products. The supply of raw milk in different dairy co-operatives is different. So, different dairy co-operatives in Gujarat have different abilities to produce different product, which ranges from just chilling the raw milk and supply it to some other dairies, to producing few to large varieties of fluid milk and milk products as per capacity of respective dairies. So, the co-operative dairies in Gujarat can be classified in three groups basically:

I. Co-operative dairies chilling the milk only and supplying it further to other co-operative dairies and mother dairy, like, Amar Dairy (Amreli), Surdhara Dairy (Surendranagar),

II. Co-operative dairies producing packed milk and other few variants of dairy products and distributing it to local markets and other districts, like, Uttam Dairy (Ahmedabad), Dudhdhara Dairy (Bharuch), Vasudhara Dairy (Valsad), Gopal Dairy (Rajkot), Sumul Dairy (Surat).

III. Co-operative dairies producing large varieties of fluid milk and milk products and distributing it to local markets and other districts like Sabar Dairy (Himmatnagar), Banas Dairy (Palanpur), Madhur Dairy (Gandhinagar), Dudhsagar Dairy (Mehsana), Baroda Dairy (Vadodara), Amul Dairy (Anand) and Mother Dairy (Gandhinagar).

e. The co-operative dairies having low supply of raw milk find it costly to produce packed milk and other variants and distribute them in market. They have to be dependent on the supply of fluid milk and milk products provided by other dairy co-operative unions to fulfill local market demand. So, these kind of co-operative dairies do not able to generate manufacturing flexibility and other internal competencies to fulfill market demand. They have to be dependent on other dairy co-operatives (GCMMF) to fulfill local demand for varieties of fluid milk and milk products in Gujarat. So, in these kind of co-operative dairies the
Manufacturing Flexibility exerts very impact on Physical Distribution and Demand Management Flexibility.

f. The co-operative dairies producing packed milk and other few variants of dairy products are not able to fulfill their local market demand due to limited supply of milk, which is very low as compared to demand for varieties of fluid milk and milk products. They also have to be dependent on other co-operative dairies to fulfill demand for fluid milk and milk products in local market. So, manufacturing flexibility is moderate in this kind of co-operative dairies, exerting moderate impact on Physical Distribution Flexibility and Demand Management Flexibility in local as well as other markets.

g. The co-operative dairies producing large varieties of fluid milk and milk products are the most flexible in managing supply chain logistics. These kind of co-operative dairies have large supply of raw milk from large numbers of village dairy co-operative societies. They are able to manufacturing huge quantities of various kinds of fluid milk and milk products. They are able to distribute varieties of fluid milk and milk products in local markets as well as other markets. But, sometimes, they also have to be dependent on other dairies for few variants of dairy products. So, in this kind of dairies, manufacturing flexibility and other internal competencies exert the most significant impact on Physical Distribution Flexibility and Demand Management Flexibility than other types of co-operative dairies mentioned above.

Overall, the impact of Manufacturing Flexibility on Physical Distribution Flexibility and Demand Management Flexibility has found to be significant, but at moderate level.

5.2.8.6 Regression of Physical Distribution Flexibility (PDF) and Demand Management Flexibility (DMF) on Customer Satisfaction (CS)

a. It is hypothesized that Physical Distribution Flexibility and Demand Management Flexibility exert significant impact on Customer Satisfaction for fluid milk and
milk products in co-operative dairies in Gujarat. The regression co-efficient $R^2$ shows the value of 0.902, which proves that the Physical Distribution Flexibility and Demand Management Flexibility, both together, creates significant positive impact on Customer Satisfaction for fluid milk and milk products in co-operative dairies in Gujarat. The $\beta$ co-efficient are $+0.639$ for Physical Distribution Flexibility and $+0.405$ for Demand Management Flexibility and the significance level of 0.000 for both the independent variables shows that both the variables are exerting significant positive impact on Customer Satisfaction. It is found that Physical Distribution Flexibility exerts more positive impact than Demand Management Flexibility on Customer Satisfaction.

b. Physical Distribution Flexibility exerts significant impact on Customer Satisfaction due to following reasons: (1) The ability to quickly assemble multiple customer orders (range) accurately in Physical Distribution leads to on time delivery (mobility) of varieties of fluid milk and milk products. (2) The varieties of various fluid milk and milk products in different pack sizes (range) also provide customization up to certain extent in terms of specific quantity and variant out of varieties of products available. (3) The accurate transport system also makes it possible to deliver the varieties of products at required time, which improves loyalty towards products. (4) The uniformity in terms of standardization of transport services in physical distribution makes it possible to carry varieties of fluid milk and milk products accurately.

c. Demand Management Flexibility exerts significant impact on Customer Satisfaction due to following reasons: (1) The ability to manage to multiple retailers’ and customers’ delivery time requirements leads to greater availability of products on time (mobility), which improves loyalty towards products. (2) The ability to manage multiple customers’ and retailers’ specific requirements (range) leads to greater customer satisfaction and loyalty. (3) The ability to respond to customers’ and retailers’ feedback and suggestions leads to greater customer satisfaction and reputation of products in the market.
5.3 Analysis of Logistics Information System and its impact on Logistics Flexibility

5.3.1 Analysis of Logistics Operating System (LOS) and its impact on Logistics Flexibility

5.3.1.1 Reliability Analysis

Reliability analysis is done to check whether the variables used to study logistics operating system scale will produce consistent results. The Cronbach Alpha is used to check the reliability. The results are shown in the table 5.3.1.1 below:

<table>
<thead>
<tr>
<th>Variables</th>
<th>Cronbach Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logistics Operating System Factors</td>
<td>0.792</td>
</tr>
</tbody>
</table>

As shown in the above table, the calculated Cronbach Alpha for logistics operating system scale is well ahead of the cut off rate of 0.70 (Hair et al., 2009) to prove good reliability. So, it can be concluded that logistics operating system scale used to study the impact of logistics operating system variables on maintaining logistics flexibility for fluid milk and milk products in Co-operative dairies in Gujarat is found to be reliable. It means logistics operating system scale will produce consistent results irrespective of time period.
5.3.1.2 Regression of Logistics Operating System (LOS) on Logistics Flexibility (LF)

**Hypothesis:**

\( H^{(Time)}_0 \): There is no significant impact of Timeliness dimension of Logistics Operating System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

\( H^{(Time)}_1 \): There is a significant impact of Timeliness dimension of Logistics Operating System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

\( H^{(Accu)}_0 \): There is no significant impact of Accuracy dimension of Logistics Operating System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

\( H^{(Accu)}_1 \): There is a significant impact of Accuracy dimension of Logistics Operating System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

\( H^{(Avail)}_0 \): There is no significant impact of Availability dimension of Logistics Operating System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

\( H^{(Avail)}_1 \): There is a significant impact of Availability dimension of Logistics Operating System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

\( H^{(EBF)}_0 \): There is no significant impact of Exception Basis Formatted dimension of Logistics Operating System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.
**H(EBF)1:** There is a significant impact of Exception Basis Formatted dimension of Logistics Operating System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

**H(FFU)0:** There is no significant impact of Formatted to Facilitate Usage dimension of Logistics Operating System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

**H(FFU)1:** There is a significant impact of Formatted to Facilitate Usage dimension of Logistics Operating System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

**H(IS)0:** There is no significant impact of Information Sharing dimension of Logistics Operating System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

**H(IS)1:** There is a significant impact of Information Sharing dimension of Logistics Operating System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

**H(Flex)0:** There is no significant impact of Flexibility dimension of Logistics Operating System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

**H(Flex)1:** There is a significant impact of Flexibility dimension of Logistics Operating System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

**H(IV)0:** There is no significant impact of Internal Validity dimension of Logistics Operating System on maintaining Logistics Flexibility
for fluid milk and milk products in Co-Operative Dairies in Gujarat.

**H(IY)**: There is a significant impact of Internal Validity dimension of Logistics Operating System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

**H(EY)**: There is no significant impact of External Validity dimension of Logistics Operating System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

**H(EV)**: There is a significant impact of External Validity dimension of Logistics Operating System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.
5.3.1.2.1 The regression co-efficient of the independent variables with their respective direction, values and significance level are given in the table 5.3.1.2.1 below:

Table 5.3.1.2.1

Regression coefficients of benefits of using Logistics Operating System

<table>
<thead>
<tr>
<th></th>
<th>Regression Co-efficients</th>
<th>t-value</th>
<th>Significance Level</th>
<th>VIF Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Direction</td>
<td>Value</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>+</td>
<td>0.408</td>
<td>0.837</td>
<td>0.405</td>
</tr>
<tr>
<td>Time</td>
<td>+</td>
<td>0.159</td>
<td>1.790</td>
<td>0.078</td>
</tr>
<tr>
<td>Accu</td>
<td>+</td>
<td>0.126</td>
<td>1.450</td>
<td>0.151</td>
</tr>
<tr>
<td>Avail</td>
<td>-</td>
<td>0.188</td>
<td>-2.198</td>
<td>0.031</td>
</tr>
<tr>
<td>EFB</td>
<td>+</td>
<td>0.063</td>
<td>0.589</td>
<td>0.557</td>
</tr>
<tr>
<td>FFU</td>
<td>+</td>
<td>0.309</td>
<td>3.587</td>
<td>0.001</td>
</tr>
<tr>
<td>IS</td>
<td>-</td>
<td>0.064</td>
<td>-0.668</td>
<td>0.506</td>
</tr>
<tr>
<td>Flex</td>
<td>+</td>
<td>0.261</td>
<td>2.668</td>
<td>0.009</td>
</tr>
<tr>
<td>IV</td>
<td>+</td>
<td>0.274</td>
<td>2.936</td>
<td>0.004</td>
</tr>
<tr>
<td>EV</td>
<td>+</td>
<td>0.209</td>
<td>2.229</td>
<td>0.029</td>
</tr>
</tbody>
</table>

Dependent Variable: LF  
\[ R^2 = 0.572 \]

Independent Variables: Time, Accu, Avail, EFB, FFU, IS, Flex, IV, EV

Durbin-Watson = 1.704  
N = 82 numbers

5.3.1.2.1.a The table 5.3.1.2.1 shows that Timeliness dimension (Time) has positive but weak relationship with maintaining Logistics Flexibility (LF); as the regression co-efficient is + 0.159. The significance level of 0.078 indicates that this regression co-efficient is statistically insignificant. So, alternate hypothesis \( H_{(Time)} \) is rejected and null hypothesis \( H_{(Time)} \) is accepted that there is no significant impact of Timeliness dimension of Logistics Operating
System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat. This means a change Timeliness dimension (Time) of logistics information operating system exerts insignificant influence over maintaining Logistics Flexibility (LF).

5.3.1.2.1.b Accuracy dimension (Accu) has positive but weak relationship with maintaining Logistics Flexibility (LF); as the regression co-efficient is + 0.126. The significance level of 0.151 indicates that this regression co-efficient is statistically insignificant. So, alternate hypothesis $H_{(Accu)}1$ is rejected and null hypothesis $H_{(Accu)}0$ is accepted that there is no significant impact of Accuracy dimension of Logistics Operating System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat. This means Accuracy dimension (Accu) of logistics information operating system exerts insignificant influence over maintaining Logistics Flexibility (LF). An increase in Accuracy (Accu) will not bring about an increase in Logistics Flexibility (LF).

5.3.1.2.1.c Availability dimension (Avail) has negative relationship with maintaining Logistics Flexibility (LF); as the regression co-efficient is - 0.188. The significance level of 0.031 indicates that this regression co-efficient is statistically significant. So, null hypothesis $H_{(Avail)}0$ is rejected and alternated hypothesis $H_{(Avail)}1$ is accepted that there is a significant impact of Availability dimension of Logistics Operating System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat. This means Availability dimension (Avail) of logistics information operating system exerts significant influence over maintaining Logistics Flexibility (LF). An increase in visibility and Availability of information (Avail) where and where desired in organization will create negative impact on maintaining
Logistics Flexibility (LF) by number of times the value of regression coefficient.

5.3.1.2.1.d Exception Based Formatted dimension (EBF) has positive but weak relationship with maintaining Logistics Flexibility (LF); as the regression coefficient is very low at + 0.063. The significance level of 0.557 indicates that this regression co-efficient is statistically insignificant. So, alternate hypothesis $H_{(EBF)}$1 is rejected and null hypothesis $H_{(EBF)}$0 is accepted that there is no significant impact of Exception Based Formatted dimension of Logistics Operating System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat. This means Exception Based Formatted dimension (EBF) of logistics information operating system exerts insignificant influence over maintaining Logistics Flexibility (LF). A change in Exception Based Formatting (EBF) will not bring about a significant change in Logistics Flexibility (LF).

5.3.1.2.1.e Formatted to Facilitate Usage dimension (FFU) has positive relationship with maintaining Logistics Flexibility (LF); as the regression co-efficient is + 0.309. The significance level of 0.001 indicates that this regression co-efficient is statistically very significant. So, null hypothesis $H_{(FFU)}$0 is rejected and alternate hypothesis $H_{(FFU)}$1 is accepted that there is a significant impact of Formatted to Facilitate Usage dimension of Logistics Operating System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat. This means Formatted to Facilitate Usage dimension (FFU) of logistics information operating system exerts significant influence over maintaining Logistics Flexibility (LF). An increase in proper Formatting to Facilitate Usage (FFU) will bring about a significant increase in Logistics Flexibility (LF) by number of times the value of regression co-efficient.
5.3.1.2.1.f Information Sharing dimension (IS) has negative and weak relationship with maintaining Logistics Flexibility (LF); as the regression co-efficient is – 0.064. The significance level of 0.506 indicates that this regression co-efficient is statistically very insignificant. So, alternate hypothesis H_{(IS)}^1 is rejected and null hypothesis H_{(IS)}^0 is accepted that there is an no significant impact of Information Sharing dimension of Logistics Operating System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat. This means Information Sharing (IS) of logistics information operating system exerts insignificant influence over maintaining Logistics Flexibility (LF).

5.3.1.2.1.g Flexibility dimension (Flex) has positive relationship with maintaining Logistics Flexibility (LF); as the regression co-efficient is + 0.261. The significance level of 0.009 indicates that this regression co-efficient is statistically very significant. So, null hypothesis H_{(Flex)}^0 is rejected and alternate hypothesis H_{(Flex)}^1 is accepted that there is a significant impact of Flexibility dimension of Logistics Operating System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat. This means Flexibility dimension (Flex) of logistics information operating system exerts significant influence over maintaining Logistics Flexibility (LF). More Flexibility in day to day logistics operating system (Flex) will bring about a significant improvement in Logistics Flexibility (LF) by number of times the value of regression co-efficient.

5.3.1.2.1.h Internal Validity dimension (IV) has positive relationship with maintaining Logistics Flexibility (LF); as the regression co-efficient is + 0.274. The significance level of 0.004 indicates that this regression co-efficient is statistically very significant. So, null hypothesis H_{(IV)}^0 is rejected and
alternate hypothesis $H_{(IV)1}$ is accepted that there is a significant impact of Internal Validity dimension of Logistics Operating System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat. This means Internal Validity dimension (IV) of logistics information operating system exerts significant influence over maintaining Logistics Flexibility (LF). An increase in Internal Validity (IV) will bring about a significant improvement in Logistics Flexibility (LF) by number of times the value of regression co-efficient.

5.3.1.2.1.i External Validity dimension (EV) has positive relationship with maintaining Logistics Flexibility (LF); as the regression co-efficient is + 0.209. The significance level of 0.029 indicates that this regression co-efficient is statistically significant. So, null hypothesis $H_{(EV)0}$ is rejected and alternate hypothesis $H_{(EV)1}$ is accepted that there is a significant impact of External Validity dimension of Logistics Operating System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat. This means External Validity dimension (EV) of logistics information operating system exerts significant influence over maintaining Logistics Flexibility (LF). An increase in External Validity (EV) will bring about a significant improvement in Logistics Flexibility (LF) by number of times the value of regression co-efficient.

Table 5.3.1.2.2

Variance Analysis of benefits of using Logistics Operating System

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>Df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>19.447</td>
<td>9</td>
<td>2.161</td>
<td>13.040</td>
<td>0.000</td>
</tr>
<tr>
<td>Residual</td>
<td>11.931</td>
<td>72</td>
<td>0.166</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>31.378</td>
<td>81</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5.3.1.2.2 The variance analysis given in table 5.3.1.2.2 above shows F = 13.040 at a significance level of 0.000 with df (9, 72), which indicates that all regression co-efficients will be non zero.

5.3.1.2.3 The emerging Multiple Regression Equation is as under:

\[ LF = + 0.408 + 0.159 \text{ (Time)} + 0.126 \text{ (Accu)} - 0.188 \text{ (Avail)} + 0.063 \text{ (EBF)} + 0.309 \text{ (FFU)} - 0.064 \text{ (IS)} + 0.261 \text{ (Flex)} + 0.274 \text{ (IV)} + 0.209 \text{ (EV)} \]

The adjusted $R^2$, i.e. the co-efficient of determination stands at 0.572 indicating that the equation can explain 57.2% variations in Logistics Flexibility (LF). For remaining variations, i.e. unexplained variations, some other variables are responsible.

**Table 5.3.1.2.3**

Co-efficient Correlations of benefits of using Logistics Operating System

<table>
<thead>
<tr>
<th></th>
<th>Time</th>
<th>Accu</th>
<th>Avail</th>
<th>EBF</th>
<th>FFU</th>
<th>IS</th>
<th>Flex</th>
<th>IV</th>
<th>EV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>1.000</td>
<td>0.392</td>
<td>0.130</td>
<td>0.293</td>
<td>0.061</td>
<td>0.359</td>
<td>0.477</td>
<td>0.122</td>
<td>0.098</td>
</tr>
<tr>
<td>Accu</td>
<td>0.392</td>
<td>1.000</td>
<td>2.555</td>
<td>0.444</td>
<td>0.238</td>
<td>0.272</td>
<td>0.291</td>
<td>0.315</td>
<td>0.267</td>
</tr>
<tr>
<td>Avail</td>
<td>0.130</td>
<td>0.255</td>
<td>1.000</td>
<td>0.215</td>
<td>0.432</td>
<td>0.082</td>
<td>0.197</td>
<td>0.341</td>
<td>0.332</td>
</tr>
<tr>
<td>BF</td>
<td>0.293</td>
<td>0.444</td>
<td>0.215</td>
<td>1.000</td>
<td>0.291</td>
<td>0.533</td>
<td>0.465</td>
<td>0.504</td>
<td>0.512</td>
</tr>
<tr>
<td>FFU</td>
<td>0.061</td>
<td>0.238</td>
<td>0.432</td>
<td>0.291</td>
<td>1.000</td>
<td>0.009</td>
<td>0.059</td>
<td>0.351</td>
<td>0.245</td>
</tr>
<tr>
<td>IS</td>
<td>0.359</td>
<td>0.272</td>
<td>0.082</td>
<td>0.533</td>
<td>0.009</td>
<td>1.000</td>
<td>0.522</td>
<td>0.346</td>
<td>0.287</td>
</tr>
<tr>
<td>Flex</td>
<td>0.477</td>
<td>0.291</td>
<td>0.197</td>
<td>0.465</td>
<td>0.059</td>
<td>0.522</td>
<td>1.000</td>
<td>0.271</td>
<td>0.396</td>
</tr>
<tr>
<td>IV</td>
<td>0.122</td>
<td>0.315</td>
<td>0.341</td>
<td>0.504</td>
<td>0.351</td>
<td>0.346</td>
<td>0.271</td>
<td>1.000</td>
<td>0.487</td>
</tr>
<tr>
<td>EV</td>
<td>0.098</td>
<td>0.267</td>
<td>0.332</td>
<td>0.512</td>
<td>0.245</td>
<td>0.287</td>
<td>0.396</td>
<td>0.487</td>
<td>1.000</td>
</tr>
</tbody>
</table>
5.3.1.2.4 The co-efficients of correlation amongst all variables are depicted in the table 5.3.1.2.3 above. It is revealed that none of all nine independent variables has the co-efficient of correlation coefficient larger than ± 0.7. The VIF statistics, in table 5.3.1.2.1, of all the independent variables are very much far from cut off rate of 10. Hence there is no cause of concern from viewpoint of multicollinearity among the independent variables. The D (Durbin-Watson) statistic stands at 1.704. The corresponding table values for D statistic stand at 1.61 for lower limit (D_L) and 1.66 for upper limit (D_U). As a result D (1.704) is greater than D_U (1.66) and 4 – D (2.296) is greater than D_L (1.61). Hence it can be concluded that either positive or negative autocorrelation does not exist.

Table 5.3.1.2.4

Descriptive Statistics of benefits of using Logistics Operating System and Logistics Flexibility

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>3.00</td>
<td>5.00</td>
<td>4.12</td>
<td>0.79</td>
</tr>
<tr>
<td>Accu</td>
<td>2.00</td>
<td>5.00</td>
<td>3.74</td>
<td>0.67</td>
</tr>
<tr>
<td>Avail</td>
<td>2.00</td>
<td>5.00</td>
<td>3.94</td>
<td>0.67</td>
</tr>
<tr>
<td>EBF</td>
<td>2.00</td>
<td>5.00</td>
<td>3.49</td>
<td>0.80</td>
</tr>
<tr>
<td>FFU</td>
<td>2.00</td>
<td>5.00</td>
<td>3.76</td>
<td>0.88</td>
</tr>
<tr>
<td>IS</td>
<td>3.00</td>
<td>5.00</td>
<td>4.07</td>
<td>0.75</td>
</tr>
<tr>
<td>Flex</td>
<td>2.00</td>
<td>5.00</td>
<td>4.21</td>
<td>0.75</td>
</tr>
<tr>
<td>IV</td>
<td>1.00</td>
<td>5.00</td>
<td>3.84</td>
<td>0.71</td>
</tr>
<tr>
<td>EV</td>
<td>2.00</td>
<td>5.00</td>
<td>3.70</td>
<td>0.72</td>
</tr>
<tr>
<td>LF</td>
<td>2.00</td>
<td>5.00</td>
<td>3.70</td>
<td>0.62</td>
</tr>
</tbody>
</table>

5.3.1.2.5 The descriptive statistics pertinent to the multiple regression equation are depicted in table 5.3.1.2.4 above. For Timeliness dimension, the minimum value rated is 3.00 and maximum value rated is 5.00, with mean 4.12 and
standard deviation 0.79. For Accuracy Dimension, the minimum value rated is 2.00 and maximum value rated is 5.00, with mean 3.74 and standard deviation 0.67. For Exception Based Formatted dimension, the minimum value rated is 2.00 and maximum value rated is 5.00, with mean 3.49 and standard deviation 0.80. For Formatted to Facilitate Usage dimension, the minimum value rated is 2.00 and maximum value rated is 5.00, with mean 3.76 and standard deviation 0.88. For Information System Dimension, the minimum value rated is 3.00 and maximum value rated is 4.00, with mean 4.07 and standard deviation 0.75. For Flexibility dimension, the minimum value rated is 2.00 and maximum value rated is 5.00, with mean 4.21 and standard deviation 0.75. For Internal Validity dimension, the minimum value rated is 1.00 and maximum value rated is 5.00, with mean 3.84 and standard deviation 0.71. For External Validity Dimension, the minimum value rated is 2.00 and maximum value rated is 5.00, with mean 3.70 and standard deviation 0.72. For Logistics Flexibility dimension, the minimum value rated is 2.00 and maximum value rated is 5.00, with mean 3.70 and standard deviation 0.62.
Figure 5.2 Relationships among various benefits of using Logistics Information Operating System (LOS) exerting significant impact on Logistics Flexibility

(* Significant at 0.05 Level of Significance)

(Indicates Impact of independent factor on dependent factor)
5.3.1.3 Discussion regarding Logistics Information Operating System

5.3.1.3.1 The objective of this section is to find out the most important characteristics of LOS, significantly affecting the logistics flexibility of co-operative dairies in Gujarat. The descriptive statistics in table 5.3.1.2.4 shows that all the nine variables are rated high by senior managers in terms of their agreeableness in co-operative dairies in Gujarat. Among the nine variables, timeliness (4.12), Flexibility (4.21) and information sharing (4.07) are rated higher than other variables. In day to day operation, the co-operative dairies in Gujarat are getting on time information to maintain accuracy in their logistics system. The dairies are able to maintain its timeliness in terms of getting information because of two reasons: (1) in distribution, distributors have to give their orders one day in advance so that dairies can make next day’s product mix plan appropriately and (2) in terms of supply of milk, every time whenever transporters take milk to dairies, the details of the raw milk taken from various sources are submitted to dairy co-operatives. The co-operative dairies are also able to maintain flexibility at various levels because of high co-ordination and information sharing among various departments regarding day-to-day operations. All dairy co-operatives are also flexible in terms of processing the information as per customer requirements. The distributors can give orders on phone, in person or through e-mail. The products mix in terms of distributors’ orders is also classified well in different software maintained by co-operative dairies.

5.3.1.3.2 Some of the large co-operative dairies like Sumul dairy, Dudhsagar dairy, Banas dairy, Anand dairy, Mother dairy, etc. are using SAP – ERP based or oracle based software in their supply chain information system, so that the required day-to-day supply chain information can be gathered very easily by managers at various supply chain levels. Other co-operative dairies like Uttam Dairy, Surdhara Dairy, Amar Dairy, etc., either producing milk and few other products or just chilling the milk and not producing anything, do not requires much
flexibility in their logistics and information system. The lowest rating is found for External Validity variable (3.70). The village dairy co-operative societies are having their own software to maintain information of raw milk, FAT and SNF content, but these software are different from software of co-operative dairies in terms of their formats. So, there is no linkage between software at village dairy co-operative society and dairy co-operatives. The distributions of dairies are handled by distributors at various levels, so final customers are not in direct contact with co-operative dairies. According to senior managers, sometimes distributors are misguiding dairies in terms of product mix required by customers in market. Distributors carry few products only, which they are capable of distributing or on which they can get good margins. So, real need of customers or retailers can not be known exactly, which affect negatively to co-operative dairies in terms of lost sales or lower satisfaction to customers.

5.3.1.3.3 Regression analysis is done to find important variables in Logistics Information Operating System affecting logistics flexibility in co-operative dairies in Gujarat. R² of 0.572 shows that the LIOS exerts significant impact on maintaining logistics flexibility due to perishability and variety aspects to be maintained on day to day basis. Formatted to Facilitate Usage, Flexibility, Internal Validity and External Validity variables exert significant positive impact on logistics flexibility, while Availability aspect exerts significant negative impact on logistics flexibility. The detailed discussion regarding impact of all these variables on maintaining logistics flexibility is as follows:

a. Formatted to Facilitate Usage aspect is important because the information collected at different places must be clubbed together on common format to bring co-ordination among supply chain members. Now days, co-operative dairies have started implementing SAP-ERP solutions in their operations throughout supply chain, which has enhanced linkages among various supply chain partners. It also creates ease of analysis in terms of changes in supply can demand condition, which is very much helpful to make necessary changes in day to day operation and it ultimately logistics flexibility throughout supply chain.
b. Routine information from ultimate customers or retailers (flexibility) enhances logistics flexibility in terms of product mix management and customization. The retailers and customers should be linked to the dairies directly so that their need and requirements can be known and necessary changes can be made production of various fluid milk and milk products. It ultimately improves the flexibility in logistics and distribution in terms of customization of product mix as per retailers’ and customers’ requirements in the market. So, flexibility of information system to adapt processes and capabilities at purchase, production and market levels as per customer requirements greatly enhances logistics and supply chain flexibility.

c. To maintain logistics flexibility, it is important to have co-ordination among managers of various departments within a dairy co-operative. All senior managers of various departments of respective co-operative dairies meet once or twice a week to discuss about routine issues (internal validity), which proves significant in routine planning. Regular changes in supply of milk and demand of various fluid milk and milk products are occurred, so to balance the demand and supply of various products, internal validity is required. The senior managers of different departments can share information about changes in demand and supply requirement through intranet so that flexibility can be maintained in response to regular changes in demand and supply conditions. So, internal co-ordination through information system among different department greatly improves the flexibility in logistics and supply chain system.

d. External Validity exerts significant positive impact on logistics flexibility because it is imperative to maintain co-ordination with upstream members and downstream members (external validity) so that, regular demand and supply balance can be managed properly. The changes in the market requirements should be known to the suppliers of variety of materials through dairy co-operatives so that, flexibility in terms of production of customized products and logistics management can be maintained properly.

e. One of the most important aspects is that more visibility and availability of information where and when required (availability) exerts negative impact on
logistics flexibility. It means the co-operative dairies with better logistics flexibility recognize the strictness in terms of availability of information limited to few people only.
5.3.2 Analysis of Logistics Planning System (LPS) and its impact on Logistics Flexibility

5.3.2.1 Reliability Analysis

Reliability analysis is done to check whether the variables used to study Logistics Planning System scale will produce consistent results. The Cronbach Alpha is used to check the reliability. The results are shown in the table 5.3.2.1 below:

<table>
<thead>
<tr>
<th>Variables</th>
<th>Cronbach Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logistics Planning System Factors</td>
<td>0.765</td>
</tr>
</tbody>
</table>

As shown in the above table, the calculated Cronbach Alpha for logistics planning system scale is well ahead of the cut off rate of 0.70 to prove good reliability (Hair et al., 2009). So, it can be concluded that logistics planning system scale used to study the impact of logistics planning system variable on maintaining logistics flexibility the logistics flexibility for fluid milk and milk products in Co-operative dairies in Gujarat is found to be reliable. It means logistics planning system scale will produce consistent results irrespective of time period.
5.3.2.2 Regression of Logistics Planning System (LPS) on Logistics Flexibility (LF)

**Hypothesis:**

**H**(Time)\(_0\): There is no significant impact of Timeliness dimension of Logistics Planning System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

**H**(Time)\(_1\): There is a significant impact of Timeliness dimension of Logistics Planning System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

**H**(Accu)\(_0\): There is no significant impact of Accuracy dimension of Logistics Planning System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

**H**(Accu)\(_1\): There is a significant impact of Accuracy dimension of Logistics Planning System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

**H**(Avail)\(_0\): There is no significant impact of Availability dimension of Logistics Planning System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

**H**(Avail)\(_1\): There is a significant impact of Availability dimension of Logistics Planning System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

**H**(EBF)\(_0\): There is no significant impact of Exception Basis Formatted dimension of Logistics Planning System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.
$H_{(EBF)}$: There is a significant impact of Exception Basis Formatted dimension of Logistics Planning System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

$H_{(FFU)}$: There is no significant impact of Formatted to Facilitate Usage dimension of Logistics Planning System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

$H_{(FFU)}$: There is a significant impact of Formatted to Facilitate Usage dimension of Logistics Planning System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

$H_{(IS)}$: There is no significant impact of Information Sharing dimension of Logistics Planning System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

$H_{(IS)}$: There is a significant impact of Information Sharing dimension of Logistics Planning System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

$H_{(Flex)}$: There is no significant impact of Flexibility dimension of Logistics Planning System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

$H_{(Flex)}$: There is a significant impact of Flexibility dimension of Logistics Planning System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

$H_{(IV)}$: There is no significant impact of Internal Validity dimension of Logistics Planning System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.
**H(Iv)**: There is a significant impact of Internal Validity dimension of Logistics Planning System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

**H(Ev0)**: There is no significant impact of External Validity dimension of Logistics Planning System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

**H(Ev1)**: There is a significant impact of External Validity dimension of Logistics Planning System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

### 5.3.2.2.1

The regression co-efficient of the independent variables with their respective direction, values and significance level are given in the table 5.3.2.2.1 below:

**Table 5.3.2.2.1**

**Regression coefficients of benefits of using Logistics Planning System**

<table>
<thead>
<tr>
<th></th>
<th>Regression Co-efficients</th>
<th>t-value</th>
<th>Significance Level</th>
<th>VIF Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Direction</strong></td>
<td><strong>Value</strong></td>
<td><strong>t</strong>-value</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>+</td>
<td>0.107</td>
<td>0.205</td>
<td>0.838</td>
</tr>
<tr>
<td>Time</td>
<td>+</td>
<td>0.109</td>
<td>1.406</td>
<td>0.164</td>
</tr>
<tr>
<td>Accu</td>
<td>+</td>
<td>0.122</td>
<td>1.183</td>
<td>0.241</td>
</tr>
<tr>
<td>Avail</td>
<td>_</td>
<td>0.122</td>
<td>-1.429</td>
<td>0.157</td>
</tr>
<tr>
<td>EBF</td>
<td>+</td>
<td>0.175</td>
<td>2.086</td>
<td>0.041</td>
</tr>
<tr>
<td>FFU</td>
<td>+</td>
<td>0.215</td>
<td>3.256</td>
<td>0.002</td>
</tr>
<tr>
<td>IS</td>
<td>+</td>
<td>0.055</td>
<td>0.053</td>
<td>0.516</td>
</tr>
<tr>
<td>Flex</td>
<td>_</td>
<td>0.082</td>
<td>-1.022</td>
<td>0.310</td>
</tr>
<tr>
<td>IV</td>
<td>+</td>
<td>0.403</td>
<td>4.001</td>
<td>0.000</td>
</tr>
<tr>
<td>EV</td>
<td>+</td>
<td>0.410</td>
<td>4.532</td>
<td>0.000</td>
</tr>
</tbody>
</table>
Dependent Variable: LF  
\[ R^2 = 0.614 \]

Independent Variables: Time, Accu, Avail, EFB, FFU, IS, Flex, IV, EV

Durbin-Watson = 1.805  
N = 82 numbers

5.3.2.1.a The table 5.3.2.1 shows that Timeliness dimension (Time) has positive but weak relationship with maintaining Logistics Flexibility (LF); as the regression co-efficient is + 0.109. The significance level of 0.838 indicates that this regression co-efficient is statistically insignificant. So, alternate hypothesis \( H_{(Time)} \) is rejected and null hypothesis \( H_{(Time)} \) is accepted that there is no significant impact of Timeliness dimension of logistics information planning system on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat. This means a change Timeliness dimension (Time) of logistic planning system exerts insignificant influence over maintaining Logistics Flexibility (LF).

5.3.2.1.b Accuracy dimension (Accu) has positive but weak relationship with maintaining Logistics Flexibility (LF); as the regression co-efficient is + 0.122. The significance level of 0.241 indicates that this regression co-efficient is statistically insignificant. So, alternate hypothesis \( H_{(Accu)} \) is rejected and null hypothesis \( H_{(Accu)} \) is accepted that there is no significant impact of Accuracy dimension of logistics information planning System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat. This means Accuracy dimension (Accu) of logistics information planning system exerts insignificant influence over maintaining Logistics Flexibility (LF). An increase in Accuracy (Accu) will not bring about a significant improvement in Logistics Flexibility (LF).

5.3.2.1.c Availability dimension (Avail) has negative and weak relationship with maintaining Logistics Flexibility (LF); as the regression co-efficient is –
The significance level of 0.157 indicates that this regression coefficient is statistically significant. So, alternate hypothesis \( H_{(\text{Avail})1} \) is rejected and null hypothesis \( H_{(\text{Avail})0} \) is accepted that there is no significant impact of Availability dimension of Logistics Planning System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat. This means Availability dimension (Avail) of logistics information planning system exerts insignificant influence over maintaining Logistics Flexibility (LF). An increase in visibility and Availability of information where and where desired in logistics information planning of organization will create negative impact on maintaining Logistics Flexibility (LF).

5.3.2.2.1.d Exception Based Formatted dimension (EBF) has positive relationship with maintaining Logistics Flexibility (LF); as the regression coefficient is high at + 0.175. The significance level of 0.041 indicates that this regression coefficient is statistically significant. So, null hypothesis \( H_{(\text{EBF})0} \) is rejected and alternate hypothesis \( H_{(\text{EBF})1} \) is accepted that there is a significant impact of Exception Based Formatted dimension of Logistics Planning System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat. This means Exception Based Formatted dimension (EBF) of logistics information planning system exerts significant influence over maintaining Logistics Flexibility (LF). An improvement in Exception Based Formatting (EBF), while planning for logistics information system, will bring about a significant improvement in Logistics Flexibility (LF).

5.3.2.2.1.e Formatted to Facilitate Usage dimension (FFU) has positive relationship with maintaining Logistics Flexibility (LF); as the regression coefficient is + 0.315. The significance level of 0.002 indicates that this regression coefficient is statistically very significant. So, null hypothesis \( H_{(\text{FFU})0} \) is
rejected and alternate hypothesis $H_{(FFU)1}$ is accepted that there is a significant impact of Formatted to Facilitate Usage dimension of Logistics Information Planning System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat. This means Formatted to Facilitate Usage dimension (FFU) of logistics information planning system exerts significant influence over maintaining Logistics Flexibility (LF). An improvement in proper Formatting to Facilitate Usage (FFU), while planning for logistics information system will bring about an increase in Logistics Flexibility (LF) by number of times the value of regression coefficient.

5.3.2.1.f Information Sharing dimension (IS) has positive but weak relationship with maintaining Logistics Flexibility (LF); as the regression co-efficient is $+0.055$. The significance level of 0.516 indicates that this regression co-efficient is statistically very insignificant. So, alternate hypothesis $H_{(IS)1}$ is rejected and null hypothesis $H_{(IS)0}$ is accepted that there is no significant impact of Information Sharing dimension of Logistics Planning System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat. This means Information Sharing (IS) of logistics information planning system exerts insignificant influence over maintaining Logistics Flexibility (LF).

5.3.2.1.g Flexibility dimension (Flex) has positive relationship with maintaining Logistics Flexibility (LF); as the regression co-efficient is $-0.082$. The significance level of 0.310 indicates that this regression co-efficient is statistically insignificant. So, alternate hypothesis $H_{(Flex)1}$ is rejected and null hypothesis $H_{(Flex)0}$ is accepted that there is no significant impact of Flexibility dimension of Logistics Planning System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in
Gujarat. This means Flexibility dimension (Flex) of logistics information planning system exerts insignificant influence over maintaining Logistics Flexibility (LF). A change in proper Flexibility in logistics Planning system (Flex) will not bring about a significant change in Logistics Flexibility (LF).

5.3.2.1.h Internal Validity dimension (IV) has positive relationship with maintaining Logistics Flexibility (LF); as the regression co-efficient is + 0.403. The significance level of 0.000 indicates that this regression co-efficient is statistically very significant. So, null hypothesis \( H_{(IV)0} \) is rejected and alternate hypothesis \( H_{(IV)1} \) is accepted that there is a significant impact of Internal Validity dimension of Logistics Planning System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat. This means Internal Validity dimension (IV) of logistics information planning system exerts significant influence over maintaining Logistics Flexibility (LF). An increase in Internal Validity (IV) will bring about an increase in Logistics Flexibility (LF) by number of times the value of regression co-efficient.

5.3.2.1.i External Validity dimension (EV) has positive relationship with maintaining Logistics Flexibility (LF); as the regression co-efficient is + 0.410. The significance level of 0.000 indicates that this regression co-efficient is statistically significant. So, null hypothesis \( H_{(EV)0} \) is rejected and alternate hypothesis \( H_{(EV)1} \) is accepted that there is a significant impact of External Validity dimension of Logistics Planning System on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat. This means External Validity dimension (EV) exerts significant influence over maintaining Logistics Flexibility (LF). An increase in External Validity (EV) will bring about an increase in Logistics Flexibility (LF) by number of times the value of regression co-efficient.
Table 5.3.2.2

Variance Analysis of benefits of using Logistics Planning System

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>Df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>20.622</td>
<td>9</td>
<td>2.291</td>
<td>15.337</td>
<td>0.000*</td>
</tr>
<tr>
<td>Residual</td>
<td>10.757</td>
<td>72</td>
<td>0.149</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>31.378</td>
<td>81</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(* Significant at 0.05 level of significance)

5.3.2.2 The variance analysis given in table 5.3.2.2 above shows F = 15.337 at a significance level of 0.000 with df (9, 72), which indicates that all regression co-efficients will be non zero.

5.3.2.3 The emerging Multiple Regression Equation is as under:

\[
LF = + 0.107 + 0.109 \text{ (Time)} + 0.122 \text{ (Accu)} - 0.122 \text{ (Avail)} + 0.175 \text{ (EBF)} + 0.215 \text{ (FFU)} + 0.055 \text{ (IS)} - 0.082 \text{ (Flex)} + 0.403 \text{ (IV)} + 0.410 \text{ (EV)}
\]

The adjusted R\(^2\), i.e. the co-efficient of determination stands at 0.614 indicating that the equation can explain 61.4% variations in Logistics Flexibility (LF). For remaining variations, i.e. unexplained variations, some other variables are responsible.
Table 5.3.2.2.3

Co-efficient Correlations of benefits of using Logistics Planning System

<table>
<thead>
<tr>
<th></th>
<th>Time</th>
<th>Accu</th>
<th>Avail</th>
<th>EBF</th>
<th>FFU</th>
<th>IS</th>
<th>Flex</th>
<th>IV</th>
<th>EV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>1.000</td>
<td>0.088</td>
<td>0.264</td>
<td>-0.158</td>
<td>0.177</td>
<td>0.165</td>
<td>0.110</td>
<td>0.187</td>
<td>0.323</td>
</tr>
<tr>
<td>Accu</td>
<td>0.088</td>
<td>1.000</td>
<td>0.355</td>
<td>0.154</td>
<td>0.329</td>
<td>0.057</td>
<td>0.083</td>
<td>0.582</td>
<td>0.202</td>
</tr>
<tr>
<td>Avail</td>
<td>0.264</td>
<td>0.355</td>
<td>1.000</td>
<td>-0.275</td>
<td>0.441</td>
<td>0.138</td>
<td>0.180</td>
<td>0.183</td>
<td>0.168</td>
</tr>
<tr>
<td>EBF</td>
<td>-0.158</td>
<td>0.154</td>
<td>-0.275</td>
<td>1.000</td>
<td>-0.311</td>
<td>-0.282</td>
<td>-0.006</td>
<td>0.167</td>
<td>-0.180</td>
</tr>
<tr>
<td>FFU</td>
<td>0.177</td>
<td>0.329</td>
<td>0.441</td>
<td>-0.311</td>
<td>1.000</td>
<td>-0.025</td>
<td>0.137</td>
<td>0.006</td>
<td>0.487</td>
</tr>
<tr>
<td>IS</td>
<td>0.165</td>
<td>0.057</td>
<td>0.138</td>
<td>-0.282</td>
<td>-0.025</td>
<td>1.000</td>
<td>0.317</td>
<td>0.248</td>
<td>0.255</td>
</tr>
<tr>
<td>Flex</td>
<td>0.110</td>
<td>0.083</td>
<td>0.180</td>
<td>-0.006</td>
<td>0.137</td>
<td>0.317</td>
<td>1.000</td>
<td>0.316</td>
<td>0.211</td>
</tr>
<tr>
<td>IV</td>
<td>0.187</td>
<td>0.582</td>
<td>0.183</td>
<td>0.167</td>
<td>0.006</td>
<td>0.248</td>
<td>0.316</td>
<td>1.000</td>
<td>-0.17</td>
</tr>
<tr>
<td>EV</td>
<td>0.323</td>
<td>0.202</td>
<td>0.168</td>
<td>-0.180</td>
<td>0.487</td>
<td>0.255</td>
<td>0.211</td>
<td>-0.17</td>
<td>1.000</td>
</tr>
</tbody>
</table>

5.3.2.2.4 The co-efficients of correlation amongst all variables are depicted in the table 5.3.2.2.3 above. It is revealed that none of all nine independent variables has the co-efficient of correlation coefficient larger than ± 0.7. The VIF statistics in table 5.3.2.2.1 also depicts the value of all the independent variables are very much far from cut off rate of 10 for VIF statistics. Hence there is no cause of concern from viewpoint of multicollinearity among the independent variables. The D (Durbin-Watson) statistic stands at 1.805. The corresponding table values for D statistic stand at 1.61 for lower limit (D_L) and 1.66 for upper limit (D_U). As a result D (1.895) is greater than D_U (1.66) and 4 – D (2.195) is greater than D_L (1.61). Hence it can be concluded that either positive or negative autocorrelation does not exist.
Table 5.3.2.2.4

Descriptive Statistics of benefits of using Logistics Planning System and Logistics Flexibility

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>3.00</td>
<td>5.00</td>
<td>4.11</td>
<td>0.72</td>
</tr>
<tr>
<td>Accu</td>
<td>1.00</td>
<td>5.00</td>
<td>3.71</td>
<td>1.06</td>
</tr>
<tr>
<td>Avail</td>
<td>1.00</td>
<td>5.00</td>
<td>3.37</td>
<td>0.69</td>
</tr>
<tr>
<td>EBF</td>
<td>1.00</td>
<td>5.00</td>
<td>3.56</td>
<td>1.09</td>
</tr>
<tr>
<td>FFU</td>
<td>2.00</td>
<td>5.00</td>
<td>3.64</td>
<td>0.79</td>
</tr>
<tr>
<td>IS</td>
<td>3.00</td>
<td>5.00</td>
<td>3.96</td>
<td>0.66</td>
</tr>
<tr>
<td>Flex</td>
<td>2.00</td>
<td>5.00</td>
<td>3.79</td>
<td>0.91</td>
</tr>
<tr>
<td>IV</td>
<td>3.00</td>
<td>5.00</td>
<td>3.98</td>
<td>0.75</td>
</tr>
<tr>
<td>EV</td>
<td>1.00</td>
<td>5.00</td>
<td>3.39</td>
<td>1.19</td>
</tr>
<tr>
<td>LF</td>
<td>2.00</td>
<td>5.00</td>
<td>3.70</td>
<td>0.62</td>
</tr>
</tbody>
</table>

5.3.2.2.5 The descriptive statistics pertinent to the multiple regression equation are depicted in table 5.3.2.2.4 above. For Timeliness dimension, the minimum value rated is 3.00 and maximum value rated is 5.00, with mean 4.11 and standard deviation 0.72. For Accuracy Dimension, the minimum value rated is 1.00 and maximum value rated is 5.00, with mean 3.73 and standard deviation 1.06. For Availability Dimension, the minimum value rated is 1.00 and maximum value rated is 5.00, with mean 3.37 and standard deviation 0.69. For Exception Based Formatted dimension, the minimum value rated is 1.00 and maximum value rated is 5.00, with mean 3.56 and standard deviation 1.09. For Formatted to Facilitate Usage dimension, the minimum value rated is 2.00 and maximum value rated is 5.00, with mean 3.64 and standard deviation 0.79. For Information Sharing Dimension, the minimum value rated is 2.00 and maximum value rated is 5.00, with mean 3.96 and standard deviation 0.66. For Flexibility dimension, the minimum value rated is 2.00 and maximum value rated is 5.00, with mean 3.79 and standard deviation 0.91. For Internal Validity
dimension, the minimum value rated is 3.00 and maximum value rated is 5.00, with mean 3.98 and standard deviation 0.75. For External Validity Dimension, the minimum value rated is 1.00 and maximum value rated is 5.00, with mean 3.39 and standard deviation 1.19. For Logistics Flexibility dimension, the minimum value rated is 2.00 and maximum value rated is 5.00, with mean 3.70 and standard deviation 0.62.

**Figure 5.3 Relationship among various benefits of Logistics Information Planning System (LPS) exerting significant impact on Logistics Flexibility**

(* Significant at 0.05 Level of Significance)
5.3.2.3 Discussion regarding Logistics Information Planning System

5.3.2.3.1 The objective of this section is to find out the most important characteristics of Logistics Planning System, significantly affecting the logistics flexibility of co-operative dairies in Gujarat. The descriptive statistics in table 5.3.2.2.4 shows that all the nine variables are rated high by senior managers in terms of their agreeableness in co-operative dairies in Gujarat. Among the nine variables, timeliness (4.11), Information Sharing (3.96) and Internal Validity (3.98) are rated higher than other variables. Under co-operative structure, at each month the managing directors and the chairman of various co-operative dairies meet at GCMMF to discuss about the next month’s planning. On the basis of season and historical milk collection data and after analyzing the current expected milk collection for the next month, they forecast total milk collection. At the same time, on the basis of historical data and current expected demand for fluid milk and milk products, they forecast total requirements for product mix in next month. So, the timeliness and information sharing variables are rated high, which helps to get better forecasting. The heads of all departments also meet once or twice in a week to discuss about the next week’s planning regarding demand and supply of product mix. Use of SAP – ERP based or oracle based software in their supply chain information system makes it possible to share information very easily by managers at various supply chain levels. Other co-operative dairies like Uttam Dairy, Surdhara Dairy, Amar Dairy, etc., either producing milk and few other products or just chilling the milk and not producing anything, do share information through internet or intranet. Due to sensitivity of information regarding planning of demand and supply of various types of fluid milk and milk products, these information are kept confidential and not be shared to managers at middle and lower levels. So, the lowest rating is found for availability variable (3.37).
5.3.2.3.2 Regression analysis is done to find important variables in Logistics Information Planning System affecting logistics flexibility in co-operative dairies in Gujarat. R² of 0.614 shows that the Logistics Planning System exerts significant impact on maintaining logistics flexibility. Exception based formatted, Formatted to Facilitate Usage, Flexibility, Internal Validity and External Validity variables exert significant positive impact on logistics flexibility. The detailed discussion regarding impact of all these variables on maintaining logistics flexibility is as follows:

a. The co-operative dairies have started implementing SAP-ERP solutions in their operations throughout supply chain, which has enhanced linkages among various supply chain partners, ease of analysis and ultimately logistics flexibility. SAP-ERP system has the ability to organize information in a form that focuses decision makers’ attention on situations requiring action (exception based formatted), which provides better product management and logistics flexibility throughout supply chain.

b. The use of ERP system also provides common format (formatted to facilitate usage), which removes the difficulty faced by co-operative dairies in linking the software at various supply chain levels. It provides common platform on the basis of which information from various sources can be clubbed together on common variables, which is very much helpful in planning of logistics management and provide flexibility.

c. To maintain logistics flexibility, it is important to have co-ordination among managers of various departments while planning for logistics and supply chain management. The better co-ordination among various departmental heads (internal validity) lead to better flexibility in planning of logistics for various fluid milk and milk products.

d. To maintain logistics flexibility throughout supply chain, it is important to maintain co-ordination with upstream members and downstream members (external validity). A close co-ordination with suppliers will provide
customization and flexibility in terms of specification in various types of raw materials, packing materials and other important ingredients used in production of dairy products. In the same manner, better communication with retailers and final consumers will provide more real time information regarding market and their requirements. It provides better flexibility and customization in terms of product mix. So, better external validity provides better flexibility in planning and logistics management.
5.4 Analysis of Third party Logistics Service Provider and its impact on Logistics Flexibility

5.4.1 Reliability Analysis

Reliability analysis is done to check whether variables regarding benefits of third party logistics service providers will produce consistent results. The Cronbach Alpha is used to check the reliability. The results are shown in the table 5.4.1 below:

Table 5.4.1: Reliability of Third Party Logistics Service Providers Factors

<table>
<thead>
<tr>
<th>Variables</th>
<th>Cronbach Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Third Party Logistics Service Providers Factors</td>
<td>0.730</td>
</tr>
</tbody>
</table>

As shown in the above table, the calculated Cronbach Alpha for variables regarding benefits of third party logistics service providers is well ahead of the cut off rate of 0.70 to prove good reliability (Hair et al., 2009). So, it can be concluded that variables used to study the impact of third party logistics service providers on maintaining logistics flexibility for fluid milk and milk products in Co-operative dairies in Gujarat are found to be reliable. It means these variables will produce consistent results irrespective of time period.
5.4.2 Regression of Third party Logistics Service Provider (TPLSP) and its impact on Logistics Flexibility (LF)

**Hypothesis:**

**H\(_{(\text{Time})0}\):** There is no significant impact of On Time Delivery dimension of Third Party Logistics Service Provider on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

**H\(_{(\text{Time})1}\):** There is a significant impact of On Time Delivery dimension of Third Party Logistics Service Provider on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

**H\(_{(\text{Corr})0}\):** There is no significant impact of Correct Delivery dimension of Third Party Logistics Service Provider on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

**H\(_{(\text{Corr})1}\):** There is a significant impact of Correct Delivery dimension of Third Party Logistics Service Provider on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

**H\(_{(\text{Cost})0}\):** There is no significant impact of Cost Consideration dimension of Third Party Logistics Service Provider on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

**H\(_{(\text{Cost})1}\):** There is a significant impact of Cost Consideration dimension of Third Party Logistics Service Provider on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.
H_{(Inv)}0: There is no significant impact of Inventory Accuracy dimension of Third Party Logistics Service Provider on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

H_{(Inv)}1: There is a significant impact of inventory Accuracy dimension of Third Party Logistics Service Provider on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

H_{(Qual)}0: There is no significant impact of Quality of Services dimension of Third Party Logistics Service Provider on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

H_{(Qual)}1: There is a significant impact of Quality of Services dimension of Third Party Logistics Service Provider on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

H_{(Flex)}0: There is no significant impact of Flexibility dimension of Third Party Logistics Service Provider on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

H_{(Flex)}1: There is a significant impact of Flexibility dimension of Third Party Logistics Service Provider on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

H_{(Cust)}0: There is no significant impact of Customization of Products and Services dimension of Third Party Logistics Service Provider on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

H_{(Cust)}1: There is no significant impact of Customization of Products and Services dimension of Third Party Logistics Service Provider on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.
**H(Cast)1**: There is a significant impact of Customization of Products and Services dimension of Third Party Logistics Service Provider on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

**H(VV)0**: There is no significant impact of Shipments in terms of Value/Volume dimension of Third Party Logistics Service Provider on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

**H(VV)1**: There is a significant impact of Shipments in terms of Value/Volume dimension of Third Party Logistics Service Provider on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

**H(CS)0**: There is no significant impact of Communication System dimension of Third Party Logistics Service Provider on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

**H(CS)1**: There is a significant impact of Communication System dimension of Third Party Logistics Service Provider on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

**H(SIS)0**: There is no significant impact of Sensitive Information Sharing dimension of Third Party Logistics Service Provider on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

**H(SIS)1**: There is a significant impact of Sensitive Information Sharing dimension of Third Party Logistics Service Provider on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.
$H_{QR0}$: There is no significant impact of Quick Response dimension of Third Party Logistics Service Provider on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

$H_{QR1}$: There is a significant impact of Quick Response dimension of Third Party Logistics Service Provider on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

$H_{(Comp)0}$: There is no significant impact of Handling of Customer Complaints dimension of Third Party Logistics Service Provider on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

$H_{(Comp)1}$: There is a significant impact of Handling of Customer Complaints dimension of Third Party Logistics Service Provider on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

$H_{(TOCT)0}$: There is no significant impact of Total Order Cycle Time dimension of Third Party Logistics Service Provider on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

$H_{(TOCT)1}$: There is a significant impact of Total Order Cycle Time dimension of Third Party Logistics Service Provider on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

$H_{(FR)0}$: There is no significant impact of Fill Rates dimension of Third Party Logistics Service Provider on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.
**H\(^{(FR)}\):** There is a significant impact of Fill Rates dimension of Third Party Logistics Service Provider on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

**H\(^{(Tech)}\):** There is no significant impact of Use of Technology dimension of Third Party Logistics Service Provider on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.

**H\(^{(Tech)}\):** There is a significant impact of Use of Technology dimension of Third Party Logistics Service Provider on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat.
5.4.2.1 The regression co-efficient of the independent variables with their respective direction, values and significance level are given in the table 5.4.2.1 below:

**Table 5.4.2.1**

Regression coefficients of benefits of using Third Party Logistics Service Providers

<table>
<thead>
<tr>
<th>Regression Co-efficients</th>
<th>Direction</th>
<th>Value</th>
<th>t-value</th>
<th>Significance Level</th>
<th>VIF Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>_</td>
<td>0.668</td>
<td>-0.810</td>
<td>0.421</td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>+</td>
<td>0.346</td>
<td>3.596</td>
<td>0.001</td>
<td>2.072</td>
</tr>
<tr>
<td>Corr</td>
<td>+</td>
<td>0.020</td>
<td>0.235</td>
<td>0.815</td>
<td>1.687</td>
</tr>
<tr>
<td>Cost</td>
<td>+</td>
<td>0.268</td>
<td>2.573</td>
<td>0.012</td>
<td>2.426</td>
</tr>
<tr>
<td>Invt</td>
<td>+</td>
<td>0.141</td>
<td>1.419</td>
<td>0.161</td>
<td>2.213</td>
</tr>
<tr>
<td>Qual</td>
<td>+</td>
<td>0.173</td>
<td>2.038</td>
<td>0.046</td>
<td>1.623</td>
</tr>
<tr>
<td>Flex</td>
<td>+</td>
<td>0.280</td>
<td>2.620</td>
<td>0.011</td>
<td>2.556</td>
</tr>
<tr>
<td>Cust</td>
<td>+</td>
<td>0.178</td>
<td>2.049</td>
<td>0.044</td>
<td>1.700</td>
</tr>
<tr>
<td>VV</td>
<td>+</td>
<td>0.291</td>
<td>3.345</td>
<td>0.001</td>
<td>1.701</td>
</tr>
<tr>
<td>CS</td>
<td>_</td>
<td>0.111</td>
<td>-1.214</td>
<td>0.229</td>
<td>1.868</td>
</tr>
<tr>
<td>SIS</td>
<td>_</td>
<td>0.097</td>
<td>-0.950</td>
<td>0.346</td>
<td>2.320</td>
</tr>
<tr>
<td>QR</td>
<td>+</td>
<td>0.095</td>
<td>1.066</td>
<td>0.290</td>
<td>1.768</td>
</tr>
<tr>
<td>Comp</td>
<td>_</td>
<td>0.143</td>
<td>-1.483</td>
<td>0.143</td>
<td>2.078</td>
</tr>
<tr>
<td>TOCT</td>
<td>+</td>
<td>0.129</td>
<td>1.133</td>
<td>0.261</td>
<td>2.895</td>
</tr>
<tr>
<td>FR</td>
<td>+</td>
<td>0.043</td>
<td>0.431</td>
<td>0.668</td>
<td>2.216</td>
</tr>
<tr>
<td>Tech</td>
<td>+</td>
<td>0.028</td>
<td>0.322</td>
<td>0.748</td>
<td>1.665</td>
</tr>
</tbody>
</table>

Dependent Variable: LF  \( R^2 = 0.639 \)

Independent Variables: Time, Corr, Cost, Invt, Qual, Flex, Cust, VV, CS, SIS, QR, Comp, TOCT, FR, Tech

Durbin-Watson = 2.110  \( N = 82 \) numbers
The table 5.4.2.1 shows that On Time Delivery dimension (Time) has positive relationship with maintaining Logistics Flexibility (LF); as the regression coefficient is + 0.346. The significance level of 0.001 indicates that this regression coefficient is statistically significant. So, null hypothesis $H_{(Time)0}$ is rejected and alternate $H_{(Time)1}$ hypothesis is accepted that there is a significant impact of On Time Delivery dimension of Third Party Logistics Service Provider on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat. This means an improvement in On Time Delivery by third party logistics service provider (Time) exerts significant positive influence over maintaining Logistics Flexibility (LF).

Correct Delivery dimension (Corr) has positive but weak relationship with maintaining Logistics Flexibility (LF); as the regression coefficient is + 0.020. The significance level of 0.815 indicates that this regression coefficient is statistically insignificant. So, alternate hypothesis $H_{(Corr)1}$ is rejected and null hypothesis $H_{(Corr)0}$ is accepted that there is no significant impact of Correct Delivery dimension of Third Party Logistics Service Provider on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat. This means Correct Delivery dimension (Corr) exerts insignificant influence over maintaining Logistics Flexibility (LF). A change in Correct Delivery function of third party logistics service provider (Corr) will not bring about a significant change in Logistics Flexibility (LF).

Cost Consideration dimension (Cost) has positive relationship with maintaining Logistics Flexibility (LF); as the regression coefficient is + 0.268. The significance level of 0.012 indicates that this regression coefficient is statistically significant. So, null hypothesis $H_{(Cost)0}$ is rejected and alternate hypothesis $H_{(Cost)1}$ is accepted that there is a significant impact of Cost Consideration dimension of Third Party Logistics Service Provider on
maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat. This means Cost Consideration dimension (Cost) exerts significant influence over maintaining Logistics Flexibility (LF). An increase in using third party in logistics of milk and milk products will create positive impact on cost structure, which in turn exerts positive impact on maintaining Logistics Flexibility (LF) by number of times the value of regression co-efficient.

5.4.2.1.d Inventory Accuracy dimension (Invt) has positive but weak relationship with maintaining Logistics Flexibility (LF); as the regression co-efficient is very at + 0.141. The significance level of 0.161 indicates that this regression co-efficient is statistically insignificant. So, alternate hypothesis $H_{(Invt)1}$ is rejected and null hypothesis $H_{(Invt)0}$ is accepted that there is no significant impact of Inventory accuracy dimension of Third Party Logistics Service Provider on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat. This means Inventory Accuracy of third party logistics service provider (Invt) exerts insignificant influence over maintaining Logistics Flexibility (LF).

5.4.2.1.e Quality of Services (Qual) has positive relationship with maintaining Logistics Flexibility (LF); as the regression co-efficient is + 0.173. The significance level of 0.046 indicates that this regression co-efficient is statistically very significant. So, null hypothesis $H_{(Qual)0}$ is rejected and alternate hypothesis $H_{(Qual)1}$ is accepted that there is a significant impact of Quality of Services dimension of Third Party Logistics Service Provider on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat. This means Quality of Services (Qual) exerts significant influence over maintaining Logistics Flexibility (LF). An improvement Quality of Services provided by third party logistics service provider will bring about an increase in Logistics Flexibility (LF) by number of times the value of regression co-efficient.
5.4.2.1.f Flexibility dimension (Flex) has positive relationship with maintaining Logistics Flexibility (LF); as the regression co-efficient is +0.280. The significance level of 0.011 indicates that this regression co-efficient is statistically very significant. So, null hypothesis $H_{(Flex)}0$ is rejected and alternate hypothesis $H_{(Flex)}1$ is accepted that there is a significant impact of Flexibility dimension of Third Party Logistics Service Provider on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat. This means Flexibility (Flex) exerts significant influence over maintaining Logistics Flexibility (LF). More flexibility in third party logistics service provider creates significant improvement in logistics flexibility of organization.

5.4.2.1.g Customization of Products and Services dimension (Cust) has positive relationship with maintaining Logistics Flexibility (LF); as the regression co-efficient is +0.178. The significance level of 0.044 indicates that this regression co-efficient is statistically insignificant. So, null hypothesis $H_{(Cust)}0$ is rejected and alternate hypothesis $H_{(Cust)}1$ is accepted that there is a significant impact of On Time Delivery dimension of Third Party Logistics Service Provider on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat. This means Customization of Products and Services dimension (Cust) exerts insignificant influence over maintaining Logistics Flexibility (LF). A proper Customization of Products and Service by third party logistics service provider firm will create significant positive impact on maintaining Logistics Flexibility (LF).

5.4.2.1.h Shipments in terms of Value/Volume dimension (VV) has positive relationship with maintaining Logistics Flexibility (LF); as the regression co-efficient is +0.291. The significance level of 0.001 indicates that this regression co-efficient is statistically very significant. So, null hypothesis $H_{(VV)0}$ is rejected and
alternate hypothesis $H_{(VV)1}$ is that there is a significant impact of On Time Delivery dimension of Third Party Logistics Service Provider on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat. This means Shipments in terms of Value/Volume dimension (VV) exerts significant influence over maintaining Logistics Flexibility (LF). More use of third party logistics service provider firm will create handling of large value/volume of goods, which in turn, will bring about a significant positive impact in Logistics Flexibility (LF) by number of times the value of regression co-efficient.

5.4.2.1.i Communication System dimension (CS) has negative but weak relationship with maintaining Logistics Flexibility (LF); as the regression co-efficient is $-0.111$. The significance level of 0.229 indicates that this regression co-efficient is statistically insignificant. So, alternate hypothesis $H_{(CS)1}$ is rejected and null hypothesis $H_{(CS)0}$ is accepted that there is no significant impact of Communication System dimension of Third Party Logistics Service Provider on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat. This means Communication and Communication System of third party logistics service provider exerts insignificant influence over maintaining Logistics Flexibility (LF).

5.4.2.1.j Sensitive Information Sharing dimension (SIS) has negative but weak relationship with maintaining Logistics Flexibility (LF); as the regression co-efficient is $-0.097$. The significance level of 0.346 indicates that this regression co-efficient is statistically insignificant. So, alternate hypothesis $H_{(SIS)1}$ is rejected and null hypothesis $H_{(SIS)0}$ is accepted that there is no significant impact of Sensitive Information Sharing dimension of Third Party Logistics Service Provider on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat. This means Sensitive Information Sharing dimension (SIS) exerts insignificant influence over maintaining Logistics Flexibility (LF). A change in Sensitive Information Sharing nature of third party
logistics service provider (SIS) will not bring significant change in Logistics Flexibility (LF).

5.4.2.1.k Quick Response (QR) has positive but weak relationship with maintaining Logistics Flexibility (LF); as the regression co-efficient is + 0.095. The significance level of 0.290 indicates that this regression co-efficient is statistically insignificant. So, alternate hypothesis $H_{(QR)1}$ is rejected and null hypothesis $H_{(QR)0}$ is accepted that there is no significant impact of Quick Response dimension of Third Party Logistics Service Provider on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat. This means Quick Response dimension (SIS) exerts insignificant influence over maintaining Logistics Flexibility (LF). A change in Quick Response of third party logistics service provider will not bring significant change in Logistics Flexibility (LF).

5.4.2.1.l Handling of Customer Complaints dimension (Comp) has negative relationship with maintaining Logistics Flexibility (LF); as the regression co-efficient is + 0.143. The significance level of 0.143 indicates that this regression co-efficient is statistically insignificant. So, alternate hypothesis $H_{(Comp)1}$ is rejected and null hypothesis $H_{(Comp)0}$ is accepted that there is no significant impact of Handling of Customer Complaints dimension of Third Party Logistics Service Provider on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat. This means Handling of Customer Complaints dimension (Comp) exerts insignificant influence over maintaining Logistics Flexibility (LF). A change in Handling Customer Complaints function of third party logistics service provider (Comp) will not bring significant change in Logistics Flexibility (LF).
5.4.2.1.m Total Order Cycle Time dimension (TOCT) has positive relationship with maintaining Logistics Flexibility (LF); as the regression co-efficient is + 0.129. The significance level of 0.261 indicates that this regression co-efficient is statistically insignificant. So, alternate hypothesis $H_{(TOCT)}$ is rejected and null hypothesis $H_{(TOCT)}$ is accepted that there is no significant impact of Total Order Cycle Time dimension of Third Party Logistics Service Provider on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat. This means Total Order Cycle Time dimension (TOCT) exerts insignificant influence over maintaining Logistics Flexibility (LF). A change in Total Order Cycle Time of third party logistics service provider (TOCT) will not bring significant increase in Logistics Flexibility (LF).

5.4.2.1.n Fill Rates dimension (FR) has Positive but weak relationship with maintaining Logistics Flexibility (LF); as the regression co-efficient is + 0.043. The significance level of 0.668 indicates that this regression co-efficient is statistically very insignificant. So, alternate hypothesis $H_{(FR)}$ is rejected and null hypothesis $H_{(FR)}$ is accepted that there is no significant impact of Fill Rates dimension of Third Party Logistics Service Provider on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat. This means Fill Rates dimension (FR) exerts insignificant influence over maintaining Logistics Flexibility (LF). A change in Fill Rates of third party logistics service provider (FR) will not bring significant change in Logistics Flexibility (LF).

5.4.2.1.o Use of Technology dimension (Tech) has positive but weak relationship with maintaining Logistics Flexibility (LF); as the regression co-efficient is + 0.028. The significance level of 0.748 indicates that this regression co-efficient is statistically very insignificant. So, alternate hypothesis $H_{(Tech)}$ is rejected and
null hypothesis $H_{(Tech)}$ is accepted that there is no significant impact of Use of Technology dimension of Third Party Logistics Service Provider on maintaining Logistics Flexibility for fluid milk and milk products in Co-Operative Dairies in Gujarat. This means Use of Technology dimension (Tech) exerts insignificant influence over maintaining Logistics Flexibility (LF). A change in Use of Technology by third party logistics service provider will not bring significant change in Logistics Flexibility (LF).

Table 5.4.2.2

Variance Analysis of benefits of using Third Party Logistics Service Providers

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>Df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>22.144</td>
<td>15</td>
<td>1.476</td>
<td>10.552</td>
<td>0.000*</td>
</tr>
<tr>
<td>Residual</td>
<td>9.234</td>
<td>66</td>
<td>0.140</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>31,378</td>
<td>81</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(* Significant at 0.05 level of significance)

5.4.2.2 The variance analysis given in table 5.4.2.2 above shows $F = 10.552$ at a significance level of 0.000 with df (15, 66), which indicates that all regression coefficients will be non zero.

5.4.2.3 The emerging Multiple Regression Equation is as under:

$LF = -0.668 + 0.346 \text{ (Time)} + 0.020 \text{ (Corr)} + 0.268 \text{ (Cost)} + 0.141 \text{ (Invt)} + 0.173 \text{ (Qual)} + 0.280 \text{ (Flex)} + 0.178 \text{ (Cust)} + 0.291 \text{ (VV)} - 0.111 \text{ (CS)} - 0.097 \text{ (SIS)} + 0.095 \text{ (QR)} + 0.143 \text{ (Comp)} + 0.129 \text{ (TOCT)} + 0.043 \text{ (FR)} + 0.028 \text{ (Tech)}$
The adjusted $R^2$, i.e. the co-efficient of determination stands at 0.639 indicating that the equation can explain 63.9% variations in Logistics Flexibility (LF). For remaining variations, i.e. unexplained variations, some other variables are responsible.

Table 5.4.2.3

Co-efficient Correlations of benefits of using Third Party Logistics Service Providers

<table>
<thead>
<tr>
<th></th>
<th>Time</th>
<th>Corr</th>
<th>Cost</th>
<th>Invt</th>
<th>Qual</th>
<th>Flex</th>
<th>Cust</th>
<th>VV</th>
<th>CS</th>
<th>SIS</th>
<th>QR</th>
<th>Comp</th>
<th>TOCT</th>
<th>FR</th>
<th>Tech</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>1.000</td>
<td>0.040</td>
<td>-0.416</td>
<td>0.093</td>
<td>0.297</td>
<td>-0.150</td>
<td>-0.304</td>
<td>-0.037</td>
<td>0.428</td>
<td>-0.318</td>
<td>0.296</td>
<td>0.199</td>
<td>-0.262</td>
<td>0.321</td>
<td>0.412</td>
</tr>
<tr>
<td>Corr</td>
<td>0.040</td>
<td>1.000</td>
<td>0.156</td>
<td>-0.049</td>
<td>0.141</td>
<td>0.119</td>
<td>0.212</td>
<td>0.200</td>
<td>0.147</td>
<td>-0.173</td>
<td>0.007</td>
<td>-0.249</td>
<td>0.197</td>
<td>0.105</td>
<td>0.208</td>
</tr>
<tr>
<td>Cost</td>
<td>-0.416</td>
<td>0.156</td>
<td>1.000</td>
<td>-0.163</td>
<td>-0.087</td>
<td>0.135</td>
<td>-0.102</td>
<td>0.203</td>
<td>-0.431</td>
<td>0.445</td>
<td>0.045</td>
<td>-0.033</td>
<td>0.351</td>
<td>0.217</td>
<td>-0.230</td>
</tr>
<tr>
<td>Invt</td>
<td>0.093</td>
<td>-0.049</td>
<td>-0.163</td>
<td>1.000</td>
<td>-0.237</td>
<td>0.445</td>
<td>0.127</td>
<td>-0.190</td>
<td>-0.024</td>
<td>0.127</td>
<td>-0.072</td>
<td>-0.235</td>
<td>0.391</td>
<td>0.230</td>
<td>0.291</td>
</tr>
<tr>
<td>Qual</td>
<td>0.297</td>
<td>0.141</td>
<td>-0.087</td>
<td>-0.237</td>
<td>1.000</td>
<td>-0.111</td>
<td>0.230</td>
<td>0.232</td>
<td>0.365</td>
<td>-0.344</td>
<td>0.395</td>
<td>0.382</td>
<td>-0.164</td>
<td>0.227</td>
<td>-0.049</td>
</tr>
<tr>
<td>Flex</td>
<td>-0.150</td>
<td>0.119</td>
<td>0.135</td>
<td>0.455</td>
<td>-0.141</td>
<td>1.000</td>
<td>0.122</td>
<td>0.290</td>
<td>0.072</td>
<td>-0.048</td>
<td>-0.134</td>
<td>-0.211</td>
<td>0.632</td>
<td>0.117</td>
<td>0.164</td>
</tr>
<tr>
<td>Cust</td>
<td>0.304</td>
<td>0.212</td>
<td>-0.102</td>
<td>0.174</td>
<td>0.230</td>
<td>0.122</td>
<td>1.000</td>
<td>0.238</td>
<td>0.292</td>
<td>-0.172</td>
<td>0.289</td>
<td>-0.338</td>
<td>-0.023</td>
<td>0.436</td>
<td>0.132</td>
</tr>
<tr>
<td>VV</td>
<td>-0.037</td>
<td>0.200</td>
<td>0.203</td>
<td>-0.190</td>
<td>0.232</td>
<td>0.290</td>
<td>0.238</td>
<td>1.000</td>
<td>0.094</td>
<td>0.107</td>
<td>0.223</td>
<td>0.193</td>
<td>0.208</td>
<td>0.287</td>
<td>0.098</td>
</tr>
<tr>
<td>CS</td>
<td>0.428</td>
<td>0.147</td>
<td>-0.431</td>
<td>-0.024</td>
<td>0.365</td>
<td>0.121</td>
<td>0.292</td>
<td>0.094</td>
<td>1.000</td>
<td>-0.499</td>
<td>0.121</td>
<td>0.144</td>
<td>-0.120</td>
<td>0.072</td>
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<tr>
<td>SIS</td>
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<td>-0.173</td>
<td>0.445</td>
<td>0.127</td>
<td>-0.344</td>
<td>0.048</td>
<td>-0.172</td>
<td>0.107</td>
<td>-0.499</td>
<td>1.000</td>
<td>-0.171</td>
<td>-0.156</td>
<td>0.407</td>
<td>0.110</td>
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<td>QR</td>
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<td>0.007</td>
<td>0.045</td>
<td>-0.072</td>
<td>0.395</td>
<td>-0.134</td>
<td>0.289</td>
<td>0.223</td>
<td>0.121</td>
<td>-0.171</td>
<td>1.000</td>
<td>-0.454</td>
<td>-0.165</td>
<td>-0.484</td>
<td>0.087</td>
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<tr>
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<td>-0.249</td>
<td>-0.330</td>
<td>-0.235</td>
<td>0.382</td>
<td>0.454</td>
<td>0.338</td>
<td>-0.193</td>
<td>0.144</td>
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<td>1.000</td>
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<td>0.351</td>
<td>0.391</td>
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<td>-0.165</td>
<td>-0.023</td>
<td>0.208</td>
<td>-0.120</td>
<td>-0.407</td>
<td>-0.165</td>
<td>-0.407</td>
<td>1.000</td>
<td>0.118</td>
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<tr>
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<td>0.105</td>
<td>0.217</td>
<td>0.230</td>
<td>0.227</td>
<td>0.171</td>
<td>0.436</td>
<td>0.287</td>
<td>0.072</td>
<td>0.110</td>
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<td>-0.032</td>
<td>0.149</td>
<td>0.270</td>
<td>1.000</td>
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</table>
5.4.2.4 The co-efficients of correlation amongst all variables are depicted in the table 5.4.2.3 above. It is revealed that none of all nine independent variables has the co-efficient of correlation coefficient larger than ± 0.7. The VIF statistics, in table 5.4.2.1, of all the independent variables are very much far from cut off rate of 10. Hence there is no cause of concern from viewpoint of multicollinearity among the independent variables. The D (Durbin-Watson) statistic stands at 2.110. The corresponding table values for D statistic stand at 1.61 for lower limit (D_L) and 1.66 for upper limit (D_U). As a result D (2.003) is greater than D_U (1.66) and 4 – D (1.890) is greater than D_L (1.61). Hence it can be concluded that either positive or negative autocorrelation does not exist.

Table 5.4.2.4

Descriptive Statistics of benefits of using Third Party Logistics Service Providers and Logistics Flexibility

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>2.00</td>
<td>5.00</td>
<td>4.18</td>
<td>0.83</td>
</tr>
<tr>
<td>Corr</td>
<td>1.00</td>
<td>5.00</td>
<td>4.33</td>
<td>0.75</td>
</tr>
<tr>
<td>Cost</td>
<td>3.00</td>
<td>5.00</td>
<td>4.18</td>
<td>0.74</td>
</tr>
<tr>
<td>Invt</td>
<td>3.00</td>
<td>5.00</td>
<td>3.78</td>
<td>0.69</td>
</tr>
<tr>
<td>Qual</td>
<td>1.00</td>
<td>5.00</td>
<td>3.61</td>
<td>0.99</td>
</tr>
<tr>
<td>Flex</td>
<td>1.00</td>
<td>5.00</td>
<td>3.41</td>
<td>1.21</td>
</tr>
<tr>
<td>Cust</td>
<td>3.00</td>
<td>5.00</td>
<td>4.38</td>
<td>0.60</td>
</tr>
<tr>
<td>VV</td>
<td>1.00</td>
<td>5.00</td>
<td>3.91</td>
<td>1.09</td>
</tr>
<tr>
<td>CS</td>
<td>3.00</td>
<td>5.00</td>
<td>4.22</td>
<td>0.79</td>
</tr>
<tr>
<td>SIS</td>
<td>2.00</td>
<td>5.00</td>
<td>3.84</td>
<td>0.73</td>
</tr>
<tr>
<td>QR</td>
<td>1.00</td>
<td>5.00</td>
<td>2.99</td>
<td>0.81</td>
</tr>
<tr>
<td>Comp</td>
<td>3.00</td>
<td>5.00</td>
<td>3.40</td>
<td>0.52</td>
</tr>
<tr>
<td>TOCT</td>
<td>2.00</td>
<td>5.00</td>
<td>3.80</td>
<td>0.85</td>
</tr>
</tbody>
</table>
The descriptive statistics pertinent to the multiple regression equation are depicted in table 5.4.2.4 above. For On Time Delivery dimension, the minimum value rated is 2.00 and maximum value rated is 5.00, with mean 4.18 and standard deviation 0.83. For Correct Delivery Dimension, the minimum value rated is 1.00 and maximum value rated is 5.00, with mean 4.33 and standard deviation 0.75. For Cost Consideration dimension, the minimum value rated is 3.00 and maximum value rated is 5.00, with mean 4.18 and standard deviation 0.74. For Inventory Accuracy dimension, the minimum value rated is 3.00 and maximum value rated is 5.00, with mean 3.78 and standard deviation 0.69. For Quality of Services, the minimum value rated is 1.00 and maximum value rated is 5.00, with mean 3.61 and standard deviation 0.99. For Flexibility dimension, the minimum value rated is 1.00 and maximum value rated is 5.00, with mean 3.41 and standard deviation 1.21. For Customization of Products and Services dimension, the minimum value rated is 3.00 and maximum value rated is 5.00, with mean 4.38 and standard deviation 0.60. For Shipments in terms of Value/Volume Dimension, the minimum value rated is 1.00 and maximum value rated is 5.00, with mean 3.91 and standard deviation 1.09. For Communication System dimension, the minimum value rated is 3.00 and maximum value rated is 5.00, with mean 4.22 and standard deviation 0.79. For Sensitive Information Sharing dimension, the minimum value rated is 2.00 and maximum value rated is 5.00, with mean 3.84 and standard deviation 0.73. For Quick Response Dimension, the minimum value rated is 1.00 and maximum value rated is 5.00, with mean 2.99 and standard deviation 0.81. For Handling of Customer Complaints dimension, the minimum value rated is 3.00 and maximum value rated is 5.00, with mean 3.40 and standard deviation 0.52. For Total Order Cycle Time dimension, the minimum value rated is 2.00 and maximum value rated is 5.00, with mean 3.80 and standard deviation 0.85. For Fill Rates Dimension, the
minimum value rated is 1.00 and maximum value rated is 5.00, with mean 3.90 and standard deviation 1.04. For Use of Technology Dimension, the minimum value rated is 1.00 and maximum value rated is 5.00, with mean 2.20 and standard deviation 1.08. For Logistics Flexibility dimension, the minimum value rated is 2.00 and maximum value rated is 5.00, with mean 3.70 and standard deviation 0.62.

**Figure 5.4 Relationship among various benefits of using Third Party Service Provider exerting significant impact on Logistics Flexibility**

(Indicates Impact of independent factor on dependent factor)

(* Significant at 0.05 Level of Significance)
5.4.3 Discussion regarding Third party Logistics Service Provider

5.4.3.1 The objective of this section is to find out the most important characteristics of Third Party Logistics Service Providers affecting logistics flexibility of co-operative dairies in Gujarat. The descriptive statistics in table 5.4.2.4 shows ratings of variables given by senior managers of various co-operative dairies in Gujarat. Among the all variables, On Time Delivery (4.18), Correct Delivery (4.33), Cost Consideration (3.98), Customization of Services (4.38) and Communication System (4.22) are rated higher than other variables. On Time Delivery variable is rated high because contract transporters have to take the supply of milk and distribute the fluid milk and milk products as per fixed schedule on time as per their contract with respective co-operative dairies. In case of inability to deliver product on time, the contract transporters have to bear heavy penalty. The contract transporters have the fixed route mostly to supply the milk to dairies from various village dairy co-operative societies and to distribute fluid milk and milk products in the market to retailers or final consumers. So, the contract transporters are able to deliver products at the right destination. Sometimes, it may be possible to add or remove few destinations from a particular route, but this information is communicated to contract transporters well in advance to minimize errors in distribution. Use of contract transporters in logistics is highly cost effective due to certain reasons like minimization of fixed investment in transport vehicles, lower maintenance and administrative cost and lower labour cost. Customization of services in terms of specification of vehicle requirements is one of the most important characteristics of logistics service provider firm. Customization in transport vehicles improves the flexibility in terms of distribution varieties of milk products in the market as per customer requirement, which in turn is cost effective and generates greater customer satisfaction. Communication system of third party logistics service provider is very much standardized and routine, so there is less chance for errors.
On the other side, Use of Technology (2.20) and Quick Response (2.99) variables are rated lowest among all variables. The extent of use of technology by third party logistics service provider firm is very minimum or nil. Few of the large third party logistics service provider firms have developed their own websites to communicate with dairies and other suppliers. But recently, some of the dairies like Panchmurti dairy have started using Global Positioning System to track transporters during supply and distribution of milk and milk products. The contract transporters have fixed schedule to bring milk to dairies and to distribute finished products to retailers and customers in the market. In case of changes in demand in routine schedule, they are able to respond quickly up to certain extent only. But, except routine schedule they are not much flexible and quick to respond to dairies and market due to varieties of products and large number of retailers and customers in market.

Regression analysis is done to find important variables in Third Party Logistics Service Provider affecting logistics flexibility in co-operative dairies in Gujarat. The value of $R^2$ of 0.639 show that the Third party Logistics Service Provider exerts significant impact on maintaining logistics flexibility. On Time Delivery, Cost Consideration, Quality of Services, Flexibility, Customization of Products and Services and Shipments in terms of Value/Volume variables exert significant positive impact on logistics flexibility.

a. On Time Delivery variable exert significant positive impact on maintaining logistics flexibility because of three reasons: (1) All the dairy co-operatives have the fixed schedule to bring the supply of milk and distribute the finished products in the market. (2) As per contract, it is compulsory for all the contract transporters to bring supply of milk and distribute the fluid milk and milk products on time as per fixed schedule. (3) If the contract transporter fails to bring the supply of milk and distribute the finished products on time, he has to bear the cost of inventory that he carries after the specified time limit. So the use of contract transporter in
logistics results in better time management, which in turn improves better flexibility in logistics management.

b. Cost consideration variable exert significant positive impact on maintaining logistics flexibility. Cost is important because sometimes flexibility leads to high cost. Use of contract transporter gives certain cost advantage to co-operative dairies: (1) It nullifies the fixed investment required in transport vehicles, which saves the capital of dairy. (2) It also reduces maintenance cost of vehicles, during the transport. (3) Use of contract transporters reduces the labour cost in terms of salary of driver and conductor. (4) The most significant advantage is the savings in administrative cost required to manage vehicles during day to day transportation. (5) The contract transporters are getting fixed rate per kilometer distance to transport milk and milk products. The rate is fixed looking at the proximity, route of vehicle and type of vehicle (whether simple or insulated vehicle). The fixed rate given to contract transporter is generally higher than what it costs to dairies if they use their own vehicles. But looking at the overall savings in cost, it is beneficial to use contract transporters in logistics of milk and milk products in co-operative dairies. So, use of contract transporter brings savings in cost, which in turn, brings better flexibility in logistics of milk and milk products.

c. Quality of service provided by contract transporters exerts significant positive impact on maintaining logistics flexibility due to following reasons: (1) The perishability aspect of fluid milk and milk products require specification of transport vehicles in terms of timings of services, specification in terms of vehicles, temperature of vehicles and cleanliness. (2) The dairy co-operatives issues tenders to select the contract transporters, in which they select those who bids to provide better services and the reasonable rates. (3) The specified services to be provided by transporters are clearly mentioned in the contract with dairy co-operatives. The non-conformance with quality standard leads to heavy penalty to be paid by contract transporters. So, the specific quality of services provided by the contract transporters in logistics fluid milk and milk products enhances the flexibility of logistics management in co-operative dairies.
d. Flexibility in services provided by contract transporters exerts significant positive impact on logistics flexibility. Flexibility aspect in service of contract transporters enhances logistics flexibility in following manner: (1) Supply of milk and demand for fluid milk and milk products changes on day-to-day basis. So, it requires contract transporters to provide vehicles with specification given by co-operative dairies as per the supply and demand condition, which will improves the flexibility in terms of supply of milk and distribution of fluid milk and milk products. (2) Sometimes, contract transporters require to follow different routes in distribution of fluid milk and milk products as per the changes in demand condition in market, which also enhances flexibility in distribution of various products. So, flexibility in services provided by contract transporters creates positive impact on logistics flexibility of co-operative dairies. But, according to some senior executives, sometimes, flexibility increases the logistics cost, as transporters charge extra cost for transporting products in case of emergency and uncertain demand.

e. Customization of services provided by contract transporters exerts significant positive impact on flexibility of logistics management. Customization can be treated in terms of specification of vehicle requirements and special services asked to be provided. As per the demand in different routes, different sizes of vehicles are required to maintain cost within limit. While in case of supply milk and distribution of fluid milk only at the nearby distance, does not require insulated vehicles, which reduces the cost of logistics to a great extent. The ability of contract transporters to customize services as per requirement of dairy enhances the logistics flexibility enormously.

f. Shipments transported by contract transported in terms of value/volume also exert significant positive impact on logistics flexibility. The contract transporters are able to handle large volume of shipments because of following reasons: (1) They are specialized in logistics fluid milk and milk products. (2) Some large transporters have many vehicles through which they can supply and distribute huge quantity of milk and milk products. (3) In case of emergency, if enough
numbers of vehicles are not available with contract transporters, they can also make arrangements of extra vehicles through some other transporters through their network. So, use of contract transporters in logistics of dairies creates huge ability to transport large shipments, which enhances the logistics flexibility.

5.5 Summary

The relationships among various components of logistics flexibility have been examined using regression analysis. The results have shown the significant relationships among various components of logistics flexibility. The analysis leads to conclusion that internal competences creates significant impact on customer perceptible capabilities, which leads to improved customer satisfaction. The results have also brought out the importance of logistics flexibility at all procurement, processing and distribution levels for fluid milk and milk products in co-operative dairies in Gujarat.

Regression analysis is done to find important variables in Logistics Operating System, affecting logistics flexibility in co-operative dairies in Gujarat. The result shows that the Logistics Operating System exerts significant impact on maintaining logistics flexibility due to perishability and variety aspects to be maintained on day to day basis. Formatted to Facilitate Usage, Flexibility, Internal Validity and External Validity variables of Logistics Operating System exert significant positive impact on logistics flexibility, while Availability aspect exerts significant negative impact on logistics flexibility. Logistics Planning System exerts significant impact on maintaining logistics flexibility. Exception based formatted, Formatted to Facilitate Usage, Internal Validity and External Validity variables of Logistics Planning System exert significant positive impact on logistics flexibility.

Third party Logistics Service Provider is also found creating significant impact on maintaining logistics flexibility. On Time Delivery, Cost Consideration, Quality of Services, Flexibility, Customization of Products and Services and Shipments in terms of Value/Volume variables exert significant positive impact on logistics flexibility.
5.6 References


Ch. 6 - Findings and Recommendations

6.1. Major Findings of the study

The major findings of the primary surveys are as follows:

6.1.1 Logistics Flexibility Model

1. Physical Supply Flexibility exerts significant positive impact on manufacturing flexibility for fluid milk and milk products in co-operative dairies in Gujarat. The ability of dairies to deliver multiple kinds of required materials on time and accurately in response to operations requirements brings manufacturing flexibility in terms of ability to respond to changes in delivery request and producing varieties of products cost effectively and quickly for fluid milk and milk products.

2. Purchasing Flexibility exerts significant positive impact on manufacturing flexibility for fluid milk and milk products in co-operative dairies in Gujarat. The ability of dairies to deliver multiple kinds of materials quickly that meet specifications, maintaining close communication with suppliers brings in-house ability in production function to respond to changes in multiple production orders and market environment at large for fluid milk and milk products.

3. Physical Supply Flexibility exerts significant positive impact on Physical Distribution Flexibility for fluid milk and milk products in co-operative dairies in Gujarat. The ability to deliver multiple kinds of materials quickly and accurately creates positive impact on Physical Distribution Flexibility in terms of distributing varieties of fluid milk and milk products quickly and cost effectively.
4. Purchasing Flexibility exerts significant positive impact on Physical Distribution Flexibility for fluid milk and milk products in co-operative dairies in Gujarat. The ability of dairies to obtain multiple kinds of materials that meet specifications quickly and maintain close communication with suppliers in terms of specification of required materials leads to more accurate physical distribution of varieties of fluid milk and milk products as per specifications quickly and accurately.

5. Physical Supply Flexibility exerts significant positive impact on Demand Management Flexibility for fluid milk and milk products in co-operative dairies in Gujarat. The ability of dairies to deliver multiple kinds of materials as per specifications quickly and cost effectively, creates ability to respond to multiple retailers’ and customers’ requirements quickly and accurately.

6. Purchasing Flexibility exerts significant positive impact on Demand Management Flexibility for fluid milk and milk products in co-operative dairies in Gujarat. The ability of dairies to maintain co-ordination with suppliers brings ability in terms of specifications of multiple materials requirements quickly creates ability to respond to feedback and specification from customers for fluid milk and milk products.

7. Manufacturing Flexibility exert significant positive impact on Physical Distribution Flexibility and Demand Management Flexibility, but at moderate level.

8. Manufacturing Flexibility exerts significant positive impact on Physical Distribution Flexibility for fluid milk and milk products in co-operative dairies in Gujarat. The ability of dairies to produce varieties of products with use of automated manufacturing technologies quickly and cost effectively brings ability in terms of responding to varieties of products delivery requests like products variants, packaging and labeling, etc. quickly and cost effectively.

9. Manufacturing Flexibility exerts significant positive impact on Demand Management Flexibility for fluid milk and milk products in co-operative dairies in Gujarat. The dairies’ ability to produce varieties of products as per customers’
requirements quickly and cost effectively brings flexibility in terms of demand management for fluid milk and milk products.

10. Physical Distribution Flexibility exerts significant positive impact on Customer Satisfaction. The ability to quickly assemble multiple customer orders in different pack size brings flexibility in terms of delivering varieties of products as per customized requirements. The accuracy of transport system to deliver varieties of products, maintaining quality standards brings uniformity on distribution of fluid milk and milk products.

11. Demand Management Flexibility exerts significant positive impact on Customer Satisfaction for fluid milk and milk products in co-operative dairies in Gujarat. The proper management of distribution schedule and delivery time requirements leads to greater availability of various fluid milk and milk products to customers as per requirements. The ability respond to retailers’ and customers’ feedback and suggestions leads to greater customer satisfaction and improved reputation of the firm in market.

6.1.2 Logistics Information System

6.1.2.1 Logistics Operating System

1. Formatted to facilitate usage, flexibility, internal validity and external validity variables exert significant positive impact on logistics flexibility, while availability aspect exerts significant negative impact on logistics flexibility

2. Formatted to facilitate aspect is important to maintain logistics flexibility because the information collected at different places must be clubbed together on common format to bring co-ordination among supply chain members, which in turn creates ease of analysis and decision making in day to day logistics activities.
3. Flexibility in information system enhances logistics flexibility in terms of product mix management, customization and quick financial transactions.

4. The internal coordination through information system among different departments and similar dairy co-operatives greatly improves the flexibility in logistics and supply chain system.

5. It is imperative to maintain coordination with upstream members and downstream members. It greatly enhances logistics flexibility in terms of balancing supply and demand on real time basis for various fluid milk and milk products in co-operative dairies.

6. The co-operative dairies in Gujarat recognize strictness in terms of availability of information limited to few people in logistics system.

6.1.2.2 Logistics Planning System

1. Exception based formatted, Formatted to Facilitate Usage, Internal Validity and External Validity variables exert significant positive impact on logistics flexibility.

2. Exception based formatted variable exerts significant positive impact on logistics flexibility because it enhances linkages among supply chain partners and ease of analysis. It creates ability to organize information in a form that focuses decision makers’ attention on situations requiring attention, which leads to better product management and ultimately logistics flexibility.

3. Formatted to facilitate usage provides common platform on the basis of which information from various sources can be clubbed together, which is very much helpful in planning of logistics for various fluid milk and milk products.
4. The better co-ordination among various departmental heads leads to better flexibility in planning of logistics management for various fluid milk and milk products.

5. The better co-ordination with suppliers and customers leads to better product mix planning and customization, which ultimately enhances the logistics flexibility for fluid milk and milk products.

6.1.3 Third party Logistics Service Provider

1. On time delivery, cost consideration, quality of services, flexibility, customization of products and services and shipments in terms of value/volume exert significant positive impact on maintaining logistics flexibility.

2. It is important to have on time delivery of raw milk to dairy co-operatives to produce varieties of products on time as well as distribute them as per requirements. All the dairy co-operative have fixed schedules to bring the supply of raw milk and distribute finished products, failing to which the contract transporters have to bear the cost of goods carried.

3. Use of third party logistics service provider save the logistics cost dairy co-operatives in terms of fixed investment required in transport vehicles, maintenance cost of transport vehicles, labour cost and administrative cost in logistics services. It brings cost of logistics services down and at the same time improves the flexibility in logistics system.

4. Perishability aspect of fluid milk and milk products require specification of transport vehicles in terms of timings of services, specification in terms of vehicle requirements, temperature of vehicles and cleanliness, which improve flexibility in logistics of fluid milk and milk products and maintains quality standards.

5. Flexibility in services provided by contract transporter is also important. Flexibility in terms of vehicles required to transport milk and milk products,
following different routes as per changes in demand greatly enhances flexibility in logistics of various fluid milk and milk products.

6. Customization in terms of specification of vehicles as per nature and quantity of products demanded and special services asked to be provided by transport service provider creates significant impact on maintaining flexibility in logistics system.
6.2 Recommendations

1. The co-operative dairies require systematic planning and integrated policies and programmes for animal breeding, genetic upgradation and feed and fodder management to improve the poor productivity of milch animals. The Government and private agencies can mediate and create funds for such programmes to be implemented.

2. Installation of more and more bulk milk coolers for efficient collection of milk is critical for preserving and improving the quality of milk, which in turn provides the following benefits: (a) longer collecting intervals, which reduces cost of transportation and gain the benefit of Full Truck Load (FTL), (b) flexibility in terms of milk delivery and pick up time, (c) handling of cans can be eliminated, (d) increased potential for collection from producers in remote locations and (5) maintenance of good hygienic condition.

3. There are regional demand-supply imbalances in different districts of Gujarat. It is critical to develop capacity in line with the increase in supply of milk supported by procurement infrastructure. The dairy co-operative having low to medium milk collection from primary co-operative societies are either producing low varieties of milk products or not producing anything and supply the chilled milk to other dairy co-operatives, which increase their logistics cost. At the same time to fulfill local demand for various milk and milk products, they have to rely on other co-operatives to distribute various milk and dairy products in local market, which again increases the logistics cost. If the proper production facilities can be developed at district unions to produce various milk and milk products, the flexibility in terms of fulfilling local as well as other market demand with specified time period can be enhanced and logistics cost can be reduced at great extent.
4. The co-operative dairies are facing time based competition, which requires them to adopt flexible manufacturing system. It can bring about significant improvements in logistics performance through their focus on compressed manufacturing lead times and improved quality. A further enhancements in time based competitiveness will necessitate: (1) Speeding the flow of information on orders to upstream organizational entities, so that manufacturing can be more responsive to changes in demand and (2) Accelerating logistics activities like storage and delivery of materials/products through the entire supply chain. (Bhatnagar et al., 1999)

5. The co-operative dairies need to place considerable importance on relationships and networking, which requires linkages with other firms both up and down the supply chain and also with firms outside the supply chain to improve performance in the areas of product handling, product tracking, information flow technology, and other product and process advancements. These, in turn, enhance customer satisfaction and firm performance (Epatko, 1994; Schilling and Hill, 1998; Vonderembse and Tracey, 1999; Shin et al., 2000).

6. Consolidation is a powerful economic force in strategic planning, which results in substantial economies of scale that is present in the transport rate structure (Ballou, 1992). Orders arriving at dairy co-operatives for different products may be combined to increase the size of the average inventory during transport, which in turn would lower the average transport cost per unit. The benefits of consolidation can be achieved by streamlining and successively combining the material flow between the manufacturing facilities and customers, leading to larger average inventory as compared to uncoordinated shipments (Bhatnagar and Vishwanathan, 2000).

7. The co-operative dairies seek to use new knowledge to innovate – primarily for the benefit of their customers. The establishment of knowledge is an essential component in the flow of material, information, and services in logistics throughout supply chain system. The implementations of information and
communication tools with employee involvement create a basis for knowledge sharing within and among the organizations involved in logistics activities throughout supply chain. Knowledge networks in logistics allow firms to create, share, and use strategic knowledge to improve operational efficiencies and to assist customers. (Chapman et al, 2003).

8. There is a need to implement more and more information and communication tools to maintain flexibility in day to day logistics activities at all the level of supply chain. There is a strong need to coordinate the information network of dairy co-operatives throughout supply chain to maintain balance in demand-supply situation. The initiatives of GCMMF to implement DISK network at dairy co-operative societies is the move in that direction to link co-operative societies to dairy co-operative unions so that real time milk procurement data can be gained concurrently and advance planning can be made regarding production of various fluid milk and milk products. It increases the flexibility in production of various milk and milk products. (Bhatnagar, 2000 and Monika, 2000)

9. There is a strong need to integrate the distribution channel members with dairy co-operative unions to get the real time information regarding changes in demand for various milk and milk products. The initiatives of co-operative dairies to introduce EIAS system to connect various channel members is the right strategy to get real time information regarding sale and demand condition in the market at local, state, national and international level. It improves the flexibility in terms of improved demand management for production and distribution of various fluid milk and milk products. The use of EIAS system also improves the decision making ability of dairy co-operatives in long term planning. (Srikanth, 2002)

10. There should be strong information network among various co-operative dairies also to manage regular demand-supply discrepancies. The strong information linkages among co-operative dairies and federation will give real time information regarding availability of various products at co-operative dairies, which is helpful to manage collection as well as distribution of various fluid milk and milk products.
products in the market. The implementation of VSAT network of GCMMF to link various co-operative dairies is the right move in that direction to manage regular flow of demand and supply of various products as well as long term planning of supply chain activities.

11. The use of technology like GIS system will also be helpful in planning of route scheduling of procurement and distribution of various milk and milk products. The location of the transport vehicles can also be found out using this technology, which will be helpful to keep control on contract transporter during procurement and distribution phase in terms of timeliness and accuracy. (Srikanth, 2002)

12. The service level consistency is one of the most important considerations while outsourcing logistics function especially for milk and milk products. The co-operative dairies need to focus control efforts to managing service levels. Management training is required with the implementation of outsourcing of logistics functions to third party logistics service providers (Bardi and Tracy, 1991). The training efforts should cover introduction of different working practices, explanation of new communication and information systems, establishing and managing contracts and moving from an operational focus to issues of planning, forecasting and strategy.

13. Process improvement can be achieved through benchmarking the logistics performance within the supply chain, thus enabling logistics partners to learn from each other (Andersen et al., 1999). Co-operative dairies can provide assistance and guidance to third party logistics service providers in performance assessment or benchmarking within the supply-chain network. Similarly, appropriate performance measurement systems can be developed and shared by co-operative dairies within the supply chain.

14. There is a need to improve the quality of transport vehicles carrying the milk from villages to dairy co-operatives. The proper maintenance of temperature in vehicles during transportation and proper scheduling of transport route must be improved
so that the milk can be brought to dairy co-operatives at reasonable cost and quality of milk can also be maintained.

15. The dairy co-operatives should take care of the customization in quality of service provided by contract transporters like quality and size of vehicles, maintenance of temperature, cleanliness and accuracy in distribution of varieties of products at various locations. It brings flexibility in delivering varieties of fluid milk and milk products effectively at various locations in local and other markets.

16. The third party logistics service providers should be educated in terms of handling retailers’ and customers’ complaints, providing their suggestions and feedback to dairy unions. It will be helpful to dairy unions in getting real picture of the market, which brings efficiency in maintaining flexibility to provide customization. It will also lead to more satisfaction to consumers.

17. Third party firm with experience, focus and expertise should be included in the logistics network. A complete understanding of customer requirements must be developed to the third party logistics service providers, which will determine the needs of the co-operative dairies, such as type of facilities required by the customers (Gooley, 1992). The co-operative dairies must plan for educating the logistics service provider about the co-operative dairies’ requirements and integrating them through information systems (Dapiran et al., 1996).

18. While outsourcing the logistics function to third party logistics service provider firms, the followings aspects should be taken care of by dairy co-operatives (Bagachi and Virum, 1998): (1) Ability to manage goods flow requirements, volumes, seasonal fluctuations, handling requirements and order sizes; (2) Ability to manage inventory volumes, vehicle requirements, in-bound and out-bound flows; (3) Ability to meet quality standards for customer service elements; (4) Ability to manage information flows and requirements for information and communication technology; (5) Ability to meet specifications of required cost and service reports and (6) Ability to maintain confidentiality in dealing with sensitive information.
6.3 References


7.1 Conclusion

There is a huge potential for growth of fluid milk and milk products in Gujarat. The co-operative structure developed by co-operative dairies in Gujarat has been proved successful. There is a strong need to educate milk producers regarding improving productivity of milch animals, which leads to improve production as well as quality of milk in the state. The government, NGOs and dairy co-operative can play important part in educating milk producers and providing proper facilities for enhancing quality and quantity of milk.

The competence and capability theory brings a systematic resource-based view of logistics flexibility management in co-operative dairies in Gujarat. It is empirically verified that flexible logistics competence supports the flexible logistics capability, which ultimately enhances customer satisfaction for fluid milk and milk products in co-operative dairies in Gujarat. Firms can achieve customer satisfaction by developing logistics flexibility, which enable quick replenishment of incoming materials and rapid delivery of finished product to customers. Customers value the visible capabilities, physical distribution flexibility and demand management flexibility, rather than the supply-side competences because customers see how capabilities are deployed to meet their needs. However, physical distribution flexibility and demand management flexibility cannot be achieved also without flexible logistics competences in terms of manufacturing flexibility.

The results have shown that the logistics information system capabilities can greatly enhance overall flexibility of logistics operation and planning competence. The use of third party logistics service provider in logistics system can significantly improve
logistics flexibility in terms of timely delivery of varieties of products, customization of services and low cost.

The logistics information system significantly improves the logistics competence of dairy co-operatives to be flexible in their logistics operations and planning at supply chain level. The coordination of different types of information flow among supply chain members is a key to faster response to customer demands, lower inventories, and lower cost associated with expediting shipment/production. Thus, investing in cost-effective information technology is a key to increasing logistics flexibility and improving customer service. It should also be noted that information sharing is an enabler for better coordination and planning along the supply chain. To improve customer service and satisfaction, firms must focus on improving both material flow and information flow.

The co-operative dairies in Gujarat outsource logistics function to third party logistics service provider for operational and cost based reasons. The role of third party logistics service providers is limited to basic logistics function of transportation only. The co-operative dairies have an internal strategic orientation and motive for outsourcing and tend to outsource for the primary purpose of reducing logistics costs. So, the outsourcing of logistics functions by co-operative dairies to third party logistics service provider firms brings out purely transaction cost economics view.

### 7.2 Implications of the research

This research helps managers to understand that flexible competence may not be sufficient to build competitive advantage. Customer value expression of these competences, which is the capability of the dairy co-operatives to provide the right product, at the right time and in the correct quantity, is more important. The dichotomy of flexible logistics competence and capability can help managers to differentiate the sub-dimensions of logistics flexibility that are critical to their customers from the sub-dimensions that support these capabilities. While competences are important, customers do not value them directly. This dichotomy of flexible logistics competence and
capability enables managers to develop a comprehensive view of flexibility. The investment in advance information technology is a key to enhance logistics flexibility. The co-ordination of different types of information flow such as demand, capacity, inventory and scheduling along a supply chain is a key to faster response to customer demands, lower inventories and lower cost associated with operations. The use of third party logistic service provider firms in logistics system of fluid milk and milk products greatly enhances the effectiveness and accuracy of logistics system and also brings down the logistics cost which comprises significant portion in total cost of fluid milk and milk products.

The future research can be done to define the dairy specific as well as product specific logistics system flexibility and relationships among various components of it. A detailed qualitative analysis in the form of dairy specific case study analysis can be done to find out the dairy specific logistics flexibility requirements and customized logistics flexibility components and characteristics. The manufacturing flexibility can also be studied from competence and capability perspective in the list of components of logistics flexibility.

The future research can also be directed toward application of specific information technology and its impact on maintaining flexibility, efficiency and effectiveness of logistics system in co-operative dairies in Gujarat. This research opens the way for other in-depth studies on some of the critical factors determining the role and scope of third party logistics service providers in logistics management for fluid milk and milk products in Gujarat. Empirical research should be directed towards identifying contractual practices and the critical success factors for implementation and establishing performance measurement system, while outsourcing logistics function. The future research can also be extended towards finding out factors affecting the integration of third party logistic service providers, management of these relationships with logistics system of co-operative dairies in Gujarat. If this integration proves successful, the further research can be done to study the impact of third party logistics service provider on firm as well as channel members and customers, which can be termed as logistics triad relationships.
Bibliography


http://www.nutritionfoundationofindia.res.in/workshop_symposia/towards
national-nutrition-security

188. Sople, V.V. (2004). *Logistics Management: The Supply Chain Imperative.* Pearson Education


221. www.amul.com/


Annexure - Questionnaire

Dear Respondents,

Myself, Tejas R. Shah, is a faculty member in Shree Chimanbhai Patel Institute of Management and Research (MBA Programme), Ahmedabad. I am doing Ph.D. for the topic on “AN IN-DEPTH INVESTIGATION ON LOGISTICS PRACTICES FOR FLUID MILK AND MILK PRODUCTS IN GUJARAT”. This questionnaire seeks information regarding logistics practices at respective co-operative dairies. I request you to fill up this questionnaire, which would be very helpful for me in my research. I assure that your response will be kept confidential and its use will be limited to academic purpose only.

Part – 1 Logistics Flexibility

This section contains the questions regarding logistics flexibility from supply chain point of view. The basic objective of this section is to find out linkages among various phases of logistics and maintaining flexibility at each stage. The flexibility can be judged on the basis of three attributes, i.e. range (ability to design, make and distribute different products), mobility (speed at which a firm can change from one product to another) and uniformity (ability to maintain performance standards).

Please tick mark (√) your responses at appropriate place.

(1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree and 5 = Strongly Agree)

<table>
<thead>
<tr>
<th>Particulars</th>
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<tbody>
<tr>
<td><strong>Physical supply flexibility</strong></td>
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<td>PS1</td>
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<td>We can deliver multiple kinds of materials in response to operation requirements.</td>
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<td>PS2</td>
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<td>Our inbound transportation can deliver the variety of shipments on time.</td>
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<td>PS3</td>
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<td>We can pick and assemble multiple production orders accurately and quickly at the material warehouse.</td>
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</table>
**PS4**  Our inbound supply systems are effective for all shipments.

**PS5**  We can quickly move materials to the correct production location.

**PS6**  We have accurate records of inventory quantities and locations at the material warehouse.

**Purchasing flexibility**

**PF1**  We can quickly obtain multiple kinds of materials that meet specifications.

**PF2**  We can obtain multiple batch sizes of materials from suppliers quickly.

**PF3**  Purchasing can fill multiple requests quickly.

**PF4**  Purchasing keeps close communication with suppliers.

**PF5**  We streamline purchasing, ordering, receiving, and other paperwork easily.

**PF6**  Suppliers cooperatively work on product and process specifications with us.

**Physical distribution flexibility**

**PD1**  We pick and assemble multiple customer orders accurately and quickly at the finished goods warehouse.

**PD2**  We can provide multiple kinds of product packaging effectively at the finished goods warehouse.

**PD3**  We can use accurate transportation system to meet schedule for deliveries.

**PD4**  We can quickly and accurately label finished products.

**PD5**  We have accurate records of quantities and locations of finished goods.

**PD6**  We can take different customer orders with accurate available-to-promise.

**Demand management flexibility**

**DM1**  We can quickly respond to multiple retailers’ and customers’ delivery time requirements.

**DM2**  We can effectively respond to multiple retailers’ and customers’ requirements in terms specifications of products.

**DM3**  We can negotiate with retailers and customers in terms of prices and delivery time effectively through long-term relationships.
| DM4 | We involve retailers and customers to improve our services effectively. |
| DM5 | We quickly respond to feedback from retailers and consumers effectively. |

**Customer satisfaction**

| CS1 | Customers keep doing business with us. |
| CS2 | Customers are satisfied with ratio of price and functions of our products. |
| CS3 | Customers perceive they receive their money’s worth when they purchase our products. |
| CS4 | Our customers are satisfied with the quality of our products. |
| CS5 | Our firm has good reputation for our products. |
| CS6 | Our customers are loyal to our products. |

**Rate the Manufacturing Flexibility in your Organization.**

Please tick mark (✓) your responses at appropriate place.

(1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree and 5 = Strongly Agree)

<table>
<thead>
<tr>
<th>Manufacturing Flexibility</th>
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<td>MF1</td>
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<td>MF5</td>
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<td>MF6</td>
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Part – 2 Logistics Information System

This section contains the questions regarding logistics information system. The basic objective of this section is to find out various outcomes/benefits of logistics information system and its impact on maintaining logistics flexibility.

Please tick mark (✓) your responses at appropriate place.

1. Rate the flexibility of logistics system in your organization.

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<tr>
<th></th>
<th>1 (Highly Inflexible)</th>
<th>2 (Inflexible)</th>
<th>3 (Neutral)</th>
<th>4 (Flexible)</th>
<th>5 (Highly flexible)</th>
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</thead>
</table>

2. Rate the impact of information system on Logistics Operating System

(1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree and 5 = Strongly Agree)

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<thead>
<tr>
<th>Sr. No.</th>
<th>Evaluation Criteria</th>
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<td>1</td>
<td>Timeliness (Available Information is current relative to the situation)</td>
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<td>2</td>
<td>Accuracy (Available information is error free)</td>
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<td>3</td>
<td>Availability (Information can be accessed when and where desirable.)</td>
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<td>6</td>
<td>Information sharing (Willingness to share common information across functions within the firm.)</td>
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<td>7</td>
<td>Flexibility (Ability to adapt information processes and capabilities to meet requirements of specific customer segments.)</td>
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<td>8</td>
<td>Internal Validity (Ability to exchange information effectively across managerial areas within the firm)</td>
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3. Rate the impact of information system on Logistics Planning System.

(1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree and 5 = Strongly Agree)

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<th>Sr. No.</th>
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<td>2</td>
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<td>9</td>
<td>External Validity (Ability to exchange information effectively with next destination customers and / or suppliers.)</td>
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Part – 3 Third party Logistics Service Provider

This section contains the questions regarding third party service provider in logistics. The basic objective of this section is to find out various outcomes/benefits of third party service provider and its impact on maintaining logistics flexibility.

Please tick mark (✓) your responses at appropriate place.

1. Rate the flexibility of logistics system in your organization.

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<tr>
<th>Sr. No.</th>
<th>Evaluation Criteria</th>
<th>1 (Highly Inflexible)</th>
<th>2 (Inflexible)</th>
<th>3 (Neutral)</th>
<th>4 (Flexible)</th>
<th>5 (Highly Flexible)</th>
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<tbody>
<tr>
<td>1</td>
<td>On time delivery (Ability to deliver products at the required time)</td>
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<td>2</td>
<td>Correct Delivery (Ability to deliver products at the right destination)</td>
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<td>3</td>
<td>Cost Consideration (Ability to deliver products cost effectively)</td>
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<td>4</td>
<td>Inventory Accuracy (Ability to maintain accurate inventory records and follow up)</td>
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<td>5</td>
<td>Quality of Services (Ability to provide services as per predefined standards effectively)</td>
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<td>6</td>
<td>Flexibility (Flexibility to respond to unexpected demand changes)</td>
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<td>7</td>
<td>Customization of products and services (Ability to customize the products and services as per the requirements of organization)</td>
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<td>8</td>
<td>Shipment in terms of Value/Volume (Ability to handle large shipments in terms of value/volume)</td>
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<td>9</td>
<td>Communication System (Ability to communicate error free, timely and cost effective manner)</td>
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(1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree and 5 = Strongly Agree)
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<tr>
<td>10.</td>
<td>Sensitive Information Sharing (Ability to share common information effectively with customers and organization)</td>
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<tr>
<td>11.</td>
<td>Quick Response (Ability to respond to organization and retailers or customers when and where required)</td>
</tr>
<tr>
<td>12.</td>
<td>Handling of Customer Complaints (Ability to solve complaints of retailers/customers or communicated it to the organization)</td>
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<tr>
<td>13.</td>
<td>Total Order Cycle Time (Ability to respond quickly (with minimum time) to the customer orders)</td>
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<td>14.</td>
<td>Fill rates (Proportion of orders that can be met by available inventory)</td>
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<tr>
<td>15.</td>
<td>Use of Technology (Extent to which technology is used in operation)</td>
</tr>
</tbody>
</table>

**Contact Information:**

1. Name of Organization:

2. Designation of Respondent:

3. Department/Field of Specialization:

4. Years of Experience of Respondent:

5. Age of Respondent: