Study of Supply Chain Management Practices of Indian Processed Food Industry to Enhance Domestic Demand and Export Potential

Ph.D Thesis

Submitted in fulfillment of requirement for the award of the degree of

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by

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10/Ph.D/09

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December 2013

Dedicated

to

My Gurus

and

My Mother and Father

CANDIDATE'S DECLARATION

I hereby certify that the research work which is being presented in the thesis entitled **"Study of Supply Chain Management Practices of Indian Processed Food Industry to Enhance Domestic Demand and Export Potential"** in fulfilment of requirement of the award of degree of Doctor of Philosophy is an authentic record of my own research work carried under the guidance and supervision of Prof. (Dr.) S.K. Garg and Prof. (Dr.) P.B. Sharma.

The matter presented in this thesis has not been submitted elsewhere in part or fully to any other University or Institute for award of any degree.

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CERTIFICATE

This is to certify that the thesis entitled **"Study of Supply Chain Management Practices of Indian Processed Food Industry to Enhance Domestic Demand and Export Potential"** submitted by Mr. Rajneesh Mahajan (10/Ph.D/09) in fulfilment of requirement of the award of degree of Doctor of Philosophy in Management is an authentic research work carried out by him under our guidance and supervision. The content embodied in this thesis had not been submitted by him earlier to any institution or organization for any degree or diploma to the best of our knowledge and belief.

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OUTCOME OF THESIS

International Journals	5 research papers
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National Conference	1 research paper
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Research Papers Published in International Journals

- Rajneesh Mahajan, Suresh Garg and P.B. Sharma (2011), **Indian frozen peas market: a case study on FPIL**, International Journal of Globalization & Small Business (Inderscience), Vol. 4, No.2, pp. 154-169.
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Awards and Recognition

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- Rajneesh Mahajan, Suresh Garg and P.B. Sharma (2011), research Paper titled **Processed food sector in India**, Abstract was published in conference proceeding of First National Conference of Research Scholars in Management (NCRSM-2011), organized by Atal Bihari Vajpayee-Indian Institute of Information Technology and Management, Gwalior, M.P, India and received Best Research Paper award in finance & Information Communication & Technology Management Track.

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EXECUTIVE SUMMARY

India is the second largest producer of fruits and vegetables. Despite the huge fresh produce available in India, food inflation and food security issues are major concerns for policy makers in the country. It may affect the basic need for Indian citizens to have sufficient, healthy and affordable food. In India, post harvest food wastages are close to ₹50,000 crores annually (US $ 81.97 billion annually) due to lack of processing and storage of fruit and vegetables. The fruit and vegetable loss is highest up to 18% of total production. There is a need of developing a bridge between agriculture and food processing sector. It can be only possible if major impediments of PFS are firmly tackled. Therefore, the motivation behind the research is to study the benefits, impediments, logistics, information technology and quality issues of processed food sector (PFS), which is very important for Indian economy. Such studies may help, on one side to reduce the food wastages and on other side to ensure food security. PFS has the potential to increase the income of the farmers and make available food products, throughout the year and across geographies. Due to the changes in the demography, the demand of processed food is expected to rise and nuclear families, working women and high disposable income are the drivers to boost the demand.

The extensive literature review has been performed to identify the research issues and define the objectives of the present research. The literature review pertaining to subject matter was classified into nine sections: sourcing of agri products for food supply chain, food processing and manufacturing, logistics management of processed food, cold supply chain, food distribution and retailing, integrated IT with logistics, food quality and food safety, traceability in food supply chain and performance management of food supply chain. The gaps were identified in the literature that include few studies on food safety standards implementation, limited literature on application of IT in food sector, and implementation of IT at grass route level for, an effective Food Supply Chain Management (FSCM), standalone studies on FSCM conducted mostly in foreign settings and need for Performance Management System for process food supply chain management (PFSCM).

The objectives of research were to identify the key issues related to PFS, to determine the relative importance of key issues in PFS, to study the quality and food safety dimensions of PFS; the logistics issues related to PFS; the importance of Information Technology (IT) in PFS and to propose the matrices for PMS of PFSCM.

To achieve the above objectives, questionnaire was designed keeping in view the literature and experts' opinion. It has four parts Part A- Advantages, constraints, counter measures of PFS Part B- Food quality and safety issues and promotional efforts, Part C- Logistic issues and performance measures for PFSCM and Part D- Profile of the respondents. It was administered in Delhi, Faridabad, Gurgaon, Kundli and Noida by sending emails with a cover letter to the relevant and identified respondents. The personal interviews were also scheduled and conducted to collect the data. The respondents were asked to rate the intensity of each factor on a five-point likert scale (1-Strongly disagree, 5-Strongly agree for example). The respondents from corporate were selected from the directories of All India Food Processors Association (AIFPA), Confederation of Indian Industries (CII), Associated Chambers of Commerce and Industry of India (ASSOCHAM) etc. In order to collect data, 1000 supply chain professionals were contacted to seek their response to the questionnaire and 252 responses were collected making the response rate to be 25.2%. The collected data was analysed using SPSS version 21 and statistical tools like descriptive statistics, correlation, regression, ANOVA and binary logistic regression applied.

Three case studies of processed food sector were conducted to get insights. The first case study is of Indian frozen peas market and food processing technique known as individual quick freezing technique. The second case study explains the implementation of Hazard Analysis and Critical Control Points (HACCP), food safety controls and its status in India using a case study of Deli Processed Food Products Ltd. The third case study built on a situation-actor-process (SAP), learning-action-performance (LAP) model which is an approach to analyze quantitative and qualitative issues of supply chain performance initiatives in a single model and its impact on the performance of the supply chain.

A performance measurement system (PMS) is also proposed by taking quality, cost, flexibility, dependability and innovations as five perspectives to measure the

performance of the Processed Food Supply Chain Management (PFSCM). These perspectives represent an aggregation of the most common approach used in the study of performance management. A holistic PMS for PFSCM has been proposed.

The research indicates a vast scope for the processed food sector in India and a great potential for researchers to study and develop the right policies and strategies.

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LIST OF ABBREVIATIONS

Acronyms	Full Term
AIFPA	All India Food Processors Association
ANOVA	Analysis of Variance
APJL	Asia Pacific Journal of Marketing and Logistics
APMC	Agriculture Produce Marketing Committee Act
ASC	Agri supply chains
ASCM	Agri Supply Chain Management
ASEAN	Association of Southeast Asian Nations
ASSOCHAM	Associated Chambers of Commerce and Industry of India
B2B	Business-to-Business
BFJ	British Food Journal
BIJ	Benchmarking: An International Journal
BLR	Binary Logistic Regression
BRC	British Retail Consortium
BSC	Balance Score Card
CAC	Codex Alimentarius Commission
CAER	China Agricultural Economic Review
CC	Cold Chain
CCC	Cost of Compliance of Standards and Certifications
CCM	Cold Chain Management
CCPs	Critical Control Points
CEC	Central Excise and Customs
CED	Central Excise Duty
CII	Confederation of Indian Industries
CIPHET	Central Institute of Post-Harvest Engineering and Technology

COPRP	Chilling Operational Prerequisite Program
CRM	Customer Relationship Management
CSCM	Cold Supply Chain Management
DPFPL	Deli Processed Food Products Ltd.
EDI	Electronic Data Interchange
EED	Fruits & Vegetables, Dairy Machineries are Completely Exempted from Excise Duty
EFSA	European Food Safety Authority
EIS	Equivalence to International Standards
EIT	Effective Use IT Required to Improve Logistics
ERP	Enterprise Resource Planning
EU	European Union
F&V	Fruit and Vegetable
FAO	Food and Agriculture Organization
FBO	Food Business Operator
FC	Food Control
FDI	Foreign Direct Investment
FMCG	Fast Moving Consumer Goods
FMEA	Failure Mode And Effect Analysis
FP	Food Policy
FPIL	Frozen Products Indian Ltd.
FSC	Food Supply Chain
FSCG	Food Supply Chain Gaps
FSCM	Food Supply Chain Management
FSO	Development of Food Safety Objectives Help to Achieve Food Safety
FSS's	Food Safety Systems
FSSAI	Food Safety Standards Authority of India

FTS	Food Traceability System
GATT	General Agreement on Tariffs and Trade
GCI	Global Competitiveness Index
GDP	Gross Domestic Product
GFSV	Global Food Safety Variables
GHP	Good Hygienic Practices
GMF	Genetically Modified Food
GMP	Good Manufacturing Practices
GOI	Government of India
GPS	Global Positioning System
GSCM	General Supply Chain Management
HACCP	Hazard Analysis Critical Control Point
HAP	HACCP Implementation Instrumental in Food Safety
HLW	High Level of Wastages from Source to Plant
HTP	Higher Turnaround Times at Ports
IBSCPF	Innovative Balance Score Card for Processed Food
ICSF	Inadequate Cold Storage Facilities
IFS	International Food Standard
IJDLM	International Journal of Physical Distribution & Logistics Management
IJFM	International Journal of Food Microbiology
IJPE	International Journal of Production Economics
IJPPM	International Journal of Productivity and Performance Management
ILM	Integrated Logistics Management
ILP	Inadequate Link between Production and Processing
₹(INR)	Indian Rupee
IPP	Improper Primary Processing, Storage and Distribution Facilities
IQF	Individual Quick Freezing

IQFS	Inadequate Focus on Quality and Safety Standards
ISO	International Standard Organisation (ISO)
IT	Information Technology
ITR	Income Tax Rebate up to 100% Of Profits for Five Years and 25% of Profits for the Next Five Years for Setting Up of New Agro-Processing Industries to Process and Package F&V
JECFA	Joint Expert Committee on Food Additives
JEMRA	Joint Meeting on Microbiological Risk Assessment
JESA	Journal Expert Systems with Applications: An International Journal
JFE	Journal of Food Engineering
JMPR	Joint Meeting on Pesticide Residues
JSBED	Journal of Small Business and Enterprise development
KPIs	Key Performance Indicators
LAP	Learning, Actions and Performance
LCRT	Lack of Connectivity between Rail Transport and Port
LFA	Long and Fragmented Logistic Activities
LIT	Labour Intensive Techniques at Port For Loading
LM	Logistics Management
LNPD	Lack of Innovation in New Product Development
LR	Literature Review
LWA	Limited Warehousing Availability
MEC	Means-End-Chain
MIS	Management Information System
MNC	Multi-National Corporations
MOFPI	Ministry of Food Processing Industries
MQKRA	Key Results Areas
MT	Metric Ton

NABL	National Accreditation Board for Testing and Calibration Laboratory
NACMCF	National Advisory Committee on Microbiological Criteria for Food
NASA	National Aeronautics and Space Administration
NCR	National Capital Region
NDP	New Product Development
NDT	Normal Distance Covered by Truck/Trailers in India is 250-300 Km/day vs International Norms of 600-800 km/day
NH	National Highways Account for only 2% of the Total Road Network, 40% of Cargo
NHB	National Horticulture Board
NIL	No Industrial License Required for Food & Agro Processing Industries Except for Beer, Alcohol & Wines, Cane Sugar, Hydrogenated Animal Fats & Oils etc.
OPRP	Operational Prerequisite Programme
PCB Hazards	Physical, Chemical and Biological hazards
PF	Processed Food
PFS	Processed Food Sector
PFSCM	Processed Food Supply Chain Management
PLC	Product Life Cycle
PMM	Performance Measurement and Management
PMS	Performance Measurement System
PPM	Poor Port Management
QCV	Quality and Connectivity of Vehicle (QCV)
R&D	Research and Development
RA	Risk Analysis
RFID	Radio Frequency Identifier Devise
RQ	Research Question

SAP	Situation, Actor and Process
SAP-LAP	Situation, Actor and Process- Learning, Actions and Performance
SASCM	Sustainable Agri Supply Chain Management
SCA	Supply Chain Analysis
SCM	Supply Chain Management
SCMIJ	Supply Chain Management : An International Journal
SD	Standard deviation
SHD	Scheme for Human Resource Development, Training Centres
SJP	Scientific Justification in Procurement
SME	Small Medium Enterprises
SOL	Seasonality of operation and low capacity utilities
SOPs	Standard Operating Procedures
SPS	Sanitary Phyto Sanitary
SPSS	Statistical Package for Social Sciences
SQA	Scheme for Quality Assurance, Codex Standards and R&D
SSOP	Sanitation Standard Operating Procedures
SWOT	Strength Weakness Opportunity Threat Analysis
TES	Transparency Norms and Standards Help to Achieve Food Safety
TFST	Trends in Food Science & Technology
TRE	Traceability up the level of farm help to achieve Food Safety
TSCM	Tomato Supply Chain Management
UHT	Ultra Heat Temperature
US $	United States of Americas' dollars
USP	Unique Selling Proposition

VAT	Value Added Tax
WHO	World Health Organization
WRT	Weak Road Transportation
WTO	World Trade Organisations

CHAPTER – 1

INTRODUCTION

1. Introduction

The food processing sector in India is increasingly seen as a potential source for driving rural economy as it brings synergy between industry and agriculture. A developed food processing sector will be instrumental in increasing the farm prices translating into amplified rural incomes, reduced wastages, ensure value addition, promote crop diversification, generate employment opportunities as well as export earnings. With such a large and diversified production base coupled with low manpower cost and modern technology, the Indian food processing sector is poised for growth, if the advantages are leveraged optimally (MOFPI 2011-12).

Agriculture is an important sector in the Indian economy, accounting for about 18 percentage(%) of the gross domestic product (GDP), employing nearly 60% of the total Indian work force directly or indirectly. The down side of the agriculture sector is large amount of wastages of the farm produce like fruits, vegetables, food grains etc. The reasons for high wastages are twofold, first, lack of appropriate and adequate storage facilities and second, low levels of food processing capacity. Processing of fruits and vegetables is just 2%, which is quite low by international standards as processing of agriculture produce is around 30% in Thailand, 40% in China, 70% in Brazil, 78% in the Philippines and 80% in Malaysia.

The focus on food processing sector, which is just one link in the multi tiered food supply chain is justified by the fact that it has big potential to reduce agri wastages, provide food security to society and easy to use food for working professionals. The scope of ready to cook vegetables, soups, juices, meat, bakery items and cooking ingredients like garlic, ginger, onion pastes and packed spices has increased many folds. All these are due to economic prosperity and the need for ready to cook products.

The food processing has tremendous export potential, enabling the farmer and food processors to add value to produce both in terms of quality and quantity. They can adhere to the requirements and standards of the market at all stages of value chain,

cultivation, harvesting, storage, processing, distribution and retail. It can create rural supply chain infrastructure in terms of creation of cold chain, warehousing, food parks etc. near the farmland. Transportation, warehousing, logistics and information technology are other very important enablers for the various activities of the process food industry.

The rapid growth and immense capability of the information technology has brought new ways of dealing with conventional supply chain problems. Its role in the evolution of supply chains has already been recognized in the literature (Lancioni, Smith and Oliva, 2000). A primary benefit of information technology (IT) is more efficient way of exchanging information and data, which results in supply chain coordination, and facilitation of logistics activities. Furthermore, significant cost reduction opportunities are created, as a result of the improved supply chain coordination. Finally, another direct benefit is the expansion of target markets and the mass promotion opportunities. Most of the aforementioned benefits have also been recognized in the agri-food context.

The global packed food retail value is (United States of Americas's dollars) US$1.95 trillion and expected to reach at US$2.14 trillion in 2015 (Euro Monitor, 2010). As per a study conducted by McKinsey and Confederation of Indian Industry (CII), the turnover of the total Indian food market is approximately ₹250,000 crores (US $ 69.4 billion) out of which value-added food products comprise ₹80,000 crores (US $ 22.2 billion) in 2012 (CII, 2012). It has grown from US$ 15 billion in 2008 to US$ 17 i.e. 14.4% growth in 2009 (Report on Packed Food in India, 2011). The processed food sector contribution to GDP of India was ₹44355 crores in 2004-05 and it has grown to ₹66078 crores in 2009-10 in absolute terms. The percentage growth is 25.77% over 2004-05 (MOFPI 2011-12).

The above discussions indicate that the processed food sector is very important for any economy as on one side it helps in ensuring food security and on other hand it helps to reduce the wastages. The value added by processed food sector (PFS) helps to increase the income to the farmers and make available food products throughout the year and in all geographies. Due to the changes in the demography, the demand of processed food is expected to rise. Nuclear families, working women and high disposable income are the drivers to boost the demand provided the sector is able to provide quality products in the local markets.

1.1 Key Issues in the Growth of PFS

The Government initiative to cut the excise duty on refrigerated vehicle led to a drastic improvement in the supply chain network and cold chain facilities in India. In 2010, the Global Cold Chain Alliance came to India to explore opportunities for development of cold chains. State Governments like West Bengal initiated plans to establish cold storage facilities in order to assist both agriculture and frozen processed food. Initiatives are also being taken in the areas of food quality and food safety. In 2006, by an act, Government established Food Safety Standards Authority of India (FSSAI) and also implemented Hazard Analysis Critical Control Point (HACCP) (FASSI, 2011). Inspite of these and many other initiatives by the Government and food processing industry, following are the key issues effecting the growth of processed food sector in India

a. Improper primary processing, storage and distribution
b. Agriculture Produce Marketing Committee (APMC) Act dependence
c. Inadequate link between production and processing because of lack of desirable varieties
d. Seasonality of operation and low capacity utilization, Inadequate focus on quality and safety standards
e. Lack of new product development
f. Supply chain gaps

1.2 Key Issues in Supply Chain Management of PFS

Process food sector is highly sensitive to quality, availability, preferences and choices of the consumer. To be successful, different players namely Government, Industry, organization, regulatory agencies etc. have to play a proactive role. Further, efforts need to be done right from farming to end consumer through harvesting, storage, processing, distribution and retailing. In all these stages, out of several issues, the critical issues identified and studied are quality, safety and standards, logistics, cold chains and information technology.

1.2.1 Food Quality and Food Safety

Food supply chains (FSCs) require quality, health and safety as central consideration. The scope of the food supply chain encompasses several parts, extending from the production of the raw materials, through processing and distribution, to the customer It includes food processing factories, commercial supply chains of wholesalers, retailers, food service restaurants and trading services. Therefore, FSCs plays a critical role within the food industry network, on the manufacturer's, wholesaler's and retailer's side in making safe food (Faccio et al., 2013). The food quality activities thus need to be initiated right from farm stage including fertilizer and irrigation and upto the consumer.

With consumers placing more trust in the food actors and institutions involved in the food supply chain, they are more likely to have trust in food safety (Chen, 2008). Individuals differ in the extent to which they trust the actors and institutions involved in the food supply chain, such as the transportation system, the local food supply system, and the regulatory institutions. From production to consumption and throughout the entire supply chain, there are many food safety approaches taken by stakeholders along with the development of food safety systems (FSSs) in the last decade. While hazard analysis and critical control point (HACCP) is the basic principle used in FSSs to specify the level at which food safety precautions are implemented, the ISO 22000, ISO 9001, International Food Standard (IFS), and the British Retail Consortium (BRC) are also often followed worldwide. As a result of mentioned changes the growing importance of food quality and safety standards in international markets are influencing production and marketing conditions of farmers' worldwide (Handschuch et al., 2013).

1.2.2 Cold Chain

The main challenge of the SCM in PFS is short shelf life of the perishable goods. Perishable goods refer to products that have short life cycle and required to be stored, transported and distributed in special conditions. This gives rise to the concept of cold chain management (CCM). The CCM is referring to time and temperature control of perishable products. CCM manages activities related to perishable food products like dairy, fruits & vegetables, mushrooms, meat etc. (Rediers et al., 2009; Montanari, 2008; Samant et al., 2007; Xia, 2007). A step further an optimal temperature monitoring is a prerequisite for cold chain management. It is useful for the reduction of food waste

and economic losses (Raab et al. 2011). The CCM has numerous activities usually spread over multiple functions across various organizations for various time horizons. Processed food products have many features that set them apart from a typical supply chain management (SCM). Some of these features include shelf life limitations, seasonality, production facilities and equipments like refrigerated transportation requirements, refrigerated storage, depot, traceability, quality and safety of product (Aramyan et al., 2007; Mangina and Vlachos, 2005, Shabani et al. 2011). Hence, monitoring all stages of the cold chain (CC) is required. Otherwise, the consequences are vitiating, toxicities, environmental and operational dangers, and wastes (Kuo and Chen, 2010; Rediers et al., 2009).

1.2.3 Food Distribution, Traceability, RFID and Information Technology for PFS

During current modern era, the consumers have the privilege to consume food products sourced from diverse locations. Production and distribution patterns have become much more complex than was common even 30 years ago. The consumer preferences have evolved to include specialist foods and all type of food products round the year (Skees et al., 2001). Traceability is defined as the ability to trace the history, application or location of that which is under consideration (ISO, 2000). It is the ability to trace and follow a food, feed or food-producing animal or substance intended to be or expected to be incorporated into a food or feed through all stages of production, processing and distribution (EU, 2002). Basil et al. (2012) had identified key drivers for improving traceability such as efficient traceability could be supported by national policies towards supply chain transparency, due diligence, consumer safety and produce quality consolidation. There is no requirement to record either transformations of the traceable units that take place within a company or to have internal traceability systems. Transformations in the food sector, especially mixing, have been shown to be important points of information loss (Donnelly, Karlsen and Olsen, 2009, Barbosa et al. 2010).

The increasing need for industry standards so that multiple information technology (IT) solutions can be provided with systems that can talk to each other among food chain members (Senneset et al., 2007). Each day, more than 14 million customers shop at Wal-Mart store and there are more than 1.3 million employees worldwide. To keep its competitiveness level intact, Wal-Mart needs to transport and track products efficiently. With the recognition of the potential benefits that RFID could bring to the company, it

is required that top 100 suppliers to put tags on their products. Although these RFID mandates intensified a love-hate relationship between the retailer and its suppliers, the implementation was successful (Roh et al., 2009). RFID system is the most cutting edge technology for supply chain integrity and traceability (Kumar and Budin, 2006, Mehrjerdi, 2011). Mehrjerdi (2013) said that RFID is a technology whose full benefits are not being percolated down to all industries yet. It will bring a good opportunity for improving supply chain efficiency and to enhance the profitability level of the organization

1.2.4 Performance Management System

Interest in performance measurement and management has increased notably in the last 20 years. It is crucial to notice that over a period of time there is a shift of focus from measuring performance from financial perspective to non-financial perspective (Taticchi et al., 2010). Performance measurement can be defined as the process of quantifying the efficiency and effectiveness of action. It is the periodic measurement of progress toward explicit short-run, long-run objectives and the reporting of the results to decision makers in an attempt to improve program performance (Neely et al., 1995). Robert Kaplan and David Norton developed the balanced scorecard in 1990. The effectiveness of the performance measurement system (PMS) depends on issues like how systematically data are collected, in what way inter-relationships among objectives and measures are understood and how these objectives are correlated to the mission and vision of organisation. Therefore, one can understand that supply chain performance is concerned with managing dependencies between various supply chain members and the joint efforts of all supply chain members to achieve mutually defined goals (Charan, 2013).

1.3 Strengths, Weaknesses, Opportunities and Threats Analysis of Processed Food Sector

Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis is a strategic-level analysis. It is a method of analyzing a business, its resources and its environment. Strengths and weaknesses are positive and negative internal factors whereas opportunities and threats are external factors. Strengths typically represent the internal strong points of an organization and these are the things companies do well over their

competitors so that they would find it difficult to emulate. Weaknesses are the factors which do not meet the standards we feel they should meet. Opportunities are presented by the environment within which our organizations operate. Opportunities may arise from market, competition, industry/government and technology. Threats are those factors which can put in danger the survival of the organization but if recognized on time they can become opportunities (Antony, 2012). It provides a mechanism to systematically find out the extent to which the company can cope with its ambient environment. A SWOT analysis is generally associated with strategic planning, in which strengths and weaknesses are associated with the internal environment of an organization and opportunities and threats generally related with the external environment (Agarwal et al., 2012).

The SWOT exercise is performed on Indian processed food sector with respect to its present status in India. It is illustrated in table 1.1. It is further reiterating the importance of PFSCM in India.

Table 1.1 SWOT Analysis to Illustrates the Importance of PFS in India

Strengths	**Weaknesses**
• Abundance of raw material • Priority sector status for agro-processing by Government of India • Titanic network of manufacturing facilities • Huge domestic market	• Inadequate infrastructural facilities • Inadequate quality control and testing methods as compared to international standards • Inefficient SCM due to intermediaries • High requirement of working capital • Inadequate R&D • Seasonality of raw material
Opportunities	**Threats**
• Large crop and material offering potential for processed food sector • Setting of Special Economic Zone (SEZ) and food parks • Rising income and changing consumption habits • Opening of global markets	• Affordability and cultural preferences of fresh food • Competition from big global players • Trade barriers by importing countries • Agri produce highly dependent upon rain for irrigation

This SWOT analysis indicates that processed food sector's strengths and opportunities outperform the sectors weakness and threats. It illustrates that PFS has huge potential for growth in future.

1.4 Objectives of the Study

a) To identify the key issues related to PFS

b) To determine the relative importance of key issues

c) To study the quality and food safety dimensions of PFS

d) To study the logistics issues related to PFS

e) To study the importance of IT in PFS

f) To identify the important matrices in PMS of PFS

1.5 Methodology

The present research work was carried out by deploying four step methodology. The research was initiated with extensive review of literature on processed food supply chain management. The present research is a mix of qualitative and empirical research. The qualitative research is carried out through case studies on processed food sector. The empirical research is conducted through structured questionnaire. The collected data is filled in Statistical Package for Social Sciences (SPSS) version 21 for analysis. A systematic scheme of four step research methodology is depicted in figure 1.1.

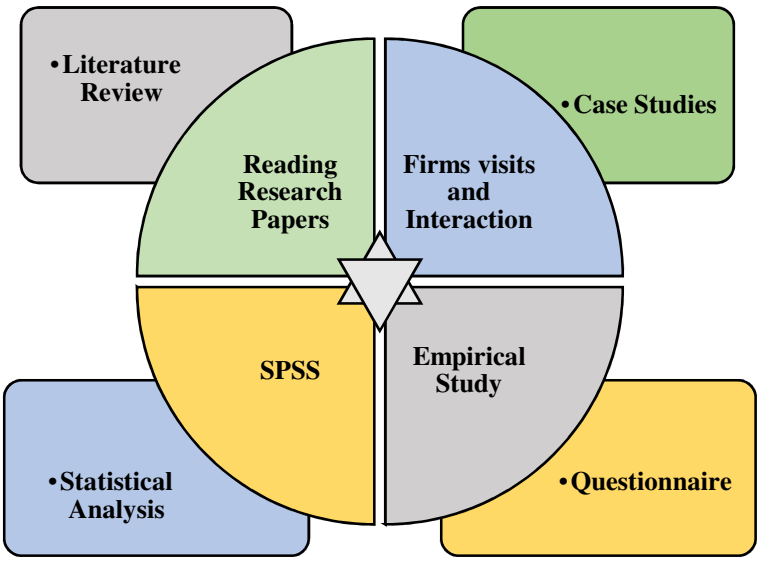

Figure 1.1 Four Steps Methodology of Research

a) Literature review and interaction with practitioners and researchers in the area of PFS

b) Questionnaire based empirical study

c) Analysis of responses

1.6 Research Design

To collect data and information from targeted set of respondents a structured questionnaire was prepared. On the basis of discussion with professionals from corporate, food experts, academicians and literature review, a preliminary questionnaire was developed. The questionnaire was tested through first pilot testing with processed food sector experts and academia. The feedback was received on pilot tested questionnaire. The final questionnaire was developed through incorporating suggested, few changes in the use of terminology, in the sequencing and presentation of questions. The research questionnaire titled study on processed food sector in India. It has four parts, part A was on the processed food advantages, part B dealt with schemes to promote processed food sector by MOFPI , food quality and safety issues part C raised logistic issues, performance measures for processed food and part D on the profile of the respondents. The personal interviews were conducted with 252 experts in Delhi and national capital region (N.C.R). The respondents were asked to rate the intensity of each factor on a five-point likert scale (5-Strongly agree, 1-Strongly disagree). The respondents were selected from the directories available at All India Food Processors' Association (AIFPA), Confederation of Indian Industries (CII), Associated Chambers of Commerce and Industry of India (ASSOCHAM). The personal interviews were carried out during March 2011-April 2012.

1.7 Organization of Thesis

The thesis is organized in eight chapters. A brief outline of each chapter is given below and chapter plan in the thesis depicted in figure 1.2.

Chapter 1

Chapter 1 begins with an introduction of the processed food sector, its status in India and abroad, its importance for India and the major roadblocks in the growth of PFS in India.

Chapter 2

Chapter 2 provides an extensive review of literature on relevant aspects of processed food supply chain management (PFSCM). This chapter discusses the concept, importance of PFSCM, quality and food safety issues, cold chain management (CCM), use of IT to support logistics of perishable food items.

Chapter 3

This chapter deals in the research methodology used in carrying out research.

It discusses the process of questionnaire development, validation and analysis. It shed light on advantages, constraints and counter measures for growth of PFS in India.

Chapter 4

The chapter 4 presents crucial issues related to information technology and logistics management in the Indian processed food sector and role of integrated information technology and logistics management to enhance performance of PFS.

Chapter 5

Food safety issues in processed food were discussed in chapter 5. The chapter is dichotomized into two parts, the first part is on Global food safety: determinants are Codex Standards and WTO's SPS food safety regulations and second part talks about the Indian PFSCM post millennium basin with WTO stand on food safety. In second part, the regression was run with equivalence to international standards as dependent variable and food safety objective, traceability, HACCP, harmonization in regard to WTO classification, and scientific justification in procurement as independent variables. Based upon the analysis of the results of hypothesis testing, various aspects of food safety discussed and inferred.

Chapter 6

The chapter 6 deals in three case studies of processed food sector. The first case study is of Indian frozen peas market and food processing technique used in case known as individual quick freezing technique. The second case study explains the implementation of Hazard Analysis and Critical Control Points (HACCP), food safety

controls and its status in India using a case study of Deli Processed Food Products Ltd. The third case study is built on situation-actor-process (SAP), learning-action-performance (LAP) model which is an approach to analyze quantitative and qualitative issues of supply chain performance initiatives in a single model and its impact on the performance of the supply chain.

Chapter 7

Chapter 7 deals in the performance measurement system (PMS) for the processed food supply chain management. Quality, cost, flexibility, dependability and innovations are taken as five perspectives to measure the performance of the Processed Food Supply Chain Management (PFSCM). These perspectives represent an aggregation of the most common approach used in the study of performance management. A holistic PMS for PFSCM has been proposed.

Chapter 8

It summarizes the research on processed food supply chain management in the thesis. It briefly states the research findings, key insights from survey and major implications. This chapter concludes with the limitations of the present research work and also provides the direction for future research. The chapter plan is illustrated in figure 1.2.

1.8 Conclusion

In this chapter an over view of the processed food sector is presented to make a case for the research in this sector. The main motivation for the research is the need to reduce the wastages and made available a hygiene food throughout the year in all geographies. The chapter also identifies the objectives, methodology and the scope of the work. Chapter wise brief outline is also presented.

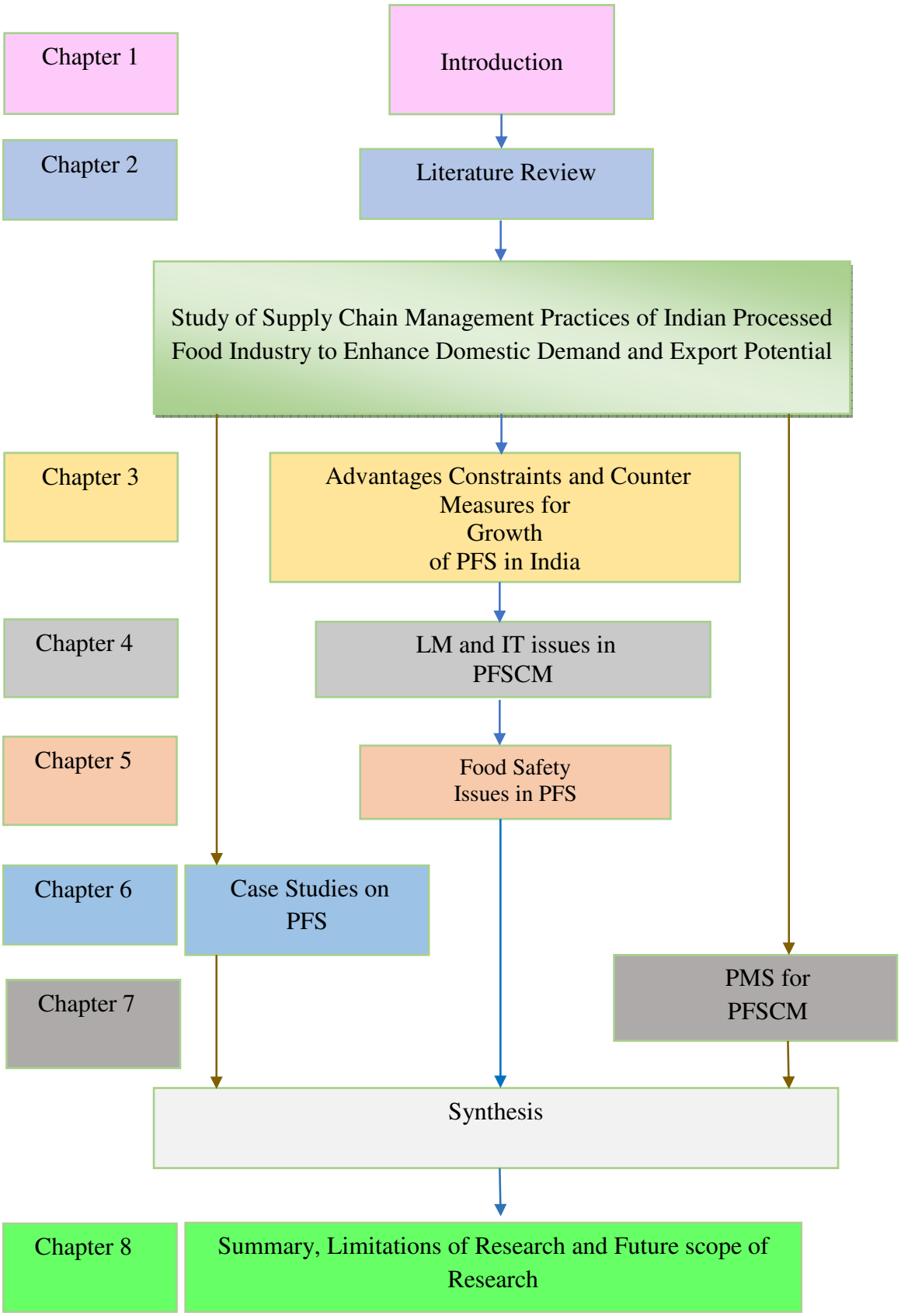

Figure 1.2 Chapter Plan in the Thesis

CHAPTER – 2

REVIEW OF LITERATURE ON PROCESSED FOOD SECTOR

2.1 Introduction

Food supply chain management has been one of the important areas to achieve food security and eliminate food shortages by reducing spoilage of food. It is evident by steep increase in practitioner and academic publications, conferences, professional development programs and university courses. The supply chain as discipline got attention in 1980's. The previous studies had highlighted the fragmented nature of the supply chain management. These studies had also shown the relationship and impact on industrial economics, systems dynamics, marketing, purchasing and inter-organizational behavior. The scientific development of a coherent supply chain management discipline requires that advancements be made in the development of empirical and theoretical models to inform understanding of supply chain phenomena. As an illustration, the application of Forrester's (1961) industrial dynamics model applied to supply chains (Forrester Effect). Its value lies in the ability to aid understanding of the actions of materials across a supply chain and had provided a basis for further advancement of understanding supply chain dynamics (Sterman, 1989).

The term agri-food supply chains (ASC) has been coined to describe the activities from production to distribution that bring agricultural or horticultural products (Aramyan et al., 2006) from the farm to the table. In this chapter, an effort is made to introduce a new term processed food supply chain management (PFSCM). It can be utilize to study all the aspects of the supply chain management of processed food sector from agriculture grower to consumer. In this context a processed food can be defined as the food that has undergone some value addition. It may be first level, just cutting, cleaning with fresh water, packaging and marketing them under a brand name. The second level of processed food may be by converting fruits and vegetable into flakes, flavors, pulp, paste, frozen fruit, frozen vegetables and frozen meat. The

Note: A Processed Food Supply Chain: Doctoral Research on Peer reviewed International Journals, Benchmarking: an International Journal (Under Review since February, 2013)

third level of processing can be extracting juices from fruits and vegetables, soups concentrate from vegetables like tomato, cauliflower, potato etc., ketchups from tomato, biscuits, namkeens (Indian snacks like peanuts, potato flicks etc.), snacks, noodles, ready to eat meals, coffee, tea bags, pasteurized milk, floured milk, probiotic milk as well as curd ,yogurt of all kind and ice creams. At this point it is important to understand what differentiates agri supply chains (ASC) from general supply chain. ASC got importance due to its nature such as perishable nature of food products, temperature controlled SCM known as cold chain. Cold chain is capable to manage issues like food quality and food safety, seasonality and weather related variability. To understand more on PFSCM, intense and extensive literature review is being discussed on lines of the definition, importance of PFSCM, storage of perishables, cold chain management, use of IT as support to logistics, comparison of CCM with general supply chain management etc. It also includes comparison among three agri SCM before 1990's, 1990-2000 and 2000 onwards in table 2.1.

2.2 Supply Chain Management

Simchi-Levi, et al. (2008) defined supply chain management (SCM) as a set of approaches utilized to efficiently integrate suppliers, manufacturers, warehouses and stores so that merchandise is produced and distributed in the right quantities, to the right locations and at the right time, in order to minimize system wide costs while satisfying service level requirements. The key feature of the current business environment is the idea that supply chains compete, not companies (Christopher, 1992). This implies the existence of a climate wherein holistic SCM is possible. Indeed an early move in this direction was proposed by Kraljic (1983), that is purchasing required to be seen from perspective of the wider supply chain. In other words, the selection of suppliers, the location of facilities and the choice of distribution channels should all be driven by the goal of enabling the marketing objectives of the organisation to be achieved.

In the ideal world, supply chains would be designed from the customer backwards rather than the conventional approach which tends to be from the factory outwards (Christopher et al. 2006). Managing supply chains effectively is a complex and challenging task as a result of the continuing trends of expanding product variety, short product life cycles, increased outsourcing, globalization of businesses, and

continuous advances in information technology (Lee, 2002). In recent years, supply chain management (SCM) has grown in acceptance. The discipline that had a difficult time getting the attention of senior managers in firms now has representatives in the top echelons of most organizations (Lancioni, 2000, Ellinger et at. 2012).

2.2.1 Food Supply Chain Management

The term food supply chain management appears to be defined by various authors with little consensus. In 2008 Outlook published that food processing industry encompasses the chains of raw material supplies, processing machinery, know-how and packaging technology etc. In 1990, Christopher, define network of organizations that are involved, through upstream and downstream linkages in different processes and activities that produce value in the form of products and services in the hands of the ultimate customer. Zanoni and Zavanella (2012) identified different processes and activities that produce value in the form of products and services for consumers. Van Donk et al., (2008) defined food supply chain as the seamless flow of products and information from supplier to customer. Food chains are product specific and have their own characteristics. These characteristics often limit the possibilities for supply chain integration in food supply chains.

The sale of perishable goods is of vast importance for grocery retailers worldwide. Perishable products are also the main driver through which retailers are able to create competitive advantages to attract additional customers apart from pricing strategies (Thron, 2007). Many German food processors, for instance, show only very limited degrees of internationalization and have mainly entered markets characterized by geographical and cultural proximity. They have so far refrained from investing in more distant markets, for instance in Asia (Heyder et al., 2011). Transparency of a supply chain is the extent to which all its stakeholders have a shared understanding of and access to the product-related information that they request without loss, noise, delay and distortion (Deimel et al., 2008). In promoting and building strong food supply chains, companies need to understand the way competition is changing. Because of product proliferation (as a consequence of mass customization), future competitiveness will depend on effective participation in and control of global food supply chains. To be competitive, supply chain partners have to coordinate and share information. Integrated information systems are needed to accomplish (Hvolby et al., 2010). Food supply chains are deal withed with increasing consumer demands on food quality and safety.

The chains are considered to be composed of the actors in these networks which vertically work together to add value to customers. A chain is defined as the processes linking supplier and user companies, from the initial raw materials to the ultimate consumption of the finished product (Omta et al. (2001).

2.2.2 Sustainable Agri Supply chain Management

The agri supply chain network is compared among three phases i.e. before 1990s, 1990 to 2000 and 2000 onwards. There is shift in focus from making food available for subsistence level before 1990's towards the higher degree of processing using advanced technology (demand driven) between 1990-2000. Where as from 2000 onwards, focus radically shifted towards food safety, cold chain, traceability and sustainable supply chain management. Welch and Mitchell (2000) had elobrated the food supply chain management (FSCM). It is illustrated in figure 2.1 and 2.2. Before1990, the food raw materials, which are mostly the products of plant and animal husbandry and fishing were consumed as fresh produce, processed into foodstuffs, or into ingredients for processing sector. A comparative of the supply chains is provided in table 2.1

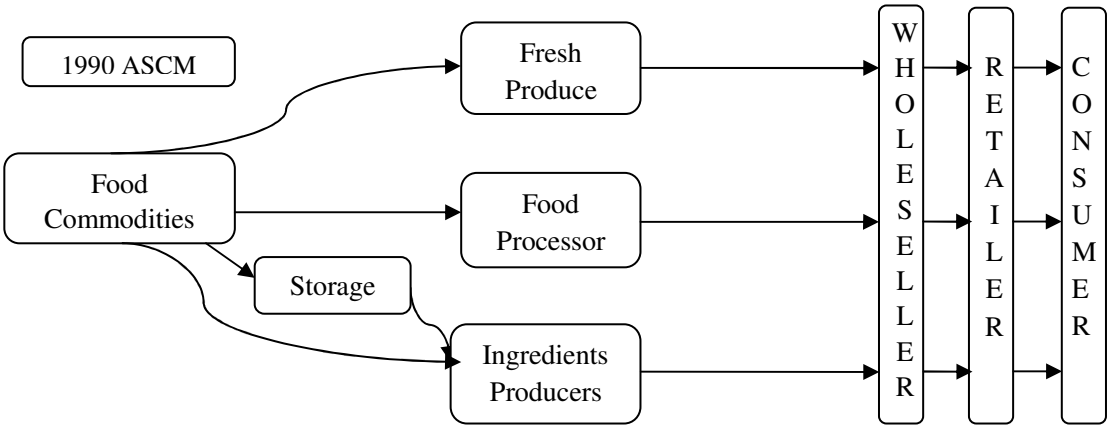

Figure 2.1 Agri Supply Chain Management before 1990

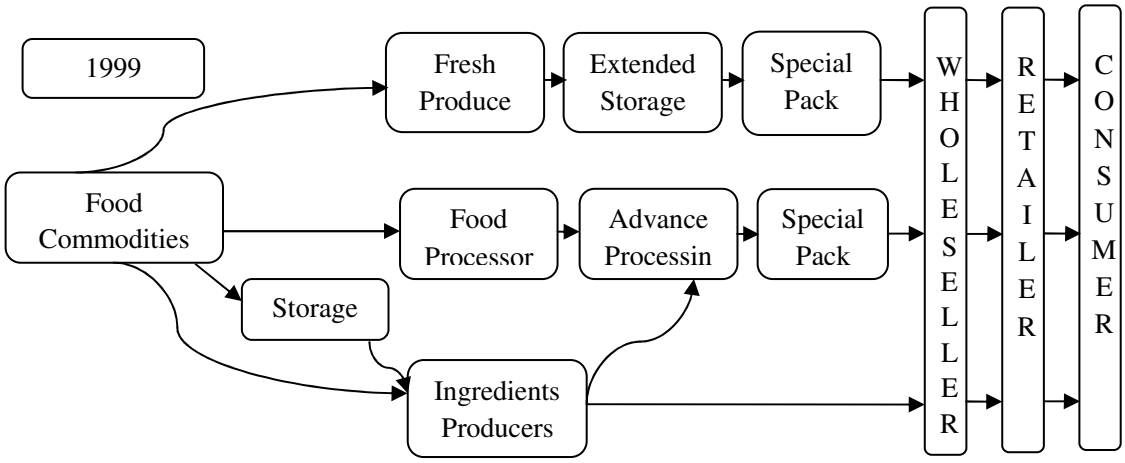

Figure 2.2 Agri Supply Chain Management during 1990-2000 (Welch and Mitchell, 2000)

A sustainable agri supply chain is depicted in figure 2.3

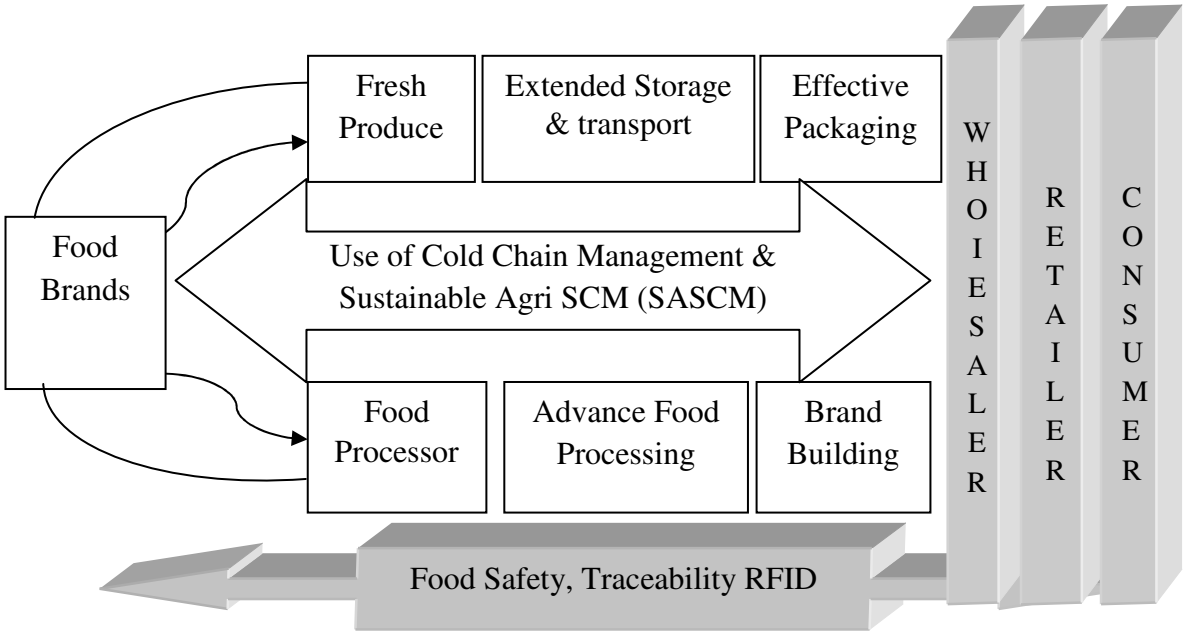

Figure 2.3 Sustainable Agri Supply Chain Management

Table 2.1 Comparison among Three Agri SCM: Before 1990's, 1990-2000 & 2000 onwards

S.No	Agri Supply Chain Management during		Sustainable Agri Supply Chain Management
	Before 1990's	**1990-2000**	**2000 Onwards**
1.	Food treated as commodity	Food commodity, partially turned to brand	Food evolved as brand
2.	Followed traditional means of processing, storage etc.	New innovations in areas of processing, storage etc.	Fully advance means of processing, storage etc.
3.	Absence of cold chain	Adhoc cold chain practices	Moved towards end to end cold chain
4.	No focus on food safety	Desired food safety	Achieved food safety, traceability
5.	Logistics management	Shift from logistics to ASCM	Adopted sustainable agri supply chain

2.2.3 Sourcing of Agri Products for Food Supply Chain

The term food chain refers to the total supply process from agricultural production, harvest or slaughter, through primary production to storage and distribution to retail or use in catering and by end users. The large-scale empirical research on how food chain actors perceive and cope with uncertainty in the face of volatile agricultural markets remains scarce. How enterprises on the upstream and downstream stages of food value chains perceive risks, how they manage these risks and what this means for the adaptation of food chains to volatile markets have only rarely been analyzed (Zazie von Davier et al., 2010). The developing countries are experiencing a food system revolution, spurred by rapid urbanization, rising incomes, and market liberalization (Mergenthaler et al., 2009; Schipmann and Qaim, 2011; Reardon and Timmer, 2012). These trends may have important implications for agricultural and wider rural development. There may be direct gains in income that accrue to farmers participating in high-value markets (Rao and Qaim. 2013).

2.2.4 Food Processing and Manufacturing

Food crisis in India during 1960s forced the Government to adopt green revolution which helped in self-sufficiency in food and focus on improving the poor sections of the society. To improve the livelihood of the poor sections of the society, land ceiling act was enforced during 1972 with the aim is to provide land to landless farmers. It also limits the area of land held by a farmer. Focus on food processing industry started in 1991 after the economic reforms. Government allowed 100% foreign direct Investment (FDI) in food processing industry, export promotion incentives and other schemes to attract investments. However, investment in this sector has been very low in India. The Government has identified food and agro processing industry as one of the sunrise sectors that has high potential for domestic demand and export markets (Deliotte Report, 2009). The food industry has a clear view of consumer behavior. It is nonetheless constrained by highly structured external factors, the sourcing, pricing of raw materials, changes in consumer behavior, distribution channels, public health regulations and standards etc. Therefore, it seems essential that each group detail its strategy by explaining its development priorities, such as gain in market share, improved profitability, international development or development in high-potential countries, support provided for existing brands and acquisitions (KPMG, 2009). The

Indian food processing industry holds tremendous potential to grow, considering the still nascent levels of processing at present. Though India's agricultural production base is reasonably strong, wastage of agricultural produce is sizeable. Processing of fruits and vegetables is a low 2%, around 35% in milk, 21% in meat and 6% in poultry products. By international comparison, these levels are significantly low. Processing of agriculture produce is around 30% in Thailand, 40% in China, 70% in Brazil, 78% in Philippines and 80% in Malaysia. Value addition to agriculture produce in India is just 20%, wastage is estimated to be valued at around ₹50,000 crores annually (MOFPI, 2012).

2.2.5 Food Distribution

Researchers have focused relatively early on the design of distribution systems considering the supply chain as a whole. Recent and comprehensive overview of models and approaches for the analysis of a distribution network elaborated and discussed by Nagy and Salhi (2007), Alumur et al. (2008), Melo et al. (2009) and Chen (2012). In order to achieve an overall optimal and integrated solution to the configuration of a distribution network, firms are facing another critical issue such as allocation points of demand or customers to their suppliers. This is performed through location-allocation problem (LAP) modelling. The strategic planning of the proper site of food processing facilities, regional and local distribution centres, in accordance with the geographical population density, might reduce transportation costs, inventory costs throughout the chain and link raw material and consumers in a sustainable way (Yu and Wang, 2006 and Bosona et al., 2011). The two main leverages and issues in warehousing systems are the design, involving layout and structural patterns specifically devoted to food products and the operations, dealing with the problem of allocation, assignment, routing, etc. Complete overview on methods and models to respond to warehousing systems criticalities are summarized by Manzini (2012).

2.2.6 Cold Chain Management

For temperature sensitive and perishable products logistics, a special type of supply chain management called cold chain management (CCM) has been established. Kuo et al. (2010) pointed that temperature monitoring and control are essential mechanisms in CCM because they are necessary for maintaining food safety and

quality. However, they are costly to logistics service providers. Smaller shipments and timely deliveries offer unique challenges when operating a cold chain. The equipment and processes used to carry, keep chilled and frozen foods in the right shape and quality intact is known as the cold chain. The cold chain is a physical process that dominates the logistics of the processed foods. Joshi et al. (2009) made an observation based on recent studies that a strong and dependable cold chain in developing economies does not exist. They identified poor infrastructure and too many intermediaries as the main inhibitors of CCM.

Montanari (2008) observed that mostly food products are perishable and their shelf life can be greatly affected by temperature conditions in the supply chain. It is because time/temperature control becomes a critical issue in fresh food logistics and the efficient as well as effective tracking of cold chain conditions is one of the main points to be addressed. Technical and managerial solutions are available in order to achieve this objective, but no methodologies exist to select the most suitable solution in order to minimize the logistics cost.

Temperature requirements vary among food items, whether frozen or chilled and they even differ across types of frozen foods. The integrity of the cold chain ought to be preserved from the point of production or processing, through each of the transport phases loading, unloading, handling and storage and extends to storage at the consuming household, restaurant and hotels. Major operational tasks from engineering as well as from sales and marketing point of view, include the need to monitor temperatures, install and maintain equipment, move products rapidly, plug in the refrigerated containers and keep the doors on cold storage units closed. The mechanics of the cold chain are an important component of supply chain management for chilled and frozen foods to focus only on the engineering aspects narrows the perspective on the networks that comprise the cold chain and the food businesses that rely on it. These tasks are required to be performed and ensured at distributors, retail levels by front line sales team. As a value-preserving mechanism, the cold chain is a necessary condition for trade in certain higher value foods. Modern food processing technology and transportation methods have enabled manufactures of food products to solve age old problems associated with storage and transporting perishable products (Sunder et al., 1990).

The robustness of the cold chain is very important as the distance travelled or time taken is uncertain. Bruckner et al. (2012) and Bogataj (2005) observed that any changes in time-distance or temperature in the chain could cause the net present value of the activities and their added value in the supply chain to be perturbed. In reality the perturbations can be robust. It is important to know the effects of these perturbations in a supply chain on the stability of perishable goods. These analyses are especially important to assure the stability of cold chains in the cold chains management (CCM). The formulation obtained in the time domain were compared with the formulation in the frequency space of the complete logistic chain, where location and distance between the activity cells of logistic chain play an important role.

Joshi et al. (2011) used Delphi-AHP-TOPSIS approach to select the best strategy for monitoring the performance of a cold chain. They used seven criteria namely cost, return on investment, innovativeness, quality, service level, traceability and relations. For each criterion, sub criteria are also identified. Use of radio frequency identify device (RFID) and global positioning system (GPS) are selected as the best method of performance monitoring. A supply chain of perishable items is referred to as a cold chain. A cold chain protects a wide variety of food, pharmaceutical, and chemical products from degradation, improper exposure to temperature, humidity, light or particular contaminants to keep them frozen, chilled and fresh (Bishara, 2006). A comparison of PFSCM, CCM and general supply chain is presented in table 2.2.

2.2.7 Food Retailing

Global retail sales in the food and grocery sector are estimated at US$6,717 billion in 2011. The total has increased by 90% since 2001 (Euromonitor, 2012). The continuous growth in sales has become essential for the survival of food retailers. They have increased their power in vertical relationships with suppliers. In the search for sales growth food retailers have become more international. The emergence of large international firms has generated a change in the structure of the sector resulting in more market concentration and a greater sectoral capacity to influence consumption (Dawson, 2013). Major food retailers have developed ranges of product. They are controlled by the retailer. Customer loyalty can more easily be built on store brands than it can on manufacturer brands (Zentes, Morschett and Schramm-Klein 2011).

2.2.8 Logistics Management of Processed Food

Logistics integration, firms can have the potential benefits of vertical integration in terms of quality, dependability, planning and control and lower costs without having it in the physical sense (La Londe and Masters, 1994). Improved logistics integration between supply chain partners yields a number of operational benefits, including reduction in costs, lead time (Liu et al., 2005) and risks (Clemons et al., 2008) as well as improve-mint in sales, distribution, customer services and service levels (Seidmann and Sundararajan, 1997) and customer satisfaction (Kim, 2009). The typical issues involving SCM are the analysis, design and control of integrated logistic architectures. Supporting-decision methods and mathematical models can be adopted to tackle strategic issues (such as the proper site of the manufacturing facilities or the distribution centres), tactical issues (e.g. the determination of the flows of materials moved within the system and fulfilment decisions) or operational issues (e.g. vehicle routing and delivery scheduling as well as material handling and inventory) (Manzini, 2012a). Logistics plays an increasingly important role in FSCM, but this awareness must grow more and more to be shared between different actors in the chain (Manzini et. al., 2013).

2.2.9 Food Quality and Food Safety

In cold chains, temperature conditions affect the risk potential, the shelf life and final quality of chilled products. The progress of predictive microbiology enables researchers to model food safety and quality by considering the effect of temperature, intrinsic characteristics and packaging environment (Montanari, 2008). The cold storage or low temperature of fresh products is essential because it can minimize the risk of food-borne illnesses, maintain optimal quality by reducing several physiological activities and reduce the growth rate of spoilage microorganisms (Rediers, Claes, Peeters and Willems, 2009). Customers expect that the products they order can be received in safe, fresh conditions and on time. Any temperature changes during the logistics process may cause loss of flavor or even spoilage.

According to Manning et al. (2006), a food safety management system would include the following pre-requisites programmes:

- Product specifications
- Standard operation procedures (SOP)
- Personal hygiene programmes
- Premises hygiene programmes and waste control procedures
- Equipment control and site maintenance procedures
- Reputable suppliers and supplier approval and raw material inspection Procedures
- Pest control programmes
- Water quality
- Calibration and training programmes

It is well known that temperature is an important parameter in food safety and quality (Montanari, 2008; Ovca & Jevšnik, 2008). Supply chain integration is widely considered by both practitioners and researchers a vital contributor to supply chain performance. The two key flows in such relationships are material and information. Previous studies have addressed information integration and material (logistics) integration in separate studies (Prajogo et al., 2012).

Saltini and Akkerman (2012) mentioned that only in Europe food borne illness affects about 1% of population (approximately seven million people) each year. Only in 2011, approximately 16.7% of population (47.8 million people) got sick in America in relation to food related illness (Resende-Filho et al., 2012).The contemporary food supply chain (FSC) should adequately provide information that consumers and other concerned bodies need to know such as variety of the food attributes, country of origin, animal welfare, and genetic engineering related issues. For this, effective food traceability system (FTS) is important (Bosona et.al., 2013).

In food quality, contamination is a big challenge. FASSI (2012) had seen the issue of contamination from two perspectives (a) accidental contamination (where education, standards development and certification and infrastructure investment would help with prevention efforts) and (b) intentional contamination (fraud and adulteration), for which monitoring, traceability, and information sharing might discourage opportunism.

A number of examples are cited and advice for the way forward includes approaches at the global, national and local levels. To improve the system following recommendations are included such as improve local enforcement, private certification

of suppliers, monitoring, traceability, education, information sharing at all levels, expanding both public sector and private use of risk analysis, expanding the reach of the European Union rapid alert system, improved communication and oversight (including border inspection) and maintaining strong private accountability for contamination.

Rong et al. (2011) integrated food quality in decision-making with production and distribution in a food supply chain. Fotopoulos et al. (2011) identified and priorities using Pareto analysis the inhibitors in the implementation of HACCP. It is given in table 2.2.

Table 2.2 Key Inhibitors in Implementation of HACCP

S.No	Inhibitors in the implementation of HACCP	S.No	Inhibitors in the implementation of HACCP
1	Limited Knowledge	17	To increase the reputation of the company
2	Skills and commitment to food safety by employees	18	Difficulties in verification and validation of HACCP plan
3	Resistance to change and attitudes of employees	19	To improve competence
4	Increased financial resources	20	To expand foreign markets
5	Lack of employee training	21	To reduce cost
6	Length of time to develop and Implement HACCP	22	To obtain other third party accreditations
7	Lack of technical expertise and support	23	To obtain a leadership position
8	Need to satisfy stakeholders customers	24	Insufficient planning
9	Low availability of human resources	25	To improve profit margins
10	Excessive paperwork and documentation of HACCP	26	To improve product quality
11	Improper organizational infrastructure and prerequisite programs	27	Media pressure
12	Difficulties related to production technology and design	28	Inappropriate company suppliers
13	Difficulties related to product type	29	To reduce waste
14	Small company size	30	To reduce customer complaints
15	Legal requirements	31	Lack of suitable physical conditions in the company
16	Lack of support from government and authorities	32	Poor reliability of certification bodies

2.2.10 Traceability in Food Supply Chain

International Standard Organisation (ISO) define traceability is the ability to trace the history, application or location of an entity by means of recorded identifications (Olsen and Aschan, 2010; Kelepouris et al., 2007; Karlsen et al., 2013). The definition of food traceability, forces that drive the implementation of food traceability, technological innovations, benefits of food traceability and barriers to the implementation of food traceability were investigated (Bosona et al., 2013). Food trade is one of the largest global businesses today and traceability throughout the food supply chains has gained considerable importance over the last few years (Thakur and Hurburgh, 2009). Requirements related to food safety, traceability and associated legislation and certification have increased a lot in recent years. Among these are the requirements for systematic recordings to be made throughout the supply chain so that in case of a food crisis it is possible to trace back to source of contamination and to perform a targeted recall of potentially affected food items. These systematic recordings must be connected to the food items through unique identifiers and the recordings, the identifiers and the documentation of how ingredients and food items join or split up as they move through the supply chain is what constitutes a traceability system. For the food industry, the traceability system is also an important tool for controlling and optimizing production for getting better industrial statistics and better decisions and for profiling desirable product characteristics. Current status is that many food producers have good, often electronic traceability systems internally, but exchange of information between the links in the supply chain is very time-consuming or difficult due to the diversity and proprietary nature of the respective internal systems (Storoy, 2013). Research into traceability systems covers a number of topics: traceability system development (Thakur and Hurburgh, 2009); traceability modelling (Thakur and Donnelly, 2010), operating mechanism and consumers perceptions of traceability system (Zhang et al., 2011). The specific research is being carried out on traceability in the product specific areas i.e. agri SCM, beef and cattle etc. (Feng et al., 2012).

2.2.11 Performance Management of Food Supply Chain

The balance score card (BSC) first appeared in the results of a research developed in 1990 by Kaplan and Norton (1992), involving many companies, moved by the

growing dissatisfaction with traditional financial measures as a sole measure for company's performance. The BSC is a tool for aligning business activities to the vision and strategy of the organization, improving internal and external communications, and monitoring organization performance against strategic goals. It includes various performance indicators, namely customer perspective, internal-business processes, learning and growth and financials (Kaplan and Norton, 1993, 1996, 2001a, b). The BSC distinguishes four different perspectives of performance measures customer, Internal processes, learning and growth and financial. Li et al. (2009) found that supply chain integration is significantly related to supply chain performance. It has become apparent that in the near future the design and operation of food supply chains will be subject to more stringent regulations and closer monitoring, in particular those for products destined for human consumption. This implies that the traditional supply chain practices and the corresponding performance measurement should be subject to revision and change (Ahumada and Villalobos, 2009). In recent years, the development and implementation of performance measurement systems (PMSs) has become a growing focus of research interest across a wide range of topics and contexts. There are several comprehensive accounts of its development (e.g. Franco-Santos et al., 2007). As the subject evolves it is clear that research gaps still exist (Bititci et al. 2012), one of which being the dearth of systematic empirical research on the effective implementation of PMS (Nudurupati et al. 2011). Bourne (2001) was one of the first to examine PMS implementation. Six crucial factors were advocated to measure performance of an organization by Taylor and Taylor (2013) as follows, strategy formulation process, senior management leadership, organisational learning orientation, information systems support, strategy implementation process, quality management culture.

2.3 PFSCM Issues in Selected Countries

Australia

Australia's food-processing industry does not seem to have a good record of performance. Output growth has been slow, competitiveness against imports weak and export growth relatively slow. This raises questions about whether there have been constraints that have impeded the ability of food-processing industries to attract investment capital for innovation-based growth in domestic and international markets.

It has been amply demonstrated that Australian manufacturing has an inward-looking focus and food-manufacturing industries are no exception (Ratnatunga, 1995).

China

Since attracting foreign direct investment (FDI) to agriculture is an important policy concern for the Chinese Government. It is necessary to develop benchmarks of the inward FDI performance. LV et al. (2010) had explored the determinants of FDI and evaluate the inward FDI performance in China's agriculture. International retailers have been in China for more than ten years, during which period a series of profound changes has occurred in the Chinese retail sector. International retailers introduced advanced retail techniques and managerial approaches, domestic retailers grew more sophisticated in their supply chain management. Foreign-based retailers in China can compete in hypermarket and supercentre formats because they offer higher-quality products and achieve larger economies of scale. Domestic retailers compete by operating smaller formats and maintaining good relationships with governments and local communities (Hingley et al., 2009). The purpose of research was to examine patterns of recent changes in China's international export trade in vegetable products between 2001 and 2005 following China's membership of the World Trade Organization (WTO) and to measure consequent changes in its export competitiveness. It also aims to consider infrastructural issues in relation to supply (Xue et al., 2009).

Switzerland

For the food industry, the depletion of arable land and a growing world population demand controlling the sustainability of agricultural inputs to the industry. Controlling the sustainability of these supplies means controlling the economic, social and environmental performance of the supply chain. In practice, little is known about how companies can efficiently extend their existing supply chain controls to cover these aspects (Hamprecht et al., 2005).

Japan

Childs had examined the Japanese food distribution channel structure with special emphasis on food wholesalers and food retailers. Reviews channel inefficiencies in

Japan with attention to historical development, regulations, consumer attitudes and food shopping behaviour, transportation and logistics, transportation alternatives, consolidation and new developments, distribution centers' and information processing (Childs, 1997).

United Kingdom (UK)

Hollingsworth (2005) tried to study the impact of the competition commission's report on the competitiveness of the UK food retail sector. Although the report found little evidence of monopolistic behaviour, the findings indicated both significance of buyer concentration and need for voluntary regulation. Recent developments are examined along with current research perspectives. This evidence suggests that not only will buyer power continue to concentrate in the hands of the major retail players but also further concentration and consolidation in the food retail sector will continue to take place.

United States of America (USA)

Explores' the adoption of strategic planning techniques by agribusiness, specifically agricultural co-operatives. It offers implications for policy makers. A survey was conducted on a sample of 345 co-operatives listed in the US Department of Agriculture's agricultural cooperative Service's directory of farmer cooperatives. Co-operatives have widely adopted many of the sophisticated strategic planning techniques such as environmental analysis, core competences and SWOT analysis (Piercy et al., 1989). An analysis of the FAO's food balance sheets for 2007 suggests that food waste in North America and Europe is roughly 95–115 kilograms (kg)/capita/year compared to 6–11 kg/capita/year in South/Southeast Asia and Sub-Saharan Africa (Gustavsson et al., 2011). Food losses can be qualitative, such as reduced nutrient value and undesirable changes to taste, texture, or color, or quantitative as measured by decreased weight or volume. Here, food loss is a subset of post-harvest losses (or post-production) and represents the edible amount of food available for human consumption but is not consumed. Food waste is a subset of food loss. According to Bloom (2010), food waste occurs when an edible item goes unconsumed as a result of human action or inaction and is often the result of a decision made farm-to-fork by businesses, governments, and individual consumers.

Definitions of food loss and waste are not universal worldwide. There is some movement to use a wider definition of food waste to frame the problem within a policy context (Buzby, 2012). Dutch Ministry of Economic Affairs, Agriculture, and Innovation more broadly defines food waste to include quality considerations and residual and waste flows in addition to the food loss analyzed here (Waarts et al., 2011).

Philippines

Jongwanich (2009) examines the impact of food safety standards on processed food exports in developing countries with special reference to Philippines by using a panel data econometric analysis of determinants of processed food exports. The sanitary and phytosanitary (SPS) is incorporated into the model to capture the impact of food safety standards. The empirical model suggested that imposing food safety standards by developed countries could impede processed food exports from developing countries. In fact, the SPS agreement by itself aims to facilitate trade between developed and developing countries by improving transparency, promoting harmonization and preventing the imposition of arbitrary food safety standards. However, the negative impact of food safety standard found in this could emerge first because during the implementation, SPS tends to be less transparent than tariff or quotas. There is an ample room for developed countries to tweak the standards stronger than necessary for achieving optimal levels of social protection and to twist the related testing and certification procedures to make their competing imports more competitive. Secondly, there are limited resources and manpower as well as institutional constraints for developing country exporters to overcome food safety standards.

Thailand

Salin et al. (2003), had examined that business relationships in the cold chain used for exporting food to new markets in developing countries. The American Potato Trade Alliance, a cross-network alliance that includes all levels of the value chain, is the subject of case study research involving participant observation and fieldwork in the Philippines and Thailand. Multinational restaurant companies

manage technical challenges in target markets with tight specifications and exclusive supply chains, while smaller firms use extensive networks to supply imported frozen potatoes.

Malaysia

The initial objective of the research was to examine the strategic approaches, processes and factors involved when food companies enter a foreign Asian market. The study focused on the South-East Asian Market, specifically Malaysia, given both the region's and the country's growing importance in world trade (Muthaly et al.,1999). The rationales for foreign MNCs investing in Malaysia are as follows:

a) Malaysian market demand for the goods

b) Vision of parent company and global expansion into the region

c) To use Malaysia as a window into the ASEAN

d) Malaysia's excellent infrastructure

e) Availability of educated, English speaking and good quality workforce

f) Corporate policy for investment in the region

g) Competitive cost of labour

h) Malaysia's growth potential in the region and Accessibility to raw materials

i) Low production costs

j) Malaysia's political stability

Brazil

Brazilian mango and grape exports to Europe has excellent potential. According to the Food and Agricultural Organisation (FAO) report on tropical fruits, the mango represents 36 per cent of tropical fruit production worldwide. Latin America is responsible for 17 per cent of world mango production and Brazil is the third largest mango producer (FAO, 2007). Almost 100 per cent of Brazilian mango and grape exports come from the Sa˜o Francisco region, located in the Brazilian Northeast. The European Union is the main destination for Brazilian mango and

grape exports, 90 per cent and 68 per cent respectively. The industrial concentration of the retail sector is one of the main events in the study about food chains. One of the outcomes of this industrial concentration is the increase of requirements (such as traceability and certificates) and suppliers have to make investments in order to meet those. It is well argue that retail suppliers are spread over different countries (de Castro Souza, 2012)

2.4 A Framework for the Categorisation of Literature

The grown interest in the food supply chain management is evident by steep increase in practitioner and academic publications, conferences, professional development programs and university courses. The present research also support the claim of sudden increase in research articles on FSCM, but the research still resides in narrow functional silos such as cold chain, agri supply chain etc. Having recognized this gap in the knowledge base of FSCM and in order to develop a better understanding of the subject matter, a two way approach is adopted to fill the knowledge gap. Firstly, to craft a framework for the categorisation of literature linked to processed food supply chain management and to contribute in food research for the benefit of researchers, academicians and corporate. Secondly, to present a commentary of systematically selected, studied, analyzed research articles.

Processed food supply chain carries processed food (PF) using its network that comprises of farmers, food processors, manufactures, carrying and forwarding agents (C&F's), distributors and retailers. The food items are transported by the channel members under controlled temperature conditions depending upon nature of products. To make definition more clear, table 2.3 is furnished, stating differences among processed food supply chain management, cold chain management and general supply chain management.

Table 2.3 Comparison of Various Types of Food Chains with General Supply Chain Management

Processed Food Supply Chain Management (PFSCM)	Cold Supply Chain Management (CSCM)	General Supply Chain Management (GSCM)
• Processed food has three levels of processing. • Level I, chopping, cleaning and packaging fresh fruits & vegetables and marketing them at +4 to +6 degree	• Specific temperature is required to maintain products quality. • Dairy & its culture products like lassi, curd etc. at +4 to +6 degree. • Ice creams at -22 to -24 degree • Frozen items like vegetables & fruit and Meat at -18 degree	• Controlled temperature is not required, for items like Non eatables, consumer durable – electronic goods etc.
• Level II, Processed food developed by converting fruits and vegetable flakes, pulp, paste frozen fruit & vegetables, meat, poultry and fishery. • It requires cold chain for PFSCM	• Require automated information system for success of Cold Chain. • Cold chain includes condition and time along with transaction and location	• Connected through mostly manual information system: information of indent, dispatch order, payment terms, warehouse & delivery location & its status. • Firms are realizing Importance of Modern MIS, therefore some automation is beginning
• Level III, The third level of processing can be juices, ketchups, biscuits, namkeens (Indian snacks like peanuts, potato flicks etc.), snacks, noodles, ready to eat meals, coffee, tea bags (under normal conditions), pasteurized milk, yogurt, ice creams(Cold Chain)	• If proper required temperature is not maintained then quality of product get & degraded where ever the cold chain breaks	• Continuous degradation in value right from the producer till final consumption
• PFSCM may or may not utilize the cold chain depending upon the nature of product under SCM. • The dry products like bakery items, namkeens, by and large FMCG (fast moving consumer goods) do not require cold chain	• Refrigerated vehicles are mandatory for transportation, when struck in traffic jam require keeping the refrigeration system in a running state, which devour more cost. • Different temperature is required for different products	• Less transportation cost as ordinary trucks, vehicles are used. • Different products can be loaded based on the space available

2.4.1 Food Supply Chain

A review of 100 research papers published in peer reviewed international journals on food supply chain is carried out. All these research articles were published during 1991 to 2012. They were randomly distributed across the world. The international journals were assessed through two major commercial databases such as Emerald and Science Direct (Elsevier). An initial key word search for articles containing term food supply chain (limited to citations and abstracts of periodicals) revealed that there were more than 35,635 articles present in both the databases. The key word search was subsequently limited to the exact phrase, processed food supply chain resulted into 8447 articles (as of October 2012). The quality of search was improved by limiting our search to peer-reviewed publications only in international journals. With this additional restriction, the number was reduced to 850. The research The prefaces, editorial notes, book reviews and interviews, in addition to any articles from magazines or industry publications were excluded from this set, leaving 620 usable articles. A comprehensive approach would require that all 620 articles be reviewed. Instead, statistical methods were used to generate a representative random sample. To be ninety percent confident of being correct to within ^0.1 of the true proportion of all articles, a minimum sample size of articles was needed (Berenson and Levine, 1996). This sample was increased to 100 to reduce the probability of Type II error. Figure 2.4, depicts the process used for selection of research paper for analysis. The above mentioned systematic process was followed to classify the literature along salient conceptual and research methodological dimension. In order to achieve laid down objectives, it is necessary to explore the underlying phenomena and processes embodied within these contrasting yet complementary bodies of literature to develop a categorization encapsulating the evident processes and phenomena of interest to supply chain researchers (Glaser and Strauss, 1967). In order to develop the categorization, two categorization principles are followed:-

Content-oriented principle:-

Research contributions have been categorized on the basis of their content.

Methodology-oriented principle:-

It was based on the framework used by Ellram (1995) which categorized researches as primarily descriptive or prescriptive and empirically or conceptually based.

This was very helpful not only in developing categorization, but also in assessing gaps in current theories, methods and empirical results analyzed.

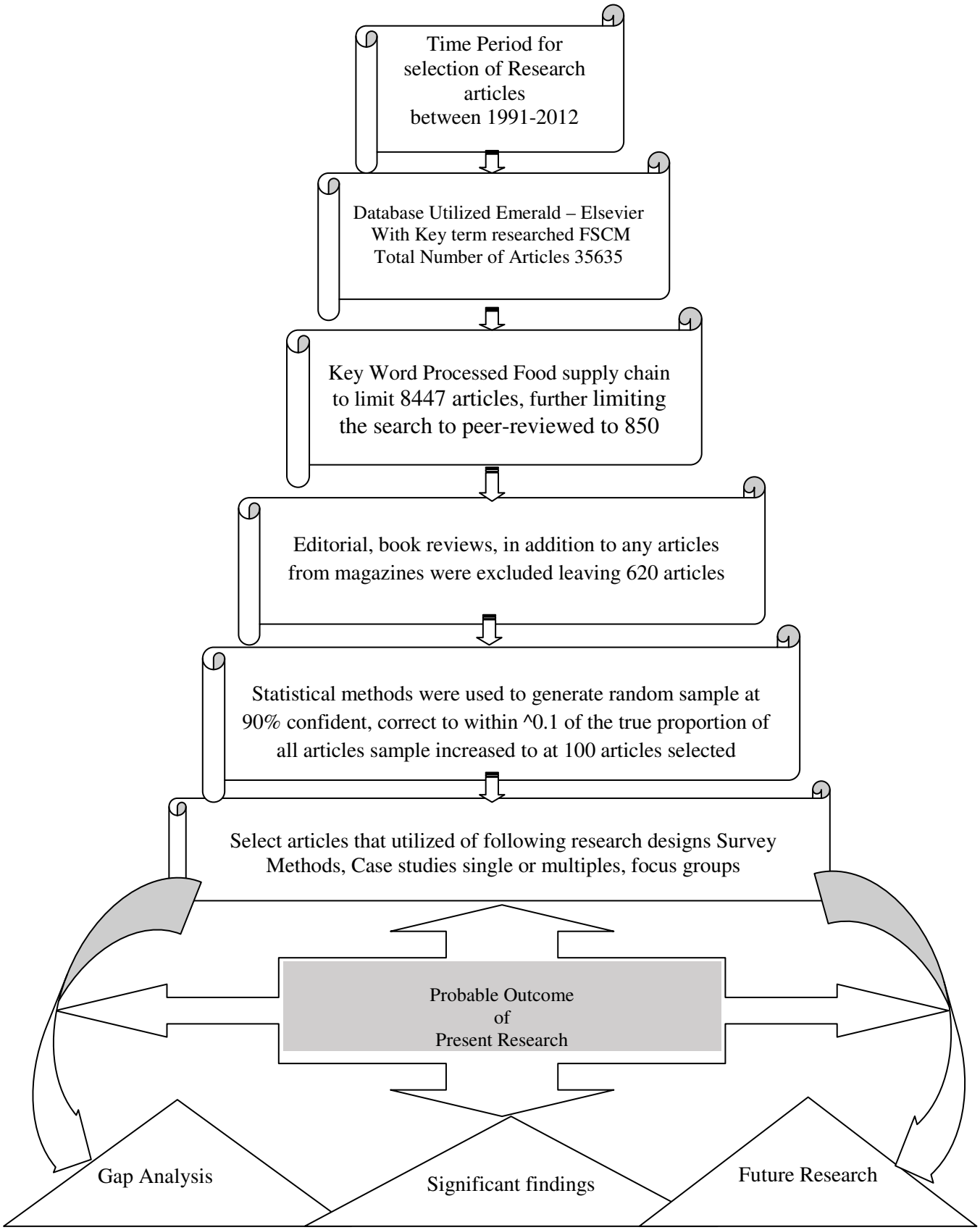

Figure 2.4 Process Used for Selection of Research Papers

2.4.2 Content Oriented Principle for Categorization

The main challenge is how to address the different aspects of networks and their analysis. For instance, one can classify literature on the basis of the operational processes. It deals with sourcing of agri supply chain, processing/manufacturing, planning and control, design, accounting, logistics of perishables, cold chain management, food safety etc. and on the basis of performance parameters like cost, time, quality, flexibility, service etc. (Cooper et al., 1997). A uni-dimensional approach to literature content enables to address level of analysis and the processes of supply chain management in a better manner.

The review is classified into three levels:-

1. Dyadic level: It considers the two party relationships between supplier and manufacturer or manufacturer and distributor or retailer
2. Chain level: It encompasses a set of dyadic relationships including a supplier, a supplier's-supplier, a customer and a customer's customer
3. Network level: It concerns a network of operations (upstream/downstream or total/immediate)

The external chain of definition authored by Saunders (1995) followed and consequently, do not explore the internal food supply chain level of analysis. The figure 2.5, depicts the kind of research article on food reviewed e.g. dyadic, chain and network.

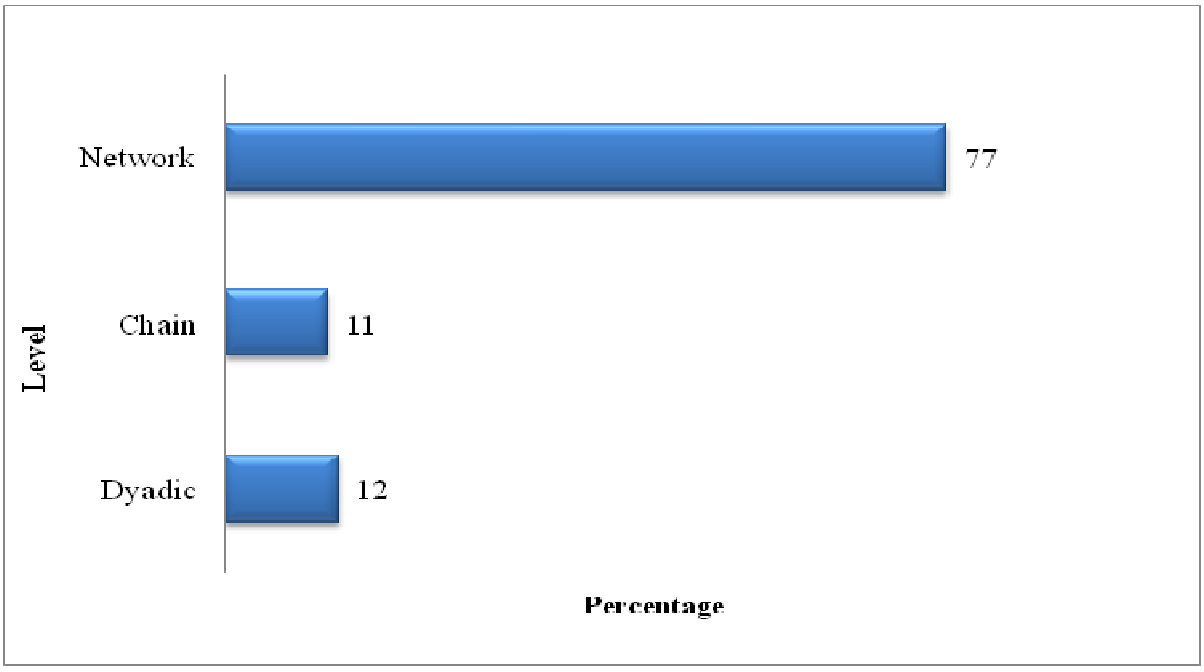

Figure 2.5 Kind of Research Articles on Food Reviewed

The figure 2.5, illustrates that 12% of the research article belongs to dyadic level, chain level received 11% attention and the network level had received highly significant attention of researchers. It has received 77% attention of global food chain researchers.

The categorization scheme is shown in figure 2.6.

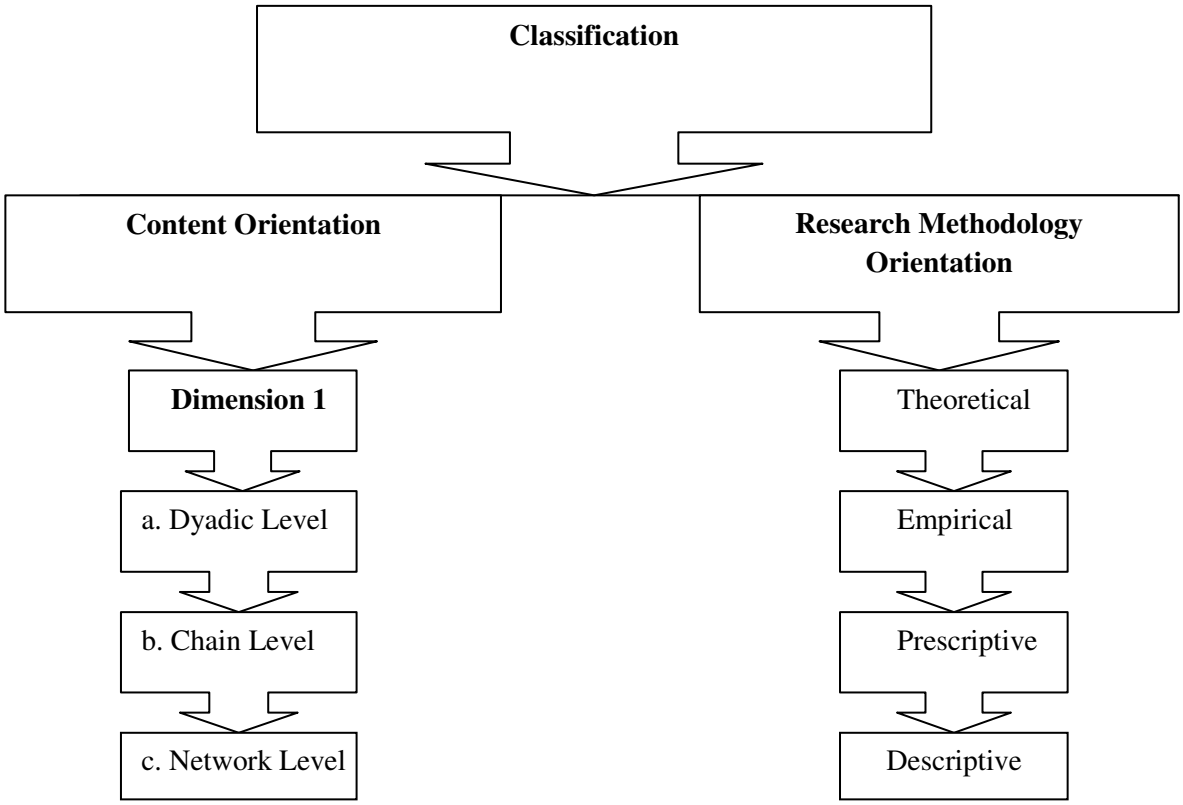

Figure 2.6 Categorization Scheme

The first distinction is made between theoretical works which set out to provide explanations of cause and effect relationship, define for underlying propose, analytical concepts and empirical work which focuses on reporting practice. The second distinction is between prescriptive and descriptive work, highlighting the emphasis of the work on either proposing normative models or summarizing current practices. The concern has been to identify the theoretical foundations of food supply chain management in terms of its antecedents, but more importantly in terms of the development of food supply chain management theory, to identify and analyze the development of research into the management of food supply chains. An observation is made that literature is dominated by theoretical descriptive studies to the tune of 50%. The empirical descriptive work has been also developed of the order of 34%.

In figure 2.7, classifying of literature is presented in four quadrants based on methodology adopted. The most significant findings have been the relative lack of prescriptive work in the area of food supply chain. The concern with the outcome is that literature work on food supply chain is primarily focused on theoretical-descriptive. There is a huge scope for future research on empirical and theoretical prescriptive form of research.

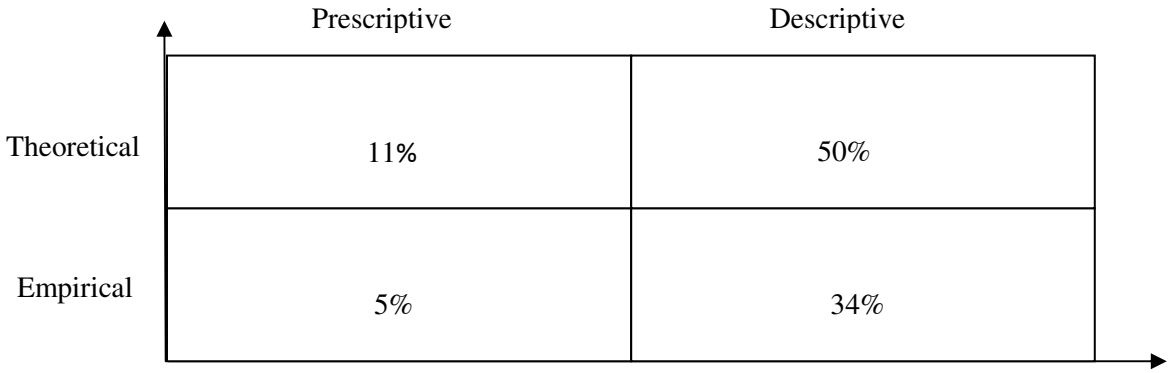

Figure 2.7 Classifying Literature According to the Methodology Adopted

2.5 Commentary of Research Papers

The refereed international journal articles on food supply chain management were reviewed. These were published from 1991 to 2012 depicted in figure 2.8. The wide range of research titles was published during the mentioned period on food supply chain. The favorite titles were on agriculture sourcing, manufacturing or processing, processed food supply chain networks, their exchange in terms of product, information, finance, services, logistics, food safety, channel of distribution, traceability, RFID, retailing and consumers etc.

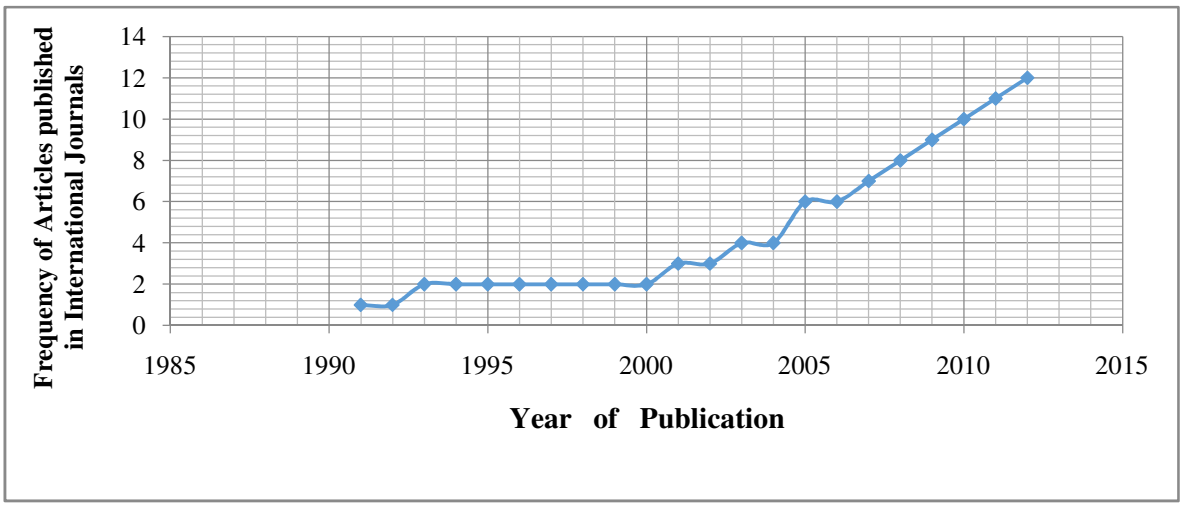

Figure 2.8 Year wise Publication of Research in International Journal

The major reason for selecting 1991 as the starting year for research was that Indian economy got liberalized in 1991. From 1993 till 1999, it had been a constant trend in publications. The publications had begun to rise in 2000 onwards. There was a steep rise in publication from 2005 till 2012. The figure 2.9, has depicted that the most of publications happened with the British Food Journal 32%. There were 17 % articles published in Supply Chain Management: An International Journal. The third most famous international journal emerged out to be Food Control 12%, followed by International Journal of Physical Distribution and Logistics Management with 9%, Food Policy 7%, Journal of Food Engineering 6% and International journal of production economics 5%. The rest of 12% articles were published in international journals such as Benchmarking: An International Journal, Trends in Food Science and Technology, International Journal of Productivity and Performance Management, Journal Expert Systems with Applications: An International Journal, International Journal of Food Microbiology, China Agricultural Economic Review, Asia Pacific Journal of Marketing and Logistics, Asia Pacific Journal of Marketing and Logistics and Journal of Small Business and Enterprise Development.

The description of abbreviations mentioned in figure 2.9 is as follows: British Food Journal (BFJ), Supply Chain Management : An International Journal(SCMIJ), International Journal of Physical Distribution & Logistics Management (IJDLM), Food Control (FC), International Journal of Production Economics(IJPE), Food Policy (FP), Journal of Food Engineering (JFE), Benchmarking: An International Journal (BIJ), Trends in Food Science & Technology (TFST), International Journal of Productivity and Performance Management (IJPPM), International Journal of Food Microbiology (IJFM), China Agricultural Economic Review (CAER), Journal Expert Systems with Applications: An International Journal (JESA), Asia Pacific Journal of Marketing and Logistics(APJL), Journal of Small Business and Enterprise development (JSBED).

It is proposed to classify the research in processed food sector into following seven major broad areas such as fruits & vegetables, dairy sector, fast moving consumer goods (FMCG), grains and oilseeds, dietary products, meat & poultry and marine sector. The results are depicted in figure 2.11.

It is found that under broad categories of FSCM, the agriculture especially fruit & vegetable based processed food products studies published 26%, fruits alone 2% and vegetables 3%. The close to half of research articles were on cross-section 57% i.e. research articles related

to more than one processed food category like F&V, dairy, FMCG, meat & poultry, dietary products, grain & oil seeds. The meat and poultry products were studied around 8%, beef 4%, pork, sheep, lamb and poultry 1%. The marine sector was studied to the extent of 3%, e.g. fish 2% and rest of marine sector 1%.

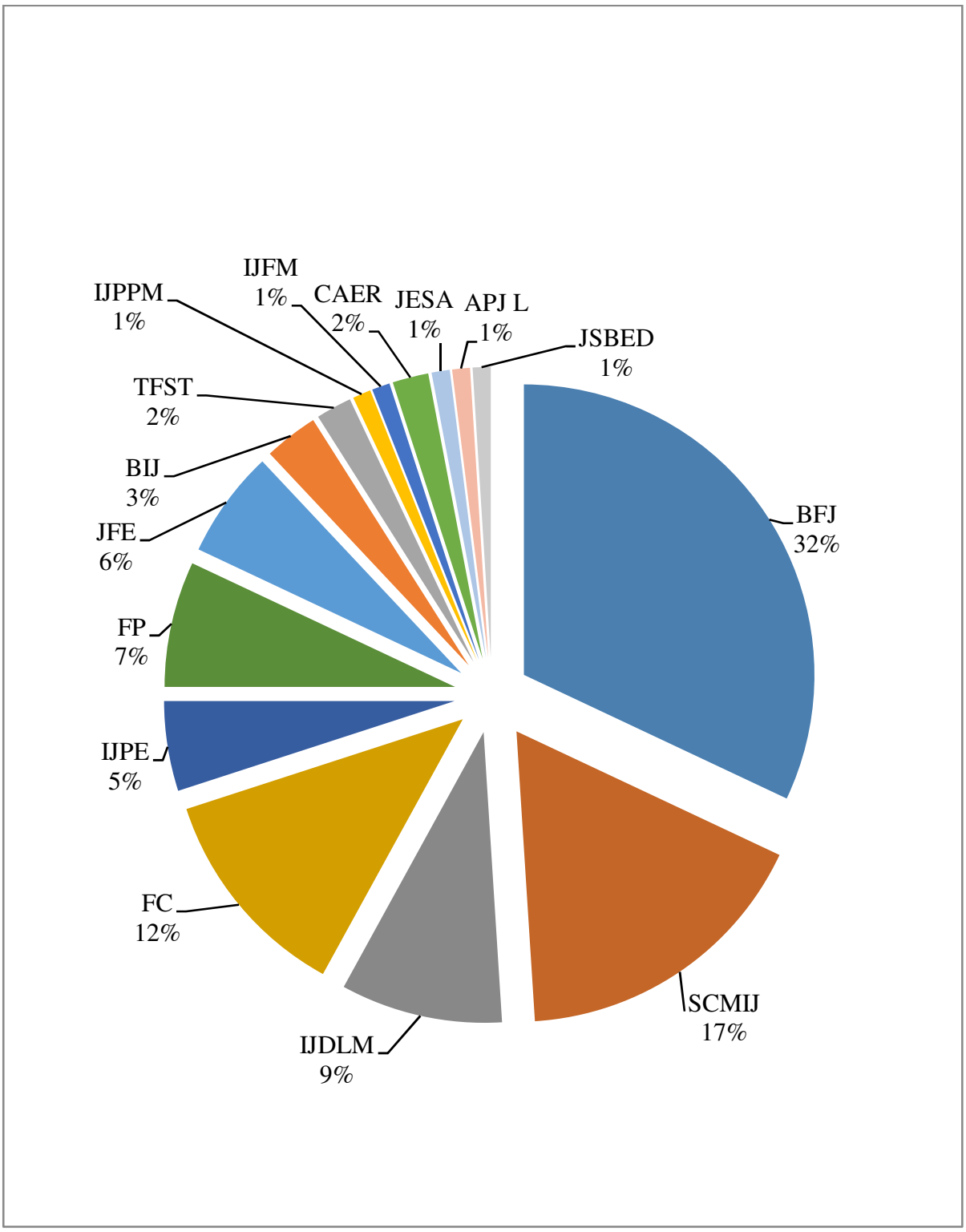

Figure 2.9 Journal wise Classification

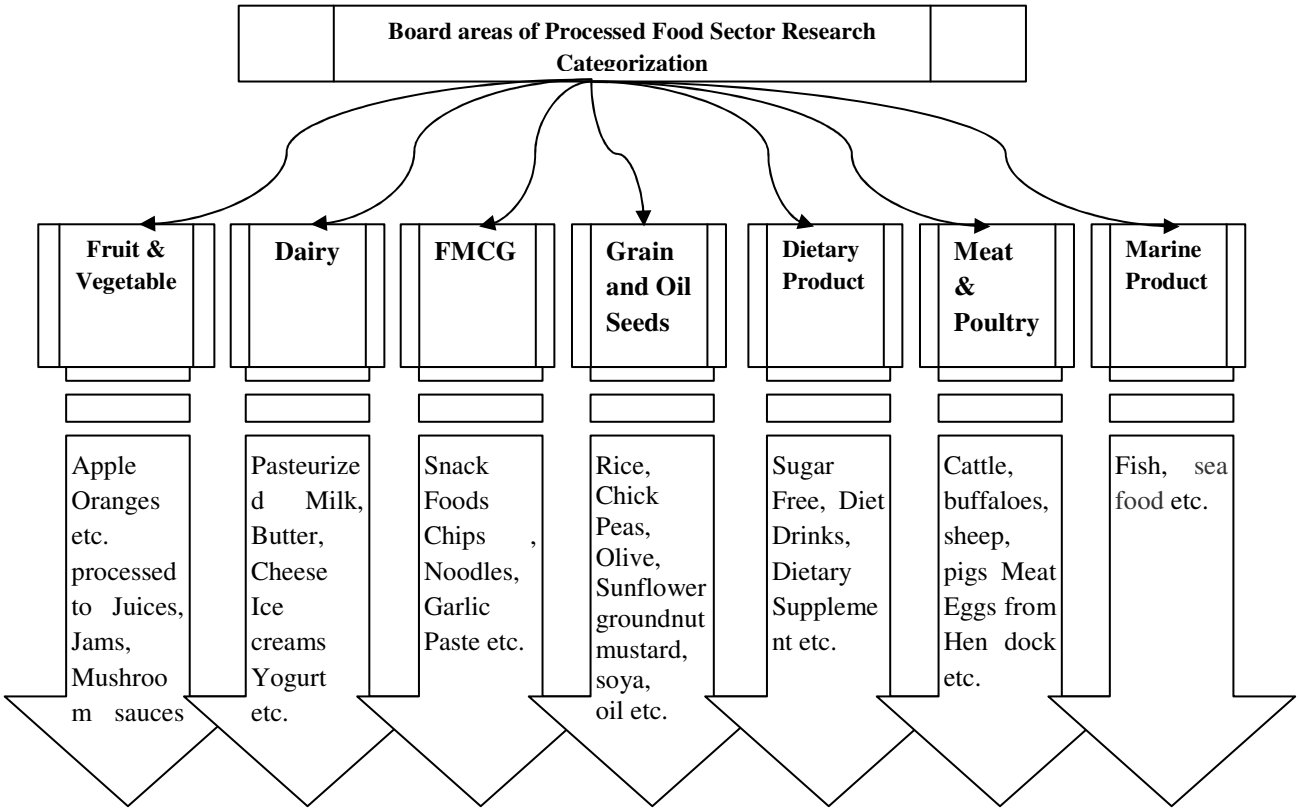

Figure 2.10 Proposed Broad areas of Processed Food Sector

The dairy and FMCG sector got attention in terms of publications around 2%. The grains and oil seed and dietary products were researched 1%. The fishery sector has been neglected as it got 2% attention of researchers, even though this sector is promising for growth. Since ages it is a fragmented sector and operates by small fishermen (Peterson et al. 2000).

The poultry sector also had received only 1% attention from international researchers. The dairy and FMCG had gained only 2% publication. Therefore, there is huge potential for international research and publications in the broad categories of fishery, poultry, dairy, grain and oil seeds, FMCGs and dietary products. The dietary products are the future of PFSCM and in the years to come the researchers are expected to do research on these food categories.

In order to depict the contribution of global publication in international journals for the convenience sake we have illustrated six rings. Three are double rings and three single rings. The double rings are indicating clubbed regions like Western and Eastern Europe, Middle East and Africa and Asia Oceania. The respective contribution was as follows, Asia Pacific 16%, Asia Oceania 6%, Latin America 2%, North America 23%, Middle East & Africa 2%, Western Europe 46% and Eastern Europe 5% in figure 2.12.

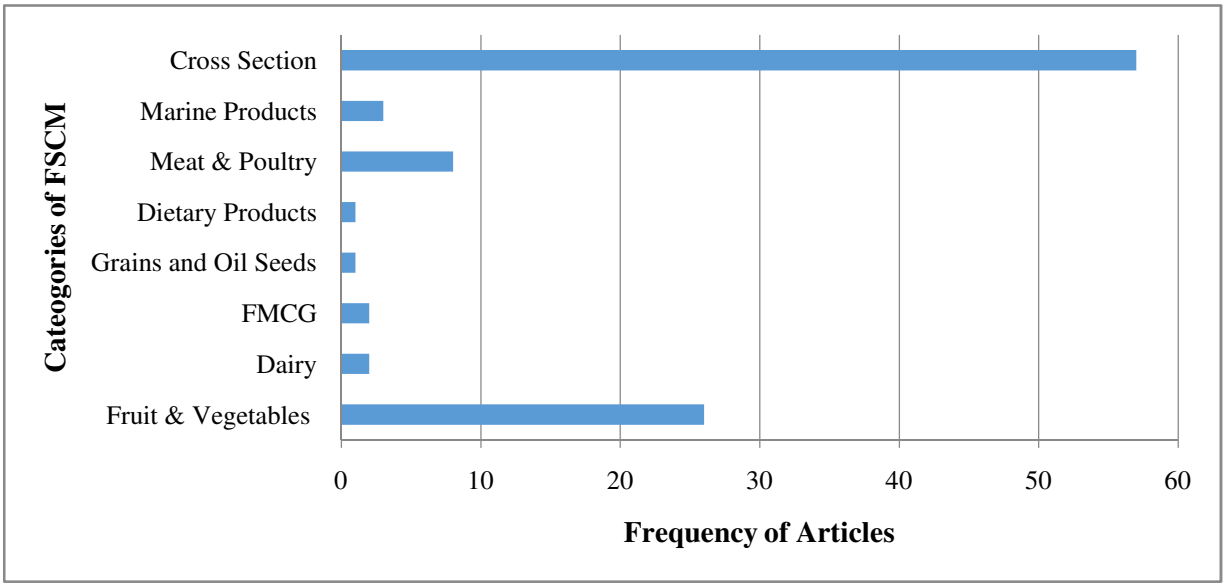

Figure 2.11 Broad Research Categories of FSCM

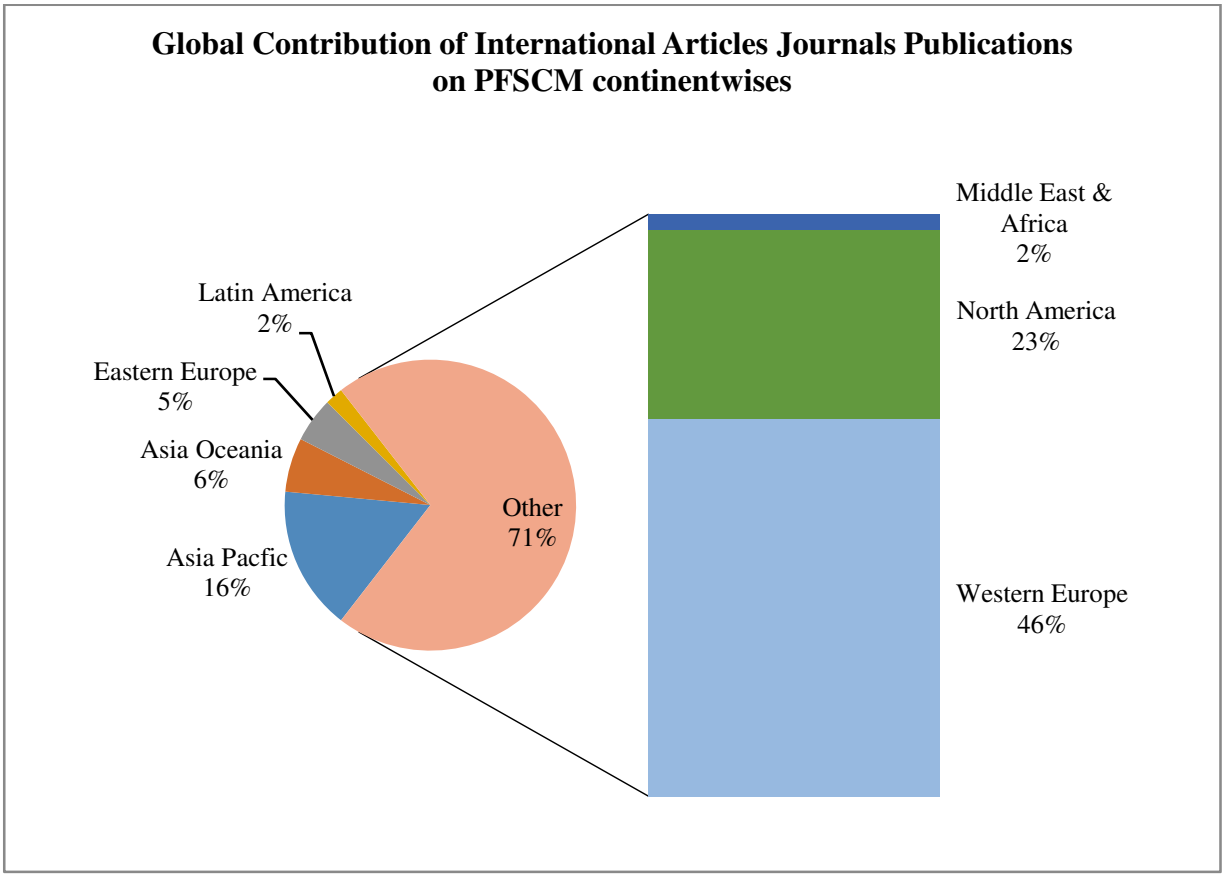

Figure 2.12 Global Contributions of Authors in International Journals Publications on FSCM

Figure 2.13, shows the nation wise contribution of research in the FSCM, which reflects the country focus on the food supply chain research activities. The maximum contribution has been done by British authors 22%, followed by North American authors 15%, Australian

authors 6%, Canadian, Chinese and Netherland authors 5%, Finland, Italy, Norway, Taiwan, New Zealand and Indian authors 3%, Belgium, Denmark, Germany, Greece, Slovenia, Spain, Sweden and Switzerland 2%, rest of countries authors like Iran, Japan, Malaysia, Philippines, Poland, South Korea, Turkey and UAE had contributed 1% each.

The earth is divided into seven continents geographically. In order to depict the contribution of global publication in international journals for the convenience sake present chapter have illustrated six rings. Three are double ring and three single rings. The double rings are indicating clubbed regions like Western and Eastern Europe, Middle East and Africa and Asia Oceania.

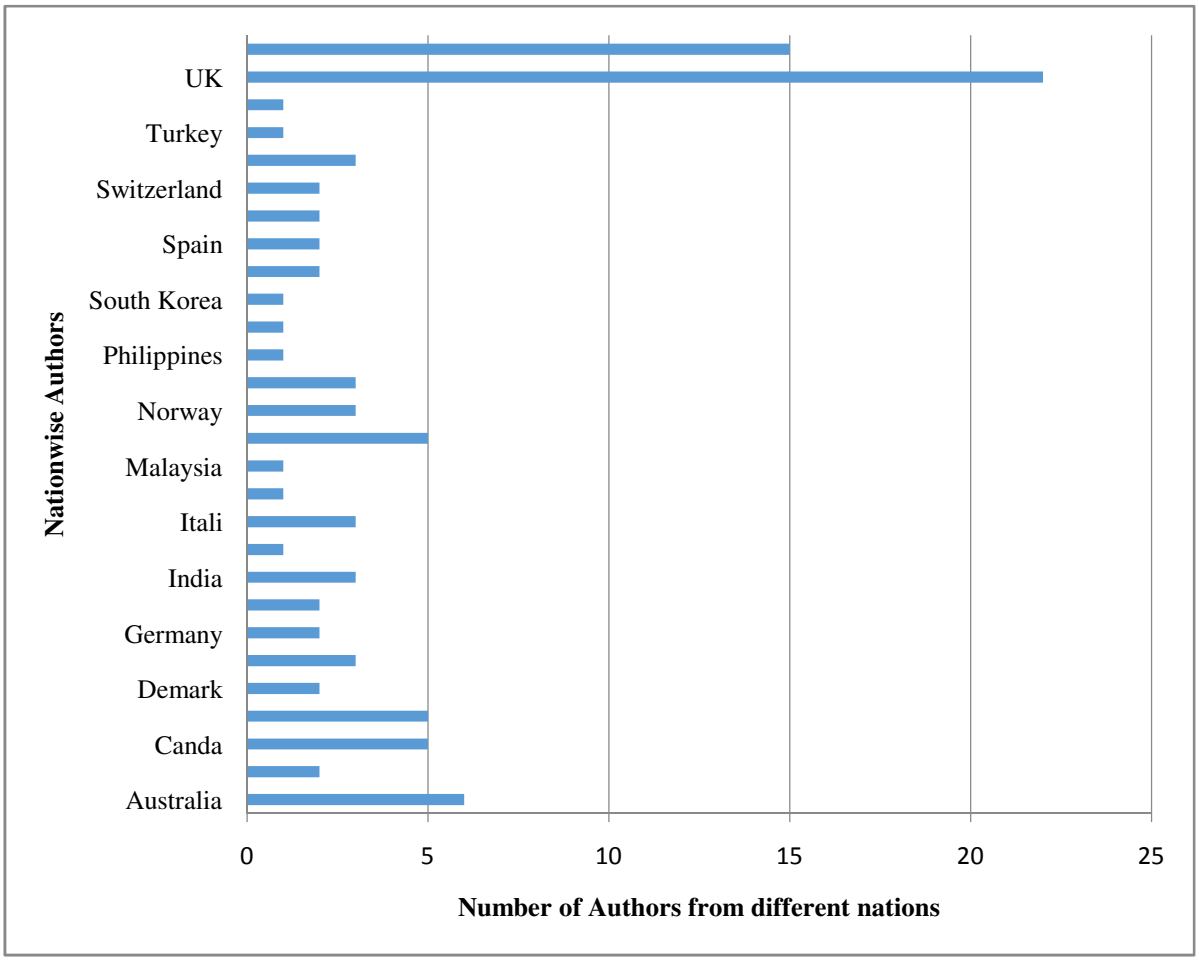

Figure 2.13 Global Contributions of Authors in FSCM Research

Under content orientation a uni-dimensional level view was followed and research papers were classified into three levels: dyadic, chain and network. It illustrates that articles were classified as 12 % dyadic, 11% chain and 77% network level. In India and many other developing nations both poultry and marine sector is characterized by a large number of fish

farms. They are fragmented in nature (Peterson et al. 2000, Cunnigham 2001). The absence of well developed chains may also explain the lack of research. It highlights the need for research to be carried out in these sectors. The dairy sector was also neglected in FSCM literature. The highest numbers of articles were from F&V sector. The broad areas of processed food research have been presented in table 2.4.

Table 2.4 Research Themes of Processed Food Supply Chain

Areas of Processed Food Research	
Sourcing	• Farmers cooperation's • Growers/Supplier collaboration and Growers Market Assess • Agri Products Quality • Supplier selection • Contracts or Trust • Global procurement • Market sanctions, monitoring and vertical coordination within retailer-manufacturer relationships
Manufacturing or Processing	• Meat, poultry, sea food processing • High pressure food processing • Consumers' attitudes towards high pressure freezing of food • Techniques of Food Processing like IQF, Heating etc. • Effects of emerging food processing techniques • Categorizing genetically modified food products • Trends in food manufacturing and packaging • Exploratory framework of the role of inventory and warehousing in • Global SCM
Storage-and Warehousing	• Cold Chain Management • Fruit and vegetable ripening chambers • Dimensional issues in agricultural warehouse designs • Centralized warehousing facilities • Features of storage and warehousing different geographies wise • Customer service: the distribution of seasonal food products
Distribution	• Third party distribution • Reducing the delivery lead time in a food distribution SME • Food Brokers in the Distribution Channel • Decision making of distributor channels centralized or decentralized • Geography wise research on distribution channels • Building alternative agro food network of distribution • Role of channels in promotion of food products • Retail history in the management context

Retail Management	• Retail Change and logistics case studies • International retail research • Developing a framework to improve retail category • Retail planning management • FDI in Retail • shelf replenishment with backroom monitoring in retail stores • Consumer Behavior studies on food
Consumers Behavior	• Factors influencing organic food purchase in various geographies • Monitoring consumer confidence food SCM • Demand-supply variation or price discrimination • Consumer demand for informative labeling of quality food and drink products • Impact of the Internet on consumers, online sales • role of food quality certification on consumers' food choices • World Trade Organization(WTO), Global Gap etc. observers on Food Safety
Food Safety, Observers	• Food Safety – Practices and Policies • The economics of food safety • Capacity Building: Harmonization and Achieving Food Safety • Ensuring Global Food Safety and HACCP • Food Safety initiatives geographies wise • Food safety: where from and where to ? • Traceability – Problem or Opportunity
IT and Traceability	• RFID-based traceability in the supply chain • Traceability as part of competitive strategy in the Food supply chain • Information asymmetry and traceability incentives for food • Business process reengineering of a supply chain and a traceability system • Electronically-enabled SCM • Information technology in agri FSCM • Supply chain management practices- Geographic Region wise
SCM and Logistics	• Performance measurement in agri supply chains • Value chain analysis • Challenges in Global food supply chains: vertical co-ordination • Collaborative practices in the logistics channel • Logistics behavior of small enterprises • logistics outsourcing in food supply chain networks • Logistics Transportation Vehicles systems • Multimodal transportation, logistics and the environment

The respective contribution was as followed, Asia Pacific 16%, Asia Oceania 6%, Latin America 2%, North America 23%, Middle East & Africa 2%, Western Europe 46% and Eastern Europe 5%. The 69% of authors were from North America and Western Europe.

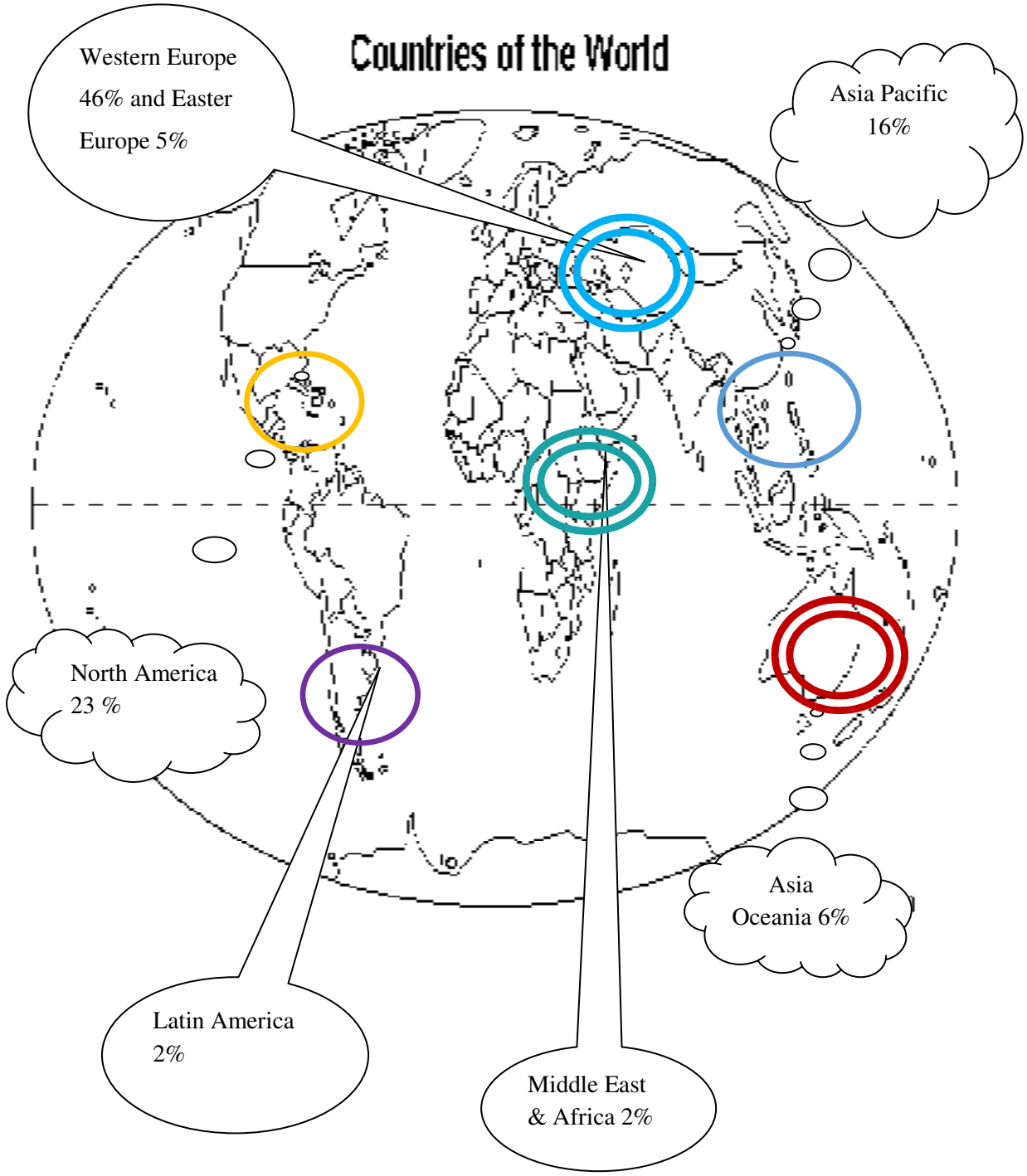

Figure 2.14. Peer Reviewed Articles Geographywise

The tools used in the FSCM research are presented in figure 2.15. FSCM, broadly utilized ten types of tools to perform research. The most favorite research tool emerged out to be qualitative research 35% followed by case study method 28%, descriptive statistics 11%, economic modeling 8%, ANOVA 7%, regression analysis, Pearson's correlation 3% each, chi square, fuzzy logic 2% and logit regression 1%.

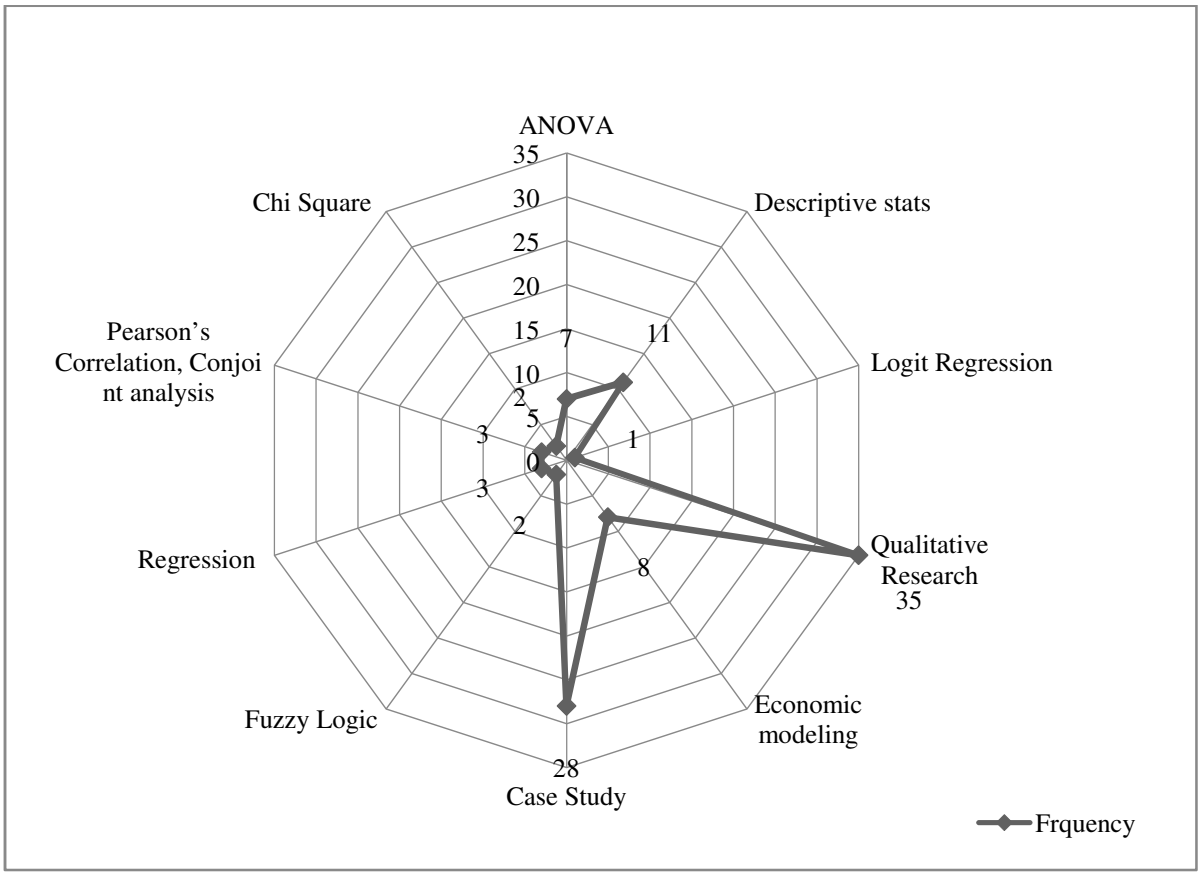

Figure 2.15 Popular Research Tools in FSCM

In figure 2.15, shows popular research tools used in most of FSCM, broadly there are ten types of tools being used to perform a research in food supply chain management. The most favorite research tool emerged out to be qualitative research 35% followed by case study method 28%, descriptive statistics 11%, economic modeling 8%, ANOVA 7%, regression analysis, Pearson's correlation 3% each, chi square, fuzzy logic 2% and logit regression 1%.

2.6 Gap Analysis in Literature

Based on literature review, the major gaps identified are illustrated in table 2.5:

These gaps offered an opportunity for present research on processed food supply chain management. There is vast scope in this area due to the fact that processed food supply chain encompasses a wide range of activities, where integration reflects the reality of business activities. The effectiveness of processed food supply chain is highly dependent on technological inputs such as use of IT tools in support of logistics of PFSCM.

Table 2.5 Key Identified Gaps in Literature

S.No	Key Identified Gap	Another's Contribution	Research to bridge gap
1.	Very few studies in Indian context. Most of them are in the developed countries like United States of America, Britain, and Australia etc. Therefore, processor had to conform to stringent legal standards, large retailers who dominated the food market at the end of the 20th century. Public health and related consumer needs have been central to these standards. The most of studies covering this matter are from outside Indian preview	Welch and Mitchell (2000)	A comprehensive empirical survey based study on Study of Supply Chain Management Practices of Indian Processed Food Industry has been conducted in present research, covers scope of food safety standards in India w.r.t. global food standards.
2.	Limited literature on application of IT in PFS and implementation of IT at grass route level for an effective PFSCM. A huge depositary of literature available on role of IT in supply chain in general not in case of processed food. Even though it is limited in discussions on its implication on one two issues of SCM i.e. strategies and top end techniques but not for entirely. The implementation of IT system at grass route level for an effective PFSCM has not received attention from researchers and practitioners.	Gunasekaran and Negi (2003)	A comprehensive empirical survey based study on Study of Supply Chain Management Practices of Indian Processed Food-Industry has been conducted in present research.
3.	Standalone studies on FSCM conducted mostly in foreign setting	Verbeke and Viaene, 1998	Therefore, the combination of empirical, case study and descriptive research planned and conducted presently to bridge research gap.
4.	Few studies on performance management system for PFS. Largely PMS requirement felt from metrics, tactical and functional. Because mainly three reasons such as lack of balanced approach, lack of understanding on deciding on number of metrics to used, lack of clear distinction among metrics at strategic, tactical and functional levels.	Gunasekaran et al., 2001	A empirically supported balanced score card was developed specially for processed food sector organizations in the present research work.

2.7 Conclusion

In this chapter a comprehensive review of literature was dealt with. The review has supported the claim of sudden increase in research articles on FSCM illustrated in figure 2.8. The research resides in narrow functional silos such as cold chain, agri supply chain etc. Having recognized this gap in the knowledge base of FSCM and in order to develop a better understanding of the subject matter, two way approach was adopted to fill the knowledge gap. Firstly, an attempt to craft a framework for the categorisation of literature linked to processed food supply chain management and to contribute in food research for the benefit of researchers, academicians and corporate. Secondly, to present a commentary of systematically selected, studied, analyzed research papers.

CHAPTER – 3

ADVANTAGES, CONSTRAINTS AND COUNTER MEASURES FOR THE GROWTH OF PFS IN INDIA

3.1 Introduction

The processed food supply chains are complex in nature. Processed Food Supply Chain Management (PFSCM) whether local or global, creates its pathways from farms to consumers, involving production, processing, distribution, and even the disposal of food (Boehlje, 1999; Aramyan et al., 2006; Trienekens and Zuurbier, 2008; Ahumada and Villalobos, 2009). Firms are increasingly extending their reach deeper into the supply chain. It is required for firms' survival and operating within more complex and dynamic networks (Mena et al. 2013, Choi and Linton, 2011; Pagell, Wu, and Wasserman, 2010). Consumers expectation of year-around availability of food products has encouraged the globalization of food markets (Trienekens and Zuurbier, 2008; Ahumada and Villalobos, 2009). United States is ranked number one as both importer and exporter in the international trade of horticultural commodities, accounting for about 18% of the $44 billion global horticultural trade even a decade ago (Cook, 2002). There is growing global competition coupled with the associated greater distances between food production and consumption locations (Ahumada and Villalobos, 2009). The pressure of the integration of food production and distribution along the chain is increasing (Boehlje, 1999) and hence, it creates new challenges for food supply chain modelling and management, analysis and solutions (Li, Sheng and Liu, 2010).

Food supply chains are distinct from general supply chains. The fundamental difference between food supply chains and other supply chains is the continuous and significant change in the quality of food products throughout the entire supply chain until the points of final consumption (Sloof et al., 1996; Lowe and Preckel, 2004; Blackburn and Scudder, 2009; Akkerman et al., 2010; Aiello et al., 2012). Markets allow for product differentiation due to product freshness and food safety concerns as well as the evaluation of alternative technologies associated with various supply chain activities

Note: An Illustration of Logistic Regression Technique: A Case of Processed Food Sector, for publication in International Journal of Business Excellence (Inderscience), accepted for publication.

(YU et al., 2013). In order to understand the various aspects of PFSCM, a questionnaire based empirical research was performed. The results of empirical research are discussed in the present chapter.

3.2 Questionnaire Development and Administration

To address the issues related to supply chain management practices of Indian processed food industry to enhance domestic demand and export potential and to gauge the status of Indian PFSCM, a questionnaire based survey was conducted. The questionnaire was designed keeping in view the available literature and experts' opinion. The experts such as corporate managers, researchers and academicians working on supply chain and food research were consulted during forming and development of questionnaire. The response rate of such surveys was not enthusiastic in past. The respondents were generally reluctant to spare time in responding to questionnaires. It is because the questions in the present questionnaire were kept closed ended requiring lesser time and efforts to fill the questionnaire. The questionnaire had four parts, part A was on the advantages, constraints and counter measures of processed food sector, part B dealt with schemes to promote processed food sector by Ministry of Food Processing Industries (MOFPI) and food safety codex standard, part C raised crucial logistic issues and performance measures for PFSCM and part D sought to get the profile of the respondents.

The questionnaire was administered by sending emails with a cover letter to the relevant and identified respondents (Lagerkvist et al., 2013). In the covering letter the purpose of the study was clearly stated along with declaration on voluntary participation and sharing detailed information about the research. It was declared that confidentially and information of participants ought to be preserved (Flower, 2009). The appointments were fixed through emails and phone for getting the positive response. The personal interviews were scheduled and conducted to collected data. During personal interview the respondents were asked to rate the intensity of each factor on a five-point likert scale (1-strongly disagree, 5-strongly agree for example). The respondents from corporate were selected from the directories of All India Food Processors Association (AIFPA), Confederation of Indian Industries (CII), Associated Chambers of Commerce and Industry of India (ASSOCHAM) etc. In order to collect data, 1000 supply chain professionals were contacted to seek their response to the

questionnaire and 252 responses were collected from Delhi and neighbouring areas. The response rate emerged out to be 25.2%. The survey was conducted from March 2011 to April 2012. The respondents profile and part of the results related to advantages, constraints and counter measures for the growth of PFS are presented in next section.

3.3 Respondents Profile

Vast arrays of respondents were covered in the survey to get the opinion from different perspectives. The respondents were divided into ten different categories and the number of respondents in each category is depicted in figure 3.1. Since the key stakeholders in the PFS are manufacturers, 49% respondents were from this category. Further 9% respondents were distributors, 5% from retailers, 4% from logistics providers, 4% from cold storage service providers and 4% from farmers. A small percentage i.e. 2% was consumers. In the survey researchers, academicians and business associations were also included and their percentages were 13%, 7% and 3% respectively.

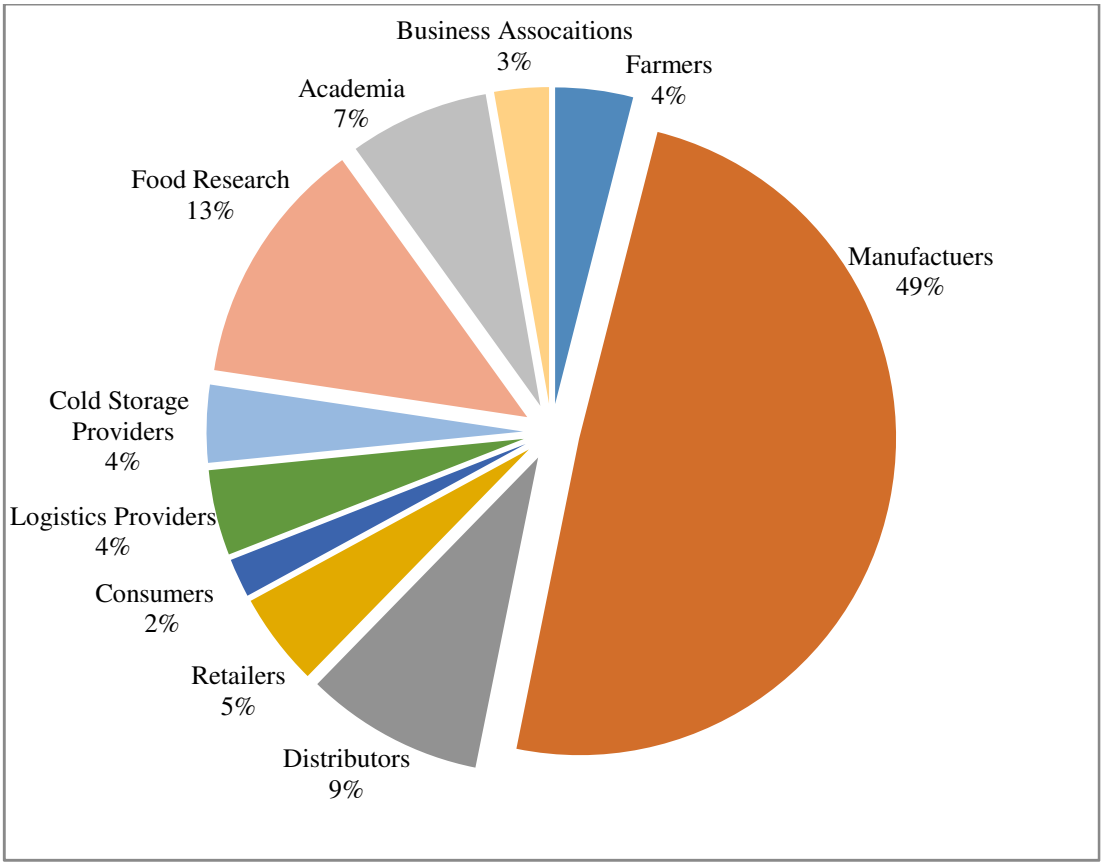

Figure 3.1 Categories of Respondents

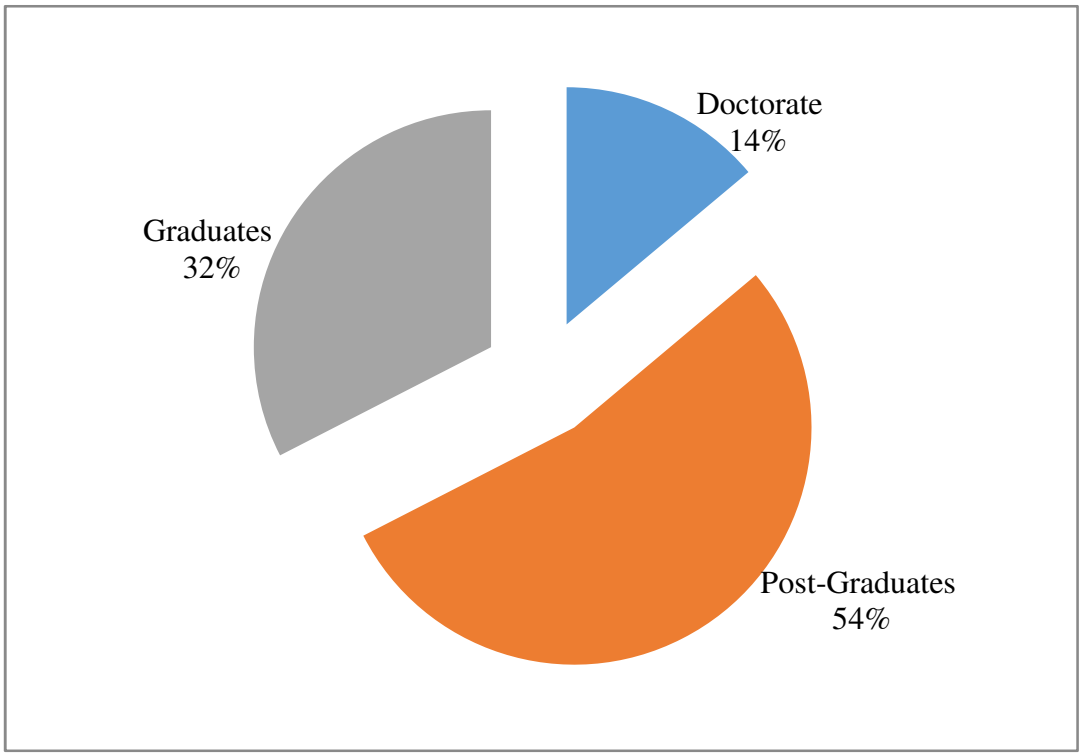

Figure 3.2 Qualifications of Respondents

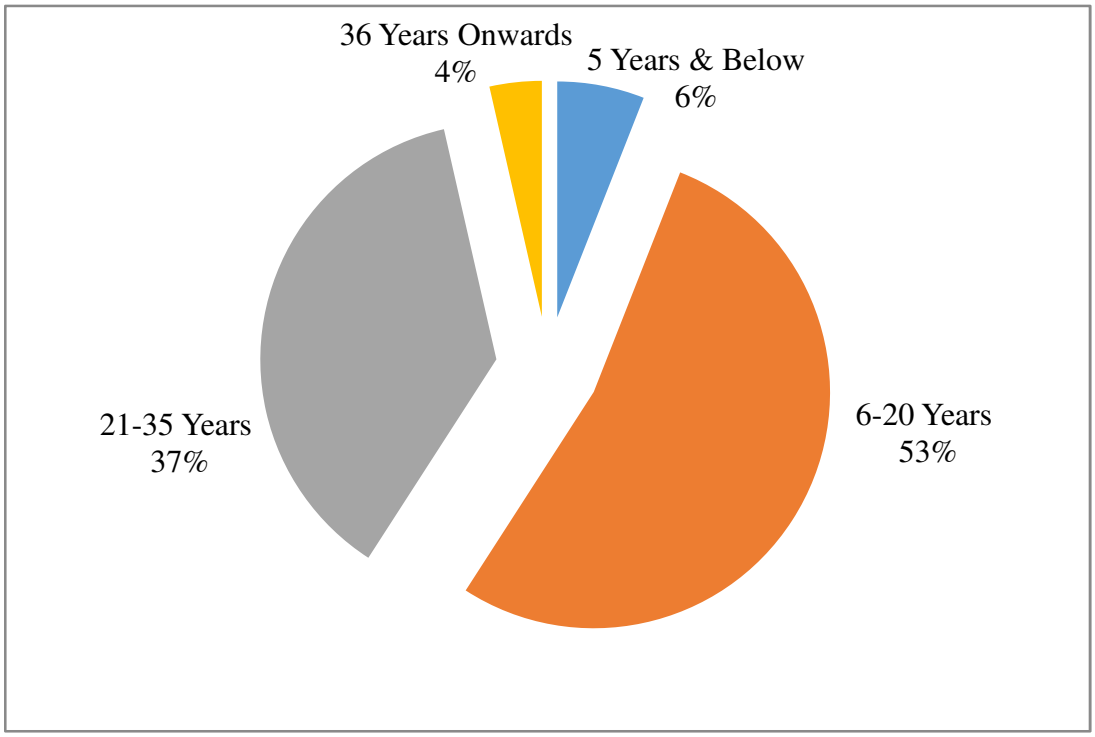

Figure 3.3 Experience of Respondents

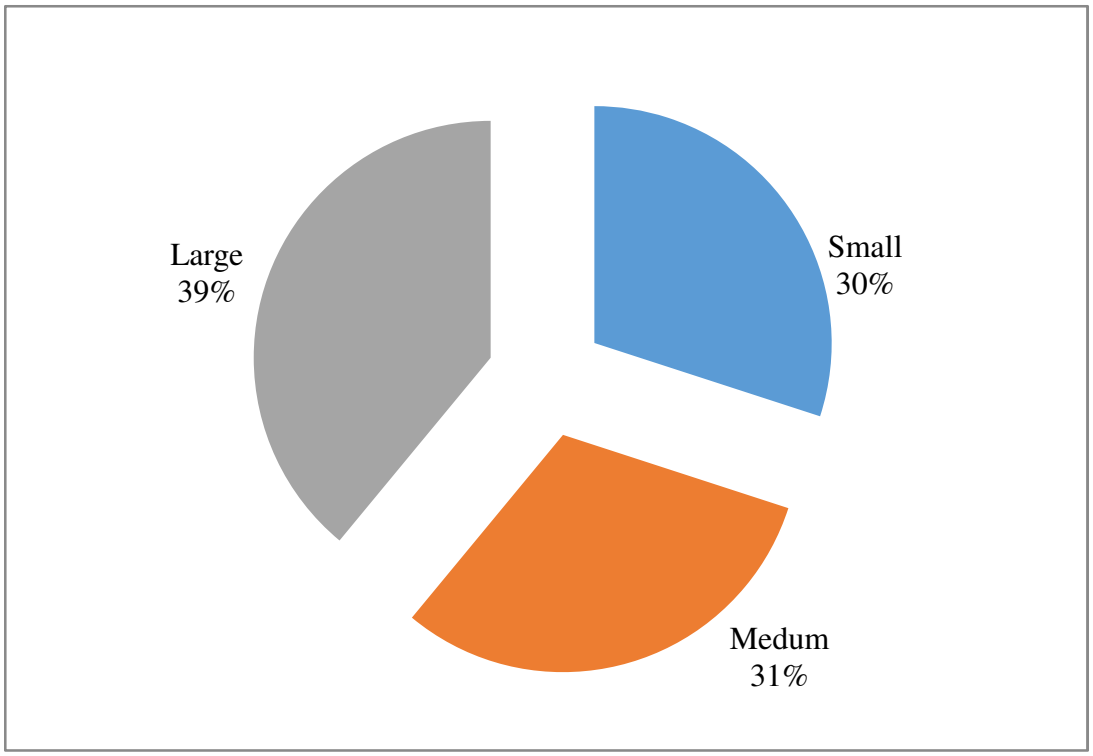

Figure 3.4 Size of Organization of Respondents

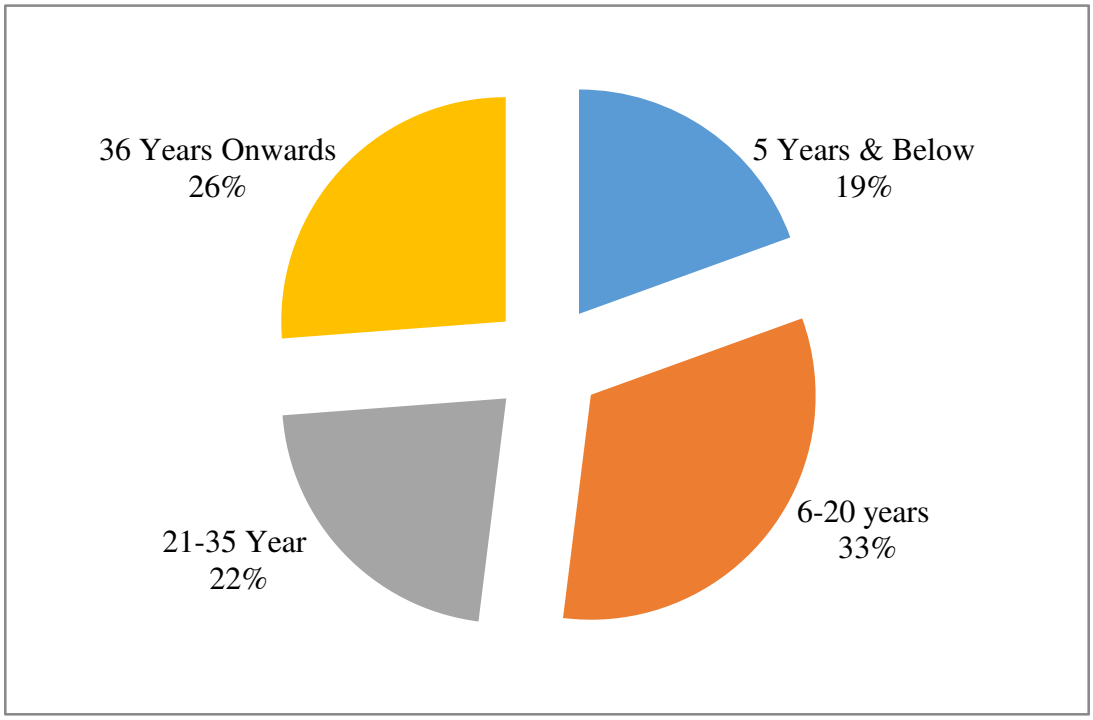

Figure 3.5 Age of Organisation of Respondents

The figure 3.2 depicts respondents' qualifications. It states that 54% respondents were post graduates, 32 % graduates and 14% Ph.D doctors. Figure 3.3, illustrates the experience of respondents 6% with 5 years and below, 53% with 6-20 years, 37% with 21-35 years and 4% with more than 36 years experience. The figure 3.4, illustrates size of respondent's organization. It was categorized into three types: 30% small organizations having employees 10 or less; 31% medium with 11-100 employees and 39% large with employees more than 100. The figure 3.5, illustrated the age of the responding organizations. They were grouped into four categories: 5 years and less (19 %), 6-20 years (33%), 21-35 years (22%), more than 36 years (26%).

3.4 Structure and Content Validation of Questionnaire

Validity refers to determining that an instrument measures accurately the content or variables that it was designed to measure. The survey instrument questions were designed to extract accurate measurements for the structure or constructs and key variables while the parameters of instruments were carefully examined (Brown, 2007).

The questionnaire was tested for the two type of validity.

1. Content Validity
2. Construct or structure Validity

The content validity represents the adequacy with which a specified domain of content was sampled (Nunally, 1978). The instrument has items that cover all the aspects of the variables being measured. The content validity cannot be determined numerically. It can be determined subjectively and on judgemental bases. It primarily depends on an appeal to the prosperity of content and manner of presentation (Nunally, 1978). The questionnaire instrument developed for the present study on PFSCM demonstrates the content validation as the selection of measurement items were based on both, an exhaustive review of literature on processed food and detailed evaluation by the corporate practitioners and academicians during the pre-testing phase of questionnaire. The content validity was further tested during pilot survey as per the guidelines by Forza (2002). The careful review was done of the answers given

by respondents during pilot survey. The few important changes were made in the use of terminology and sequencing of questions as suggested by experts during the pilot testing. A likert scale was utilized to create an ordinal scale (Trochim, 2006), for the construct statements to record the scores as perceived by respondents. The operational definitions were provided to help specially the rules of assigning the numbers that represent the opinion of participants (Zikmund, 2003). The survey instrument was designed to reflect the elements of research topic and contracts. The following steps were followed to assure construct of instrument validation.

1. The survey instrument questions were designed to extract accurate measurements for the constructs and key variables.
2. The parameters of the instrument were excreted learning's from extensive review of literatures and experts opinion.
3. A pilot test to determine the suitability of the instrument was conducted after tested on to the 30 respondents. The final questionnaire was developed through incorporating suggestions received in pilot testing.
4. The instrument face and content validity were examined through a field test and pilot test to determine accurate interpretation of design of questions.
5. Randomization was assured by distributing the survey without targeting a particular group of people, places or times by using convenient sampling.

3.5 Non Response Bias

The response rate was expedite through soft reminder emails and phone calls. Therefore, it is quite interested to look at the issue of non response bias. One suitable test on response bias is to compare the answers of early and late respondents (Lambert and Harrington, 1990). The logic behind this is to check the later respondents more likely to fill the questionnaire just for the sake of filling it (Armstong and Overton (1977), Donaldson and Grant-Vallone (2002), Lagerkvist et al. (2013)). Therefore, responses which were received after sending the one or two reminders compared with the earlier responses received without any reminder. The forty three responses were received late after reminder in present research. It was observed that they did not significantly differ from the early responses. Therefore, non response bias in the current research is ruled out.

3.6 Reliability of the Questionnaire Survey

Reliability implies that data collected through survey is dependable for analysis. Therefore, purpose of research will be fulfilled and bring fruitful results. Cronbach's alpha was calculated to test the reliability and internal consistency of responses. Alpha with a value of more than 0.5 is considered as adequate for such exploratory work (Nunally, 1978). The value of Crobach's alpha for all the questions has been found to be more than 0.5 (except question A4) with an average 0.70, whereas the consolidated value for the research questionnaire is 9.28. This implies a high degree of trend consistency in the responses to the questionnaire and thus a high degree of reliability. The cronbach's alpha of all the questions is presented in table 3.1.

Table 3.1 Internal Consistency of the Responses

Q.No.	Key Concern	No. of Items	Cronback's Alpha
A1	Benefits to the consumers of processed foods(PF)	7	.514
A2	Advantages of processed food to Indian economy	6	.713
A3	Advantages of processed food sector to Farmers	6	.718
A4	Reasons for low popularity of PF in India	6	.463
A5	Reasons for low Indian exports of PF	8	.544
A6	Percentage of consumer spent on PF	6	.713
A7	Reasons for high cost of PF in India	9	.541
A8	Reasons for low quality of PF in India	7	.611
A9	Suggestions to enhance domestic sale and export of PF	6	.514
B1	Processed food Categories in India	28	.802
B2	MOFPI promotional schemes for Indian PFS	9	.838
B3	Food safety standards: Codex Standards	5	.528
B4	Private food safety standards imposed by Retailer	5	.747
C1	Crucial logistics issues	16	.808
C2	IT tools support logistics of processed food	Qualitative Response	
C3	Environmentally efficient PFSCM	12	.743
C4	Performance Measurement System for PFSCM	43	.919

3.7 Different Aspect of PFS in India

Descriptive analysis is presented for different aspects of the PFS in following section. The descriptive analysis deals with summary measures relating to the sample data. The common ways of summarizing data are by calculating frequency, percentage, mean, range and standard deviation. In the present research context, mean and standard deviation (SD) is calculated and analyzed. S.D. is used as a measure of dispersion (Chawla 2011, Zikmund 2003). The data collected through research questionnaire was digitized in IBM's Statistical Package for Social Sciences (SSPS) version 21.

3.7.1 Benefits to Consumers of Processed Foods

Consumer decision-making in relation to food is known to be largely influenced by habitual, symbolic and emotional aspects as well as characterised by a relatively low level of involvement (Costa et al., 2003; Grunert et al., 1996; Steenkamp, 1997, Chen, 2012, Bonaiuto et al 2012).

The means-end-chain approach (MEC) (Gutman, 1982) is useful when looking not only at attributes and their valence but also at how these valences can be explained institutively and their consequences for the consumer. Consumer decision-making in relation to food is known to be largely influenced by habitual, symbolic and emotional aspects as well as characterised by a relatively low level of involvement. MEC theory assumes that consumers do not buy products for the sake of it, but for the benefits that can be gained from its consumption. By analyzing the link between the consumer and the product the MEC approach attempts to reveal the often hidden motives behind consumer choices (Grunert, 2010).

Standard deviation (S.D.) is a measure of how the spread out of data points. A set with a low S.D. has most of the data points centred surrounding the average. A set with a high S.D. has data points that are not so clustered around the average (Chawla 2011, Zikmund, 2003).

The respondents were asked to rank the benefits of processed food to the consumers on the five point Likert scale (1 stands for strongly disagree and 5 for strongly agree). The results are presented in figure 3.6. Most of the respondents ranked the easy to

cook (4.23 mean score on a scale of 5) feature of processed food as the major benefit for consumers. The other benefits like easy to store, longer shelf life (4.22), availability throughout the year (4.18), low wastage (4.13) are also rated as the major benefits. Benefits like more delicious taste (3.83) and high nutrition value (2.65) emerges relatively lesser benefited for consumers of processed food. There can be two reasons for low ranking to high nutrition value. First, can be that the processed foods core benefits failed to attract Indian consumers and second lot require to be done to improve products and supply chains to build confidence. It can also be observed that there was maximum variation in the features like high nutrition value (SD=1.27) and more delicious taste (SD=0.97). It indicates that significant variation in adoption of processed food by Indian consumers in place of fresh food.

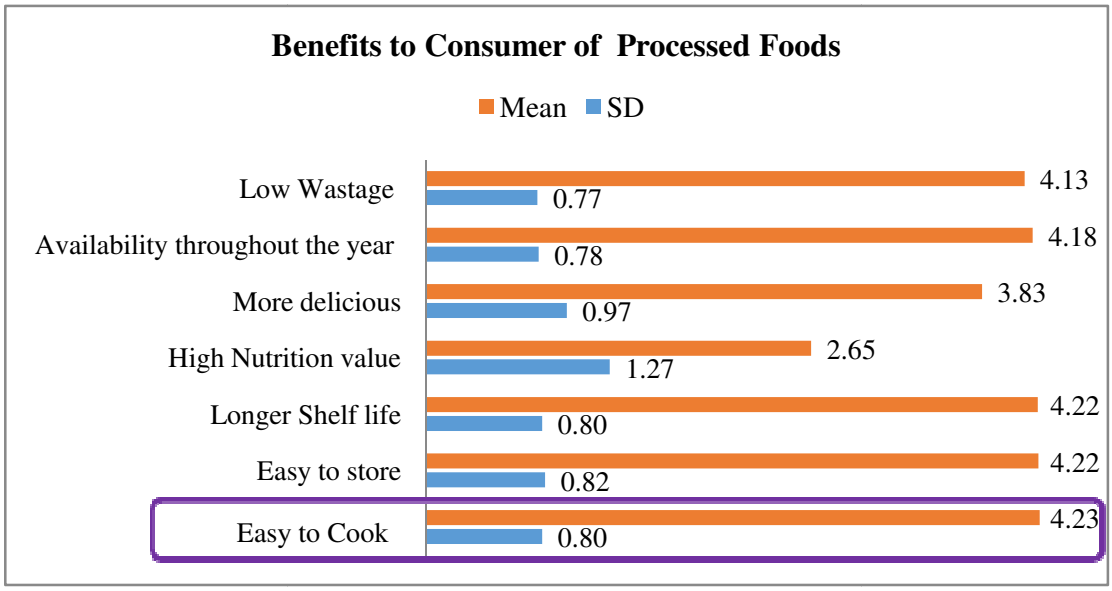

Figure 3.6 Benefits to the Consumer of Processed Foods

3.7.2 Advantages of Processed Food to Indian Economy

Indian economy is highly dependent on agriculture sector both in terms of contribution to GDP and employment. India is the second largest agri producer, but the basic challenges are wastage of food grains, fruits and vegetables, low income to farmers due to lack of warehousing and processing infrastructure and inadequate distribution system.

Therefore, if above mentioned issues of food wastage is resolved through creation of appropriate food supply chain and adherence to SPS-WTO food safety standards then

European market can be the most important destination for local agro-food exports. It will further strengthen Indian economic condition through earning foreign currency (Neeliah et at., 2013). It will support economic development of India. In the present survey, the opinion of the respondents was taken on the advantages of the PFS in improving the above mentioned parameters of Indian economy. The results are shown in figure 3.7. The maximum mean score was earned by reduction in wastage of agri produce (4.04), followed by improved employment in rural and urban India (3.80), earning foreign exchange (3.69), high income for the farmers (3.63), industrialization of rural India (3.62) and better food security (3.31). It is observed that highest variation is reported for better food security (SD=1.24) and high income for famers (SD=1.04).

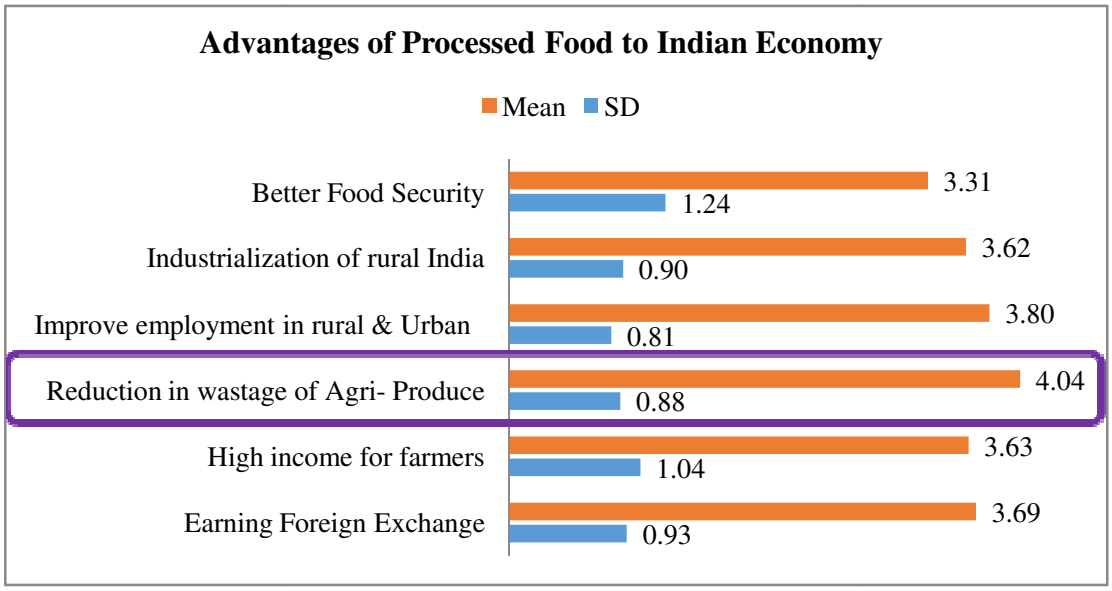

Figure 3.7 Advantages of Processed Food to Indian Economy

3.7.3 Advantages of Processed Food Sector to Farmers

Increasing globalization has brought the inflow of capital, technology and information to enhance vertical integration in food supply chain management (FSCM) (Reardon and Barrett, 2000). In the present survey respondents were asked to rate the advantages of processed food sector to farmers. The results of their response are depicted in figure 3.8. The respondents rated reduction in wastage of fresh produce as the most important advantage for farmer with mean score (4.24), followed by evolution in contract farming (4.16), ensured regular purchase and use of advance

farming techniques (4.01). The advantages for farmers like improved yield had mean score (3.87) and higher income for farmers (3.78). It implies that first the primary advantages will be achieved then the trickle down effects automatically leads to enhance economics status of farmers. It can be further observed that highest variation in opinion is for the high income for farmers with standard deviation of 0.99. Globalization had provided farmers altogether different market channels and facilities. It had helped the farmers to look beyond the traditional spot market and sell their produce in a global market at a competitive price and increase their income. It brought in funds which triggered the consolidation of the food organization (processers, retailers, etc.) and farms. This gave rise to funding in research and development, automation and development of innovative farm and processing practices (Shukla et al., 2013).

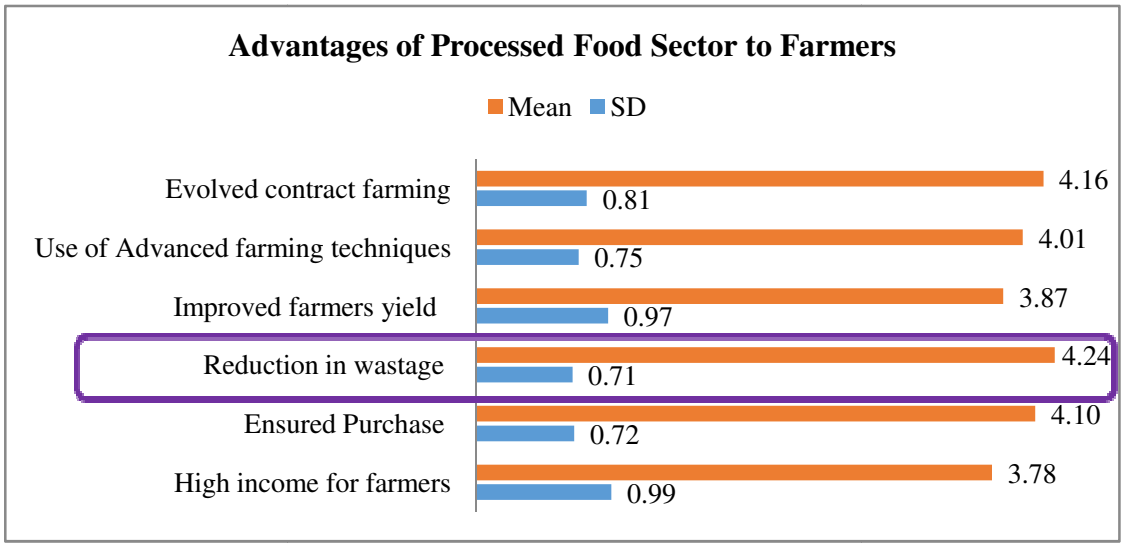

Figure 3.8 Advantages of Processed Food Sector to Farmers

3.7.4 Reasons for Low Popularity of Processed Food in India

The food industry is more traditional unlike other sectors e.g white goods industry. Ravichandran (2010), discussed that processed is unpopular because of consumer awareness and Government of India (GOI) lesser favourable policies for its growth. In 2003, the WHO/FAO released an expert consultation diet, nutrition and the prevention of chronic diseases which reported that there was convincing evidence that weight gain is associated with a high intake of energy-dense, micronutrient-poor foods. The experts also found probable evidence linking weight gain to heavy marketing of energy-dense

foods and fast food outlets and high intake of sugars-sweetened soft drinks. In the current survey an attempt has been made to understand why processed food is less popular in India and the results are presented in figure 3.9. Six probable reasons of low popularity were identified from literature, discussions with academicians and processed food sector experts. The respondents were asked to rate these factors. Three most widely accepted reasons of low popularity had been pointed out. These are culture and consumer preferences with mean score of (4.40), high price of processed food (4.32) and easy availability of fresh food (4.29). It can be infer that the promotion of processed food in India is unable to convince the consumers for its benefits. Even though it is true that top six social trends fuelling changes in food consumption were rising use of convenience and prepared food, aggressive food marketing and growing availability of and access to food. Dixon et al., (2006) gave description of convenience food that led consumers to define the category as the domestic outsourcing, food planning, preparation or cooking.

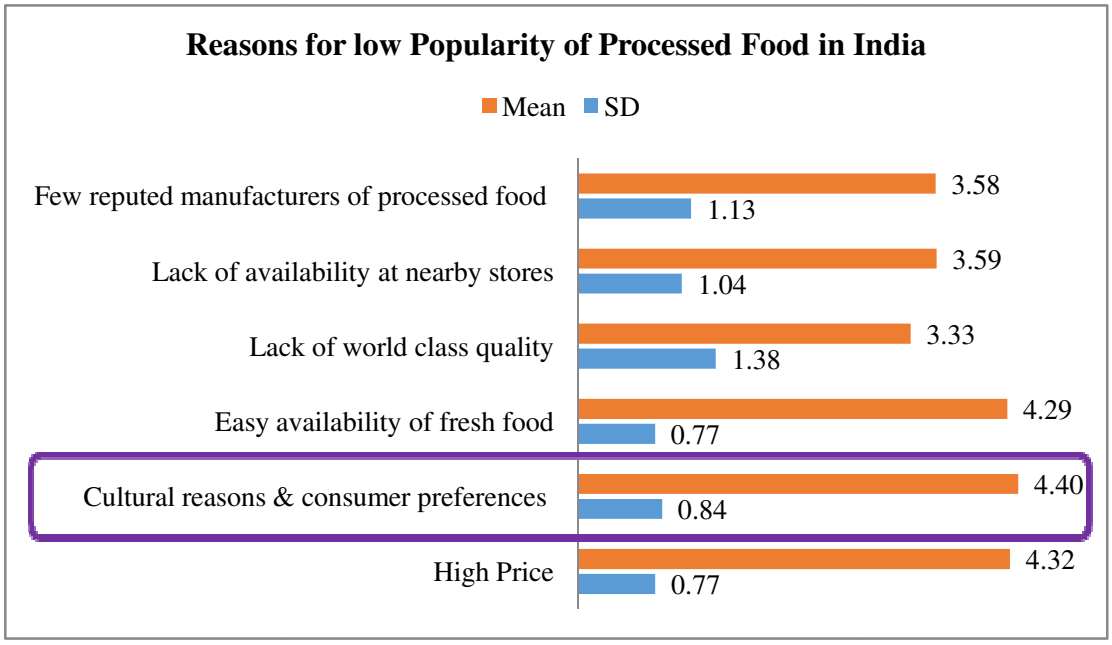

Figure 3.9 Reasons for Low Popularity of Processed Food in India

3.7.5 Reasons for Low Exports of Processed Food

India has been the world's largest milk producer since 1995, yet not a single Indian dairy company featured in the list of global top 20 dairy companies. Estimates say around 35 to 40 percent of the total production of fresh fruits and vegetables is wasted in India, which is about the total production of the Great Britain (Khan, 2005). Even at

current level of production, farm produce valued at ₹50,000 crores is being wasted every year only because there is no adequate storage, transportation, cold chain facilities and other infrastructure supports (Viswanadham, 2006). As traditional market access barriers, such as tariffs and quotas, have fallen in many countries over recent decades, attention has increasingly turned to other regulatory measures that have the potential to act as trade barriers. Whereas, the nontariff barriers are new means to protect the national interests of advance economies by imposing food safety standards and certification. That results in cost elevation of food products from developing nations resulting in non competitive in exports from them (Disdier et al. 2008, Shepherd, 2013). The eight reasons for low processed food exports were analyzed through data gathered in survey shown in figure 3.10. It had been observed that major reasons with mean score like lack of end to end cold chain (4.46), required high investment (4.14) and high cost of manufacturing (4.10) and closely followed by trade barriers erected by most of advance economies against Indian food products exports on pile of food safety issues. The maximum variation was depicted by lack of world class quality of processed food available in India (1.51). India's geographical situation gives the unique advantage of connectivity to Europe, the Middle East, Japan, Singapore, Thailand, Malaysia and Korea. India is able exports limited processed food. It is because of lack of suitable processing, good grade varieties, low yield, and inadequate preservation. It is the major reason less competitive and higher cost in foreign trade (Joshi et al. 2009).

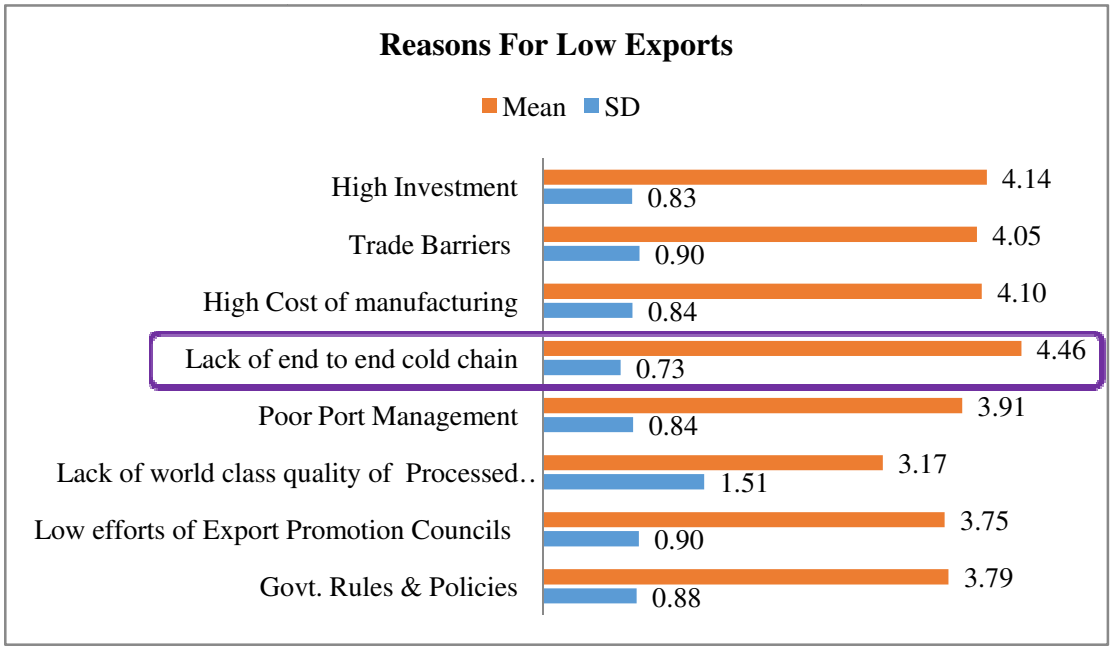

Figure 3.10 Reasons for Low Exports of Processed Food from India

3.7.6 Reasons for High Cost of Processed Food in India

The long and fragmented supply chain begins right from farm to mandi to processors to distributors and ends at retailers. There are many points of intermediation and disconnect in the whole network. Therefore, miss-match between demand and supply, limited choice offered to consumers, unacceptable wastage, unavoidable cost escalations and opportunistic profiteering bond to happen. In the process all qualities and grades also get mixed up. In addition distribution and intermediation increases the end consumer price by 15% to 30%. On the top of it taxes on food in India are very high as compared to international standards. Central and State taxes together increase costs to consumer often by 20-30%. The following nations such as UK, Ireland, Malaysia virtually charge zero tax (MOFPI 2005, Vol.1). The respondents were asked in the survey to rate reasons of high cost of processed food in India. The survey results are depicted in figure 3.11. The high cost of capital implies the credit cost had maximum mean scored (4.31), high rejection/wastages of agri produce (4.25), inadequate application of IT tools (4.22). High cost of raw material (0.96) and high cost of labour (1.95) are not identified as important reason for high cost. The opinion was not taken with respect to taxes and intermediaries from respondents. There response is beneficial for research as they are part of the system.

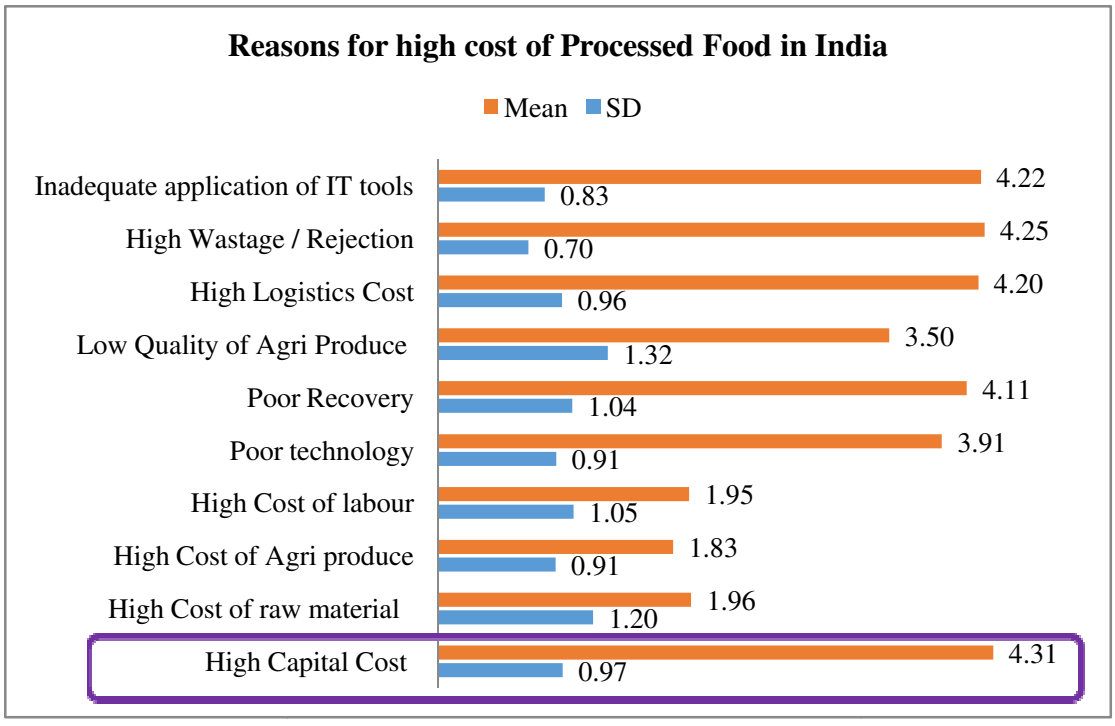

Figure 3.11 Reasons for High Cost of Processed Food in India

3.7.7 Environmentally Efficient PFSCM

The definitions of sustainability found in the literature are increasingly referring to the integration of social, environmental and economic responsibilities (Carter and Rogers, 2008). It explains that true sustainability only occurs at the interaction of all three areas: environmental, social and economic. The sustainability of food chains generally consists of ecological, economic and social dimensions. The fourth dimension suggested in literature is personal health or wellbeing, which is especially important for food consumption activities (Lehtinen, 2012).

In the present survey, respondents were exposed to initiatives, given in figure 3.12, to become environmentally efficient processed food manufacturer. They were further asked to rate them on five point scale from which mean score is calculated and the results are: record keeping in soft instead of hard copy (4.21), design for transportation and warehousing (4.18), scheduling of delivery route and modern transportation for delivery (4.17). The highest variation was shown by using returnable and reusable containers (1.07).

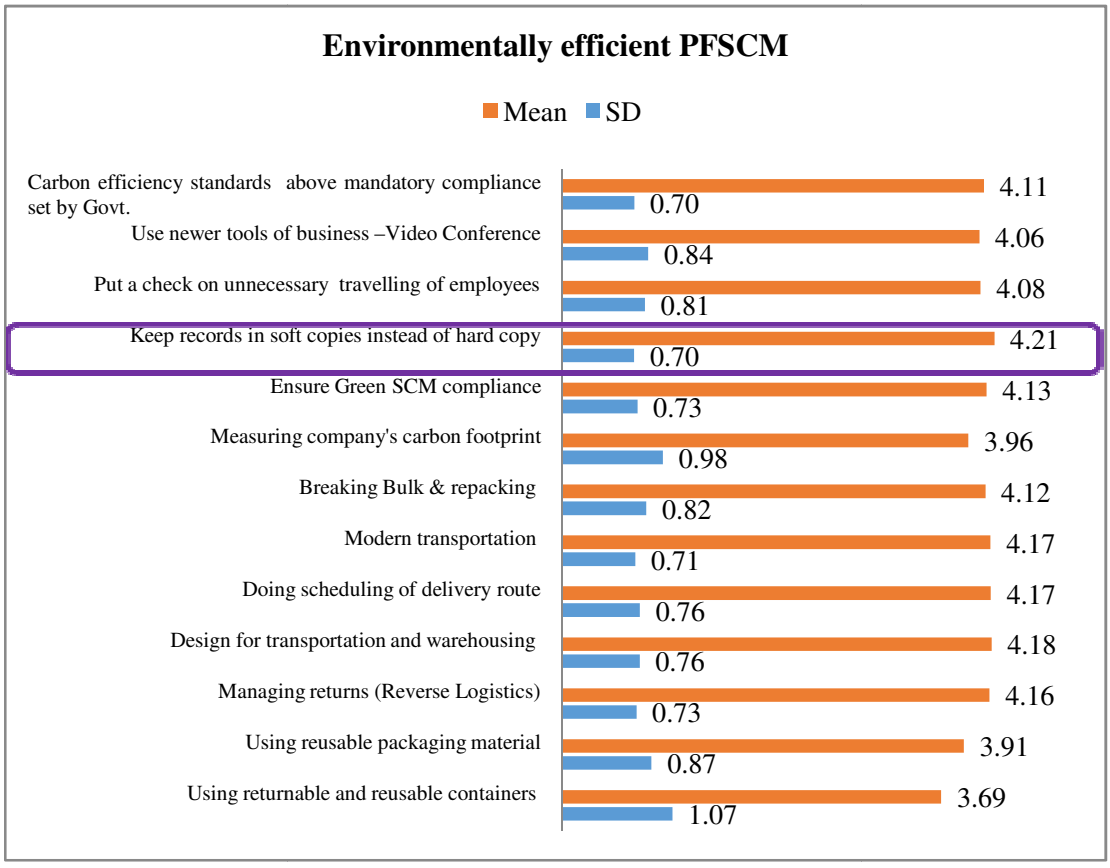

Figure 3.12 Importance of Different Parameters in Environmentally Efficient PFSCM

3.7.8 Growth of Different Processed Food Categories in India

India's gross domestic product (GDP) growth rate for 2010-2011 was 8.6 percent (Economic Survey, 2010-2011). There is a strong relationship between economic development, rise in per capita income, growing consumerism, proliferation of branded products and retail modernisation (Witt, 2001). International studies show that with high economic growth, per capita income increases, which leads to a shift in consumption patterns from necessity items to discretionary consumption (Mukherjee et al., 2012). An exhaustive list of processed food categories (28 items) is furnished in figure 3.13.

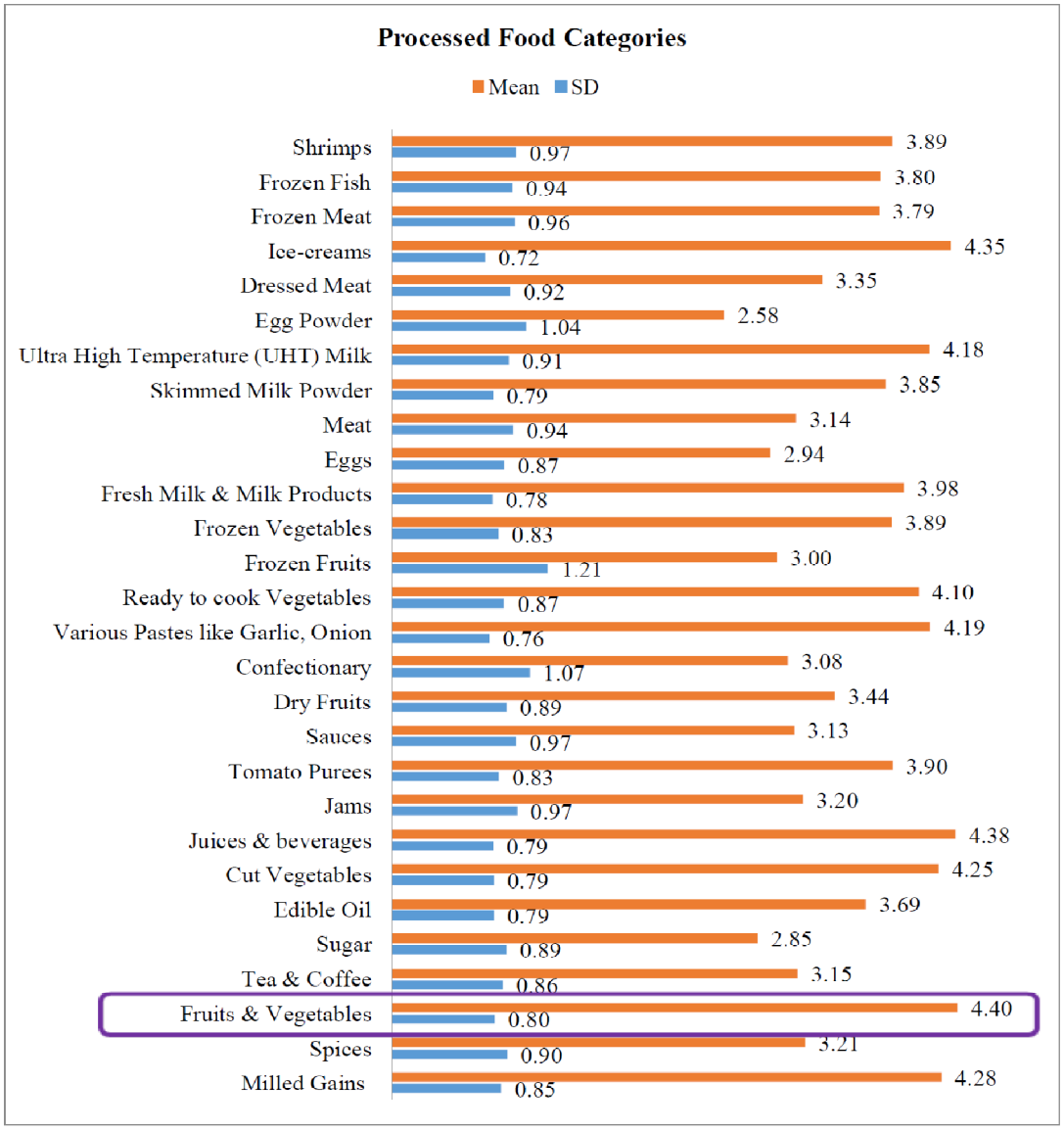

Figure 3.13 Perception Regarding Growth of Different Categories of Processed Food Sector

The respondents were requested to give their valuable opinion regarding food category growth in demand in next 5 to 10 years. The rating was provided on five point scale, 1 no significant increase in demand and 5 very high increase in demand. The fruits and vegetables (4.40), followed by juices and beverages (4.38), ice-creams (4.35), milled gains (4.28), cut vegetables (4.25), various pastes like garlic, onion (4.19), UHT milk (4.18), ready to cook vegetables (4.10) were on the top of list on growth prospects in next 5 to 10 years. The maximum variation in opinion was observed in frozen fruits (SD= 1.21), confectionary items (1.07) and egg powder (1.04).

3.7.9 Suggestions to Enhance Domestic Sales and Export of India Processed Food

The published cases of many developing countries in literature reported that most of the small farmers had experienced many problems in supplying supermarkets. They were excluded from supermarket procurement systems due to their limited capital investment, their reliance on rain-fed production and their inability to maintain consistent supply throughout the year (Reardon and Gulati, 2008; Alonso, 2011). In present survey the respondents were asked to rate suggestions to enhance domestic sales and export of processed food from India. The results are presented in figure 3.14.

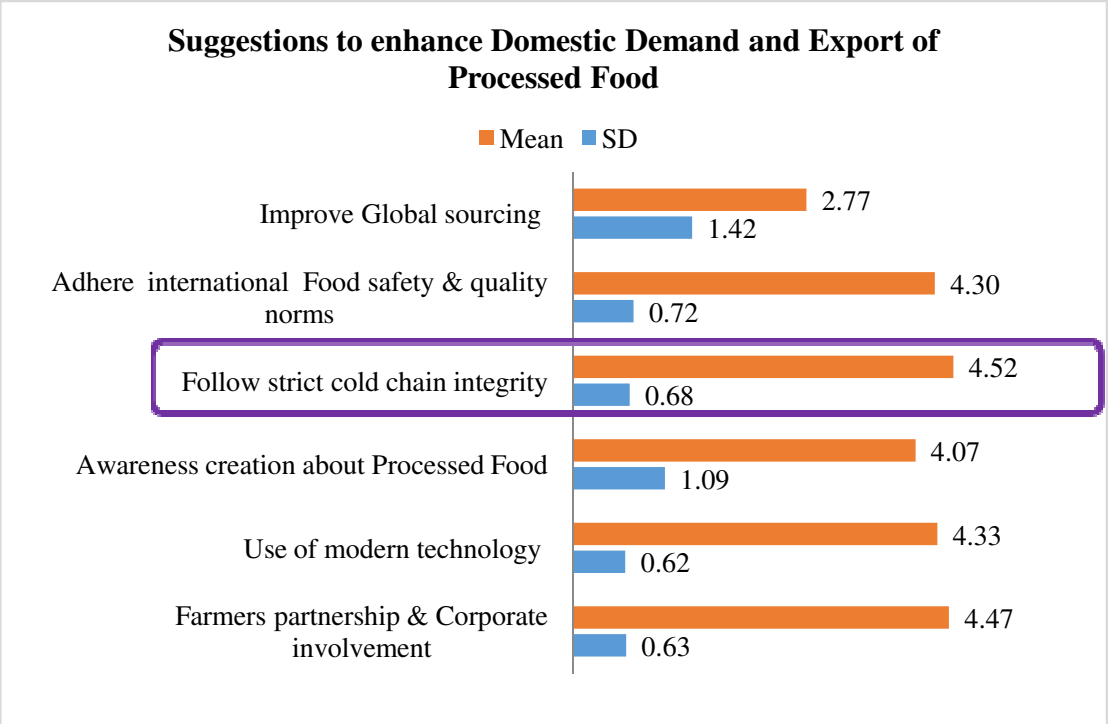

Figure 3.14 Suggestions to Enhance Domestic Demand and Export of Processed Food

The suggestions like follow strict cold chain integrity (4.52), farmers partnership and corporate involvement (4.47), use of modern technology (4.33), adhere international food safety and quality norms (4.30) were topped the table with their respective mean scores. The maximum variation was depicted by improve global sourcing (SD=1.42). These improvements will help to overcome the hurdles like poor quality and grading mechanisms, high wastage across the value chain, presence of many intermediaries implying a high cost of raw material, low technology equipment and knowledge, absence of proper and stringent food safety standards and traceability issues etc.

3.7.10 MOFPI Promotional Schemes for Indian PFS

Indian Government is providing various incentives to promote the food processing sector. The major nine promotional schemes were offered by MOFPI (2011-12). The respondents were asked to rate the importance of schemes on five point scale varies from 1 not important and 5 highly important and results are presented in figure 3.15.

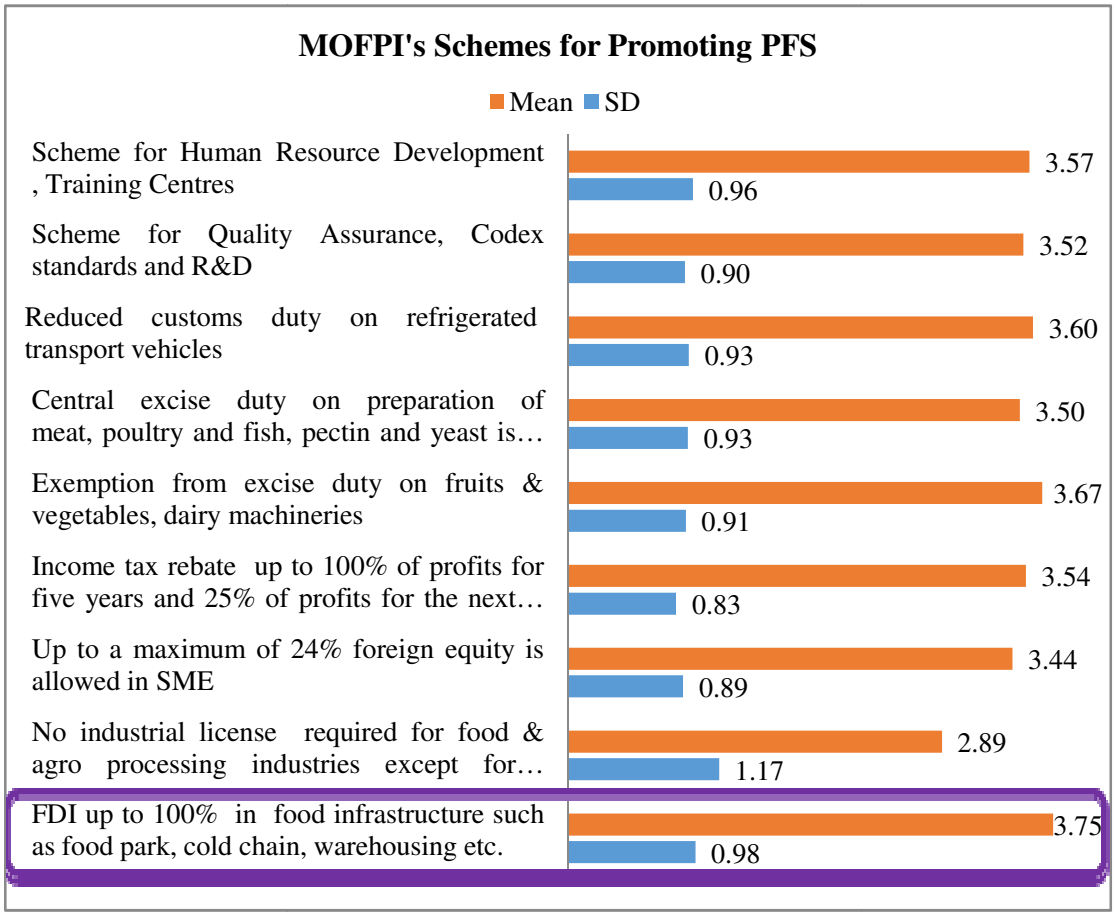

Figure 3.15 Importance of MOFPI's Schemes for Promoting PFS

The scheme of FDI up to 100% in food infrastructure such as food park, cold chain, warehousing etc. scored highest mean score (3.75), exemption from excise duty on fruits and vegetables, dairy machineries (3.67), reduced customs duty on refrigerated transport vehicles (3.60) and human resource development and training centres (3.57). In this case maximum variation in opinion was shown by scheme of no industrial license required for food and agro processing industries (SD =1.17).

3.8 Bottlenecks in Growth of Indian Processed Food Sector: A Proposed Model

The results of empirical study are presented in the previous section. A model is proposed to understand the key bottlenecks and the strategies required to overcome them furnished in this section. The model hypotheses are developed and tested using binary logistic regression (BLR) technique. Figure 3.15 shows the importance of MOFPI's Schemes for Promoting PFS. The mean and S.D. is calculated based on respondents response on the MOFPI schemes.

The bottlenecks in the growth of PFS are as follows:

a) Improper Primary Processing, Storage and Distribution Facilities (IPP) -PSD

A wide range of fresh produce from multiple sources is stored for variable Periods. These products may be processed in various ways, subsequently order-picked, dispatched to retail and other centres (Broekmeulen, 1998; Rouwenhorst et al., 2000). Schmidt et al. (2011) advocated role of food hub, farmers benefitted from creative strategies to secure stable, new markets and mitigate challenges with marketing, distribution and storage. A critical evaluation of the processes, space and time utilization of fresh and processed produce distribution centres has been studied through site visits. Most of fresh produce spoils at farm land in the absence of proper storage. This bottleneck required to be tackled on suggested lines. The trio of remedial promotional strategy such as FDI up to 100% in food infrastructure (FDI); exemption of excise duty on preparation of meat, poultry, fish and yeast (CED) and reduction of customs duty on refrigerated transport vehicles (CDG) can be useful.

b) APMC Act (APMC)

The agriculture produce marketing committee (APMC) Act does not allow direct purchase of fresh produce from the farmers. Setting up of private market yards is allowed only with the prior permission of state government authorities. The fresh produce

has to route through Mandi (wholesale market of state/town). Two contrasting views are expressed with respect to the need of this act. The first one, multi-national corporations (MNCs) and private companies will exploit famers in the absence of this act. The fear is that firms may take the farmland forcefully from farmers on long leases. The second view sees this act as a conspiracy to exploit the farmers and the consumers by creating artificial fluctuations in the agricultural produce prices (Andrew Webster, 1997). Establishment of private markets is being proposed by amending this act. Already it has been enforced in 21 Indian states. It will encourage foreign direct investment (FDI) in agriculture. It may solve Indian problem of huge wastages at farm land (Chandrashekar, 2012), however action plan is required for training and deployment of human resource made surplus due to the amendment in the act. Suggested action can be a scheme for development of human resources management (SHD).

c) Inadequate Link between Production and Processing (ILP)

The landscape of food is changing dynamically because of the cumulative impact of food scares, food miles, fair-trade (Donovan et al., 2012). All these issues had refocused public attention on the growth, variety production and distribution of food (Bord Bia, 2008). In the past, food production was about resource extraction and economic value, whereas the future seems to tend increasingly towards resource conservation and sustainable value. Guthrie et al.(2006), identified that a growing desire for better food by increasingly discerning customers has lead to questioning and a re-assessment of the way food is grown, distributed and sold. There is an emerging debate that questions; perhaps we have gone too far from our agrarian roots in pursuit of economies of scale and industrial food production techniques. The changing landscape of food production, processing and retailing have however led to a growing interest in supply chain management (SCM), as producers, suppliers and buyers increasingly seek more direct relationships with their trading partners. In the past, the food industry suffered from deteriorating public opinion because the weak linkages among producers, middleman and consumers were deemed increasingly distant. Therefore, know there is growing trend towards supply chain co-operation. Where as in India still limitation of inadequate link between production, processing and supply chain because of lack of desirable varieties exits and distribution facilities. To overcome limitations, MOFPI is offering a promotional strategy to motivate the famers to grow desirable variety for food processing to bridge the gap. This bottleneck can be tackled with combination of two strategic schemes such as no industrial license

required for food & agro processing industries except for wine, alcohol & wines, cane sugar, hydrogenated animal fats and oils (NIL) and upper cap up to a maximum of 24% foreign equity in SME (SME).

d). Seasonality of Operation and Low Capacity Utilities (SOL)

The role of seasonality has created space for internationalization for the processed food supply chain. However, the research on food supply chain (FSC) and its internationalization is still a recent phenomenon (Soman, 2008) and there are many opportunities for the food industry to benefit from SCM research and that is yet to be explored (Cunningham, 2001; Mena and Stevens, 2010). This is partly because the food industry has specific characteristics such as product perishability, short product life cycle (PLC), non-modular product structure, product safety and traceability, product temperature sensitivity, and seasonality, etc. (Christopher et al., 2009; Entrup, 2005; Soman et al., 2004; van der Vorse et al., 2001)that place specific requirements on SCM. Due these unique features of FSC, the limitation of seasonality of operation and low capacity utilization required to be better addressed through MOFPI's promotional strategy. It can be handled by deploying good food processing processes, so the F&V during peak season can be processed and preserved for consumption during off season. For example, skimmed milk powder is prepared from fresh milk. This can be promoted through a full exemption of excise duty on food processing machineries used for processing of fruits & vegetables, dairy etc. (EED).

e) Inadequate Focus on Quality and Safety Standards (IQFS)

There is a need for early identification of emerging food safety issues in order to prevent them from becoming health risk. The food safety issues are also getting importance in India. It is not because of pressure of World Trade Organization (WTO), a monitoring agency in respective field. It is because of consumers increasing demand for better quality food. The Food Safety Standards Authority of India (FSSAI, 2011) came into existence under Food Safety and Standards Act, 2006. The FSSAI has been created for developing scientific standards for food products and to regulate food manufacturers, warehousing, distribution channels, domestic sales, exports and import to ensure availability of safe and food fit for human consumption (Jamuna, 2013). The act's likes Vegetable Oil Products (Control) Order 1947, Prevention of Food Adulteration Act 1954, Fruit Products Order 1955, Meat Food Products Order 1973, Edible Oils Packaging Order 1988, Milk and

Milk Products Order 1992, are replaced by Food Safety and Standards Act, 2006. The major aim is to establish a single reference point for all matters relating to food safety and standards. It will be good action of GOI by moving from multi level, multi departmental control to a single line of command. Therefore, inadequate focus on quality and safety standards is addressed by various scheme's offered for quality assurance, Codex standards and research and development (R&D). This is the one of crucial issue always faced by exports mainly. Therefore, to management this issue a strategy for quality assurance, codex standards and R&D (SQA) offered.

f) Lack of Innovation in New Product Development (LNPD)

Innovation is increasingly recognized as an important contribution to improve organizational success, performance and survival. Damanpour (2009) suggests that innovation is often driven by pressure from the external environment, including factors such as competition, deregulation, isomorphism, resource scarcity and customer demand. It is associated with adaptive behaviour that changes the organization in order to maintain or improve performance. Innovation is increasingly considered as a process of co-production (Hartwich and Negro, 2010) whereby actors along a value chain or working in a particular domain of interest interact, co-operate, and co-ordinate their activities to generate new knowledge, technologies, and practices for desired change (Klerkx et al., 2013). The food industry has experienced many societal, economic and technological changes in India. These changes have significant impacts on the entire food processing chain right from production, processing, distribution and to retail to end consumers (Menrad, 2004). The innovation imperative is very strong for firms in the sector. It can play a key role in sustaining and enhancing their competitiveness (Capitanio et al., 2010; Rama and Von Tunzelmann, 2008). MOFPI is addressing this bottleneck by offering strategy income tax rebate up to 100% of profits for five years and 25% of profits for the next five years for setting up of new agro-processing industries to process and package F&V (ITR).

g) Food Supply Chain Gaps (FSCG)

The enormous losses of fruits and vegetables produced in the country are mainly because of the lack of proper infrastructure for storage and transportation under temperature controlled conditions. Parfitt et al., (2010) put forward that most of food loss is happing because food supply chains namely information gap among supply chain members,

uncertain supply chain environment, seasonality, poor harvesting techniques, lack of R&D in agri supply chain, lack of proper postharvest techniques, lack of marketing facilities at village level. Therefore, supply chain management is gaining importance due to globalization. A supply chain is a set of three or more organizations linked directly by one or more of the upstream or downstream flows of products, services, finances, and information from a source to a customer. Supply chain management, then, endorses a supply chain orientation and involves proactively managing the two-way movement and co-ordination of goods, services, information and funds (i.e. the various flows) from raw material to finished product to the end user. There are several gaps in supply chain management of PFS. Three main gaps are: First, the cost and availability of information resources between entities leading to time delays in the network. Second, the level of competition in both domestic and international markets requires organizations to be fast, agile, and flexible. Third, customer expectations and requirements are becoming much more stringent. So to satisfy the consumers, SCM system should operate with the objectives of cost competitiveness, timeliness and quality.These gaps can be plugged through several schemes of the MOPFI. Nine such schemes (I-IX) are selected to be tested for overcoming the seven bottlenecks (a-g) through the framing of hypothesis. A set of six hypotheses are prepared and tested through binary logistic regression analysis.

3.9 Hypothesis Development

The extensive review literature and analysis of above stated bottlenecks in growth of Indian processed supported us to form six hypotheses for testing in the present research paper.

H1. There is a positive relation between promotional strategy referencing FDI, CED, CDG in overcoming IPP bottleneck in PFS growth

H2. There is a positive relation between promotional strategy referencing NIL, SME in overcoming ILP bottleneck in PFS growth

H3. There is a positive relation between promotional strategy referencing SME and in overcoming SOL bottleneck in PFS growth

H4. There is a positive relation between promotional strategy referencing EED and in overcoming LNPD bottleneck in PFS growth

H5. There is positive relation between promotional strategy referencing SQA and in overcoming IQFS bottleneck in PFS growth path

H6. There is positive relation between promotional strategy referencing SHD and in overcoming FSCG, APMC bottleneck in PFS growth path

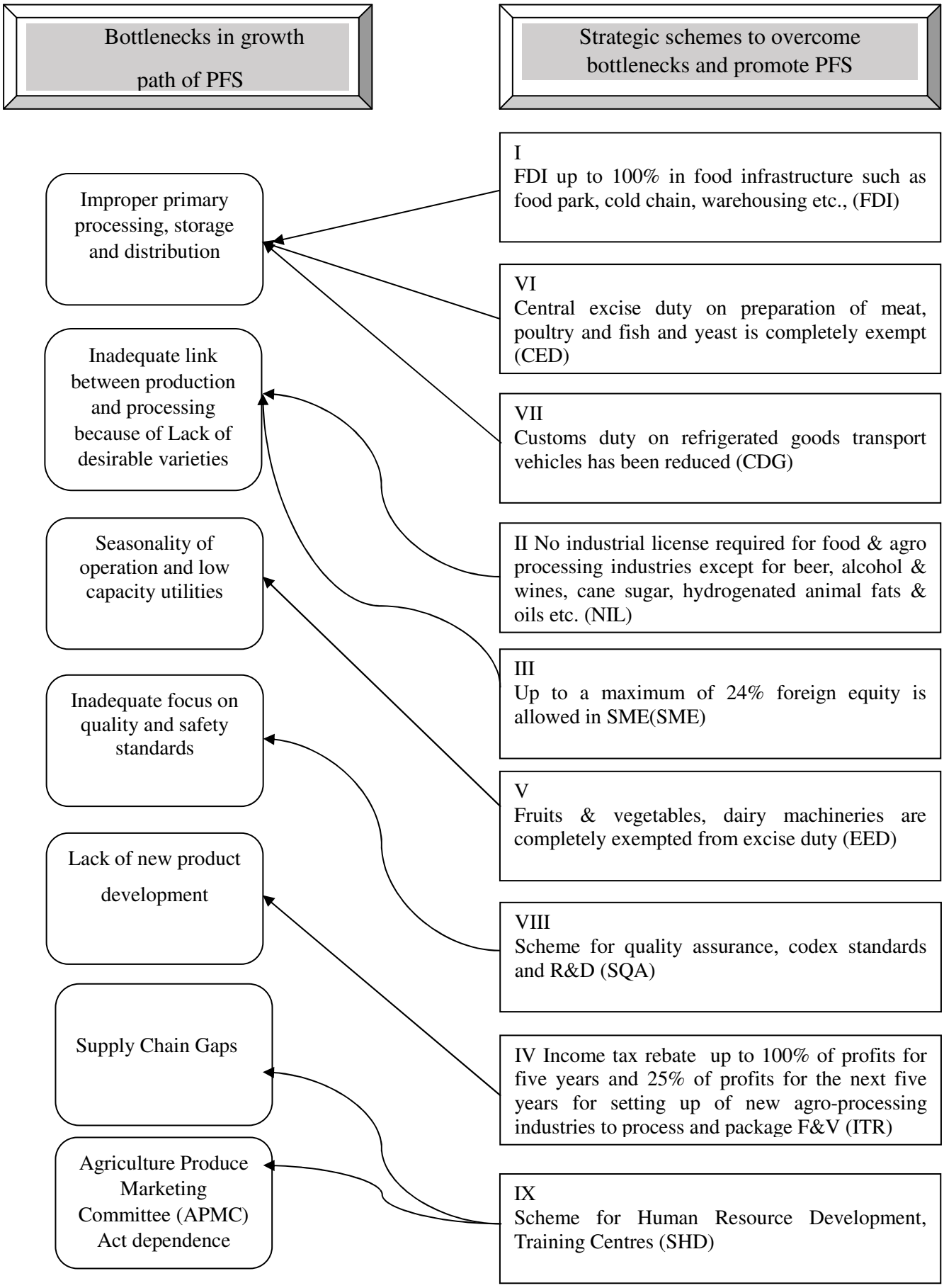

Figure 3.16 Strategic Promotional Model

Bottlenecks	Promotional Strategy	Hypothesis
IPP	FDI	H1There is a positive relation between promotional strategy referencing FDI,CED,CDG and in overcoming IPP bottleneck in PFS growth
	CED	
	CDG	
ILP	NIL	H2There is a positive relation between promotional strategy referencing NIL, SME and in overcoming ILP bottleneck in PFS growth
	SME	
SOL	EED	H3There is a positive relation between promotional strategy referencing EED and in overcoming SOL bottleneck in PFS growth
LNPD	ITR	H4There is a positive relation between promotional strategy referencing ITR and in overcoming LNPD bottleneck in PFS growth
IQFS	SQA	H5There is positive relation between promotional strategy refereeing SQA and in overcoming IQFS bottleneck in PFS growth path
FSCG	SHD	H6There is positive relation between promotional strategy refereeing SHD and in overcoming FSCG,APMC bottleneck in PFS growth path
APMC		

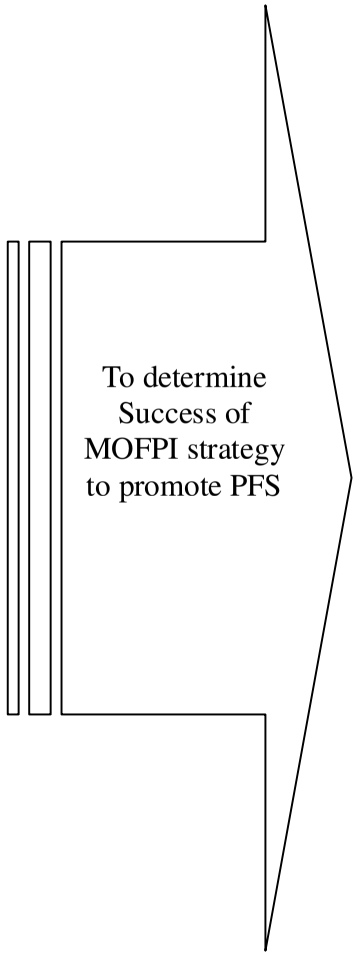

Figure 3.17 Hypotheses to Examine the Relationship between Bottlenecks and MOFPI Strategies to Promote PFS

3.10 Binary Logistic Regression (BLR)

To test the hypotheses and determine that whether MOFPI's promotional strategies are successful to overcome bottlenecks in growth path of processed food sector (PFS), the responses to the questionnaire is analysed. The modelling technique is applied on nine elements of strategy as independent variables and bottlenecks in growth of PFS as dependent due to limitation of the variables being categorical and non-normally distributed. Logistic analysis is a preferred technique because it does not assume equal variance-covariance matrices group and multivariate normality of variables (Hair 1998, Jaccard 2001, Ramdani et al. 2009). Moreover, output from the analysis is very similar to regression and therefore easier to draw inferences. Logit uses a binomial probability function for the dichotomous dependent variables (Nine elements of strategy to overcome bottlenecks) and estimates whether it is one way or the other using an odd ratio. Unlike regression, where we try to minimize the square deviations (Premkumar 2003, Ramdani et al. 2009), logit is applied to maximize the likelihood of MOFPI promotional strategy to be successful in overcoming the bottlenecks of PFS. It ought to be preferred when dependent variable is discrete. It is particularly appropriate in estimating a discrete outcome from a set of binary predictors, which are linearly related (Tansey et al., 1996; Tabachnick and Fidell, 2007).

To transform the overall rating variables received in from respondents into a dichotomous variables the median (response rate 3) was utilized as the cut –off point. Those with response rate 3 and below were recorded as zero (low success of promotional strategy) and those above 3 were recorded as 1 (higher success of promotional strategy). The median was used for making cut off point because it has greater validity as it is the mid–point separating one type of variables from another (Wood 2006, Hair, 2010). The Binary Logistic Regression (BLR) were used to allow for the cross checking of results and better assessment of the validity of the resulting model. In addition, BLR is able to estimate the individual and also combination effects when more than one promotional strategy (treated as predictors) is employed simultaneously (Hosmer and Lemeshow, 2000, Yeung et al. 2012). In the present research, nine conditions were formulated to reflect the number of optimal possible combinations. Each of the 9 conditions for each respondent was transformed in binary

form as a case scenario. As a result 9 x 252 =2268 case scenarios were entered into SPSS version 21 for analysis. Thus, a mathematical model developed for the BLR is as follows:

$$\textbf{Logit (p) = log [p}_j \textbf{ / 1-p}_j\textbf{]= A + }\Sigma\textbf{B}_j\textbf{X}_{ij}$$

Where p_j is estimated probability of j^{th} case (j runs from 1,.….2268) in one of the conditions with constant A, coefficient B_j, and predictor X_{ij} (i……1,2,3,4,5,6,7,8 and 9). The maximum likelihood was used to estimate the coefficients and the purpose was to find the optimal combination of predictors for success of promotional strategy. Chi-squared distribution was checked for the difference between their log-likelihood of the null model and the hypothetical model and the Wald test was used for testing the significance of individual independent variables. Classification table was checked to assess the success of the model and to evaluate the accuracy of the prediction as it produced the probability of accurate classification for the presence/absence of the strategy and the overall pooled rate of all sample cases across both of those representing the presence or absence of a certain type of strategy (Tabachnick and Fidell, 2007, Yeung et al.2012). Furthermore, the resultant model which shows the linear portion of the equation for the nine predictors ($A+B_1X_1+B_2X_2+B_3X_3+B_4X_4+B_5X_5+B_6X_6+ B_7X_7+B_8X_8+ B_9X_9$) is not the end in itself, but it creates the logit of the odds where the odds of a particular outcome for each independent variable can be determined (Hosmer and Lemeshow, 2000).

3.11 Results and Discussions

Promotional Strategy to overcome bottlenecks in growth of PFS, the estimation terminated at iteration number 8 because Log likelihood decreased by less than 0.001. Omnibus test was used to test if the framework with these dependent variables were significantly different from the null model, which is to test the capability of all independent variables in the model jointly to predict the dependent variable (Yeung et al.,2012). As shown in table 3.2, Chi-square was 258.544 with degree of freedom equals 9 and p-value less than 0.001 suggesting that there is adequate fit of the data to the model which implied that there is at least one of the independent variables is significantly related to the dependent variable.

Table 3.2 Goodness of Fit test of the Promotional Strategy

Omni bus Test	Chi-square	df	Significance
Step	258.544	9	0.000
Block	258.544	9	0.000
Model	258.544	9	0.000

The Negelkerke R Square is 0.85 and Cox & Snell R Square 0.64. The Negelkerke R Square and Cox & Snell R Square both are measures of Good Fit (Hair et al., 1998). In the present research paper, Negelkerke R Square 0.85 is fairly high, suggesting a good fit for the model. These value are in line previously reported by Premkumar (2003); Ramdani et al., (2009).

To test strategy's success, the estimated coefficients (in binary logistic regression) of the predictors provided by the Wald test were assessed. The outcome of analysing the variables in the equation, all strategies are significant at the 95 percent confident level, with $p < 0.001$. The odds Exp(B) for the FDI up to 100% in food infrastructure (FDI); no industrial license required for food & agro processing industries except for wine, alcohol & wines, cane sugar, hydrogenated animal fats and oils (NIL), upper cap up to a maximum of 24% foreign equity in SME (SME), Income tax rebate up to 100% of profits for five years and 25% of profits for the next five years for setting up of new agro-processing industries to process and package F&V (ITR), full exemption of excise duty on food processing machineries used for processing of fruits & vegetables, dairy (EED), exemption of excise duty on preparation of meat, poultry, fish and yeast (CED), reduction of customs duty on refrigerated goods, transport vehicles (CDG), scheme for quality assurance, codex standards and R&D (SQA) and a scheme for development of human resources management (SHD). The Exp. (B) values were FDI=3.752, NIL=3.362, SME=5.125, ITR=3.989, EED=2.001, CED=4.620, CDG=7.969, SQA=1.879, SHD=3.371, depicted in table 3.3. The above mentioned results were used to present the framework:

In {pj / 1-pj} = -41.237 +1.322 x FDI+ 1.213 x NIL+ 1.652 x SME + 1.384 x ITR+

0.693 x EED+ 1.530 x CED+ 2.076 x CDG + 0.631 x SQA + 1.215x SHD

All these elements are from strategy of MOFPI. This indicates that by implementing the strategy of FDI up to 100% in food infrastructure (FDI), there will be an increase in the

odds of bottlenecks in growth path of PFS by 3.752 times [odds ratio exp.(1.322) = 3.752], by implementing a scheme of no industrial license required for food & agro processing industries except for wine, alcohol & wines, cane sugar, hydrogenated animal fats and oils (NIL). There will be an increase in the odds of bottlenecks in growth path of PFS by 3.362 times by implementing a scheme of upper cap up to a maximum of 24% foreign equity in SME. There will be an increase in the odds of bottlenecks in growth path of PFS by 5.215 times by implementing a scheme of Income tax rebate up to 100% of profits for five years and 25% of profits for the next five years for setting up of new agro-processing industries to process and package F&V (ITR). There will be an increase in the odds by 3.989 time implementing a scheme of full exemption of excise duty on food processing machineries used for processing of fruits & vegetables, dairy (EED). There will be an increase in the odds 2.001, by implementing a scheme of exemption of excise duty on preparation of meat, poultry, fish and yeast (CED). There will be an increase in the odds by 4.620, by implementing a scheme of reduction of customs duty on refrigerated goods, transport vehicles (CDG). There will be an increase in the odds by 7.969. by implementing a scheme for quality assurance, codex standards and R&D (SQA). There will be an increase in the odds by 1.879 and by implementing a scheme for quality assurance, a scheme for development of human resources management (SHD). There will be an increase in the odds by 3.371.

Table 3.3 Binary Logistic Regression Results of MOFPI Promotional Strategy

Variables	Coefficient B	S.E.	Exp(B)	95% CI for Exp (B)		Wald	df	p-Value
				Lower	Upper			
FDI	1.322	0.361	3.752	1.850	7.607	13.439	1	.000
NIL	1.213	0.351	3.362	1.689	6.693	11.917	1	.001
SME	1.652	0.479	5.215	2.040	13.334	11.889	1	.001
ITR	1.384	0.523	3.989	1.431	11.118	7.001	1	.008
EED	0.693	0.479	2.001	.782	5.120	2.092	1	.148
CED	1.530	0.498	4.620	1.739	12.271	9.429	1	.002
CDG	2.076	0.529	7.969	2.828	22.461	15.415	1	.000
SQA	0.631	0.409	1.879	.843	4.190	2.379	1	.123
SHD	1.215	0.433	3.371	1.442	7.882	7.867	1	.005
Constant	-41.237	6.845	---	---	---	36.292	1	.000

Table 3.4 Classification Table for Assessing the Success of the Model for Promotional Strategies of MOFPI

Observed Success of Promotional Strategy	Predicated Success of Promotional Strategy		Percentage Correct
	0	1	
0	78	42	65.0
1	0	132	100.0
Overall Percentage correctness			83.3

The cut value is .050

A classification table was created to evaluate the classification of cases which fit the model when predict the outcome. As depicted in table 3.4, the accuracy of the present strategy is 83.3%. The outcomes of preceding analysis can also highlights all the nine elements of MOFPI's strategy has caste an individual and combined effect in overcoming the bottlenecks in growth of PFS. Any addition or subtraction of in element of strategy would affect the others as well as comprehensively bottlenecks in growth of PFS. Therefore, the MOFPI ought to take care about all the constituents of promotional mix while making any changes in strategy. A scheme of reduction of customs duty on refrigerated goods, transport vehicles (CDG), has the relatively highest impact (7.969) to hit bottlenecks. The lowest impact has been created by a scheme for quality assurance, codex standards and R&D (SQA) (1.879). Thus hypotheses are supported by analysis of the respondents to the survey (table 3.5). The ground reality behind both the outcomes is that India is wasting huge amount of agri produce at farm land as outlined earlier in the section of food wastage. The abundance of local vendors and higher consumption of street food because of its low cost further makes it difficult to enforce food safety rules.

Table 3.5 Results of Hypotheses Testing

Hypothesis	Results
H1: There is a positive relation between promotional strategy referencing FDI,CED,CDG and in overcoming IPP bottleneck in PFS growth	Supported
H2: There is a positive relation between promotional strategy referencing NIL, SME and in overcoming ILP bottleneck in PFS growth	Supported
H3: There is a positive relation between promotional strategy referencing SME and in overcoming SOL bottleneck in PFS growth	Supported
H4: There is a positive relation between promotional strategy referencing EED and in overcoming LNPD bottleneck in PFS growth	Supported
H5:There is positive relation between promotional strategy refereeing SQA and in overcoming IQFS bottleneck in PFS growth path	Supported
H6: There is positive relation between promotional strategy refereeing SHD and in overcoming FSCG,APMC bottleneck in PFS growth path	Supported

3.12 Conclusion

The results of this chapter show that MOFPI's strategy comprises of the nine elements are successful in promoting PES to an extent through overcoming the bottlenecks in growth path. Further, the application of Binary Logistic Regression, in this chapter has empirically tested the different aspects of the promotional policy of Ministry of Food Processing of Industries (MOFPI) and proved their claim of successful implementation to an extend with development of comprehensive model. There has been exponential growth of processed food globally and in India too scope of processed food is increasing. With more super markets and hypermarkets opening-up in the country, especially in cities, women are increasingly shopping in these outlets as they are more convenient and comfortable. Also, the infrastructure in the larger

cities is much more developed; therefore, retailers and consumers are able to store processed food without worrying about consistent and long power cuts (Mahajan et al., 2011). The current research has also supported the claim that the cold chain and other supply chain infrastructural issues can be key in growth of PFS i.e. the strategy of reduction of customs duty on refrigerated goods, transport vehicles (CDG), has the relatively highest impact (7.969) to hit bottlenecks. It will support the new investments in the field for further development of food supply chain infrastructure in India to achieve said goals. The lowest impact has been created by a strategy for quality assurance, codex standards and R&D (SQA) (1.879). The farmers are required to produce desirable right quality and desirable variety. The processors and manufacturers need to procure the required good quality of produce from famers at right market rates before fresh produce get stale through developing its efficient and effective supply chain. With this building a food processers and manufactures base who will address the food safety issues also in order to make processed food more popular domestically as well as to target the global food business. Indian Government specially MOFPI have to create infrastructure conductive for food supply chain, make aware the all the channel partners in food sector about the benefits of food quality & safety and offer more to achieve the targeted growth in PFS.

CHAPTER – 4
LOGISTICS MANAGEMENT AND INFORMATION TECHNOLOGY ISSUES IN PROCESSED FOOD SECTOR IN INDIA

4.1 Introduction

The focus on food processing sector is one of the important links in the multi-tier food supply chain. It is justified by the fact that, it has big potential to reduce agri wastages, provide food security to society and ease to use food for working professionals. In the last chapter the status of processed food sector was studied through the analysis of the responses to the questionnaire surveys carried out in Delhi and N.C.R., India. In this chapter the analysis and discussions on the issues related to logistics and information technology of processed food sector (PFS) are discussed. The PFS has several attributes which are significantly different from other supply chains as listed in table 4.1.

Table 4.1 Generic Features of Processed Food Supply chain

S.No.	Generic Features of Agri Processed Food Supply Chains
1.	Seasonality of raw material
2.	Agri produce available at specific geographical places, procurement of fresh produce at collection centre
3.	Fresh produce not consistent
4.	Demand throughout the year
5.	Demand in all geographies
6.	Requirement of availability in local markets
7.	Quality and safety issues as products related to human health
8.	Temperature sensitive produce and products
9.	Product quality changes with time
10.	Hygiene maintenance from production to retail
11.	Organizations responsibility even for product deteriorate at customers place
12.	Conscious use of nutrients in products
13.	Long and cost intensive product development
14.	Maintaining varieties according to consumers taste and preferences and requirements of pack sizes
15.	Small, bulky, delicate products
16.	Shorter shelf Life
17.	Merchandizing
18.	Packaging as per food law
19.	Different products with specific temperature needs for storage and transportation
20.	Ability to identify the sources of supplies
21.	Broken, damaged and expired products at distributors and retailers
22.	High creation of packaging waste. Packaging used to maintain freshness and ease of logistics
23.	Intense competition from food giants

Logistics management and the use of Information Technology play an important role in strengthening the supply chains of PFS. In the last decade, intense competition has drastically changed the way companies operate their production and distribution systems. These changes include the application of the integrated logistics management (LM) concept to the analysis and design of their supply chains. It is important to observe that firms stared the extensive use of information technology (IT) to gain a competitive edge (Chiu, 1995). Introducing IT for integrated supply chain management could lead to better efficiency and effectiveness compared to existing logistics systems (Goldhar and Lei, 1991).

Supply chain integration must comprise both information and material. It cannot restrict itself to only one. Higher integration levels are characterized by increased logistics-related communication, greater coordination of the firm's logistics activities with suppliers and customers (Stock et al., 2000). Thus in the light of supply chain integration concept, logistics and information integration originally reflect two interrelated forms of integration. Both the interrelated forms of integration flow in opposite directions (i.e. forward and backward, respectively). Forward integration is concerned with the physical flows of materials from suppliers to manufacturers which refer to logistics integration. On the other hand, backward integration is concerned with the coordination of information technologies and the flows of information from manufacturers to suppliers (Prajogo et al., 2012).

IT and logistics systems form the structural and infrastructural processes relating to the transformation of materials into value-added products and the delivery of finished products through appropriate channels to customers and markets so as to maximize customer value and satisfaction (Narasimhan and Kim, 2001). The introduction and utilization of integrated IT for managing the supply chain would not only enhance quality and reduce cost and delivery time, but also eventually enhance the company's competitiveness and position it for further growth (Huggiss and Schmitt, 1995). The transfer of information among supply chain partners requires support of information technology (IT) in an effective way. Telephone, email, bar-code, Radio Frequency Identifier Devise (RFID), Electronic Data Interchange (EDI), Enterprise resource planning (ERP) etc. are the tools that forms an integrated Information Technology

Note: Logistics Management and Information Technology Issues in Processed Food Sector in India, Communicated to IIMB Management Review (First Review is done in July 2013).

(IT) infrastructure and facilitates the flow of information within and between the organization. The internet has also brought about a revolution in making supply chain processes integrated efficient and effective.

The judicial use of logistics management and integrated information technology is a practice that continues to have an enormous s effect on processed food supply chain management (PFSCM). Logistic management (LM) and IT implementations are strategic business initiatives that aspire to improve firm performance. Preceding research studies on the IT and integration of logistics management has emphasized the importance of each element to organization's performance(Wang et al.,2006).Studies have mainly focused on manufacturers and not the agri-food processing business or food processing organizations for which agri-food is a non dominant business (Laframboise and Reyes, 2005, Narasimhan and Kim, 2001). In addition, more emphasis was paid to the integration of suppliers through integrated IT and logistics management (Laframboise and Reyes, 2005, Han et al., 2009). In today's competitive environment, effective and timely responses to ever-changing customer tastes and preferences have become essential components for successful business performance (Jerong and Hong, 2007).

4.2 Objectives and Research Propositions

Since 1991, with onset of economic liberalization policy adopted by India, a steep rise in income has been created which has acted as a catalyst to changing lifestyle through rapid economic and social development. Indian processed food sector has automatically benefited by such movement. Indian consumers are continuously demanding more and more safe food, with world class quality and convenience. In order to meet such kind of revolutionary demand, many leading food processing organizations like Mother Dairy, Dabur, Amul and multinational companies like PepsiCo., Tropicana, Cadbury, Nestle etc. has established a vertical coordination mechanism with their source of supply, farmers, carrying and forwards (C&F Agents), distributors and retailers. They have invested heavily in developing cold chain and use IT systems to provide excellent quality processed food products to Indian consumers.

Most of these leading national and international organizations have developed ERP, deployed EDI, RFID and used the telephones, emailing and internet to facilitate information sharing and data processing among their channel partners.

The literature suggests that there are two interrelated forms of integration that manufacturers regularly employ. The first type of integration involves coordinating and integrating forward physical flow of deliveries between suppliers, manufacturers and customers (Trent and Monczka, 1998, Prajogo et al., 2012). It has been pointed out by Saunders (1997) that the importance of delivery integration was for exploiting third-party logistics. The other prevalent type of integration involves the backward coordination of information technologies and the flow of data from customers to suppliers (Trent and Monczka, 1998). Information technologies allow multiple organizations to coordinate their activities in an effort to truly manage a supply chain (Handfield and Nichols, 1999). One of the major reason why integration of logistics and IT is most desired as business is always found to face uncertainties. It is often associated with low probability and high consequence of disasters (Zhang et al., 2010). In order to deal with uncertain business environment the IT can play a decisive role (Hall et al. 2012).

There is a considerable amount of research in the area of diffusion of innovation in different contexts, such as IT (Bakker et al., 2008); electronic data interchange (Chau and Hui, 2001; Seyal et al., 2007); and enterprise resources planning (Li, 2011; Upadhyay et al., 2011). Tarofder et al. (2013) had investigated empirically the critical factors for the diffusion of web technologies in supply chain management (SCM) functions, based on the technology-organizational-environment model and to identify the benefits resulting from diffusion. Information technologies include electronic data interexchange (Jayaram and Vickery, 1998; ERP (Laframboise and Reyes, 2005) as well as sharing data from traditional planning and control systems (Bowersox and Daugherty, 1995). A few empirical studies earlier have examined the relationship between IT, logistics management and firm performance. Among those, Bharadwaj (2000) compared the performance of firms.

As defined by the Council of Logistics Management, logistics is that part of the supply chain process which plans, implements and controls the efficient, effective flow and storage of goods, services and released information from the point of origin

to point of consumption in order to meet customers' requirements. In a successful integrated logistics management, all logistics activities in a system work simultaneously to minimize total distribution costs and maintain desired customer service levels (Kenderdine and Larson, 1988). Best logistics practices embrace the transaction tradeoffs that allow simultaneous improvement in economic performance and service quality (Stank et al., 2001).

Earlier research studies have indicated a close relationship between integrated IT and integrated LM. For example, Chiu (1995) states IT is an important prerequisite to good LM integration. Integrated IT and information systems can lead to higher quality products, enhanced productivity and ultimately increase logistics efficiency and flexibility (Narasimhan and Kim, 2001). Through the utilization of IT and information systems, companies are able to integrate similar functions spread over different areas as well as curtail unnecessary activities, thus enhancing their capacity to cope with sophisticated needs of customers and meet product quality standards (Bardi et al., 1994). Production and distribution efficiency and effectiveness can also be achieved through logistics improvements with cost justification (Chiu, 1995). Investment in logistics facilities can not only enhance quality, but also reduce delivery time. Processed Food Sector's performance review literature has been devoted to three main aspects of performance: financial, organizational and strategic. Organizational theory offers three approaches to measuring organizational effectiveness or performance (Murphy et al., 1996), namely the goal-based, systems and multiple constituency approaches. After comparing different measures of performance, they suggest that multiple dimensions of performance should be considered where possible, including both financial and non-financial measures. Accounting-based indicators, with efficiency, sales growth rate and profitability (e.g. return on sales or on investments) are the financial indicators most commonly used (Murphy et al., 1996). In addition, operational (non-financial) performance measures, such as product quality, customer satisfaction and market shares are often examined.

The objective of present research is to identify crucial issues related to information technology and logistics management in the Indian processed food sector. Can the strategy of integrated information technology and logistics management enhance performance of PFS.

Keeping in view these objectives and supported by literature, a framework developed for this research is depicted in figure 4.1. The strategies and their effective implementation will decide their performance.

Following are the research prepositions:-

P1: There is a significant relationship between long and fragmented logistic activities and high level of wastages from source to plant

P2: There is a significant relationship between inadequate cold storage facilities and effective use IT required to improve logistics

P3: There is a significant relationship between effective use of IT and limited warehousing availability

P4: There is a significant relationship between limited warehousing available and quality and connectivity of vehicles

P5: There is a significant relationship among quality and connectivity of vehicles and (a) weak road transportation; (b) national highways account for only 2% of the total road network (c) normal distance covered by truck/trailers in India is 250-300 Km/day vs international norms of 600-800 km/day

P6: There is a significant relationship among overall port management and (a) lack of connectivity between rail transport and ports (b) labour intensive techniques at port for loading (c) higher turnaround time at ports

P7: There is a significant relationship between integrated IT and logistics management to improve PFS performance

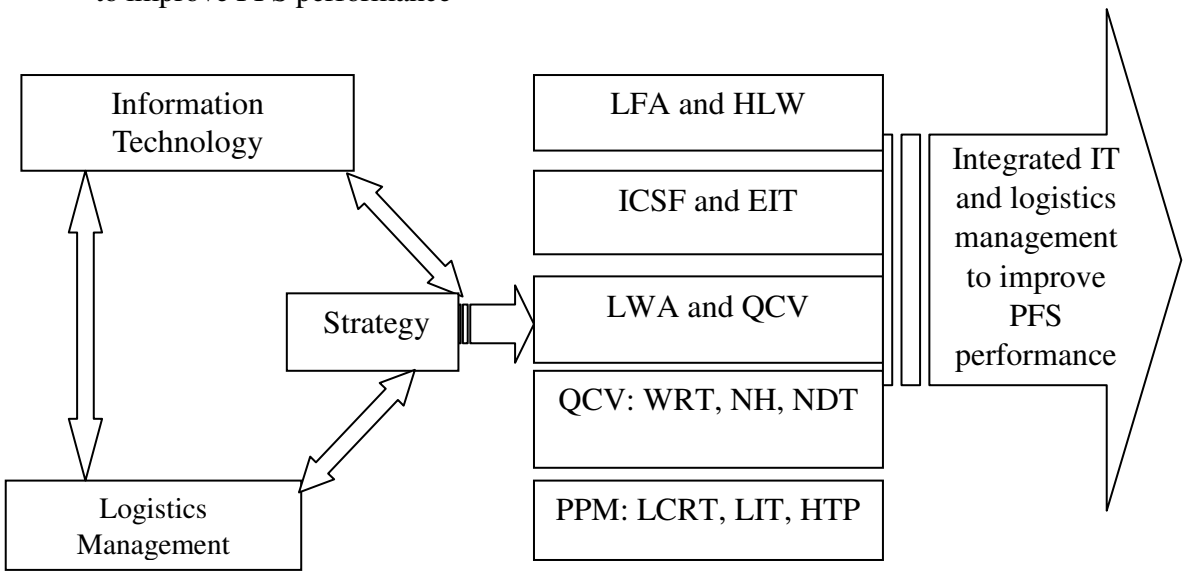

Figure 4.1 Model of Logistics and IT to Improve PFS Performance

Description of abbreviations in model: Long and fragmented logistic activities (LFA), high level of wastages from source to plant (HLW), inadequate cold storage facilities (ICSF), effective use IT required to improve logistics (EIT), limited warehousing availability(LWA), quality and connectivity of vehicle (QCV), weak road transportation (WRT), national highways account for only 2% of the total road network, 40% of cargo (NH), normal distance covered by truck/trailers in India is 250-300 Km/day vs international norms of 600-800 km/day (NDT), lack of connectivity between rail transport and port (LCRT), poor port management (PPM), labour intensive techniques at port for loading (LIT), higher turnaround times at ports (HTP).

4.3 Applications of Information Technology in PFS

The information technology and logistics management can improve production and demand of processed food (PF) in India. To study the respondents' views on the use of various electronic tools to support supply chain of processed food, in the present research, thirty seven key processes of the PF supply chain were identified and classified into five heads.

A. Sourcing of Raw Material

B. Production Management

C. Logistics and Materials Management

D. Customer Relationship Management

E. Integrated Information System

F. Collaboration with suppliers and customers

Figure 4.2 illustrates the sourcing, production and distribution management are associated with physical flow of the material, whereas logistics, information and collaboration are across all the three stages of the supply chain which forms an integrated approach.

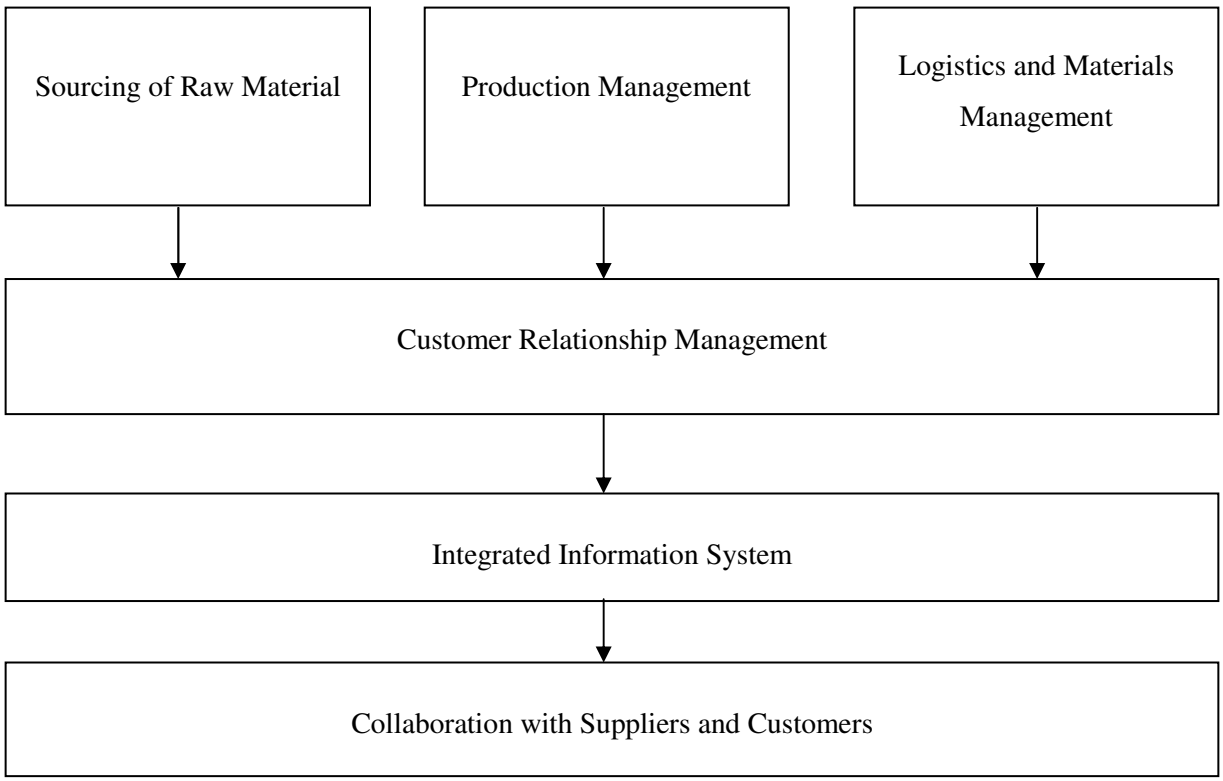

Figure 4.2 Different Aspects in Processed Food Supply Chain Management

Though there are several IT tools, which are used in any supply chain management, for the purpose of simplicity, only six IT tools which are forming integrated information system are considered in the present research. These tools are being used in processed food sector identified through discussions with corporate practitioners and academia.

a. Telephone

b. Email

c. Bar code

d. Radio Frequency Identifier Device (RFID)

e. Electronic Data Interchange (EDI)

f. Entrepreneur Resource Planning (ERP)

The respondents were asked to tick the appropriate tool(s) utilized by them for conducting business operations. For field selection, out of 252 respondents, 196 responded reported the use of telephone resulting in a percentage of 77.78%. Similarly 92 respondents (36.51%) tick for the use of email for field selection. The results of respondents are shown in percentage in table 4.2 and presented in figure 4.3, where solid lines indicate that the percentage usage is above 60% and dotted lines indicate the usage between 40-60% and no line means usage below 40%.

4.3.1 Use of Telephone

The telephone is used widely for communication and information sharing. It is significantly used in more than 70% logistics functions such as the field selection (78%), managing customers (74%), complaint handling (73%) and customer satisfaction (70%). It is being utilized in 63% in the processes like negotiation with farmers as well as customers involvement in various processes like product feature enhancement exercise, new product development etc. Despite the availability of the most advance IT tools, telephone prove to furthered utilities more than 50% in rest of logistics functions/processes like logistics cost control and response time to customers quarries (58%), supplier selection criteria (53%), demand forecasting (51%).

4.3.2 Use of Email

The literature fails to present evidence of agri-food small medium enterprises (SME's) of understanding relation to the efficacy of the email / internet. The various researchers have argued that basic internet applications offer benefits to agri-food SME's (Simmons et al., 2007). The email and internet can play an importance role in gaining access to marketing knowledge. According to Pickernall et al. (2004), corporate are using emails as an effective tool of information technology. It has three unique benefits, namely cost, speed and automatic preservation of all the documentation created in the corporate servers. It creates knowledge base with in the organizations. About 73% of Corporate are using emails in managing customer relationship and complaint handing. The emails are referred around 67% in building customer satisfaction, 62% of responding them back, 61% making part or involving, 55% at the time of negotiations, 52% in supplier selection, 50% for controlling logistics cost.

Table 4.2 Use of IT Tools in Various Supply Chain Processes of PFS (% of Respondents)

S.No.	Supply Chain Processes/ Functions	Use of IT Tools (%age respondents)					
		Telephone	Email	Bar Code	RFID	EDI	ERP
A	**Sourcing of Raw Material**						
1	Field Selection	77.78	36.51	2.38	0.00	0.00	13.49
2	Negotiation	63.10	54.76	0.79	1.59	0.40	9.13
3	Providing Crop details	41.27	36.90	0.40	2.78	0.79	10.32
4	Quality Check at sowing seeds	30.16	27.38	1.98	3.97	0.79	11.11
5	Field Tracking	31.35	29.76	3.97	3.97	0.40	13.89
6	Scheduling of inbound logistics	25.00	26.19	3.17	4.37	11.90	33.73
7	Payment to suppliers	13.10	1.59	0.40	1.59	70.24	65.48
B	**Production Management**						
8	Communicate Kanban	5.95	5.95	1.19	1.19	6.35	46.43
9	Lean manufacturing technique	2.78	3.57	2.78	4.76	5.95	48.02
10	Manage inventory	19.84	17.06	6.35	14.68	12.70	76.59
11	Analysis of product mix	13.89	17.46	5.56	9.13	10.32	75.79
C	**Logistics and Materials Management**						
12	Logistic Cost	58.33	50.00	5.16	11.90	16.27	77.78
13	Automation administration process	42.86	36.11	5.95	16.27	13.89	81.35
14	Tracks logistics cost	37.70	36.90	10.71	21.03	15.48	80.16
15	Routing & Scheduling	32.94	33.73	6.35	17.06	11.90	78.97
16	Commercial audits	33.33	37.70	3.57	9.52	13.10	78.57
D	**Customer Relationship Management**						
17	Managing customer relations	74.21	73.41	3.57	7.14	13.49	58.73
18	Complaint handing	73.41	73.02	1.19	7.54	11.11	56.35
19	Customer satisfaction	69.84	67.06	1.19	7.54	7.94	55.16
20	Involvement in processed	63.10	61.11	2.38	5.56	11.11	53.17
21	Response Time to customers	58.33	61.90	1.98	5.95	10.71	46.03
E	**Integrated Information System**						
22	Demand Forecast	50.79	44.05	2.78	7.54	13.10	83.73
23	Order Processing	23.02	26.98	2.38	6.75	19.05	82.14
24	Invoicing	16.67	20.63	3.57	5.95	19.05	84.13
25	Dispatching right order	17.46	18.25	3.17	5.56	15.08	83.73
26	Sales tracking	26.19	26.98	1.59	5.56	15.08	79.37
F	**Collaboration with Suppliers and Customers**						
27	Supplier Selection Criteria	52.78	51.98	1.98	5.95	13.89	80.16
28	Supplier Management	46.03	48.41	3.17	4.76	9.52	80.16
29	Tracking functioning of suppliers	41.67	46.83	3.17	6.35	10.32	78.97
30	Making them business associate	45.24	42.86	3.17	5.16	9.52	80.16

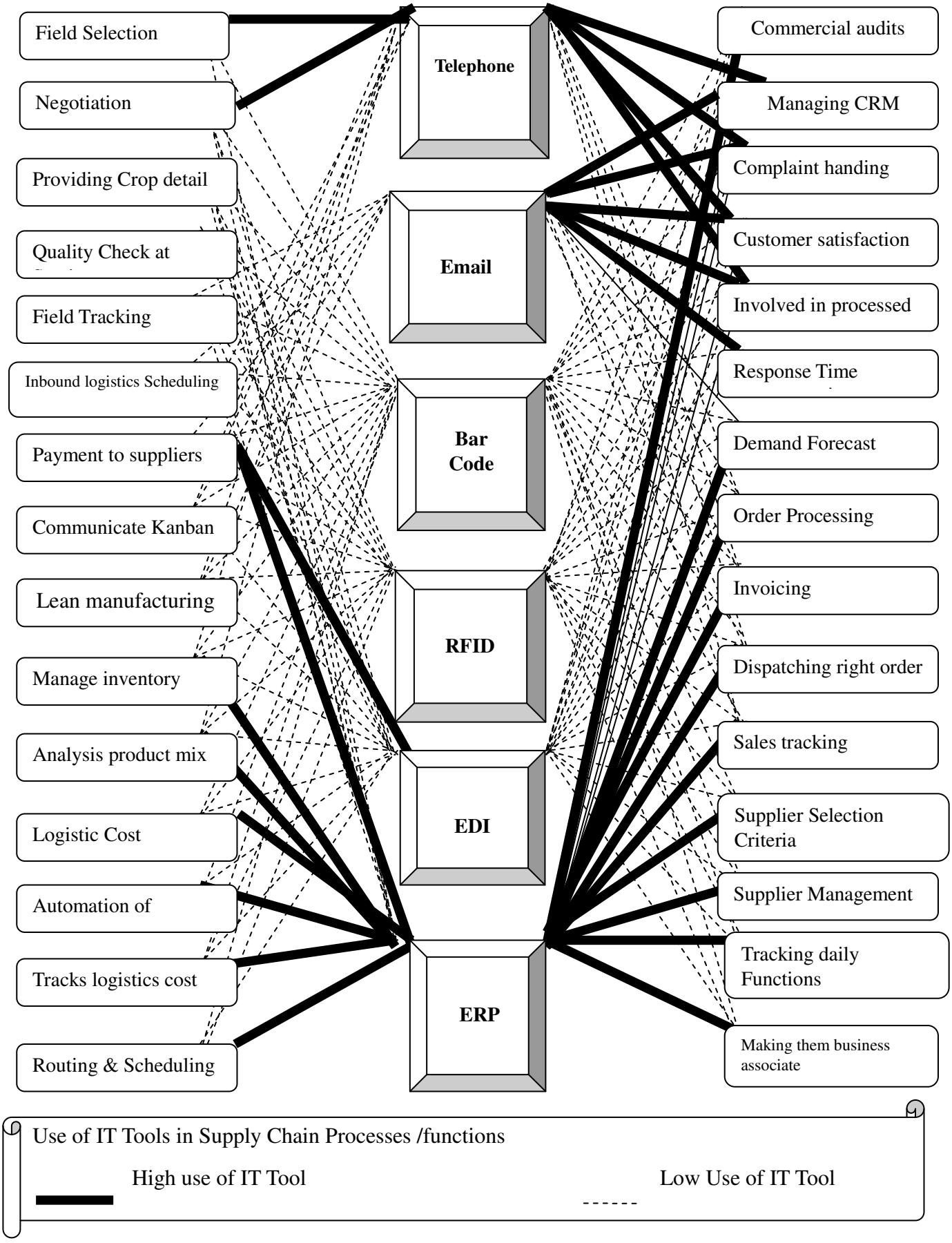

Figure 4.3 Use of IT Tools in Supply Chain Processes /functions

4.3.3 Use of Bar Code

The use of auto-identify technologies provides high levels of information accuracy (Bowersox and Closs, 2001). There are two important applications of optical reading technologies in logistics. The first is the monitoring of items in retail stores and at points of sale, which enables a more agile replenishment. The second refers to the handling and tracking of materials (Barbosa et al., 2010). Barcode technology consists of assigning computer-readable codes to items, boxes, containers and even wagons. A scanner reads the bar codes and converts them into usable information. Bar codes can improve logistics efficiency and support various logistics activities such as vehicle loading, unloading, order tracking etc. (Dawe, 1994, Bowersox and Closs, 2001, Hou and Huang, 2006). Indian perishable trade logistics largely operates through unorganized sector. Therefore, the use of IT tools such as barcode is limited. It is evident in respondent's responses in the present research but these IT tools have important role to play in Indian PFS in years to come. It has limited use 11% of tracking logistics cost, 6% firms implemented in the field of managing inventory, routing and scheduling, automation of administrative processes and product mix analysis, 5% in logistics cost management, 4% in field tracking, commercial audits, managing customer relations and invoicing.

4.3.4 Use of RFID

RFID is entering in a new phase and is said to improve the performance of many agricultural processes. The recent advances offer vast opportunities for research, development and innovation in agriculture (Ruiz-Garcia et al., 2011). RFID has various advantages over previous technologies like barcode. The most noticeable advantage are reduced shrinkage, reduced material handling, increased data accuracy, improved information sharing, faster exception manage, production tracking, quality control, material handling, space utilization, asset management, reduced stock-outs, customer service, after-sales service and lower inventory (Mehrjerdi, 2013, Osyk et al., 2012). RFID tags do not require direct line of sight to the reader and thus can be embedded in an item, placed inside the packing or injected inside the body of animals. Despite RFID's proven importance globally, it is not extensively used in India. It is because of high cost of RFID's tags, weak infrastructure facilities, lack of electricity connections, limited use of computers and internet facilities etc. The analysis depicts

that 21 firms tracks logistics cost, 17% use RFID to do routing and scheduling, 16% do automation through RFID, 15% manages inventory, 12% manage logistics cost and 10% implement RFID in commercial audits. In order to improve performance of PFS, organizations must adopt RFID for tracking, inventory management, order replenishment and transportation etc. so that information sharing can be encouraged and used effectively.

4.3.5 Use of Electronic Data Interchange

Electronic Data Interchange (EDI) is commonly used in the business-to-business (B2B) environment as a reliable mode for electronic data exchange between business and trading partners. EDI is a set of standards for structuring information that is to be electronically exchanged between and within business organizations. The effectiveness of using EDI has been widely investigated (Bechini et al., 2008). The central premise of EDI is that it aid inter-organizational communication by coordinating information and material flows. Supply chain members seek to reduce uncertainty by utilizing formal and informal information sharing agreements, adopting compatible information systems and sharing information such as future strategic needs and feedback from end-users (Tan et al., 2010). EDI is the most popular IT tool widely and significantly accepted by 70% firms in Indian businesses in the present study. It is mostly being used for online payments in India. This feature actually reduces the chances of payment defaults at all the level of logistics stakeholders. The respondents are making use of EDI for the purpose of order processing and invoicing to the tune of 19% manage logistics cost by 16%, tracks their logistics cost and conduct dispatch the right orders to their customers and sales tracking by 15%.

4.3.6 Use of Entrepreneur Resource Planning

Akkermans et al. (2003) gave definition of an entrepreneur resource planning (ERP) as a speedy transaction management system that integrates several types of information. ERP's ability to integrate and standardize the various organizational processes may have an impact on the improvement of customer service and costs reduction. The major advantages of ERP are speed, real time information, help in quick decision making and provides desirable information on all the crucial aspects of business such as landing cost, pricing, selling price, margins, logistics cost, suppliers

and customers' information, employee details (Helo and Szekely 2005, Closs et al., 2005; Schramm-Klein and Morschett, 2006). Various authors has reviewed critical success factors for ERP adoption such as Woo (2007), Zhang et al. (2003), Chung et al. (2008, 2009) and Li (2011). ERP is adopted on the bases of critical success factors categorized into five heads namely organizational environment, technical issues, people issues, adoption process and external support (Li, 2011). The data analysis indicates that in the present research, corporate use ERP to the tune of 84% for their vital tasks like invoicing, demand forecast, dispatching the right order, 82% applies in order processing, 80% in supplier management and forming supplier selection criteria, 79% in sales tracking, routing and scheduling, tracking day to day functioning. Around 65% manage funds and payment to suppliers through ERP, 56% cases in customer complaints, 55% in customer satisfaction and 53% involving them in their processes. The similar uses of ERP are also mentioned by earlier researchers.

4.4 Logistic Issues Crucial For the Performance of Indian Processed Food Sector

As mentioned in section 4.3, logistics play an important role in the success of any change in the way of serving society. A good logistics help in making the products and services available to the customers at their door step, reducing cost and maintain quality, especially in sector like processed food. In PFS, the emphasis appears to be on cost, efficiency and availability. These parameters are influenced by logistics. Table 4.2 gives the analysis of the responses received on issues related with logistics. These issues relevant for the Indian processed food sector (PFS) are classified into five broad categories as presented in figure 4.4.

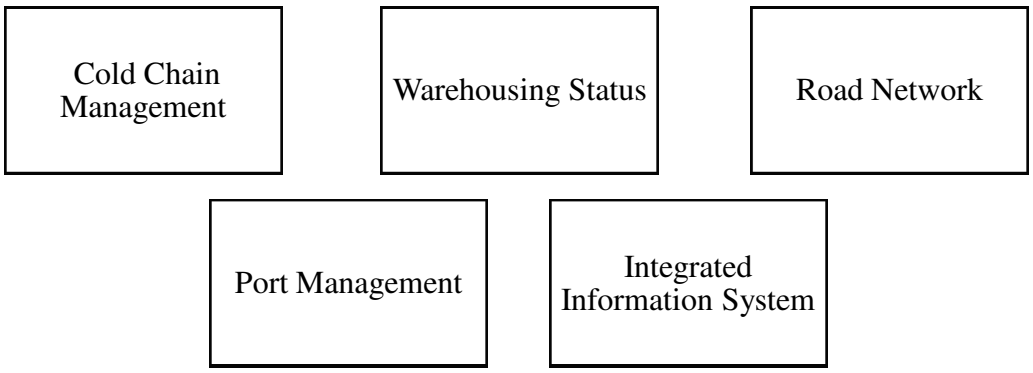

Figure 4.4 Logistics issues in Indian PFS

Most of processed foods are affected by temperature variation, humidity, other environmental conditions and transportation time. 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. Customer service management requires logistic management flexibility at supply side, production and distribution levels (Gotzamani et al., 2010). The important logistics issues in the survey are listed table 4.3, where the respondents were asked to provide their rating on a five point likert scale. The analysis of responses shows that inadequate cold storage facilities had mean score (4.53), single product cold storage (4.42), long and fragmented logistics (4.40). The maximum variation was depicted by labour intensive techniques at port for loading, SD (1.10).

4.4.1 Cold Chain Management

Prakash et al. (2012), A cold chain is temperature control supply chain management. Cold chains help in maintaining products freshness and avoiding deterioration in quality. Major issues in cold chain in India are most of CCM equipment is old and require replacement, large part of CCM equipment in county is currently operating on obsolete CCM refrigerant; CCM is poor in many parts of India, lack of CCM operators. On the other hand, mismanagement of the cold chain, caused by equipment failure or poor processes, will inevitably generate waste. The research revealed that failure in maintaining the cold chain (which can be mitigated by the development and investment in advance reliable technologies) can cast an impact on agri waste. In the logistics of PFS, cold chain is the most important and unique entity, which effects the availability of good quality food to the consumers. It consists of equipment as well as the processes used to transport, store products at the right desirable temperature. The temperature requirements vary for different products, depending on its state-chilled like milk products, frozen like vegetables and ice cream etc. The integrity of the cold chain ought to be preserved from the point of production or processing, during transportation, loading, unloading, handling, storage at home, restaurants and hotels etc. It is important to consider the broader value-based concept of chain advanced by Omta et al. (2001). In the questionnaire, two issues were raised to the respondents during personal interviews related to CCM:

(a) Inadequate cold storage facilities across India from farm to retail

(b) Effective use IT required to improve logistics

The responses indicate that inadequate cold storage with mean score 4.53 (on a five point scale) is the major bottleneck in the logistics of PFS. The use of effective IT system to improve logistics has a mean score 4.42 as given in table 4.2. The data analysis and its interpretation advocates that the cold chain is a crucial connect for the logistics of processed food from farm to consumers and effective use of IT can improve logistics. Therefore, strategies ought to be devised to build new cold storage and strengthen the old CCM by pumping new investment on account of its modernization. The deployment of effective IT system across firms is the need in today's business.

4.4.2 Warehousing Status

One of the key components within the logistics is warehousing. The role of warehousing is growing rapidly and thus wishes to increase capacity by establishing more warehouses (Kah-Shien Tan et al. 2010, Osyk et al., 2012). There are two issues related to agri product storage and warehousing:

(c) High level of wastage at farm, processing plant, central warehouse, resellers

(d) The limited warehousing availability for finished agri produce

The impact of both of these issues is equally crucial for the domestic as well as for global PFS. Its impact is indicated by their significant mean score 4.198 and 4.222 respectively in table 4.3. The inference can be deduced that warehousing and storage facilities ought to be improved. To reduce the wastage of raw material at one end and on other end distribution required to be strengthened. The old, traditional and open air warehouses must be replaced by roof top and ultra-modern warehouses.

4.4.3 Road Network

The road network is important for faster transportation. It is the backbone of the national infrastructure. It can contribute swiftly in improving Indian economic status. The road sector handles 65 per cent of the overall freight and about 87 per cent of the passenger traffic (Sharma et.al, 2009). A study highlighted that the share of road

sector in total freight movement in India has been increasing over the past three decades which is estimated to have increased from 34.5 percent in 1970-1971 to around 63 percent in 2001-2002 (Deloitte Consulting, 2003). The weaknesses of road transport in India are:

(a) The low proportion of national highways, only 2% of the total road network

(b) Average normal distance (250kms/day) travelled by truck/trailers in India as compared to global standards of above 650 kms / day

(c) Weak road transportation

All three issues are interrelated. The respondents were more concerned about the low efficiency of trucks/ trailers in term of distance travelled per day, whose mean score is 4.186 on the five point scale. There are several reasons for weak and inefficient transport. The weak road network is one of them. The other reasons are sighted in the literature. For example, Govt. levies like octroi, central sales tax, VAT, Govt. regulations, poor manpower skill at level of truck/trailer crew with respect to education and driving skills, inadequate facilities for them and poor maintenance of vehicles. The second important factor related to road network is weak road transportation with a mean score of 4.18 on a five point scale in table 4.3. In the recent past, Indian economy has grown at a faster pace than the growth rate of the infrastructure sector. The road is being the first as well as the last link in every mode of transport. It has experienced the highest number of constraints. The issue of the low proportion of national highway, the respondents have shown their concern that only 2% of total road network of the Indian national highway (mean score 4.20 in table 4.3) for fast transit of cargo.

4.4.4 Port Management

Ports are an important link in the logistics and the port efficiency affect to large extent the country's competitiveness (Yen-Chun Jim Wu et al., 2008). Previous research has approached choice of sea port for freight from the angle of functionality (Weigmans et al., 2008) as markets have grown in previous five decades. Tan et al.,(2012) has discussed excellent port management processed followed at Dubai and Singapore. It is because they have grown as leading ports in world trade. The greater port efficiency can lead to lower tariffs on exports which in turn favour the competitiveness of a

country's products in international business. However, in comparison with the leading nations and counterparts like Brazil, Russia, China, India's performance in knowledge dimensions is clearly lagging behind these economies, suggesting there is still a long way to go for India (Pillania, 2007). The port management issues are classified into five heads in present the research:

a) Port Management
b) Labor intensive techniques being used at ports
c) Lack of connectivity from rail to ports
d) Higher turnaround time
e) Integrated IT & LM improve PFS performance

The mean score of port management is 4.09 on a five point scale which simply states its importance for trade. It is part of the international logistics management. The similar trend is being depicted by the mean score of labour intensive techniques being used on port 3.72 on a five point scale in table 4.3. It indicates the ineffectiveness of ports management. The ports are nodal point in the end to end logistics. It is integrating the upstream and downstream movements of cargo in the value chain. The end to end connectivity is required whereas the mean score for lack of connectivity by rail to ports is 4.15 on a five point scale in 4.3. The mean score of higher turnaround time is 3.99 on a five point scale in table 4.3. The port services contribution in Indian foreign trade can be improved by addressing issues enlisted. It can be achieved by replacing labour intensive techniques with modern techniques, by tracking and tracing cargo movement electronically, the export and import procedures ought to be simplified making use of information technology (IT) tools etc.

4.4.5 Integrated Information System

The literature has characterized interdepartmental integration as interaction or communication activities. The more and more meetings and information flow among departments results in effective integration. Other literature has characterized integration as collaboration, which suggests that teamwork, shared resources and joint goals among departments (Vijayvargiya et al., 2010).

Table 4.3 Logistic Issues

Logistic Issues		Mean	S.D	t Test	p-Value*
I.	Long and fragmented logistic activities	4.405	.727	8.536	.000
II.	High level of wastages from source to plant	4.198	.757	4.084	.000
III.	Inadequate cold storage facilities	4.532	.621	13.338	.000
IV.	Effective use of IT required to improve logistics	4.416	.712	9.628	.000
V.	Limited Warehousing availability	4.222	.802	4.328	.000
VI.	Quality & connectivity of vehicles	4.095	.797	1.746	.082
VII.	Weak Road Transportation	4.127	.788	2.484	.014
VIII	National highways account for only 2% of the total road network and carry 40% of Cargo	4.200	.739	4.279	.000
IX.	Normal distance covered by truck/trailers in India is 250-300 Km/day vs international norms of 600-800 km/day (Delays in transit)	4.186	.703	4.131	.000
X.	Lack of connectivity between rail transport and ports	4.150	.709	3.136	.002
XI.	Poor Port Management	4.087	.861	1.777	.077
XII.	Labour intensive techniques at port for loading	3.722	1.102	-3.880	.000
XIII.	Higher turnaround times at ports	3.988	.733	-0.172	.863
XIV.	Integrated IT & LM to improve PFS performance	4.031	.707	0.718	.474

Note: p value is sig (2 tailed test), test value 4

It ought to be arriving at consensus within the organization, issues like high lead time, fragmented logistics activities, quality and connectivity of vehicles, the poor emphasis on reverse logistics covered under the integration of logistics management of PFS. The respondents found that long and fragmented logistics activities are the major bottleneck

for the smooth and seamless logistics management. The impact is visible in its mean score of 4.405 on a five point scale in table 4.3. This can be taken care by a strategy of integrated IT and logistics management whose indicative mean score is 4.031 in table 4.3.

The use of information technology is to reduce the spoilage of fresh produce at farmland. It will be the further enhance the competencies development for newer processed food products as well as bigger capacity building. Major indicators can be high level of wastage from source to plant with t value 4.198, effective use of IT required to improve logistics management t value 9.628 and use of integrated IT and logistics management can improve processed food sectors performance t value 0.718 in table 4.3.

4.5 Results and Discussions

To see the relationship among different issues, correlation analysis is performed. From the discussions with executives from corporate world, seven research propositions were drafted given in the table 4.3. The main research propositions are (a) the relationship among long and fragmented logistic activities and high level of wastages from source to plant, (b) relationship between inadequate cold storage facilities and effective use of IT required to improve logistics, (c) relationship between effective use of IT and limited warehousing availability, (d) relationship between limited warehousing available and quality and connectivity of vehicles, (e) relationship among quality and connectivity of vehicles and weak road transportation reflected by national highways account for only 2% of the total road network, normal distance covered by truck/trailers in India is 250-300 km/day vs international norms of 600-800 km/day, (f) relationship among overall port management and lack of connectivity between rail transport and ports, labour intensive techniques at port for loading, higher turnaround times at ports, (g) relationship between Integrated IT and logistics management to improve PFS performance and overall strategy to enhance performance of Indian PFS. The Regression analysis and Pearson's correlation was carried out. The results are given in table 4.5 and table 4.6.

Table 4.4 Analysis, Outcome of Correlation and Regression

Research Proposition		Outcome Correlation Analysis
P1	There is a significant relationship between Long and fragmented logistic activities and High level of wastages from source to plant	Not supported with significant correlation +0.274
P2	There is a significant relationship between Inadequate cold storage facilities and Effective use IT required to improve logistics	Supported by significant correlation +0.338
P3	There is a significant relationship between Effective use of IT and Limited Warehousing availability	Not supported by significant correlation +0.030
P4	There is a significant relationship between limited warehousing available and quality & connectivity of vehicles	Supported by significant correlation +0.402
P5	There is a significant relationship among quality & connectivity of vehicles and weak road transportation, national highways account for only 2% of the total road network, Normal distance covered by truck/trailers in India is 250-300 Km/day vs international norms of 600-800 km/day	Supported by significant correlation +0.353,+ 0.370, +0.461respectively
P6	There is a significant relationship among overall port management and lack of connectivity between rail transport and ports, labour intensive techniques at port for loading, higher turnaround time at ports	Supported by significant correlation +3.11, +3.11,+4.15, +4.13 respectively
P7	There is a significant relationship between Integrated IT and logistics management to improve PFS performance	In the regression analysis (R square = 0.254) indicates that these strategies explain 25.4 per cent of the variability. This means that in addition to these independent variables, other factors related to industry and Indian conditions such as Govt. policies etc. are also playing a significant role to enhance the performance of PFS

Table 4.5 Regression Summary for Integrated IT & LM to Improve PFS Performance

R	R Square	F	Sig.
0.504	0.254	5.277	0.000

Table 4.6 Correlation Analysis

Parameters	LFA	HLW	ICSF	EIT	LWA	QCV	WRT	NH	NDT	LCRT	PPML	LIT	HTP	IT&LM
Long and fragmented logistic activities (LFA)	1													
High level of wastages from source to plant (HLW)	.274	1												
Inadequate cold storage facilities (ICSF)	.202	.240	1											
Effective use IT required to improve logistics (EIT)	.166	.210	.338	1										
Limited Warehousing availability(LWA)	.146	.186	.274	.030	1									
Quality & connectivity of vehicles(QCV)	.102	.190	.085	.190	.402	1								
Weak Road Transportation(WRT)	.187	.328	.161*	.099	.324	.353	1							
National highways account for only 2% of the total road network, 40% of Cargo (NH)	.057	.130	.102	.128	.257	.379	.370*	1						
Normal distance covered by truck/trailers in India is 250-300 Km/day vs international norms of 600-800 km/day(Delays in transit) (NDT)	.096	.045	.182**	.059	.226	.243	.370	.461	1					
Lack of connectivity between rail transport and ports (LCRT)	.122	.083	.042	.000	.151	.342	.228	.308	.311	1				
Poor Port Management(PPM)	.246	.101	.222	.165	.250	.259	.220	.275	.411	.311	1			
Labour intensive techniques at port for loading (LIT)	.111	.030	.049	.030	.237	.286	.211	.376	.289	.283	.415	1		
Higher turnaround times at ports(HTP)	.262	.198	.106	.061	.241	.194	.300	.255	.275**	.250	.296	.413	1	
Integrated IT & LM improve PFS performance	.081	.266	.099	.118	.214	.260	.202	.234	.174	.281	.248	.345	.412	1
**. Correlation is significant at the 0.01 level (2-tailed)., *. Correlation is significant at the 0.05 level (2-tailed).														

Two important elements in supply chain integration, the integration of IT and LM should contribute to higher performance of PFS. However, the regression analysis resulting in R square =0.254 indicates that these strategies explain 25.4 per cent of the variability. This means that in addition to these independent variables, other factors related to industry and Indian conditions such as Government policies etc. are also playing a significant role to enhance the performance of PFS. Specifically, poor logistics services included carriers' lack of delivery dependability, inadequate transportation infrastructure and lack of communication infrastructure (Pearson et al., 1998). These barriers hinder the improvement of PFS's performance.

4.6 Conclusion

In the current research an integrated information technology system comprises of telephone, email, bar-Code, Radio Frequency Identifier Devise (RFID), Electronic Data Interchange (EDI), Enterprise resource planning (ERP) were studied. In India IT tools such as barcode, RFID, EDI and ERP are currently used in limited manner due their higher initial investment. In near future the visionary corporate should deploy integrated IT and logistic practices to bring higher business growth. This trend is also depicted by result of correlation and regression analysis in present research. But this is not the sufficient condition for better performance and other factors like Government policies, incentives, economic conditions etc. also have to support efforts in performance improvement.

In advanced countries, processed food sector is growing at faster pace because of better supply chain infrastructure. It helps to reduce wastage of agri produce and provide food security. Incidentally, in India, its performance is below the global average. The key findings of research explains that the application of integrated IT is positively and significantly related to integrated logistics management. Furthermore, the implementation of integrated IT and integrated logistics management in PFS have major impacts to enhance the performance of FS in India.

CHAPTER – 5

FOOD SAFETY AND QUALITY IN PROCESSED FOOD SECTOR

5.1 Introduction

The food safety is the major concern besides sensory properties of the food. The food borne outbreaks have been a serious problem in the history of mankind. Therefore, to achieve an appropriate level of protection for human health, consumer's interests, including fair practices in all kinds of food trade, International bodies like Codex standards, Sanitary and Phytosanitary (SPS) introduced by World Trade Organization (WTO) and regulation by Food Safety Standards Authority of India (FSSAI) are instrumental in carrying out risk analysis and enforcing regulations for the prevention of fraudulent, deceptive or unfair trade practices which may mislead or harm the consumer by unsafe or contaminated or substandard food. The standard of food safety has increased in the last decades and policy makers' attention is shifting to other food-related problems such as obesity and unhealthy diets (Van Kreijl et al., 2006). The industrialized countries reported a continuing burden of food borne illness (Flint et al., 2005). The primary objective of this chapter is to provide some perspective in explaining how global food safety can be created through stringent implementation of Codex and WTOs SPS food safety regulations.

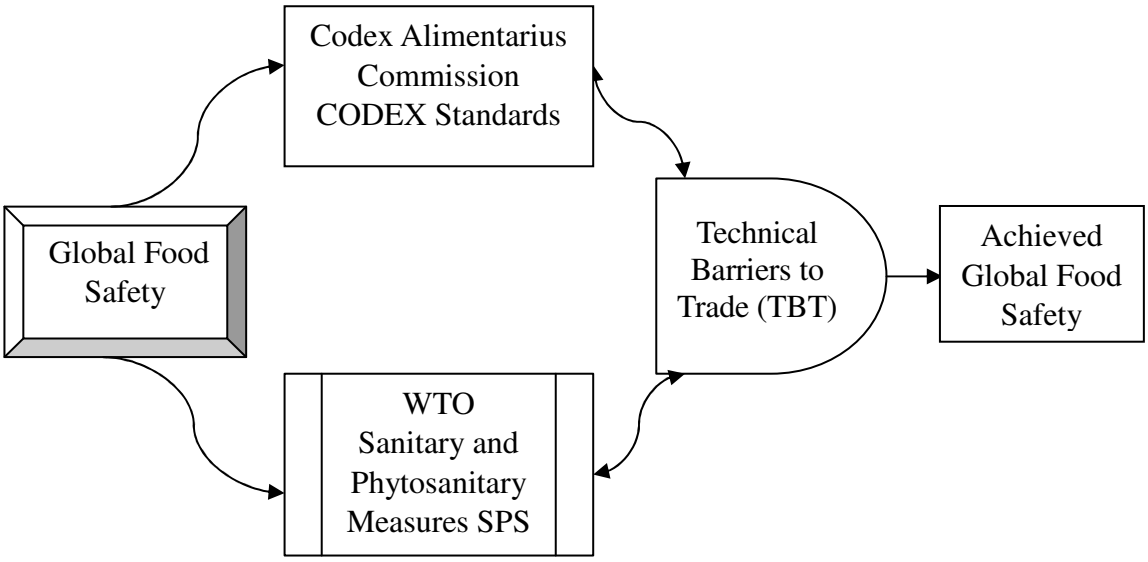

Figure 5.1 Model of Global Food Safety

5.2 Codex Alimentarius Commission (Codex-CAC)

The Codex Alimentarius Commission (CAC) is an intergovernmental body established in 1961. The purpose is about protecting the health of consumers and ensuring fair practices in the global food trade. The mandate is to develop and implement Joint food standards by the Food and Agriculture Organization (FAO) of the United Nations and World Health Organization (WHO). The CAC is currently comprises 172 member countries. The CAC is assisted by an Executive Committee and has of a small secretariat at the FAO headquarters in Rome. It has a relatively simple structure operating through a number of specialized committees and task forces and is supported by three standing expert scientific bodies convened under the auspices of FAO and WHO to generate food data and provide advice on risk-assessment type:

- Joint Expert Committee on Food Additives (JECFA)
- Joint Meeting on Pesticide Residues (JMPR)
- Joint Meeting on Microbiological Risk Assessment (JEMRA)

Codex Alimentarius is a Latin word, whose meaning is food law or code. The CAC is a collection of internationally adopted food standards, guidelines, codes of practice and other recommendations (USDA, 2012). It includes provisions in respect of hygienic and nutritional quality of food, including microbiological norms, provisions for food additives and contaminants, pesticide and veterinary drug residues, labelling and presentation, and methods of analysis and sampling. It also contains provisions of an advisory nature in the form of codes of practice, guidelines and other recommended measures. The publication of the Codex Alimentarius is intended to guide and promote the elaboration and establishment of definitions and requirements for food to assist in their harmonization and in doing so to facilitate international trade (DA&M Ireland, 2012). Since the conclusion of the Uruguay Round in 1994-95 the role of Codex Alimentarius standards has been strengthened. The world trade organization agreement on sanitary and phyto sanitary measures (SPS) considers that WTO members applying codex standards meet their obligations under this agreement. This means that codex standards are considered scientifically justified and are accepted as the benchmarks against which national measures and regulations are evaluated.

Note: Global Food Safety: Determinants are Codex Standards and WTO's SPS Food Safety Regulations, Journal of Advances in Management Research (Under Review since February, 2013).

5.3 Sanitary and Phyto Sanitary (SPS) Agreement

The WTO, SPS agreements and the codes of practices issued by the Codex Alimentarius Commission constitute the benchmark for international harmonization that guarantee the trade of safe food (Juke 2000, Boutrif 2003, Mayeda, 2004).

The specific objectives of Neeliah et al. (2013) research were to assess and compare the importance of European Union (EU) SPS measures as an export determinant for Mauritian fishery and horticultural products exports. To determine whether these measures have acted as a barrier to trade and lastly to describe the compliance strategy adopted by exporters using firm-level surveys and in-depth interviews. The findings of Neeliah et al. (2013) are as follows: EU SPA measures are required to sale the produce in EU markets. This certification is an indicator that product is certified and fit for human consumption. It is necessary but not the sufficient condition for trade to take place with EU.

All member nations need to enforce food legislations. The market access agenda of most of the advance nations extends trade impeding regulations such as environmental and health standards and restrictive rules of origin as well as restrictions and regulations that limit the ability of developing countries to sell services abroad, especially through the temporary movement of workers (World Bank, 2002). The agreement on the application of SPA measures came into existence with the formation of the World Trade Organization (WTO) 1995. The SPS Agreement was aimed at controlling issues affecting food safety measures.

The countries are using food safety concerns to justify their act of erecting food regulations against imported foods. It is acted as barrier to trade against developing and underdeveloped nation's products. One major qualification is contained in Article 3(3) of the SPS Agreement which states that members may introduce or maintain sanitary or phyto sanitary measures which result in a higher level of sanitary or phyto sanitary protection than would be achieved by measures based on the relevant international standards, guidelines or recommendations if there is a scientific justification, or as a consequence of the level of sanitary or phyto sanitary protection. There is a scientific justification if, on the basis of an examination and evaluation of available scientific information in conformity with the relevant provisions of this agreement, a member

determines that the relevant international standards guidelines or recommendations are not sufficient to achieve its appropriate level of sanitary or phyto sanitary protection. SPS agreement applies to all sanitary and phyto sanitary measures that may affect international trade. Exporters must meet the quality and safety demanded by import market consumers. For this reason, international trading rules are in place in order to ensure that public standards are applied fairly and equally to export and import. WTO members supported the following SPS principles depicted in figure 5.2.

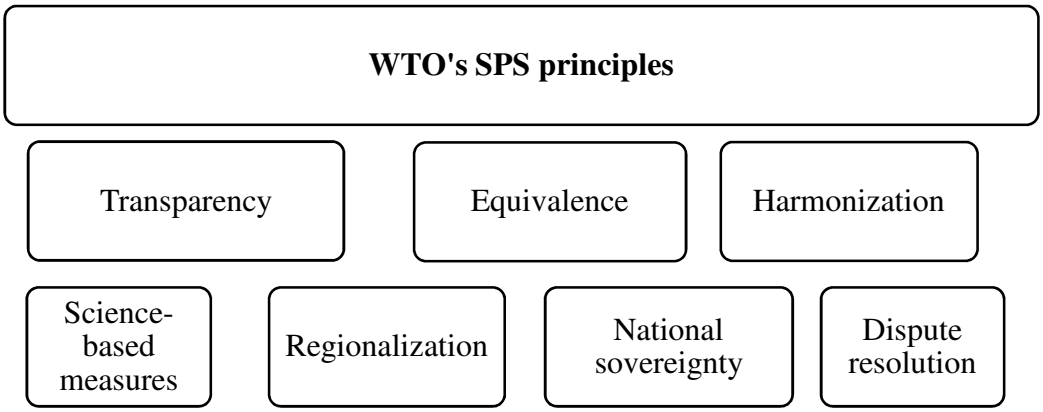

Figure 5.2 SPA Principles

The term sanitary or phytosanitary measure is defined as any measure applied to protect human, animal, or plant life or health from certain risks.

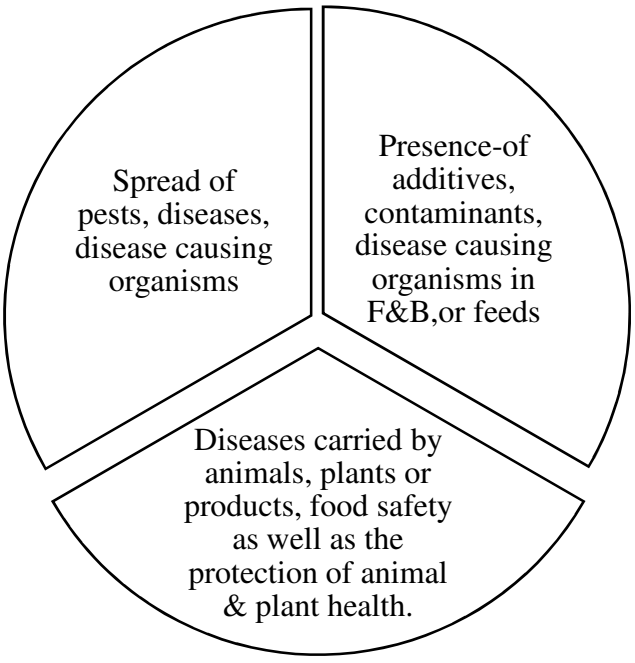

Figure 5.3 Sanitary-Phyto-Sanitary Measures

SPS agreement applies to all sanitary and phytosanitary measures that may affect international trade. Exporters must meet the quality and safety demanded by import market consumers. WTO members supported the SPS principles such as transparency, science-based measures, regionalization, national sovereignty, harmonization, dispute resolution and equivalence. The SPA principles are given in figure 5.2 and the SPA measure are presented in figure 5.3. Engler et al. (2012) identified Categories and items of SPS and quality related regulations and standards.

Categories	**Item of regulation**
Sanitary Phyotsanitary measures	Number of pest, diseases and weeds regulated, quarantine treatment requirements
Tolerance limits for pesticide residues and contaminants	Maximum residue limits
Hygiene requirements	Microbiological requirements
Labeling, marking and packaging	Packing materials for quarantine treatment, Labeling requirement
Product and process standards	Good Agricultural Practices requirements, Quality standards
Registration procedures and other import requirements	Registration of production sites, export firm, producer and phytosanitary Inputs, Import permission requirement, Bioterrorism inspection/24 hours

Under WTO regulations all the member nations are required to publish their regulations and provide a mechanism for answering questions from trading partners. The member nations must accept SPS measures of another country as equivalent if they result in the same level of public health protection, even if the measures themselves differ. The same level of health protection should apply to both domestic and imported products. This recognizes that individual nations are unwilling to subscribe to uniform international standards for all hazards. There is a clearly defined mechanism for resolving disputes between countries in a timely manner. The dispute settlement panel is expected only to state whether the SPS measures under question have a scientific basis and are consistently applied.

5.4 Indian Stands on Food Safety

The food safety issues are also getting importance in India. It is not because of global pressure of World Trade Organization (WTO) rather because of customers increasing demand for better quality food. The Food Safety Standards Authority of India (FSSAI) came into existence under Food Safety and Standards Act, 2006. FSSAI has been created for developing scientific standards for food products and to regulate food manufacturers, warehousing, distribution channels, domestic sales, exports and import to ensure availability of safe and food fit for human consumption. The acts like Vegetable Oil Products (Control) Order 1947, Prevention of Food Adulteration Act 1954, Fruit Products Order 1955, Meat Food Products Order 1973, Edible Oils Packaging (Regulation) Order 1988, Milk and Milk Products Order, 1992, is replaced by Food Safety and Standards Act, 2006. The major aim is to establish a single reference point for all matters relating to food safety and standards by moving from multi level, multi departmental control to a single line of command.

The exporters saw compliance to SPS requirements as a strategy to compete against other countries with lower cost of production. A similar trend has been observed in many developing countries since 2000, for instance, Argentina, Brazil, Paraguay, Uruguay, Thailand, Nicaragua, India, China and Kenya where SPS measures have been used as a lifeline (Farina and Reardon (2000), World Bank (2005), Diaz Rios and Jaffee, 2008). Mauritius was part of this emerging trend, as SPS measures were considered as a competitive tool in the fishery export sector and have acted as a catalyst (Neeliah et al., 2012).

There is willingness to invest to meet the evolving SPS requirements for the market. This can be attributed to the fact that EU is a remunerative market. The returns on investment will be rewarding for organizations compliance SPS certification in long run. This finding is concur with finding of Henson and Jaffee (2008) who found that Indian processors improved their standards to gain premium prices on exports.

5.5 Reasons for Low Quality of Processed Food in India

The hazards arise from improper agricultural practices, poor sanitary and hygiene conditions at all stages of the food, lack of preventive controls in food processing

operation, misuse of food additives and chemicals coupled with inappropriate storage and handling. Specific concerns about food hazards are mainly chemical, microbiological, pesticide residues, veterinary drug residues and allergic compounds. All these were major reasons of low quality of processed food in India (Vemula et al., 2012).

The respondents were requested to give their opinion in terms of agreement or disagreement on five point scale on reasons furnished for low quality of processed food in India in figure 5.4. The poor traceability (4.41), inadequate R&D (4.40) are followed by primitive farming at small farm holding (4.35). The maximum variation was observed in case of inferior agri produce S.D (1.45) and lack of skilled worker SD (1.20). It implies that all the issues of low quality boils down to food safety and hygiene conditions in processed food sector resulted in low quality of PF in India.

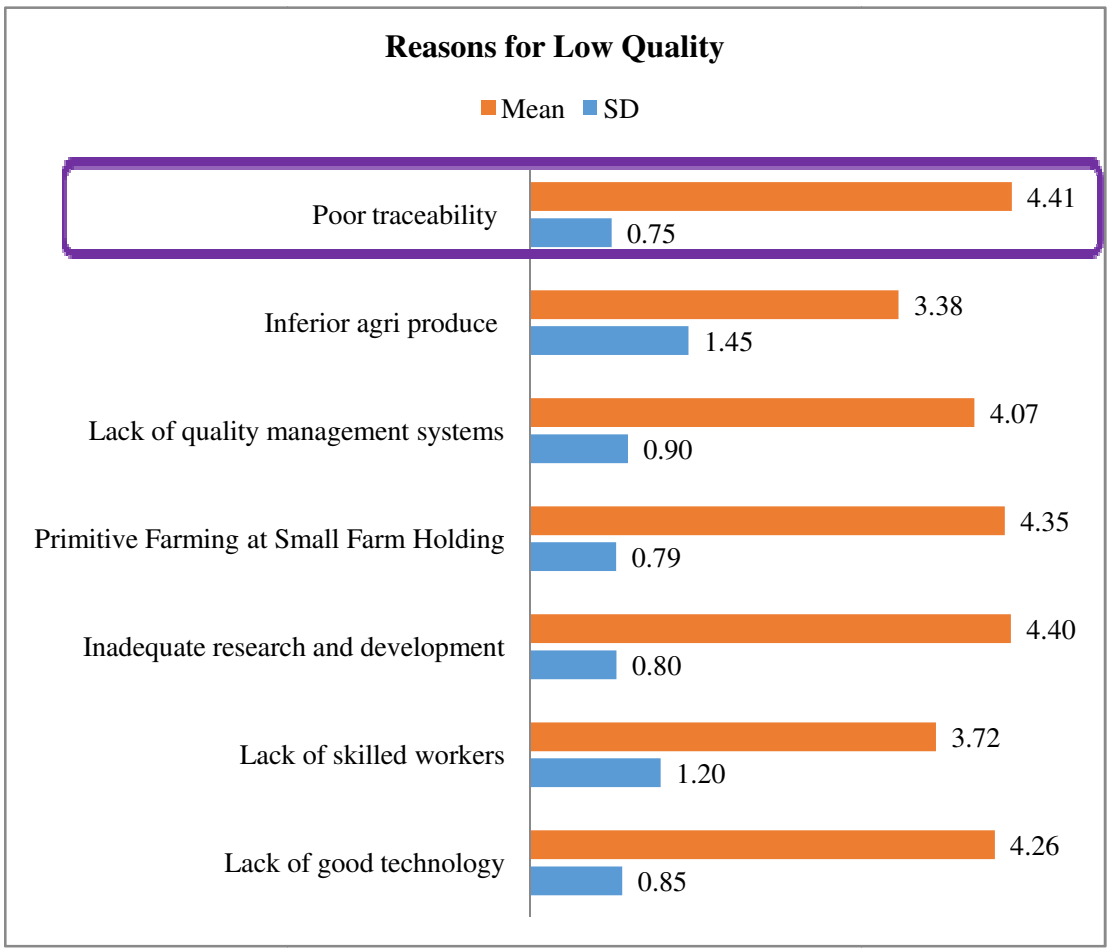

Figure 5.4 Reasons for Low Quality of Processed Food

5.6 Food Safety Standards and Quality Issues

Effective national food control systems are essential to protect the health and safety of domestic consumers. They are also critical in enabling countries to assure the safety and quality of their foods entering international trade and to ensure that imported foods conform to national requirements. The new global environment for food trade places considerable obligations on both importing and exporting countries to strengthen their food control systems and to implement and enforce risk-based food control strategies. Consumers are taking unprecedented interest in the way food is produced, processed and marketed, and are increasingly calling for their Governments to accept greater responsibility for food safety and consumer protection.

5.6.1 Food Safety Objectives

The principal objective of the new general and specific hygiene rules is to ensure a high level of consumer protection with regard to food safety (Regulation EC, 2004). Consumers have become very critical about food safety and food quality due to a number of food affairs which have received a great deal of media attention. Time scarcity, the feeling of not having enough time, has been implicated in changes in food consumption patterns such as a decrease in food preparation at home and increase in the consumption of fast foods, a decrease in family meals, and an increase in the consumption of convenience or ready-prepared foods (Jabs and Devine, 2006).

H1: Development of Food Safety Objectives help to achieve Food Safety (FSO)

5.6.2 Traceability of Processed Food up to Farm Level

Food safety and quality issues generally occur due to incorrect processing and handling of food products. Monitoring the flow of products, their quality and the process parameters throughout production and linking them to each transition in the state of these products is an effective way of implementing and ensuring product safety and traceability (Thakur et al. 2010). Besides the capability to track food products as they move through the supply chains, one important objective of any food traceability system is to ensure product safety and quality. The most important elements of traceability have been identified as unique identification, lot integrity, product transformations and data collection and retrieval (Jansen-Vullers et al., 2003; Bechini et al., 2008; Folinas et al., 2006; Trace Food Wiki, 2009)

H2: Traceability of processed food up to the level of farm helps to achieve Food Safety (TRE)

5.6.3 HACCP Implementation

The HACCP concept was initially developed by the National Aeronautics and Space Administration (NASA) in order to guarantee that food used in the United States space program would be completely free of pathogens. Although the HACCP concept continues to develop, it was not until the late 1980s that HACCP development began to accelerate with support from the WHO/FAO and National Advisory Committee on Microbiological Criteria for Food (NACMCF) (FAO/WHO, 1983; NACMCF, 1992). The HACCP concept then has been legitimized by the Codex Alimentarius Commission who incorporated the HACCP guidelines into the food hygiene code (CAC, 1997). From 1993 onwards, HACCP based controls were required by UK law through the implementation of a range of EU food hygiene directives. The Hygiene of Foodstuffs Directive 93/43/EEC (covering food retailers, caterers and manufacturers of non-animal origin products) required hazard analysis to be carried out by food businesses (European Community Directive 93/43/EEC, 1993) and governments have mandated the use of HACCP system (Unnevehr and Jensen, 1999). Minimally processed fresh-cut produce represents a particular challenge to food safety. The research has highlighted the need to mitigate risk at all stages but with specific emphasis at the farm gate stage. A more comprehensive and integrated approach to risk management is arguably needed. A call for HACCP on the farm or farm food safety management system may be warranted in future if fresh produce outbreaks continue to rise (Soon et.al, 2012).

H3: HACCP Implementation Instrumental in Food Safety (HAP)

5.6.4 Risk Analysis

The decision making is based on level of risk involved in the activity to be performed. Risk analysis has relationship among three co-existing approaches: risk assessment, risk management and risk communication. According to internationally accepted principles and definitions, risk assessment is the scientific evaluation of known or potential adverse health effects resulting from human exposure to food-borne hazards (FAO/WHO, 1995). It includes the identification of the risk, its likelihood and severity, nature of adverse effects e.g whether the impact is on humans, food producing animals, or the environment (EU, 2000). Risk assessment entails the following steps: (1) hazard identification, (2) hazard characterization, (3) exposure assessment and (4) risk characterization. Hazard is defined as a physical, chemical, biological (PCB) agent in or

property of food that may have an adverse health effect and risk as a function of the probability of an adverse effect, magnitude of that effect and consequences (FAO/WHO, 1995). West (2008) had discussed the classification proposed by Nestle (2003), who suggested two approaches to the debate about safety and risk perceptions in food. One approach, based on science, emphasise observation and empirical evidence to assess risks. The other approach, based on values, is justified in accordance with psychological, cultural and social contexts. West (2008) argues that these approaches overlap because science is not value free and likewise values-based approaches also consider science-based values. De Cruz (2013) has done detailed research on understanding the risk perceptions related to food products and secondly on recognising and legitimating traditional forms of knowledge of food processing.

Risk management is defined as the process of weighing policy alternatives in the light of the result of risk assessments, together with other relevant evaluations, selecting and implementing appropriate control options (EU, 2000). This includes appropriate monitoring and surveillance activities. Risk communication is defined as the interactive exchange of information and opinions concerning risk and risk management activities among risk assessors, risk managers, consumers, and other interested parties (EU, 2000). To date, the analysis of food safety issues has been confined to scientific experts in risk assessment and professional risk managers with very limited formal input from other interested parties, such as consumer organisations, non-governmental organisations, industry, or indeed, consumers themselves (Marvin et al. 2009).

H4: Risk Analysis is the Basic Requirement in Food Safety (RA)

5.6.5 Genetically Modified Foods

At international level, genetically modified (GM) crops have increased from 1.7 million hectares in 1996 to more than 160 million hectares in 2011, making biotech crops the fastest-adopted crop technology in the history of modern agriculture (James, 2011). As a result, so-called GM foods have been marketed in the global marketplace over the last ten years. This commercialization of GM foods has prompted opposing reactions worldwide. Consumers' attitudes with respect to agro-biotechnology vary according to cultures and regions (Chen and Li, 2007) because the public's assessment of GM foods is very heterogeneous (Costa-Font et al., 2008). Entrena et al. (2013), studied attitudes towards GM foods linked to purchase intentions, perceived benefits and risks pose and attitudes

towards GM technology impacts both perceived risks and benefits. Thus, as authors expected, consumers' perceptions of the risks and benefits posed by GM foods play a significant role in shaping attitudes towards these foods. With at least 14 legal instruments governing food safety, a minimum of three government ministries are involved in law enforcement. The jurisdiction of law enforcement is devolved to local authorities. Out of these 14 legal instruments, one of them is Genetically Modified Organisms Act, Act 25 of 1997. The major issue is implementation at local level. In 2006, 22 countries grew commercial biotech crops, including 11 developing countries (James, 2007). Notably, eight of these 22 (USA, Argentina, Brazil, Canada, India, China, Paraguay and South Africa) each grew more than 1 million hectares each. Of these eight, India and China were noteworthy for confining their activities to non-food crops, mainly Bt cotton (James, 2007).The difference in the consumer perception of biotechnology and GM food between Europe and United States (as representatives of opposite sides) is huge. Americans are searching for foods that are not only safe, but also promote good health, overall well being and therefore they are accepting GM food much more than Europeans who are much less trusting GM food (Senauer, 2001; Onyango and Govindasamy, 2005, Klein et al. 2009). Opposition to GM foods is driven primarily by concerns about food safety and environmental risks associated with their use (Wachenheim et al. 2008).

Cerjak et. al, 2011 conducted a face-to-face survey with 360 consumers in order to collect data on importance of food production technology, respondents' knowledge about GM food, consumers' beliefs about GM food, fear of genetic modifications, willingness to consume and pay for GM food and respondents' demographics. However, the majority of respondents rejected consumption of GM food. The rejection of GM food is mostly associated with fear of possible negative impact of such food on human health and on the environment. Additionally, most respondents fear the transfer of genes between animals and plants more than gene transfer being plant based.

H5: Genetically Modified Foods are Safe as per Food Safety Norms (GMF)

5.6.6 Transparency in Norms and Standards

The definition of transparent is free from pretence or deceit, easily detected or seen through or readily understood. Hence, a transparent system or proposition is frank, obvious and clear. The processes by which the current global food safety system and HACCP system evolved were contemporaneous and entirely transparent. The current global food safety

system, under the auspices of the United Nations, began in 1945 with the organization of the Food and Agriculture Organization. The General Agreement on Tariffs and Trade (GATT), concluded in 1947. In 1963, the FAO/WHO Codex Alimentarius Commission (CAC) was formed both to protect the health of consumers, and to ensure fair practices in world trade. Sanitary and Phytosanitary Agreement (SPS) has "transparency" as its most important underlying concept.

H6: Transparency norms and standards help to achieve food Safety (TES)

5.6.7 Harmonization of Food Safety Standards to WTO

A single European market was formed in 1992 that not only addressed the need to remove trade barriers but also to address differences in national regulation. Regulations such as personnel health and safety, environmental, animal welfare, social issues may potentially cause trade restrictions. Harmonization removes barriers to free trade and this has been gaining pace in the EU since 1992 (WTO 1995). Harmonization of trade regulations and standards is perhaps the most contentious issue regarding export markets due to the impacts that it can have on trade (Engler et al., 2012). The requirements for food safety and the introduction of HACCP (hazard analysis critical control point) based food safety risk management systems helps to prevent trade disputes in the future. The WTO Agreement on the application of Sanitary and Phytosanitary Measures, which came into force in January 1995 with the WTO, was aimed at minimizing the negative effects of unjustified health barriers to international trade (Baines, 2002). The harmonization of product standards is one techniques, the other is deregulation.

H7: Harmonization for Food Safety Standards with WTO is essential to achieve Food Safety (WTO)

5.6.8 Equivalence to International Standards

Prior to 1995, SPS measures were part of the 1947 General Agreement on Tariffs and Trade (GATT) which has measures that were necessary to protect human, animal or plant life and health. The WTO SPS Agreement reiterates earlier commitments under the GATT, but also requires regulators to: (1) base measures on a scientific risk assessment, (2) recognize that different measures can achieve equivalent safety outcomes (equivalence) and (3) allow imports from distinct regions in an exporting country when presented with evidence of the absence or low incidence of pests or

diseases (regionalization). Adoption of international standards (harmonization) is encouraged and desired (Donna Roberts et al. 2002, Engle, 2012).

H8: Adoption of Equivalence to International Standards (EIS) helps Food Safety

5.6.9 Scientific Justification in Procurement

Where international standards or practices do not exist or are in the process of being formulated, or international standards and practices would not be an effective or appropriate means for securing the objectives and where there is a scientific justification that it would result in a better level of protection and is scientifically justified can be adopted by the organization for the procurement of raw materials and imports. As per Article 2 of the SPS agreement stresses that members have the right to adopt SPS measures to achieve their self-determined health protection level. This level, called the appropriate level of protection (ALOP) or the acceptable level of risk (WTO, 2012).

H9: Scientific Justification in Procurement (SJP)

5.6.10 Cost of Compliance of Standards and Certifications

Concerns have been raised, in particular in developing countries, that some private certification systems may create barriers to market access and raise the costs of production and marketing. When the costs of compliance and certification are high and not properly compensated by the market, small-scale farmers and businesses may be unable to obtain certification and run the risk of being excluded from some export markets. Small-scale producers need reliable information, technical assistance and institutional support in order to take advantage of the opportunities offered by voluntary standards while minimizing risks (FAO 2005). The growing importance of food quality and safety standards in international markets is influencing production and marketing conditions of farmers worldwide. Export oriented developing countries increasingly introduce these standards into their agricultural production systems to secure continuing access to major markets. In the scientific debate, the effects of this development on small-scale farmers in developing countries are controversially discussed. On one hand, small-scale farmers may benefit from technology upgrading and access to more remunerative, high-value markets. On other hand, high recurrent and non-recurrent costs of standard

implementation and certification may lead to the exclusion and marginalization of smallholder farmers (Handschuch, 2013).

H10: Cost of Compliance of Standards and Certifications (CCC)

5.7 Results and Discussions

In the questionnaire, respondents were requested to express their opinion on the importance of the food safety and quality issues outlined in the previous section. The results of the analysis of the responses are presented in table 5.1. To test the reliability of the responses, Cronbach-alpha is calculated which was 0.75 and considered to be acceptable (Tavakol and Dennick 2012, Nunnally 1994, Bland and Altman D 1997). Single sample t test is applied with the assumptions that the issues are independent of each other and the sampling distribution is normal, the results of which are also in table 5.1.

To check the correlation among these issues, Pearson's coefficient of correlation between all the pairs is calculated and results are given in table 5.2. Further the results of regression analysis are presented in table 5.3 and ANOVA results in table 5.4. The table 5.5 shows the Beta coefficients of regression model. The interpretation of these tests is as follows:

1. The significance of the individual food safety issues has been tested using t-statistic at level of significance $\alpha = 0.05$. Now if p value is less than α for a particular coefficient means the variable attached to that coefficient are significant.
2. The t test is calculated at test value 3, all the t values are positive and $p <= 0.01$, which implies that, food safety objective, traceability, HACCP, harmonization in regard to WTO classification and scientific justification in procurement are significant for the food safety and quality of food. They can help to achieve the international standards of food safety norms.
3. There is significant relationship among ten global food safety factors.
4. The regression was run with equivalence to international standards as dependent variable and as food safety objective, traceability, HACCP, harmonization in regard to WTO classification, and scientific justification in procurement as independent variables. The R^2 value for the model is 0.34 which indicates that 34% of the

variations in the preference are explained by food safety objective, traceability, HACCP, harmonization in regard to WTO classification and scientific justification in procurement. The significance of R^2 is tested with the help of F statistic through ANOVA which works out to be F=25.68 and is significant at 5% significance level. This is because the p value for F equals zero which is less than the level of significance. A significant F value means that there is a significant difference in the importance of variables e.g all is not equal.

5. Further, the relative importance of the independent variables in influencing preference is determined by examining the standardized coefficients (called β). They are reported in table 5.5. The standardized coefficients were obtained by running the regression of standardized values of the dependent variable on the standardized values of the independent variables. The standardized values of a variable were obtained by subtracting from the variable its mean value and dividing by its standard deviation. Higher the value of the absolute standardized coefficient, the higher was the importance of that variable in influencing preference. Therefore, food safety objective, traceability, HACCP, harmonization in regard to WTO classification and scientific justification in procurement are significant variable in influencing equivalence to international standards of Food Safety Norms.

Table 5.1 Mean, Standard Deviation and Significance of Food Safety Variables

Food Safety Variables	Mean	Std. Deviation	t	p-value
FSO	4.044	0.987	16.8	0
TRE	4.567	0.685	36.3	0
HAP	4.425	0.679	33.3	0
RA	3.73	0.993	11.7	0
GMF	2.397	1.137	-8.4	0
TES	4.345	0.82	26.0	0
WTO	4.167	0.706	26.2	0
EIS	4.044	0.815	20.3	0
SJP	3.849	0.911	14.8	0
CCC	3.845	0.972	13.8	0
Test value t-test is three				

Table 5.2 Correlation Analysis of the Variables in Food Safety and Quality

GFSV	Mean	S.D	Correlation								
			FSO	TRE	HAP	RA	GMF	TES	WTO	EIS	SJP
FSO	4.044	0.987	1.000								
TRE	4.567	0.685	0.140	1.000							
HAP	4.425	0.679	0.032	0.508	1.000						
RA	3.730	0.993	0.626	0.126	0.123	1.000					
GMF	2.397	1.137	0.077	-0.142	-0.070	0.081	1.000				
TES	4.345	0.820	0.104	0.415	0.208	0.066	-0.203	1.000			
WTO	4.167	0.706	0.144	0.364	0.243	0.093	-0.137	0.492	1.000		
EIS	4.044	0.815	0.424	0.170	0.103	0.404	0.041	0.299	0.216	1.000	
SJP	3.849	0.911	0.380	0.195	0.085	0.400	-0.019	0.235	0.337	0.530	1.000
CCC	3.845	0.972	0.381	0.150	0.094	0.328	0.128	0.297	0.241	0.552	0.500

*. Correlation is significant at the 0.05 level (2-tailed).,
GFSV Global Food Safety Variables,
S.D Standard Deviation

Table 5.3 Summary of Statistical Measures of Regression Analysis

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
	0.59	0.34	0.33	0.67
a. Predictors: (Constant), SJP, HAP, FSO, WTO, TRE				
b. Dependent Variable: EIS				

Table 5.4 One Way ANOVA

ANOVA						
Model		**Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**
	Regression	57.11	5.00	11.42	25.68	0.00
	Residual	109.41	246.00	0.44		
	Total	166.52	251.00			
a. Predictors: (Constant), SJP, HAP, FSO, WTO, TRE						
b. Dependent Variable: EIS						

Table 5.5 Beta Coefficients

Coefficients						
Model		**Un-standardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
		B	**Std. Error**	**Beta**		
	(Constant)	1.30	0.38	----	3.42	0.00
	FSO	0.21	0.05	0.26	4.60	0.00
	TRE	0.03	0.08	0.02	0.36	0.72
	HAP	0.05	0.07	0.04	0.72	0.47
	WTO	0.02	0.07	0.02	0.34	0.74
	SJP	0.37	0.05	0.42	7.09	0.00
a. Dependent Variable: EIS						

5.8 Conclusion

The food safety apprehensions ought to wrap the array of food chains. The food safety regulation must have a major aim to protect the consumer health, increasing economic disparity, harmonizing well-being of trading nations and allowing barrier less international business among various nations. The Codex Alimentarius Commission (CAC) was pioneering to come up with food safety standards. In 1995, when the World Trade Organization established, WTO proposed major food safety components under SPS Agreements. The food hazard has the potential to cause an adverse health effect to the consumer of the food. The risk analysis of food hazard's level and its intensity is crucial to be evaluated for finding its root cause. It infers the status of food supply chain whether it is risk free or risk prone from food hazard. It has been observed that it is extremely difficult to implement all the Global food safety measures especially for small and even medium exporters of processed and fresh food. It is due to cost incurred in procuring international certifications. Due to this, export from India becomes dearer and therefore, opportunities of international business are lost many times. A new framework of food safety in India and other nations like us is proposed based on the empirical study conducted as depicted in figure 5.5.

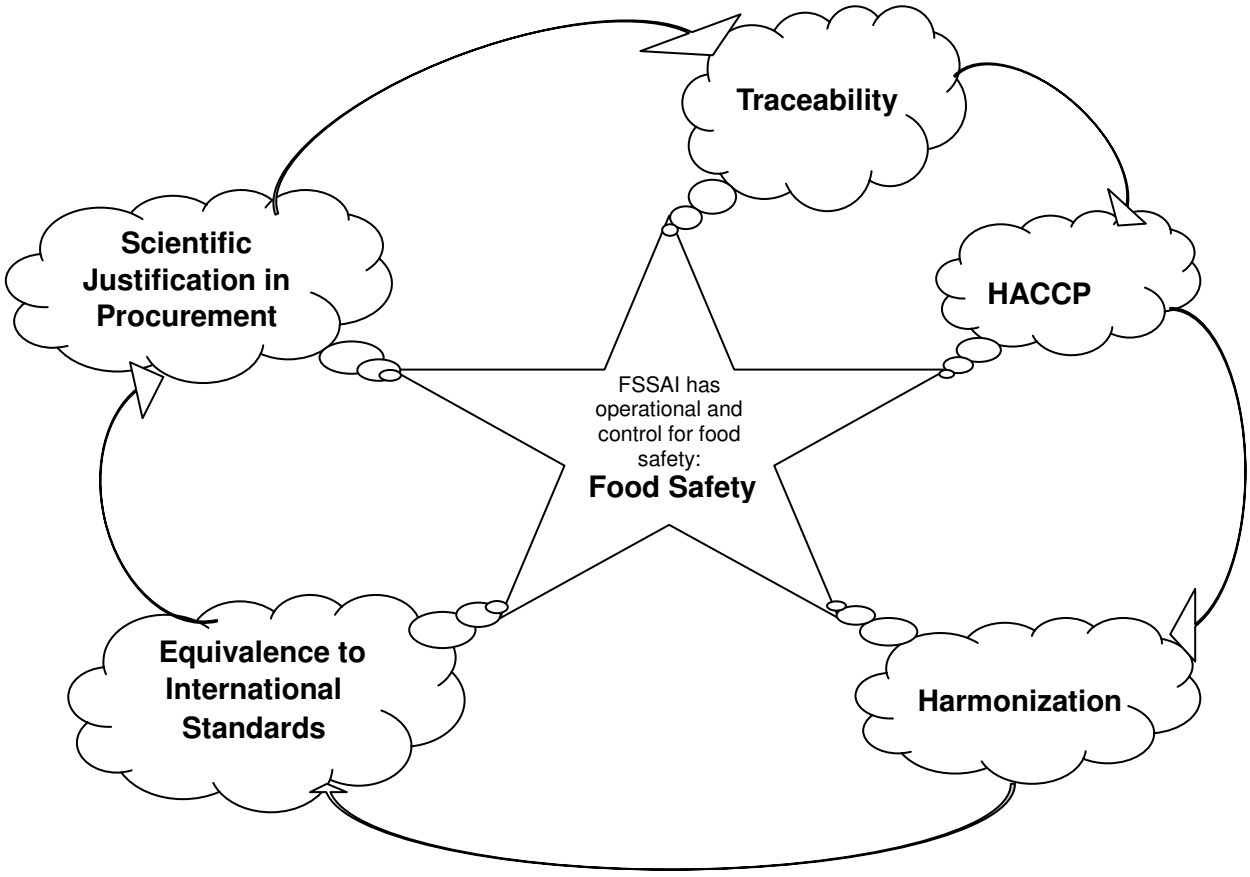

Figure 5.5 Proposed Model of Food Safety for Developing Nations

In this chapter, two major concerns on food safety were discussed. Firstly, concerns on the global food safety, its determinants like Codex standards and WTO's SPS regulations are discussed which was followed by description of the Indian stance on food safety. The food safety is the major concern besides sensory properties of the food. The food borne outbreaks have been a serious problem in the history of mankind. Therefore, to achieve an appropriate level of protection for human health, consumer's interests, including fair practices in all kinds of food trade by the international bodies like Codex standards, WTO's SPS. The adequate explains were presented on the Codex standards and WTO's SPS norms on food safety.

The results of the study in Indian context proposed that food safety objective, traceability, HACCP, harmonization in regard to WTO classification, and scientific justification in procurement considered as independent variables and equivalence to international standards was taken as the dependent variable. The regression analysis was run to produce a new model of food safety.

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CHAPTER – 6

CASE STUDIES ON PROCESSED FOOD SECTOR

6.1 Introduction

In this chapter three case studies are discussed. They are carried out on the processed food organizations having selling and distribution network all over the India. The case studies have focused on important supply chain issues of processed food in India. First case study is related frozen peas supply chain, where the processing and cold chain management are the key issues. The second case study elaborates the issue of food safety in processed food in general and milk in particular. The third case study deals in the cold chain management for frozen corn manufacturing organization. The general type of supply chain is different from cold supply chain. It is presented in table 6.1.

6.2 Case Study Method of Research

The case studies can be comprehended as a particularly useful approach for assessing real world examples (McCutcheon and Meredith, 1993). Case studies allow direct observation of the field, which would be particularly suitable for approaching several stages of a supply chain. Case study research has often been criticized for its lack of rigor (Ellram, 1996). The research process is carried out in a structured way and well documented then case study research will continue to allow the in-depth analysis of contemporary phenomena. For ensuring rigor, quality criteria have been put forward which should be comply with. It comprises of case selection, data collection, validity and reliability. Taking up this research process and related criteria should enable useful case study research in supply chain management. The importance of case based research has been highlighted by a number of authors for operations (McCutcheon and Meredith, 1993; Stuart et al., 2002) and logistics management (Ellram, 1996) and supply chain management (Hilmola et al., 2005, Seuring, 2005) in recent years.

Note: Indian frozen peas market: a case study on FPIL, International Journal of Globalization & Small Business (Inderscience), Vol. 4, No.2, pp. 154-169.

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The case study method is used in present research on processed food supply chain as it is exploratory in nature. It investigates a contemporary phenomenon within its real life context, when the boundaries between phenomenons are not clearly evident (Yin 1984).

It is proved to be a good method of research to support and elaborate empirical studies. In keeping this fact in mind present research on processed food supply chain was performed. Yin (2003) had suggested techniques for organizing; conducting the case study based research successfully and proposed six steps to carry a case study.

Table 6.1 Comparison of Cold SCM with General SCM

Parameters	Cold Supply Chain Management	General Supply Chain Management
Temperature Requirement	Specific temperature is required to maintain products quality. Dairy and its culture products like lassi, curd etc. at below plus 8 degree; Ice creams at -18 to -30 degree; frozen items like vegetables, fruit and meat at -18 to -20 degree	Controlled temperature is not required for items like consumer durable, electronic goods etc.
Information Technology	Require automated information system for success of cold chain. Information includes condition and time along with transaction and location.	Generally connected through manual information system: information of indent, dispatch order, payment terms, warehouse and delivery location and status. Firms are realizing importance of modern MIS, therefore some automation is beginning to happen.
Quality	If required temperature is not maintained then quality of product tend to get degraded where ever the cold chain get breaks	Generally no degradation in value due to ambient conditions.
Cost	Refrigerated vehicles are mandatory for transportation. Require the refrigeration system in a running state, which devours more cost. Different temperature conditions for different products.	Less transportation cost as ordinary trucks, vehicles are used. Different products can be loaded based on the space available

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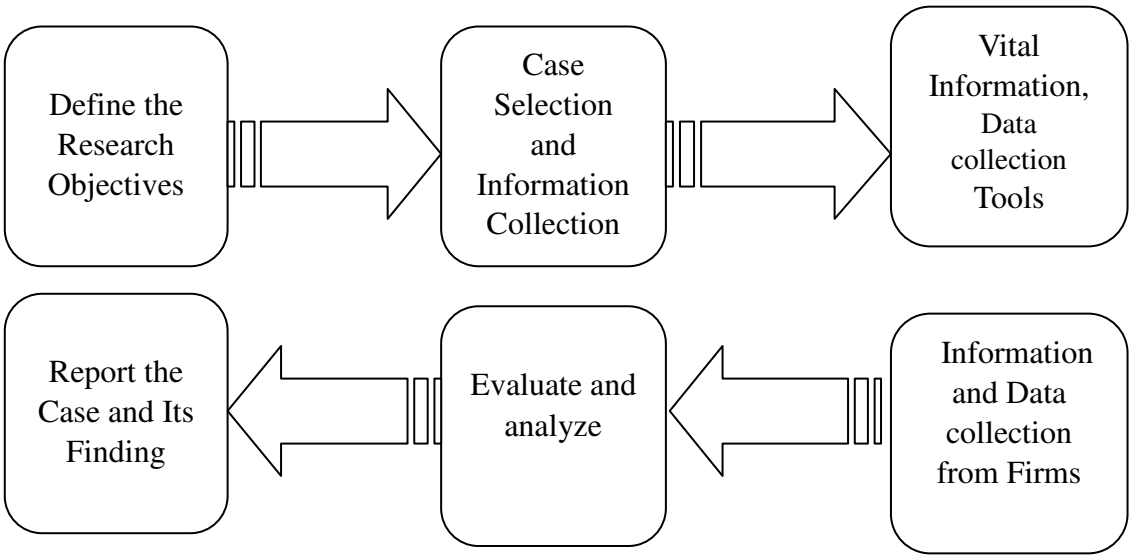

Figure 6.1 Steps in Case Study Research

6.3 Case Study on Indian Frozen Peas Market

Indian consumer had been introduced to frozen processed food first time through a pioneering organisation, Frozen Products Indian Ltd., 'FPIL', (name of company is disguised). FPIL had launched organised retail trade of fresh fruits and vegetables and frozen range of products such as frozen peas, aloo tikki (a popular India snack made from boiled mashed potatoes), vegetables in India way back in late 1980s. With more super markets and hypermarkets opening-up in the country, especially in cities, women are increasingly shopping in these outlets as they are more convenient and comfortable. Large modern retail outlets in the bigger cities have the space to keep giant refrigerators to store frozen processed food. Also, the infrastructure in the larger cities is much more developed; therefore, retailers and consumers are able to store frozen processed food without worrying about consistent and long power cuts. The convenience of frozen processed vegetables, meat and ready to cook meal has encouraged many women to increase their usage of these products as they reduce the preparation time required for meals. Garden peas are the most popular frozen processed vegetable type in India. Green peas are used in almost all Indian meals. Thus, the availability of green peas in frozen processed form has ensured that consumers can use this type of vegetable throughout the year.

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6.3.1 Garden Peas Production in India

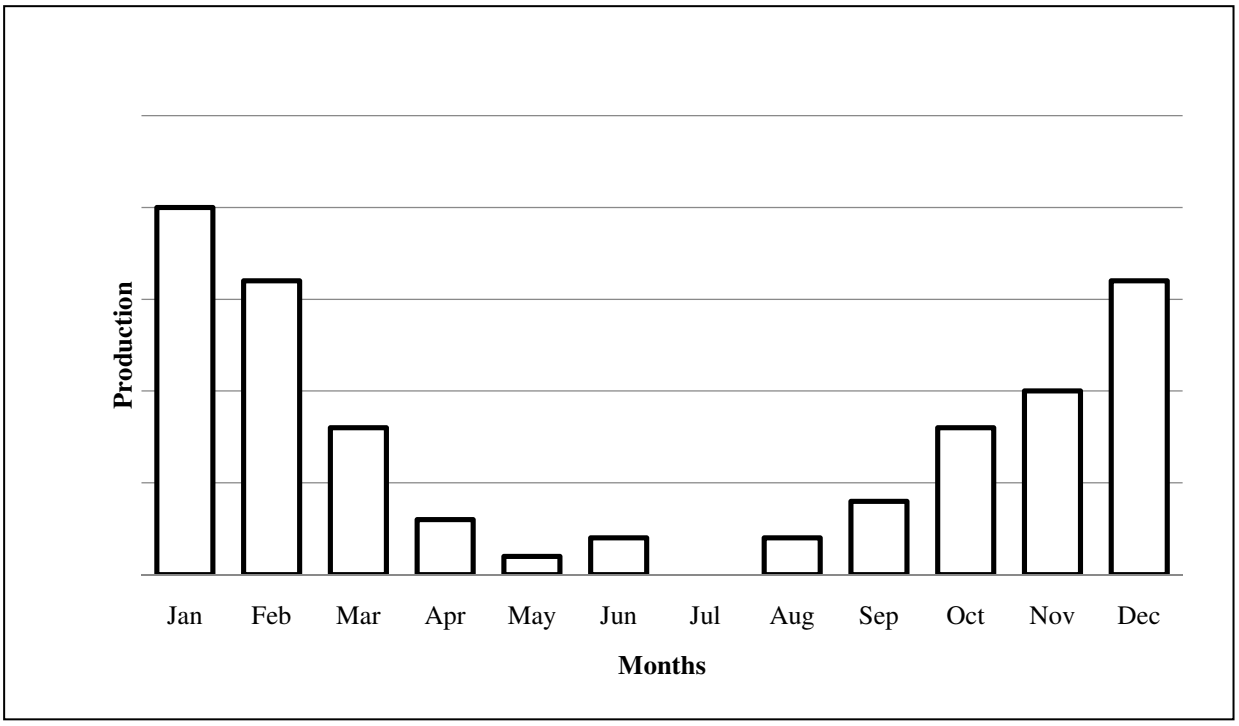
The total production of fresh garden peas in India in 2010 was 3,312 million metric tons, depicted in table 6.2. The major fresh garden peas growing states are Uttar Pradesh, Jharkhand, Madhya Pradesh, West Bengal, Haryana, Punjab, Himachal Pradesh, Orissa and Karnataka. Uttar Pradesh is contributing 48% in total production of fresh garden pea in India. Rest of 52% is being contributed by Jharkhand, Madhya Pradesh, etc. Major harvesting season is between January–February and October–December (Figure 6.3.).

A complete supply chain network right from souring of fresh garden peas from its growing states to the processing plants located at Delhi, Pune, Mumbai, Ghaziabad, Chennai and many places in the states of Uttarakhand, Haryana and Gujarat to the distribution to frozen consuming states mostly urban parts of above-mentioned states of India is depicted in figure 6.4. At each and every connect point in the supply chain, refrigeration is required, i.e. cold chain must be maintained at -18° temperature as otherwise frozen produce tends to get damaged. Therefore, all the participants of processed frozen peas supply chain is required to create a bridge to connect the sourcing centres, processing hubs and consumption points.

Table 6.2 State wise Fresh Garden Peas Production in India in 2009-10

State	Production ('000'MT.)
Uttar Pradesh	1573
Jharkhand	287
Madhya Pradesh	279
Jammu & Kashmir	232
Himachal Pradesh	203
West Bengal	126
Punjab	116
Chhattisgarh	97
Uttarakhand	71
Bihar	64
Haryana	64
Rajasthan	61
Orissa	44
Manipur	34
Maharashtra	32
Karnataka	18
Andhra Pradesh, Daman & Diu, Delhi, Nagaland	11
Grand Total	**3312**

Source: National Horticulture Board (NHB 2010), (http://nhb.gov.in/)



Source: National Horticulture Board (NHB 2010),(http://nhb.gov.in/)

Figure 6.2 Production of Green Peas in Different Harvesting Seasons

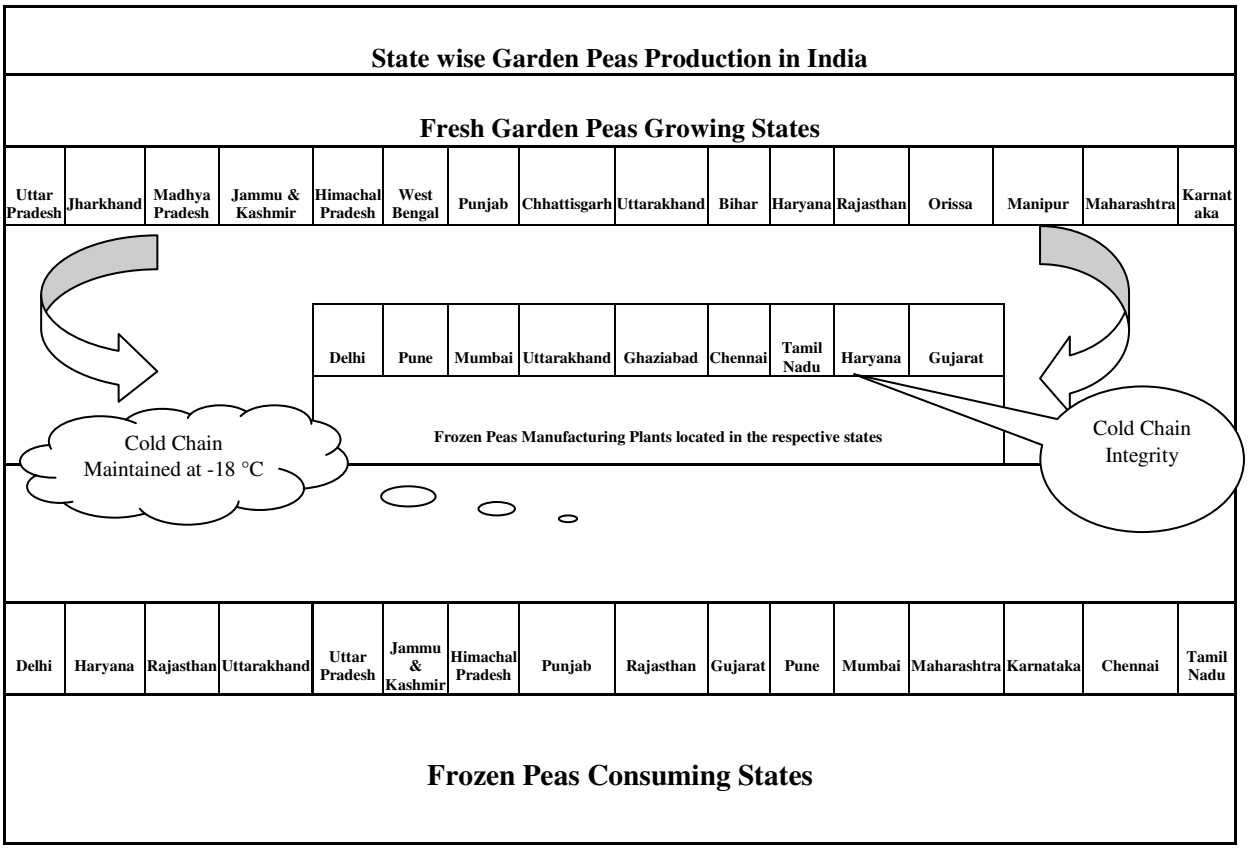


Figure 6.3 Supply Chain Networks of Peas in India

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6.3.2 Current Trends of Frozen Peas Market in India

In 2009-10 current value sales grew faster as compared to 2008-09, as the economic downturn had forced consumers to cut back on their spending on products deemed as luxuries. With the impact of the economic recession easing in 2009-10, consumers were encouraged to increase their spending on frozen processed food. The current value sales recorded fastest growth rate of the review period in 2009-10. Frozen processed vegetables registered the highest current value growth of 24% in 2009-10. The frozen peas market is monopolistic in nature, brands such as Safal, Ever Fresh, Al Kabeer are well known in India as major brands. The size of India frozen vegetable market is 9,219.60 tons in 2009-10. Out of a total Indian frozen vegetables sale, frozen peas amount to 75%, i.e. 6,915 tons (table 6.3). Consumption of frozen processed food has been increasing in urban India. Table 6.4 presents data of frozen vegetables from period 2005 to 2010. Frozen peas sale is consistent and its contribution in total store value of frozen processed is maintained at 75%. Table 6.5 depicts shares enjoyed by major companies in frozen processed food sector during period 2005–2009. Mother Dairy Fruit and Vegetable Ltd. have topped the table with 21% market share in frozen processed food category. Other major companies and their shares include Al Kabeer with 17%, Venky's 11%, Temptation food 9% and Innovation food 8%.

Table 6.3 Sale of frozen Food by Category

Sale of frozen food by category						
Items	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Frozen Processed Fish/ Seafood	668	716	783	863	935	1031
Frozen Processed Potatoes	763	842	931	1036	1143	1273
Frozen Processed Poultry	1122	1222	1343	1485	1610	1763
Frozen Processed Red Meat	446	476	522	577	626	690
Frozen Processed Vegetables	6035	6484	7180	7820	8446	9220
Frozen Ready Meals	426	483	543	610	677	762
Frozen Processed Food	9459	10223	11300	12391	13438	14740

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Table 6.4 Frozen Processed Vegetables by Type

Frozen Processed Vegetables by Type: % Value Breakdown 2005-2010					
% retail sales price					
Frozen Products	**2005**	**2006**	**2007**	**2008**	**2009**
Baby corn	3	4	3	4	4
Cauliflower florets	3	3	3	3	3
Garden peas	75	76	76	76	75
Vegetable Mix	9	10	9	9	9
Others	10	8	10	10	10
Total	100	100	100	100	100

Table 6.5 Frozen Processed Food Company Shares

Frozen Processed Food Company Shares 2005-2009					
(% retail sales price)					
Company	**2005**	**2006**	**2007**	**2008**	**2009**
Mother Dairy Fruit & Vegetable Ltd	23	22	22	20	21
Al Kabeer Exports Pvt Ltd	16	17	17	16	17
Venky's India Ltd	12	12	11	11	11
Temptation Foods Ltd	-	-	9	10	9
Innovative Foods Ltd	-	-	7	8	8
Darshan Foods Pvt Ltd	4	4	4	5	5
McCain Foods India Pvt Ltd	4	4	4	4	4
Triveni Fisheries Pvt Ltd	3	3	3	3	3
Attari Enterprises	0	0	0	0	0
Chambal Fertilisers & Chemicals Ltd	7	8	-	-	-
Amalgam Foods & Beverages Ltd	5	7	-	-	-
Total	25	24	23	22	22

Source (Table 6.3, 6.4, 6.5): Euromonitor International from official statistics, trade associations, trade press, company research, store checks, trade interviews, trade sources

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6.3.3 Processed and Cold Chain Management of FPIL

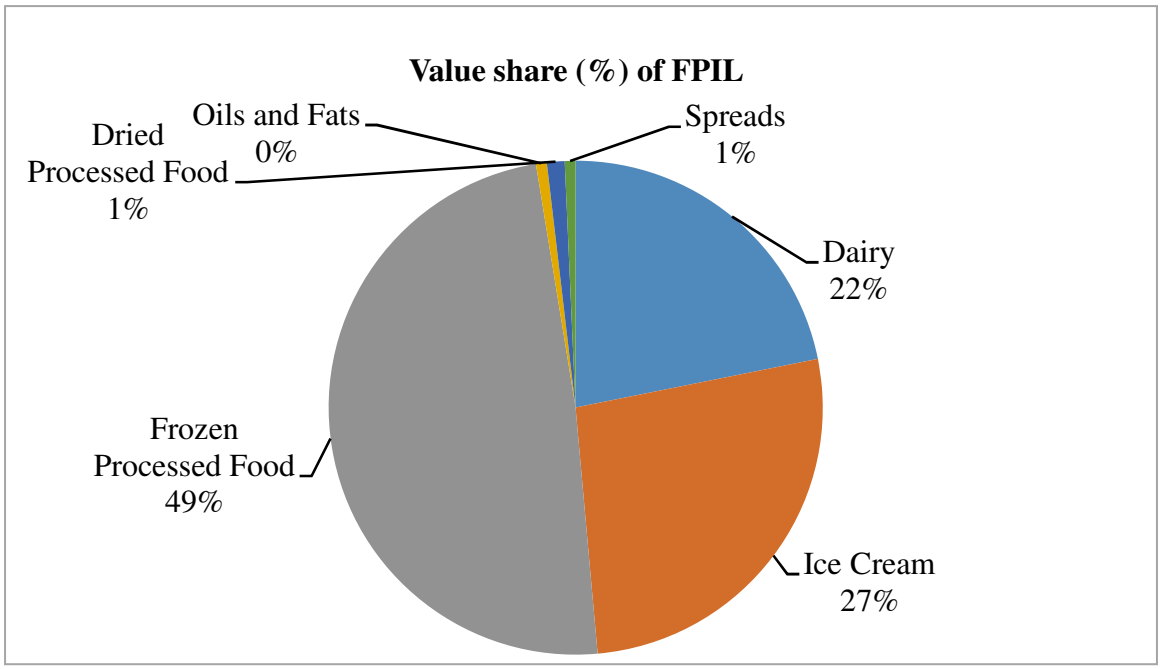
FPIL occupies 20 acres of area, comprises of pre-fabricated building consisting of cold store chambers with different sets of temperature and humidity conditions suitable for storage of various fruits and vegetables. The company was ranked fifth in the market with 4% value share in 2009. The company benefits from strong positions in ice cream, where it had a value share of 11% in 2009 and dairy products, where its share was 9%. The company generates most of its dairy sales from North India, specially New Delhi and its surrounding areas. Its frozen products have a larger presence in other parts of India also, particularly in Western India.

The company had a 21% value share in frozen processed food in 2009 as well as a small presence in oils and fats, spreads, dried processed foods and sauces, dressings and condiments. The company has benefited from its expansion into Mumbai, which has allowed it to develop a fast growing loyal consumer base for products like yoghurt outside of Delhi. It is apparent that FPIL has achieved highest market share in terms of value in frozen processed food products of 49%, such as peas and vegetables, followed by ice cream 27% and dairy products 22% (figure 6.4). The company's infrastructure initiates and supports production enhancement activities at farm, improved pre and post-harvest practices and efficient logistics from farm to the retail outlets, scientific quality assurance and education of grower.

The case depicts that how FPIL has optimally utilised its resources and implemented appropriate cold SCM for the benefit of society and organisation by reducing the wastage of fresh produce. Figure 6.6 shows the procurement network of the organisation.

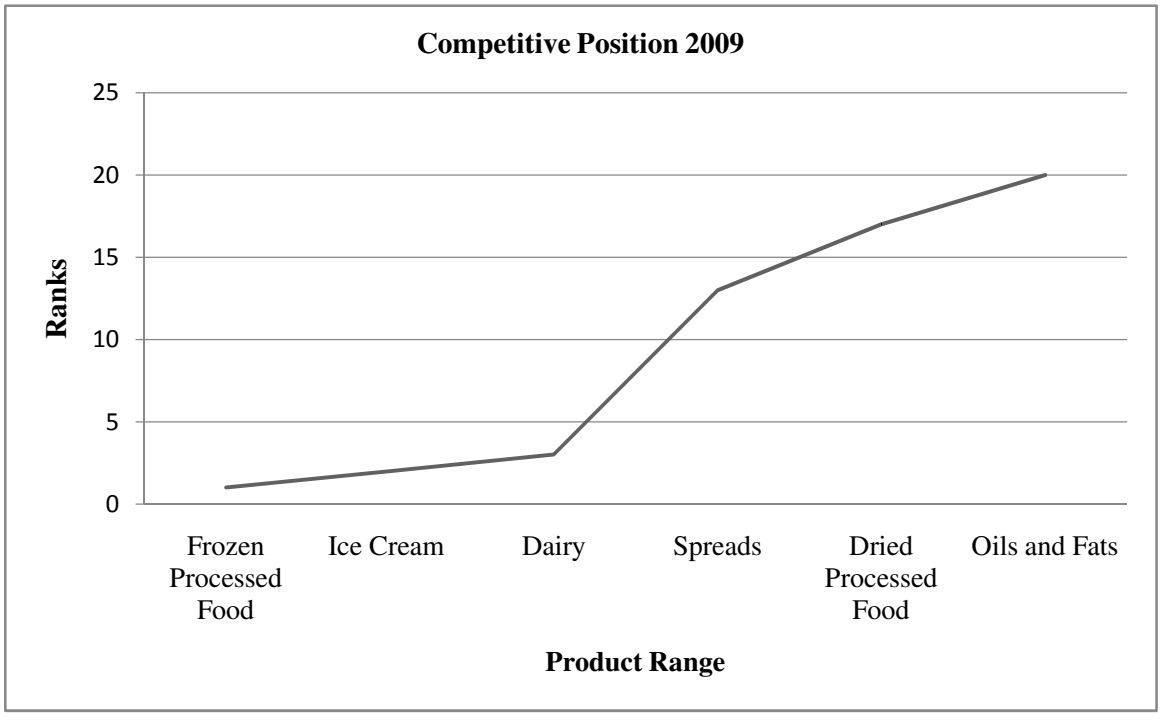
FPIL's unit complex comprises of a pre-fabricated building consisting of cold store chambers with different sets of temperature and humidity conditions suitable for storage of various fruits and vegetables. It has controlled atmosphere chambers and ripening rooms, deep freeze rooms, preparation hall, processing hall, dispatch hall, reception, dispatch facilities, etc.

Material handling is done in specially designed plastic crates with the help of forklift. The complete process of individual quick freezing (IQF) of frozen peas is demonstrated with the support of Figure 6.8. This figure shows a complete processing process from arrival of truck at docks, the truck load of shelled peas sent to peas processing plant, till the IQF of peas done at the end.



Source: Euromonitor International Data Base (2010)

Figure 6.4 FPIL's Product wise Share (% age in value) in India



Source: Euromonitor International Data Base (2010)

Figure 6.5 FPIL Ranking in Indian Market

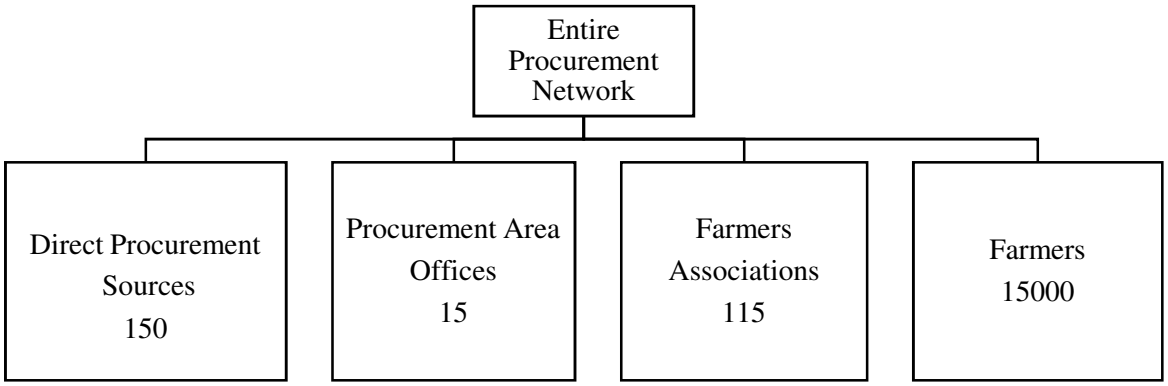


Figure 6.6 Procurement Network of FPIL

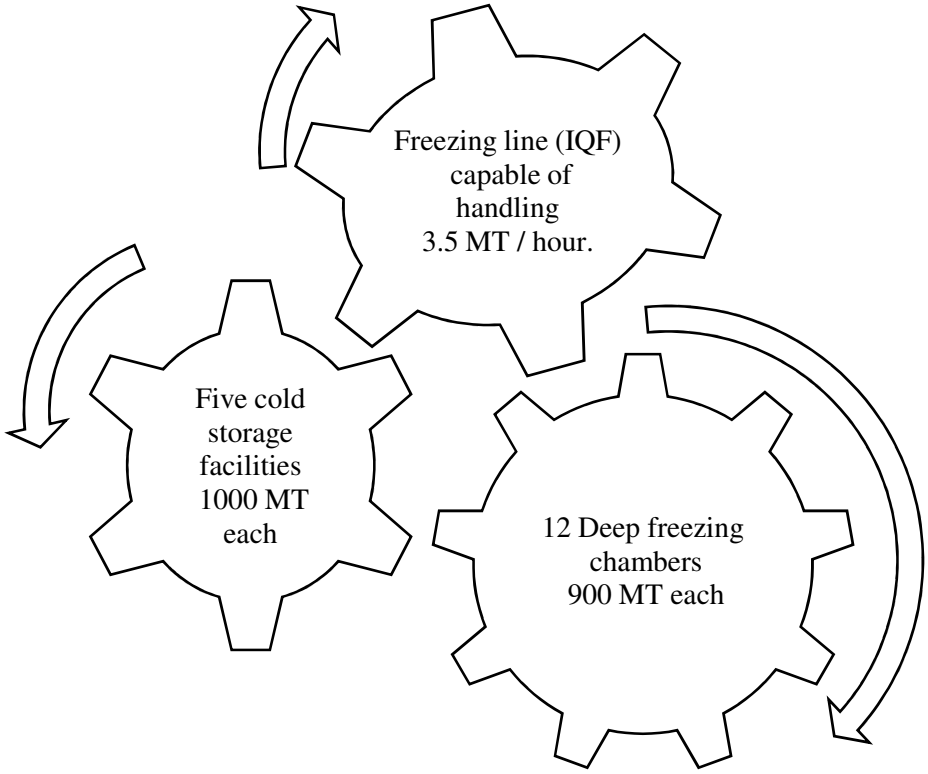


Figure 6.7 Key Temperature Control Processed Capacities at FPIL

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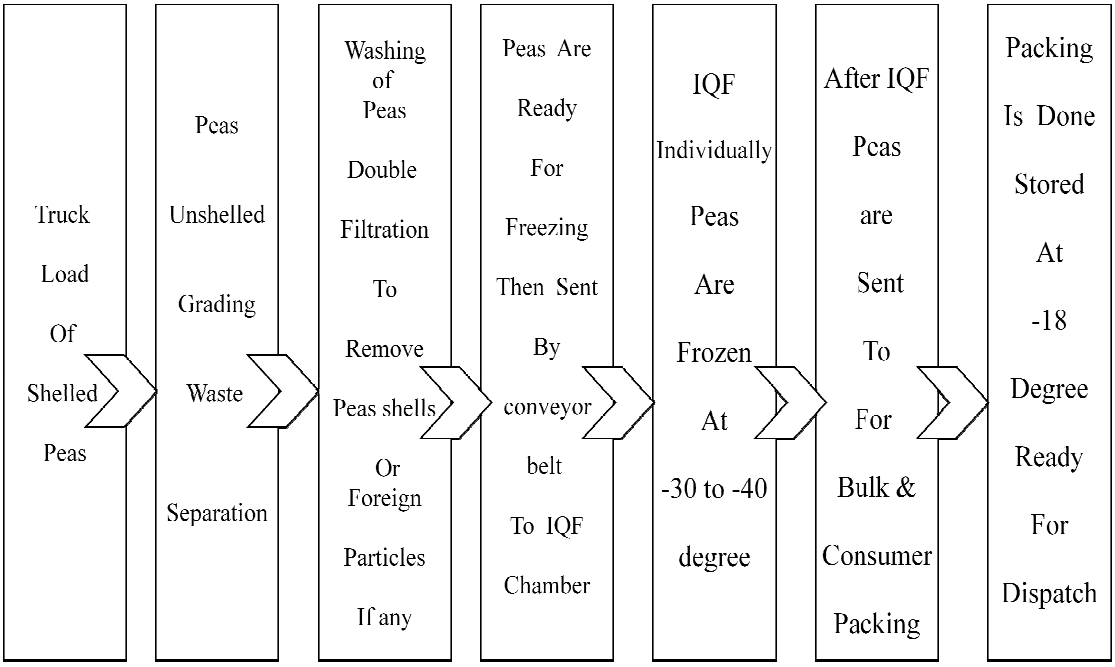

Figure 6.8 Individual Quick Process Technique (IQF)

More than 300 specially designed modern retail outlets have been set up in and around Delhi to market fresh and frozen fruit and vegetables directly to the consumers. Each shop caters to large number of customers with a capacity to sell 1600 kilograms (Kg) of fruit and vegetables a day. The shops are equipped with e-machines that automatically weigh the produce and print item wise bills. Cold chain needs to be maintained at -18°C temperature. If at any level cold chain gets broken even, the quality of product gets deteriorated. Frozen products turn pale in colour. If it remains broken for longer hour, then the product may get spoiled completely without any recovery.

6.3.4 Key Result Areas (MQKRA)

The Government has brought support to the processed food sector in various forms of enactment and regulatory practices. Some of the initiatives included formulation of a national food processing policy, amendment to the APMC Act, lowering of VAT rate, integrate the promotional structure, awareness about the use of IT and RFID technology will have tremendous impact in the management of the cold chain particularly for source identification and tracking and also in providing visibility.

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To enhance the acceptability of processed food, a seven steps strategy is outlined in figure 6.9. The strategy is focused to make the supply chain customer centric, offering additional value proposition for customer, increase variety and better market penetration etc.

Customer Centric

Being customer centric is about ability for every corporate in the business to continuously learn about customers and the market. Many organisations also find it helpful to state what being customer centric does not mean. It should be obvious that it is not about simply doing everything as per the customer wants, irrespective of the impact on the business. It is recommended that products, services and resources ought to be utilised in line with the organisations overall strategy for meeting the needs of customers.

Simplify Manufacturing Processes

Current trend is that packaged food companies have realigned their product ranges, simplifying some products and reducing proliferation in their product categories. There are a lot of different things that can be done to simplify manufacturing process. The manufacturing process is a very important part of business. There are four ways to implement this strategy through first look for bottlenecks in production, secondly consider every details and impart training to employees at regular intervals, thirdly eliminate complicated steps and make a process chats of all the activities, lastly organized the business activities.

Increase Variety

Product proliferation is a well established strategy for gaining market share and deterring potential competitors by raising the amount of marketing spend required by rivals to gain a foothold in the market. Product proliferation is in large part the result of the trend toward mass customization–under which middle-class consumers are insisting on getting custom-designed, personalized products at affordable prices. Other trends and established business practices also contribute to the continuous problem solving practice, such as retailers' demands for private brand labels, custom

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labeling, and the increased use of store displays and promotional packs. Globalization too plays a role. Products must be modified to meet the varying regulatory requirements of different countries and product labels must also be translated into different languages.

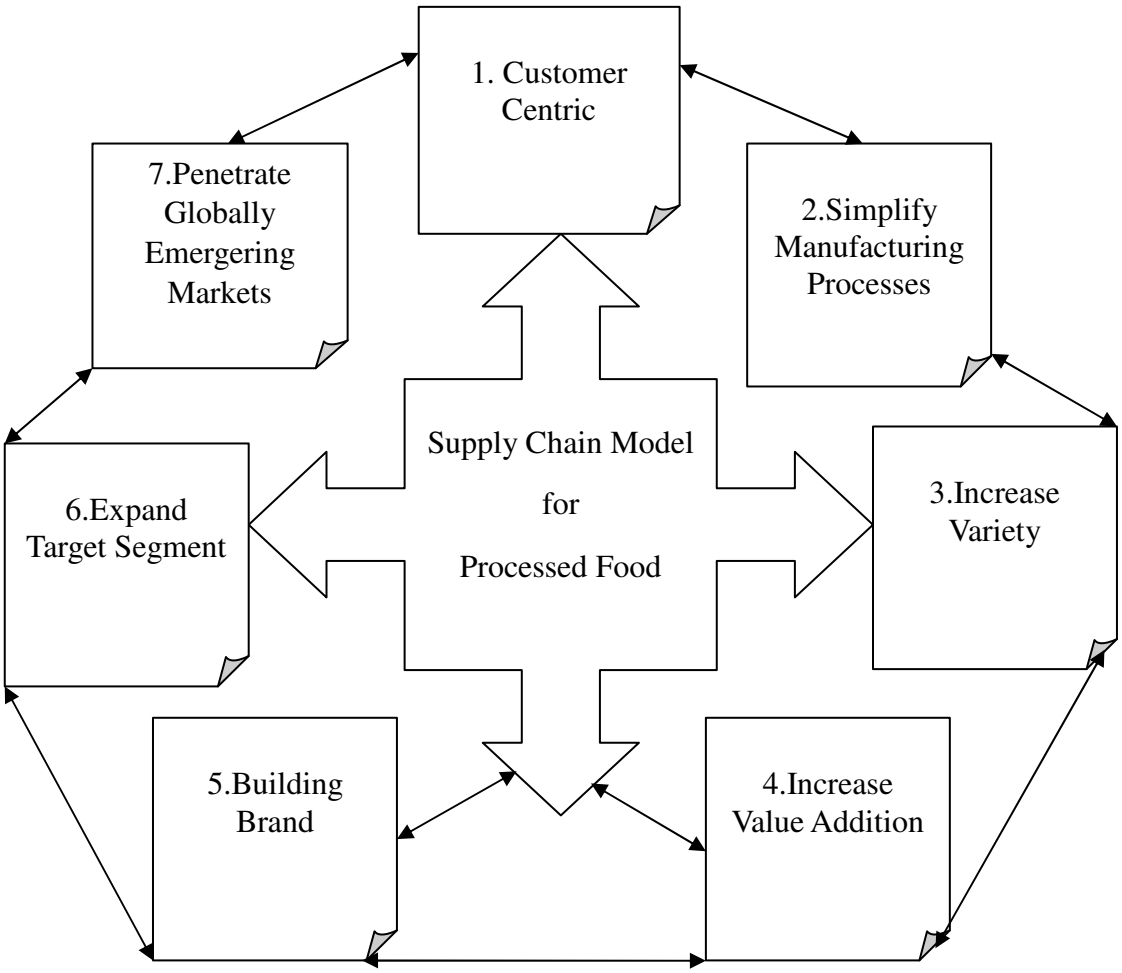

Figure 6.9 Key Result Areas (MQKRA)

Increase Value Addition

Increasing costs have the biggest impact on markets where products are relatively homogenous, i.e. the ability of participating firms to impose price increases on the market is circumscribed by the ready availability of close substitutes. One solution to this problem would be for manufacturers to alter their product mixes to increase their exposure to more heterogeneous markets, where competition is less fierce and margins are both higher and more defensible.

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Building Brand

In spite of the difficult market conditions currently prevailing, branding remains the best defence against shrinking margins. High level of brand equity enable manufacturers to better pass on cost increase to consumers without undermining market share. The organisations must take fundamental route to build the brands in today's environment. The more integrated multi functional approach is for brand planning that focus customer insights, economic potential and reinforcing organisation capacities. This fusion in turns deliver three key requirements of branding strategies such as rigorous focus on customer segment, follow future economic of business and look in to organisational capabilities for creating customer delight.

Expand Target Segment

Rather than moving upmarket, packaged food manufacturers could refocus their efforts on lower-income consumers also. They ought to emphasis on mass marketing of processed food. The application of the four Ps (product, price, promotion, and place) of marketing revolves mainly around the customers in the target segment. The target segment for any product is that homogeneous group of people which is purported to be the most potential customer for the product. The market follows the Pareto principle, which says that 80% of the sales comes from 20% of the people. Thus, for any product, one of the major tasks of marketers is to identify the group of 20% that gives 80% revenue of that product's sale to the company.

With the increase in number of customers, product moves up the product life cycle curve and reaches a maturity stage where further sales expansion comes to a halt. This is a challenging stage for a marketer when increase in promotional budget fails to give any remarkable increase in sales and validates the law of diminishing return. At this stage, companies are left with three options to increase sales: increase in product usage, increasing product users and increasing product consumption. These days, many companies are aggressively pursuing various strategies of expanding their user base to improve the sales and market share. In this perspective, companies can be grouped into two categories: one which is trying to attract other segments to use their existing products which are performing well in their conventional, target markets; and the other, which are targeting more segments by line extension (launching new

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variants of existing market-performer products) to suit the need of customers in new segments. In this endeavour of targeting newer segments, advertising has become an all important tool.

Penetrate Globally Emergering Markets

- For packaged food manufacturers in developed markets, a downturn in domestic demand can represent an excellent opportunity to increase sales in export markets.
- Growth in Eastern Europe, Asia-Pacific and Latin America is expected to remain above 4% per annum in constant value terms over the 2009-2013 period.
- Although it is sometimes argued that developing markets have decoupled from their developed counterparts, if demand in developed markets falters, it is likely to have significant repercussions for developing markets, even relatively large economies like China and Russia.
- With the foreign-exchange value of the US-dollar presently weakened, these opportunities could be particularly lucrative for firms with US production facilities.
- Moreover, an increasing number of Developing Economy governments are reducing trade barriers on foodstuffs in an effort to relieve inflationary pressures.

6.4 Conclusion and Discussions: Case of FPIL

The cold chain management is a challenging task. This case study has tried to highlight the critical factors for making FPIL frozen peas supply chain more responsive and improved. It is observed that lack of adequate infrastructure along with high cost for installation and operation are the biggest bottleneck for strong and efficient cold chain. Most of the entities participating in cold chain are from unorganised sector. Remedial steps to support the cold chain management includes creating awareness about the use of IT, introduction of RFID technology particularly for source identification and tracking and also in providing visibility, organising all the participants, recognising an immediate need for suitable

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infrastructure of warehouses, temperature controlled transportation and creation of awareness among consumers with respect to importance of temperature-controlled items. There is a need for a strategic supply chain model intuitively using professional approach and research experience. The creation of acceptability campaign for processed food, building policy support, focus on major quick key result areas (MQKRA) amendment in the Agriculture Produced Marketing Committee Act, lowering of Value Added Tax (VAT) rates, integrating the promotional structure and awareness about the use of IT and RFID are other steps which need to be initiated.

6.5 Food Safety in India: A case of Deli Processed Food Products Ltd.

Deli Processed Food Products Ltd. (DPFPL) is more than 30 years old organization. It is a manufacturer, marketer of milk and milk products. DPFPL has a policy of purchasing milk directly from farmers. The organization ensures that farmers regularly get a market going rate from DPFPL by offering quality milk as raw material. In DPFPL, the processing of milk is managed by fully automatic machines untouched by human hands to ensure high product quality cum reliability and food safety. It is an ISO 9001:2008 (QMS), ISO 22000:2005 (FSMS) and ISO 14001:2004 (EMS) certified firm. It is certified from Export Inspection Council of India and quality assurance laboratory, National Accreditation Board for Testing and Calibration Laboratory (NABL) for exports of its products. It sells more than 27 million litres of milk daily in the markets like Delhi, Mumbai and Hyderabad etc. It has a strong hold in milk and milk products in Delhi, NCR and Mumbai. To adhere to rigorous food safety standards, DPFPL has a team comprises of core experts called as HACCP Team. It is consisting of at least one member from quality, maintenance and production department.

It comprises of HACCP coordinator and food safety team leader such as Vice President and Deputy General Manager. The rest of team members are Purchase Head, Marketing Head, Deputy Manager -Quality Assurance, Microbiologist, Senior Manager – Production, Deputy Manager – Production, Packing in-charge, Deputy Manager Maintenance. The HACCP and food safety management system was implemented in March 2003 by DPFPL.

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6.5.1 Role and Responsibility of HACCP Team

Following are the roles and responsibilities dichotomized under heads like planning, establishing, implementing, monitoring and control.

Planning

- Formulating and approving policy and objectives
- Overall responsibility for production planning

Establishing

- Overall Administration in the company
- Establishing, implementing and maintaining the HACCP system

Implementing

- Overall responsibility for implementation of process plan
- Resolving statutory, regulatory food safety requirements
- Initiate action to prevent the happening of any non-conformity
- Locate and record any problem of the product, procedure and food safety

Monitoring

- Regular monitoring system in place
- Taking feedback from production and quality assurance
- Monitoring the all departments working to achieve the objective of HACCP

Control

- Disposition authority for in process non-conforming materials
- Approving authority for all documents related to the FSS
- Ensuring the critical control parameters (CCP's) under control
- Initiate, recommended or provide solutions to quality problems
- Check the effectiveness of the solution

The HACCP team has full authority to take independent decisions for the betterment of the organization. They can also hire an external HACCP expert if required. In that

Note: Food safety in India: a case of Deli Processed Food Products Ltd., International Journal of Productivity and Quality Management (Inderscience), Vol. X, No.xx, accepted for publication in September 2013.

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case the qualification of external lead auditor and auditor for HACCP is certified ISO 9001:2008, HACCP as per guidelines, ISO 22000:2005 International Standard and ISO 22716:2007. They had completed more than 300 man days of conducting regular audits for ISO 9001:2000/ HACCP, ISO 9001:2008, Good Manufacturing Practices (GMP), Good Hygiene Practices (GHP) compliance, ISO 22716:2007 and ISO 22000:2005 standard.

They have experience of conducting awareness programs, workshops and trainings on food safety and implementing HACCP, GMP, GHP (Pre-requisite programs) etc. applicable to all food and related industries. The detailed process is discussed in the next section. The qualification of lead auditor and auditors for HACCP team is given in table 6.6.

Table 6.6 Qualification of Lead Auditor and Auditors for HACCP Team

Department	Qualifications	Experience in Year
Production	Minimum M.Sc. In Microbiology /Dairy Technologist from institute of National Repute	More than 10 years Experience in Processed Food Sector / Milk Processing Industry or 15 Year experience in the Food Processing Industry.
Quality	Minimum M.Sc. In Microbiology from institute of National Repute	More than 5 years Experience in Processed Food Sector / Milk Processing Industry or 10 Year experience in the Food Processing Industry.
Maintenance	B.E in Mechanical/ Electrical Engineering	More than 5 years Experience in Processed Food Sector / Milk Processing Industry or 10 Year experience in Food Processing Industry.

6.5.2 Benefits of HACCP

Following are the benefits of HACCP: reduces contamination, reduces recall/product destruction, provides market protection, provides preferred supplier status, matching

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international standards, regulations, requirements of overseas markets, transforms commodities into branded products and international acceptance. Table 6.7, presents the various authors contribution in the literature on the subject matter.

The HACCP system is not fully applicable at the primary production level and that food safety is obtained through the careful implementation of GHP at the farm. Guides to GHP intended at primary productions cover one activity, such as cattle rearing or corn production (Cerf et al., 2011). The three-dimensional HACCP objectives are hazard identification, hazard assessment and hazard control. This measurement instrument can be used by a food company as a self assessment tool and a benchmarking tool. In doing so, food organization can select suitable strategies in order to allocate resources, increase HACCP effectiveness and improve its product safety (Kafetzopoulos et al., 2013).

Table 6.7 Authors' Contribution in the Literature

Author	Year	Contribution in Literature	Sector and Location
Miljkovic et al.	2009	Analysis of Pathogen Reduction (RP), HACCP in food production and processing ensure the safety	Meat Processing in USA
Arpanutud et al.	2009	Thai food producers and processors are aware about food safety measures for boosting food business globally	Agri Products in Thailand
Chountalas et al.	2009	ISO 22000:2005 modified the classical HACCP approach by embedding food safety	Dairy in Greece
Sweet et al.	2010	HACCP applied to frozen food facility	Frozen Food in Canada
Janevska et al.	2010	Integration approach for HACCP with the Quantitative Microbial Risk Assessment (QMRA)	Fruits in Mexico
Cerf et al.	2011	Food safety is obtained by implementing good hygiene practice (GHP) at the farm	Agri Food in France
Ragasaa et al.	2011	HACCP approval requires procedures and strategies to ensure the safety of raw materials and other inputs	Seafood processing in Philippine
Carol A et al.	2012	Explains HACCP team selection, formations and working strategy to achieve food safety	Agri Food in UK
Soon et al.	2012	Minimally processed fresh-cut produce represents a particular challenge to food safety	Agri Food in UK
Lowe et al.	2013	Investigated the extent and nature of barriers to HACCP implementation	Agri Food in UK

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6.5.3 Barriers in HACCP Adoption

They are categorized into three heads: knowledge, attitude and behavior. The barriers are explained in the figure 6.10.

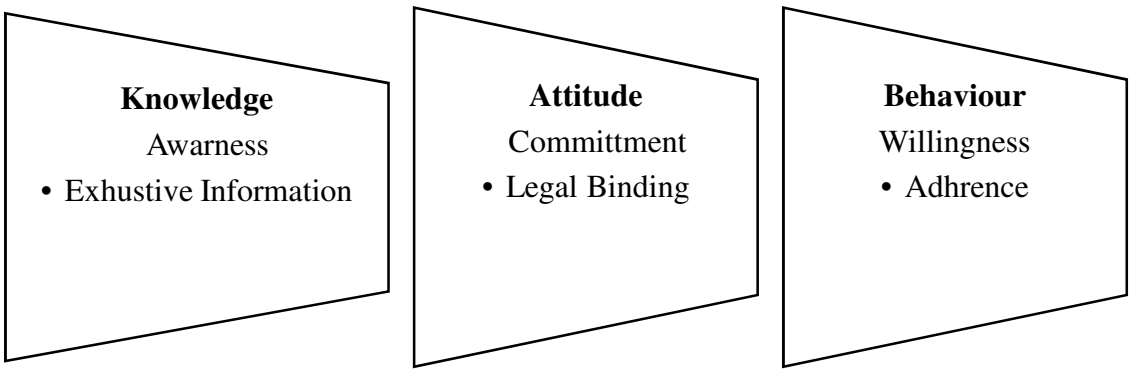

Figure 6.10 Barriers in HACCP Implementation

6.5.4 Food Safety Control System

The prerequisite for deployment and implementation of HACCP philosophy is to introduce sanitation standard operating procedures (SSOP) and standard operating procedures (SOP) in processed food sector. Therefore, Food Safety and Standards Act, (2006) have made provisions in governing food sanitation requires that food HACCP, GMP and GHP must be implemented in processed food sector. The resultant food safety control system is three fold in India. It comprises of HACCP, GMP and GHP.

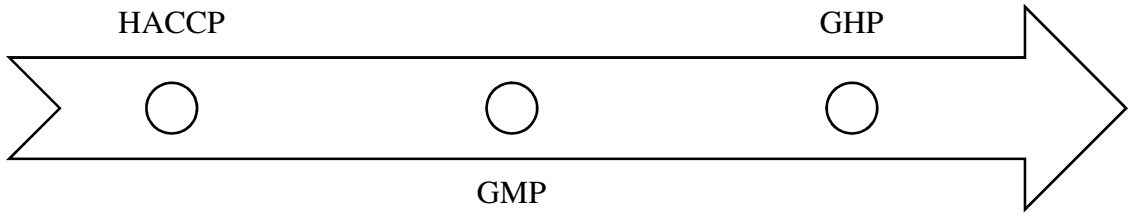

Figure 6.11 Food Safety Control System

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FASSI laid-down SOPs for processed food manufacturing and food processing sector for implementation of HACCP in India. These SOPs must be written and describes daily procedures. It will be conducted before and during operations to prevent direct product contamination or adulteration. In addition, the SOPs are also including the frequency at which each procedure performed. The SOPs in HACCP, GMP and GHP must be signed by an official with overall authority on-site or a higher-level official of the plant. Even for miner alteration, initiation and modification the SOPs must be signed. The microbiological testing including the total aerobic count, coliform and E. coli, is often being done to ensure that each particular SOPs achieve an acceptable level of performance in controlling microbial hazard. The table 6.8 is depicting standard operating procedures (SOPs) for food manufacturers, processed food processors and food services in India.

Table 6.8 SOPs for Food Manufacturers, Processors and Food Services

Food manufacturers, Food Processors and Food Services	
S.No.	SOP for Sanitation Management
1	Factory, building facilities etc.
2	Cleaning of equipment and utensils
3	Sanitation management of workers
4	Management of chemicals and detergents
5	Waste product treatment
6	Person responsible for sanitation
SOPs For Operations Management	
1	Purchase and receiving
2	Contract vendor management
3	Food additive management
4	Process design
5	Prevention of cross contamination
6	Prevention of chemical and physical hazards
7	Measurement of samples
8	Sample holding

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On the above mentioned lines other SOPs can be developed separately for storage, delivery, testing, measuring, customer complaints, product recall and documentation.

6.5.5 Good Manufacturing Practices for Food

Good Manufacturing Practice (GMP) is defined as a bundle of feasible methods and practices that ensure quality manufacturing system. It can provide consistent manufacturing for controlling product quality through qualitative and conformity assessing criteria. It has a clear goal as desired by international and national legal authorities specification, marketing channels, consumers.

The investment required to ensure that a food handling facility is suitably constructed to offer safe food. This may be stating the obvious but the lack of effective GHP and GMP has often been overlooked (Jackson 2006). The advance manufacturing techniques are used by production plants for performing tasks related to quality assurance systems such as GMP, GHP and HACCP (Konecka et al. 2005). Three broad categories of interrelated issues arose during the development of the GMPs (Berger, 1995)

- Concern that the regulations were unduly stringent and especially burdensome for small food companies without necessarily improving the quality or safety of foods.
- Contention that the GMP regulations must prescribe conditions that reasonably relate to insanitary conditions that may contaminate food and render it injurious to health.
- Assertions that the regulations did not have the force of law

6.5.6 Key Provisions of Food GMP

The current GMPs consist of seven parts. The requirements are purposely kept general to allow variation by individual manufacturers to implement the requirements in a manner that best suit their needs.

Food GMPs (FAO 2004)

- Personnel

  -Disease control

  -Cleanliness

  -Education and training, supervision

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- Plants and grounds

  -Grounds
  -Plant design and construction

- Sanitary operations

  -General maintenance
  -Substances used for cleaning
  -Pest control
  -Sanitation of food-contact surfaces
  -Storage and handling.

- Sanitary facilities and controls

  -Water supply
  -Plumbing
  -Sewage disposal
  -Toilet facilities
  -Hand-washing facilities
  -Rubbish and offal disposal

- Equipment and utensils

- Processes and controls

  -Raw materials
  -Manufacturing operations

- Warehousing & distribution

6.5.7 Good Hygiene Practice for Food

Good Hygiene Practice (GHP) consists of practical procedures and processes that return the processing environment to its original condition (disinfection or sanitation), keep building and equipment in efficient operation (with adequate maintenance), control of cross-contamination during manufacturing (employees, preparation cum

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processing areas, the air and the segregation of raw and processed product). The Good Manufacturing Practice and Good Hygiene Practice as laid down in the relevant code of practice (IFST 1991, Grigg et. al, 2001)

Eight general principles of food hygiene- GHP

1. **Primary production**

   The environmental and production hygiene should be maintained. To minimize the food contamination or food hazards.

2. **Establishment Design and Facilities**

   The risk analysis should be performed on premises, equipment, facilities used for preparation of the product. The manufacturing process must ensure food safety.

3. **Control of operations**

   The package material must be food grade. The water must be cleaned and as per guidelines for food production. The production process must be documented. It should be supervised properly. The product recalls and their handing must be properly done.

4. **Maintenance and sanitation**

   The cleaning method, pest control, waste management and their effective monitoring is required to be in place.

5. **Personal Hygiene**

   Employee's health status, personal cleanliness of cloths and personal behavior in terms of spitting, chewing, smoking etc. required to be checked regularly.

6. **Transportation**

   The arrangement of transporting vehicles is as per required goods to be transported. The wet products will be moved using cold chain. The dry products will be transported using closed or even open vehicles.

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7. Product information and consumer awareness

The information should be shared among supply chain members for example lot identification, labelling and consumer education on hygiene, nutrition etc.

8. Training

Training ought to be imparted on regular intervals. It is one of tool to protect food hazards.

6.5.8 Control and Verification of Information Process at DPFPL

The HACCP core team at the Deli Processed Food Products Ltd. has verified for compliance of the process and layout plan with the actual situation. Further periodical repetition of the verification is kept annually for every product in order to identify and document timely changes or modification of the process installation and in the layout. The risks to the safety of food can be assessed on time to time basis.

The issues of how quality cum safety managers can objectively and automatically implement the first and second principles of hazard analysis in the application of HACCP, which is the identification of risk priorities and of the related CCPs, by means of a structured, quantitative and qualitative methodology. The verification progress of HACCP and its implementation is documented. The verification plan is described in tables 6.9 and 6.10.

Table 6.9 is about team responsibilities of activities to be performed using laid down method on a certain frequency and recording the results information of health test, Swap report, sanitation report, environment test, daily hygiene report preparation. It is the verification plan for implementation of HACCP.

In table 6.10 presented records of activities, responsibilities, methods and frequencies is outlined. The team manages temperature records to monitor the variation if any, check pest control measures, do metal direction and hygiene status records. The six monthly HACCP review is maintained, use external audit reports and certificates of regulatory and statutory authorities. The purpose of the verification plan matrix is to regularly check as well as control the damages, if any, arises from variation between plan and the actual situation of food safety in food processing plant.

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Table 6.9 Verification Plan of DPFPL: Adequacy of Process, PRP's, OPRP's and SOP's

Activity	Responsibility	Method	Frequency	Records
Verification of Prerequisite program (PRP's) at DPFPL	HACCP Team of DPFPL	On site at DPFPL Verification of adequacy of Process, PRP's, Operation Pre-requisite Programmes (OPRP's) and sanitation standard operating procedures (SSOP's)	• On site Verification of DPFPL Process, PRP's, OPRP's and sanitation standard operating procedures (SSOP's) is done when internal audits are conducted • Sanitation checks like swab testing, hygiene check and sanitation check etc. are done daily in DPFPL	Six monthly Management Review and HACCP review records of DPFPL
		Verification of Hygiene, Sanitation and GMP and other PRP's of DPFPL		• Health checkups, illness records of employees • Swab Testing from prepared food recorded at DPFPL • Sanitation of cooking & packaging/ serving areas • Daily Hygiene floor Records • Environment Test Reports Maintained by Microbiologist

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Table 6.10 Verification Plan OPRP's Like Product Chilling, Pest Control

Activity	Responsibility	Method	Frequency	Records
Verification of Operation Pre-requisite Programmes (OPRP's) at DPFPL	HACCP Team of DPFPL	By verification of the Records of OPRP's of DPFPL	• OPRP's Like Product chilling as per requirement varies for different processes, pest control, • Verification of Metal in products through detectors etc. in DPFPL	Temperature Log Sheet of DPFPL Pest Control Record Outsourced for DPFPL
Verification of the Inputs for hazard analysis at DPFPL	HACCP Team of DPFPL	By On-site Verification of the Process of DPFPL	On site Verification of Process, is done when internal audits are conducted at DPFPL	Six monthly Management Review and HACCP review the records of DPFPL
Verification of identifying hazards in DPFPL	Microbiologist, Laboratory In-charge of DPFPL	By Monitoring of Records for DPFPL	Daily monitoring at DPFPL	Records Refer Master List of Controlled Documents & HACCP Plan for DPFPL
Verification of the final products of DPFPL	HACCP team Leader of DPFPL	By Getting the sample tested by an external laboratory	Once in Six months in DPFPL	External Test Reports of DPFPL
Compliance with regulatory and statutory requirements	Manager – Works at DPFPL	By verifying the compliance records of DPFPL	Once every year in DPFPL	Certificates of regulatory and statutory authorities for DPFPL

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6.5.9 Hazard Analysis in Practice

The milk from buffaloes, cows and in mixed form from farmers, own chilling centres, milk suppliers and state federations is received and processed in the form of cream pasteurization, separation and churning.

It is carried out in their respective product line to minimize all potential hazards associated with raw material ingredient, process operation and post production step. The labelling is created as hazard B (Biological), C (Chemical), or P (Physical).

Failure mode and effect analysis (FMEA) is a structured, bottom-up approach that starts with known potential failure modes at one level and investigates the effect on the next subsystem level. All complex mechanical systems are composed of several subsystems which can be further broken down up to a component level (Wang et al., 1996). FMEA as a formal design methodology was first proposed by National Aeronautics and Space Administration (NASA) in year 1963 for their obvious reliability requirements.

Since then, it has been extensively used as a powerful tool for safety and reliability analysis of products and processes in a wide range of industries particularly, aerospace, nuclear and automotive industries (Gilchrist, 1993; O'Connor, 2000; Ebeling, 2000, Sharma et. al. 2005).

The list of preventive measures to control hazards is prepared to determine the risk of its occurrence. High risk is likely to happen, medium risk could happen, low risk is not likely to happen. Then determine the severity of each hazard ie criticality of risk. Determine the significant risk hazards through group consensus. Then Pick a risk and severity classification that together equal a significant Hazard.

Table 6.11, gives an overview of the application of hazard and risk analysis at receiving of milk, filtration, chilling and Pasteurization. Further periodical repetition of the verification is kept as yearly for every product in order to identify and document timely changes / modification of the process installation and in the layout such that risks for the safety of Food can be assured in time.

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Table 6.11 HACCP Analysis in the Process of Receiving of Milk and its Processing

Process	HAZARD	Risk (High, Med. Low)	Severity (Critical, Serious, Major, Minor)	Preventive Measure (s)
Receiving of Milk	**Microbial**			
	Unhygienic contacts	Low	Major	Implementation of GMP*
	Physical			
	Temperature	Low	Major	Cooling (OPRP)
	Extraneous matter	Low	Minor	Effective Filtering
	Chemical			
	None			
Filtration	**Microbial**			
	Un Hygienic contacts	Low	Major	Implementation of GMP
	Physical			
	Metal	Low	Major	Effective Cleaning
	Extraneous materials	Low	Minor	Effective Cleaning
	Chemical			
	None			
Chilling (OPRP) Operational Prerequisite Programme	**Microbial**			
	Improper chilling may increase acidity	Medium	Major	Monitoring of Temperature
	Physical			
	None			
	Chemical			
	None			
Pasteurization	**Microbial**			
	Microbial load if un-pasteurized	Low	Major	Monitoring of pasteurizer temp.
	Physical			
	Extraneous materials	Medium	Minor	Effective CIP
	Chemical			
	None			

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6.5.10 Verification Progress and its Execution

The Critical Control Point worksheet is created to monitor HACCP critical control points.

Table 6.12 Critical Control Point (CCP) Worksheet

Critical Control Point (CCP) Worksheet		
CCP 1	**Pasteurization**	
Product/ Process	**Fresh Milk**	
Hazards	Any Microbial Contamination etc.	
Preventive Measures	Monitoring of Pasteurizer Temperature	
Operational Limit(s)	**75° ± 3° C**	
Target Value	**75° C**	
Critical Limit(s)	**Min 72° & Max 78° C**	
Monitoring Procedures	***What***	Pasteurizer Temperature
	How	Pasteurization Temperature Controller
	When	Hourly
	Where	Pasteurizer(Temperature Controller)
	Who	Operator / Technical Officer
Correction	***Product***	Diversion for re-pasteurization
	Line	at Balance Tank
	Who	Automatically (in Built system)
Corrective Action	***Produce***	Effective Monitoring & check of FDV & Temperature Controller
	Line	at Pasteurizer FDV
	Who	Maintenance Team
Record Name	**Milk Processing Log Sheet**	
Verification	***What***	Temperature by Calibrated Thermometer
	How	By verification of temperature
	When	Immediately after corrective action and again after 4 hours
	Who	QA/ Production Manager/ Verification Team

In table 6.12., the comprehensive and exhaustive details of processes are depicted using live illustration of fresh milk received from milk growers and it's processing in the milk plant.

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6.5.11 Food Safety Control System Assessment

The main purpose of HACCP implementation is twofold firstly: To access that, food producers, processors, hotels, restaurants, flight and railway catering services, food caterers, canteens and street food kiosks are able to produce and market food safely. Secondly, to ensure marketers, distributors, retailers, food service operators, 3rd and 4th party logistics organizations handle and deliver food product safely to consumers.

The processed food sector is required to carry out in-house HACCP assessment using internal resources and an external expertise. The implementation of complete food safety control systems in the Indian food sector is guided by Food Safety and Standards Act (2006) in India. The audit team, which includes government inspectors, experts from research institutes and food sector, has the responsibility to ensure that the HACCP plan used by the food sector is properly designed and implemented. The assessment and verification of HACCP implementation is depicted through the flow chart in figure 6.12. The HACCP plan is prepared first then the action plan for its implementation is developed by taking employees in confidence of manufacturing, processing, sales and marketing inbound, outbound logistics, supply chain, human resource, financial and internal auditing departments. The role of top management is the most important in its fair implementation of a HACCP plan in achieving excellent quality prospective for the organization. The even minor hygiene failure is not tolerated at any level of processing at DPFPL.

The strict-follow approach is useful to achieve 100% food safety the products produced by DPFPL. The strategy of has brought brand equity and consumer loyalty for DPFPL. Therefore, it has acquired more than 61% market share of Delhi and NCR milk market since more than three decades. The DPFPL became a synonym of milk and milk products. It is the most trusted brand. Both the assessment cum verification of the HACCP plan and its implementation at DPFPL is done using written reports. It is proven to be necessary and useful tool for achieving food safety. It is instrumental to provide a harmonized approach within the inspection agency FASSI.

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The major achievements, since 2003, after implementation of HACCP, DPFPL has been able to control Physical, Chemical and Biological hazards (PCB Hazards) in their products. If PCB Hazards are not controlled it may cause illness to consumers. Therefore DPFPL has strictly put a check on it. The whole process of Food Safety management achieved consistency in product quality and reduced customer complaints. It helped in devising better traceability of the product by its origin through systematic records and documentation. It has evolved better controls of process parameters and corrective cum preventive measures. HACCP has helped the DPFPL to manufacture the products with uniform standard quality with minimum rejection and losses. This system has increased the employee's awareness and participation in food safety.

6.5.12 Conclusion

FASSI is encouraging HACCP implementation in the processed food sector in India. FASSI since its inception, continued to be responsible for developing the regulations, standards, policies and procedures. These regulations, standards, policies and procedures serve as guidelines for Indian processed food producers, processors, marketers, distributors, retailers, food service operators (hotels, restaurants, flight and railway caterers, caterers, canteens, street food kiosk etc.) and 3rd and 4th Party logistics organizations. There has been an increase in knowledge and understanding of GMP, GHP and HACCP by the Indian processed food sector. Indian manufactured processed food which is 100% compatible with international food safety standards adopted by CODEX Alimentarius (HACCP 1997a, 1997b). India ought to play a crucial role in adhering to food safety norms for its domestic market as well as for global processed food business. The guidance and implementation of FASSI provided by the GOI has set a good model of collaboration among government authority, processed food sector, experts from the processed food industry, research and academia. All the questions related to HACCP implementation are answered in the current research study through a case study of DPFPL.

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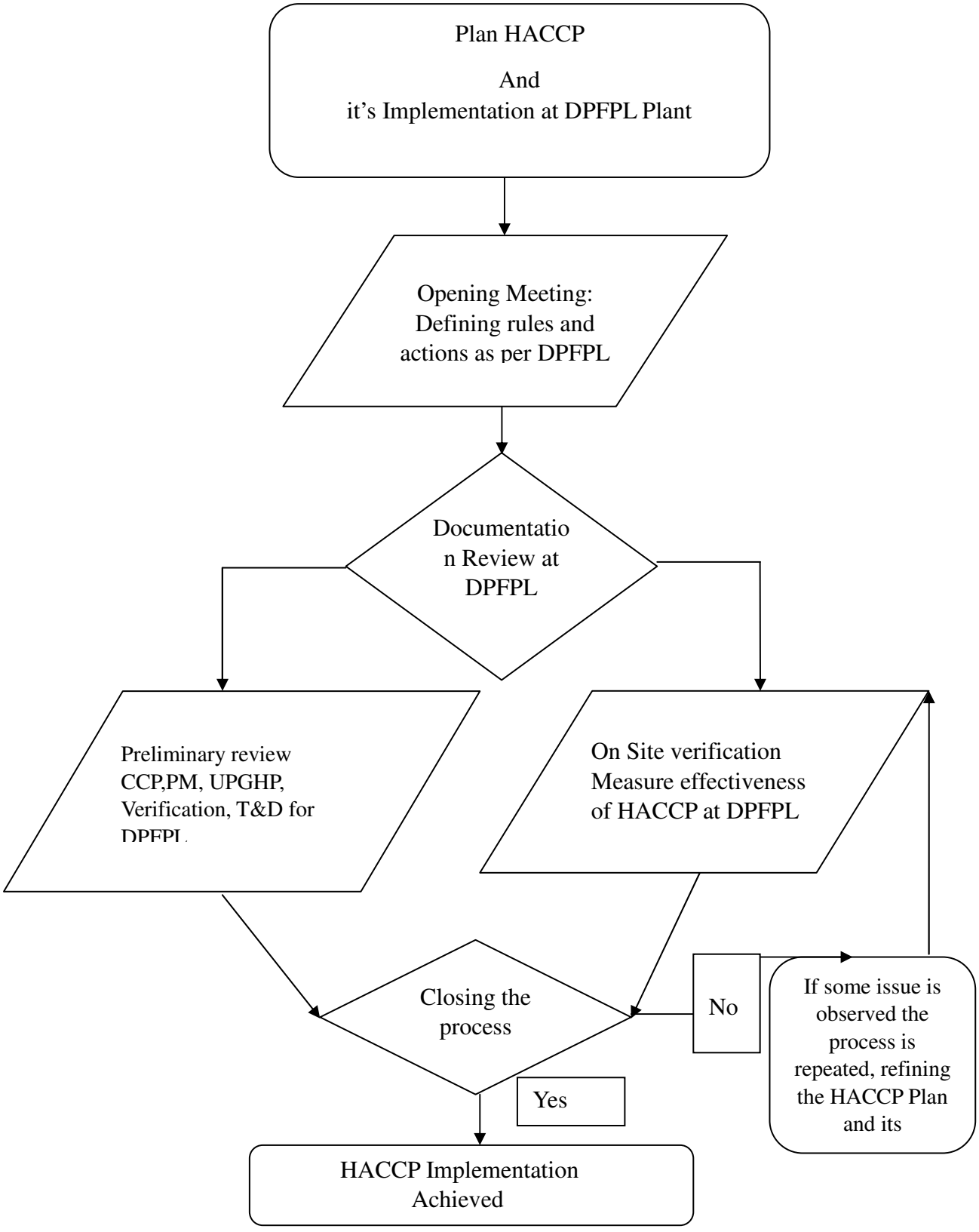

Figure 6.12 Flow Chart of HACCP Implementation

Note: CCP: Critical Control Points, PM: Performance Measurement, UPGHP: Up grading HACCP Plan, T&D: Training and Development

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6.6 Case Study on Frozen Corn Manufacturing and its Supply Chain: SAP-LAP Approach

A case study of an India processed food manufacturer and marketing company (named A1) dealing in manufacturing of frozen peas, frozen corn and frozen vegetables is reported. The A1 is one of the leading brand names for fresh and frozen products. The sweet corn is selected only from the best farms. It is converted into frozen using the ultra advance individual quick freezing (IQF) technique. The sweet corn is frozen by using an IQF technique through a tunnel of fluidized bed, leading to freezing of each and every kernel of corn individually. In this process cells do not damage, preserving the natural nutrition and flavour of sweet corn. The sweet corn is natural and contains no preservatives or additives. A1 has wonderful distribution support in terms of cold chain management and the market is also ready for frozen corn. They have excellent central distribution hub or depot in Delhi and dependable channel partners in terms of carrying and forwarding agents (C&F's), distributors and retailer. The frozen corn required typical frozen temperature to the tune of minus 18 to 20 degree calcius for storage.

If the desirable temperature breaks at any channel member, frozen corn tend to become puffy, dull or heavily speckled. It implies the frozen corn got damaged. Therefore the company is always facing challenges to keep such a delicate product under desirable temperature. It can help to maintain frozen corn shape, quality and nutritional value intact. The individual quick freezing (IQF) technique for frozen corn is illustrated in figure 6.13. It shows a complete processing cycle from the arrival of truck at the docks, the truckload of shelled corn sent for unpeeling of fresh corn manually at the plant, then corn off loaded at IQF Plant. The IQF process for converting fresh sweet corn to frozen corn is explained through four stages first, stock management, pre IQF process, IQF technique applied and post IQF processes. Individual Quick Freezing technique helps in creating better quality products. It preserves all the nutritional value of the product. The quality and taste of the products remain uniform as like fresh ones.

Note: Frozen Corn Manufacturing and its Supply Chain: Case study using SAP-LAP approach, Global Journal of Flexible Systems Management (Springer), Vol.14, No.3, pp. 167-177.

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6.7 Current Trends of Frozen Processed Food Market in India

In 2011 current value sales grew faster as compared to 2010, with the impact of the economic recession easing, consumers were encouraged to increase their spending on frozen processed food. The current value sales recorded fastest growth rate in 2011. Frozen processed vegetables registered the highest current value growth of 13% and in value terms ₹ 2.8 billion in 2011. The size of India frozen vegetable market is 16,885 tons in 2011. Out of a total Indian frozen vegetables sale, frozen peas amount to 72%, i.e. 7279 tons and frozen corn amount to 6%, i.e. 606 tons in 2011. Consumption of frozen processed food has been increasing in urban India. The table 6.13 is depicting the sales of frozen processed food by category in volume term for 2006-2011.

Table 6.13 Volume Sales of Frozen Processed Food Category 2006-2011

Frozen Range of Products	2006	2007	2008	2009	2010	2011
Frozen processed fish/seafood	716	783	863	935	1028	1126
Frozen processed potatoes	842	930	1036	1143	1273	1415
Frozen processed poultry	1222	1342	1485	1610	1763	1929
Frozen processed red meat	475	521	577	620	678	736
Frozen processed vegetables	6483	7179	7819	8446	9219	10111
Frozen ready meals	885	994	1118	1240	1399	1566
Grand Total Frozen processed food	10623	11749	12898	13994	15360	16883

Source: Euromonitor Report 2012

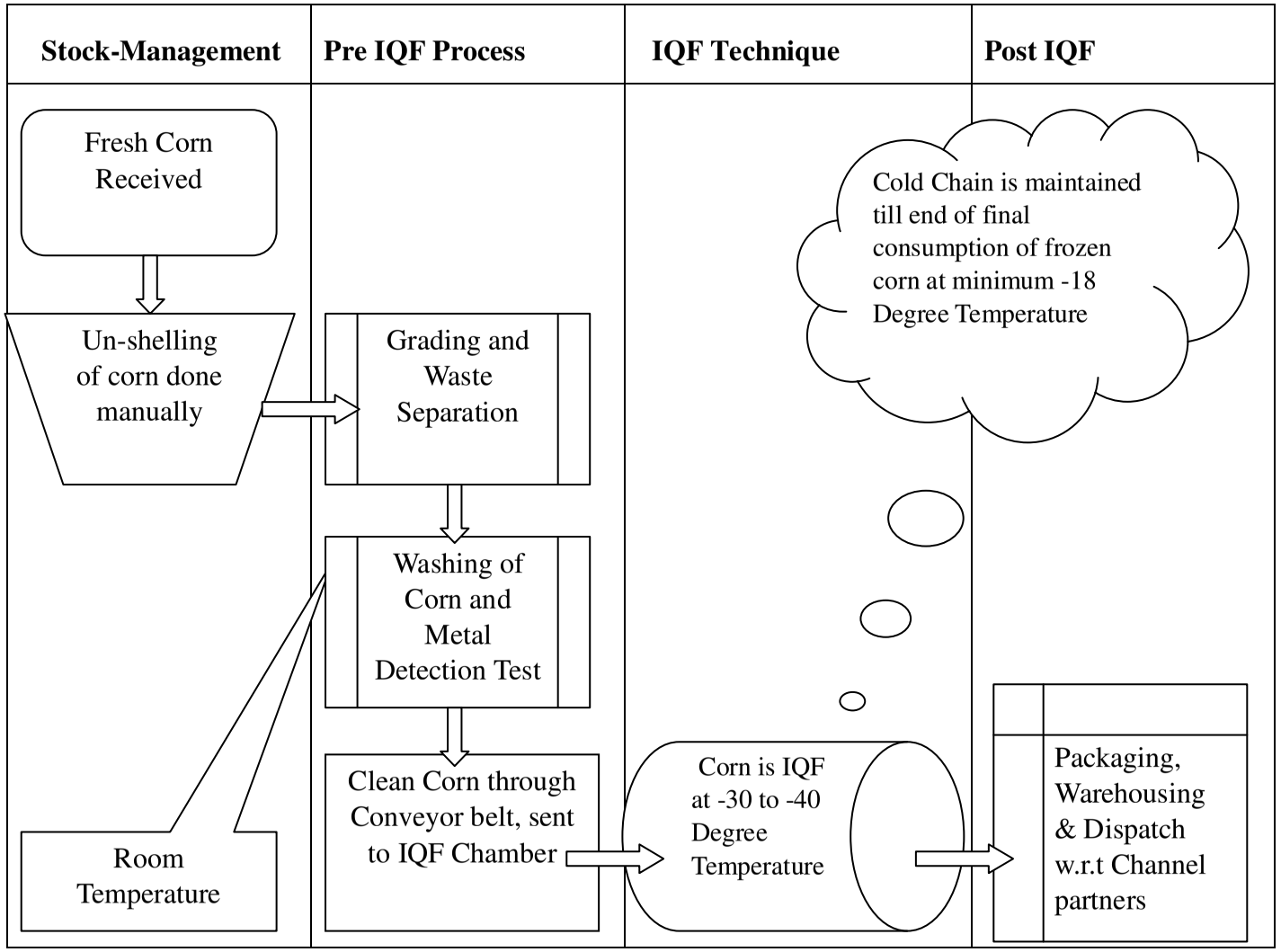

Figure 6.13 IQF of Frozen Corn

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6.8 Integrated Supply Chain at A1

The fresh corn is being sourced from Maharashtra in India directly from the farmers as well as from farmer cooperatives or groups. The prices are market driven, set through the open negotiation based on the quality of the corn. The stock thus purchased is initially processed locally and transportation is arranged to bring the frozen corn to the processing plant in Delhi through reefed vans at temperature -20 degree. The stock is packed in bulk bags of 30 kg. The road transportation time is 4 days to deliver the stock at Delhi. In Delhi plant, the final processing takes place by applying IQF technology.

The actual shelf life right from point of processing to the point of consumption at consumer level is 24 months. Whereas, the prescribed shelf life mentioned on frozen corn packs is 12 months. It is because of a strategy to deal with a situation of slow liquidation of stocks. A1 procures corn on yearly bases.

At A1, the bulk bags are opened and repacked into consumer (200gm, 500 gm, 1kg) as well as institutional packs (5 kg). The frozen corn is then ready for redistribution in India. The pan India distribution takes place as per the respective markets sales potential and their orders as per their sales planning. With in Delhi and National Capital Region (NCR), the distribution can be managed in 24 hours of orders received from distributors. For rest of India the delivery time will be as per the respective geographical distances. The stocks are distributed and redistributed at all the point of sales on first come first bases (FIFO).

A1 depends on its strong pan India distribution network which comprises of 20 carrying and forwarding agents and 200 distributors. For example, the delivery time for making frozen corn available at Amritsar will be two days, for delivery the same stock from Delhi to Chandigarh in a day and in order to deliver the stock in Bangalore A1 takes five days. Figure 6.14. is depicting comprehensive frozen corn supply chain of A1.

A1 is utilizing two types of channels for distribution. The first one is own outlets and second, open retail channel of marketing and sale of frozen corn. A1 has full control over its own outlets. Therefore, the present case study focused on the retail market operations. Here lies the challenge of maintaining, monitoring of cold chain at all the levels immediately after the central distribution hub. A1 channel of distribution is depicted in figure 6.15. The distribution in Delhi begins from central distribution hub. It is owned by the A1. The A1 supply their distributors on the bases of weekly indent of distributors. The complete supply chain of A1 is under temperature control condition. The major challenge in front of A1 is monitor the cold chain integrity.

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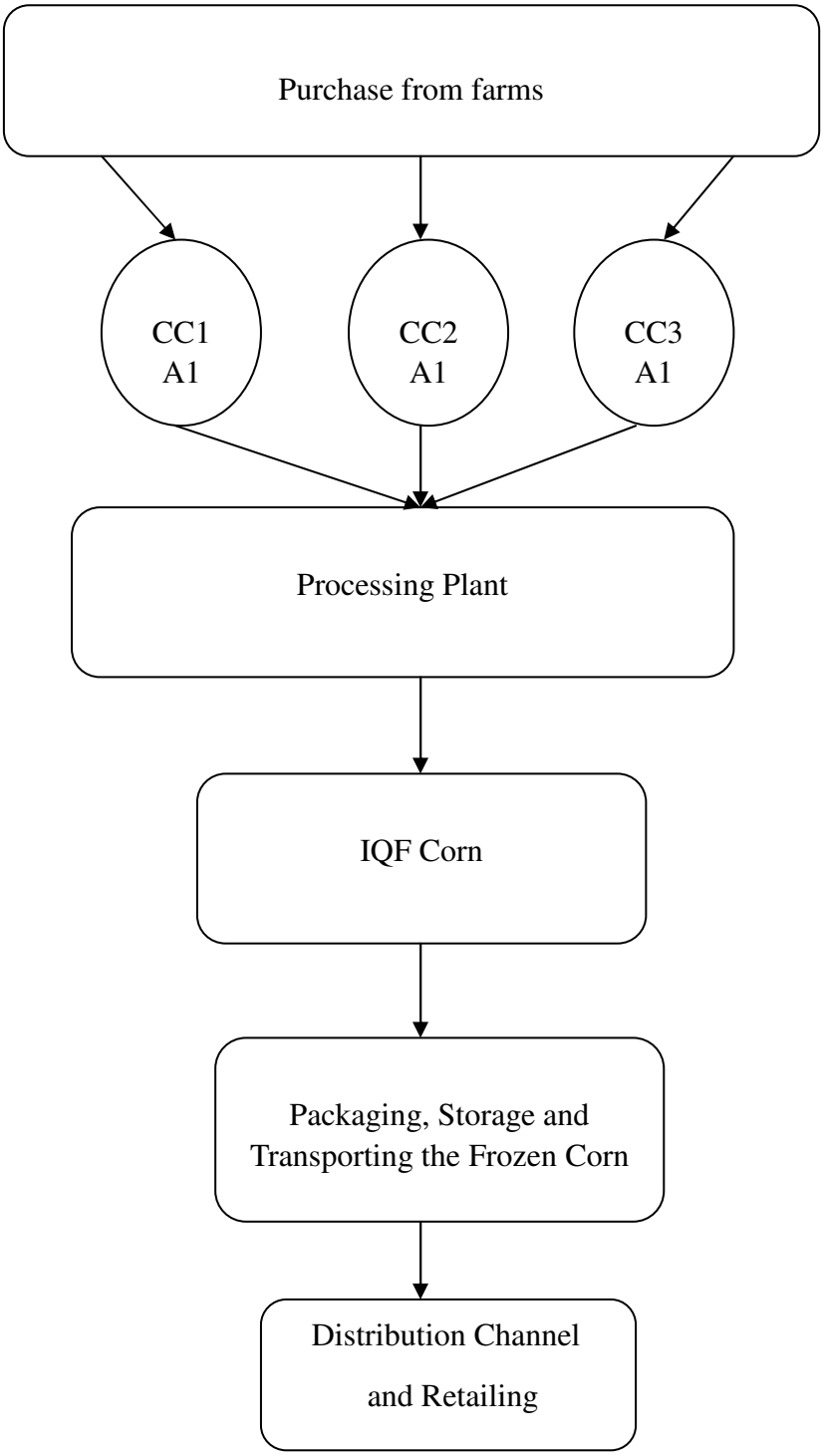

Figure 6.14 Comprehensive Frozen Corn Supply Chain

Note: CC1, CC2 and CC3 are collection centres for fresh corn from farmers.

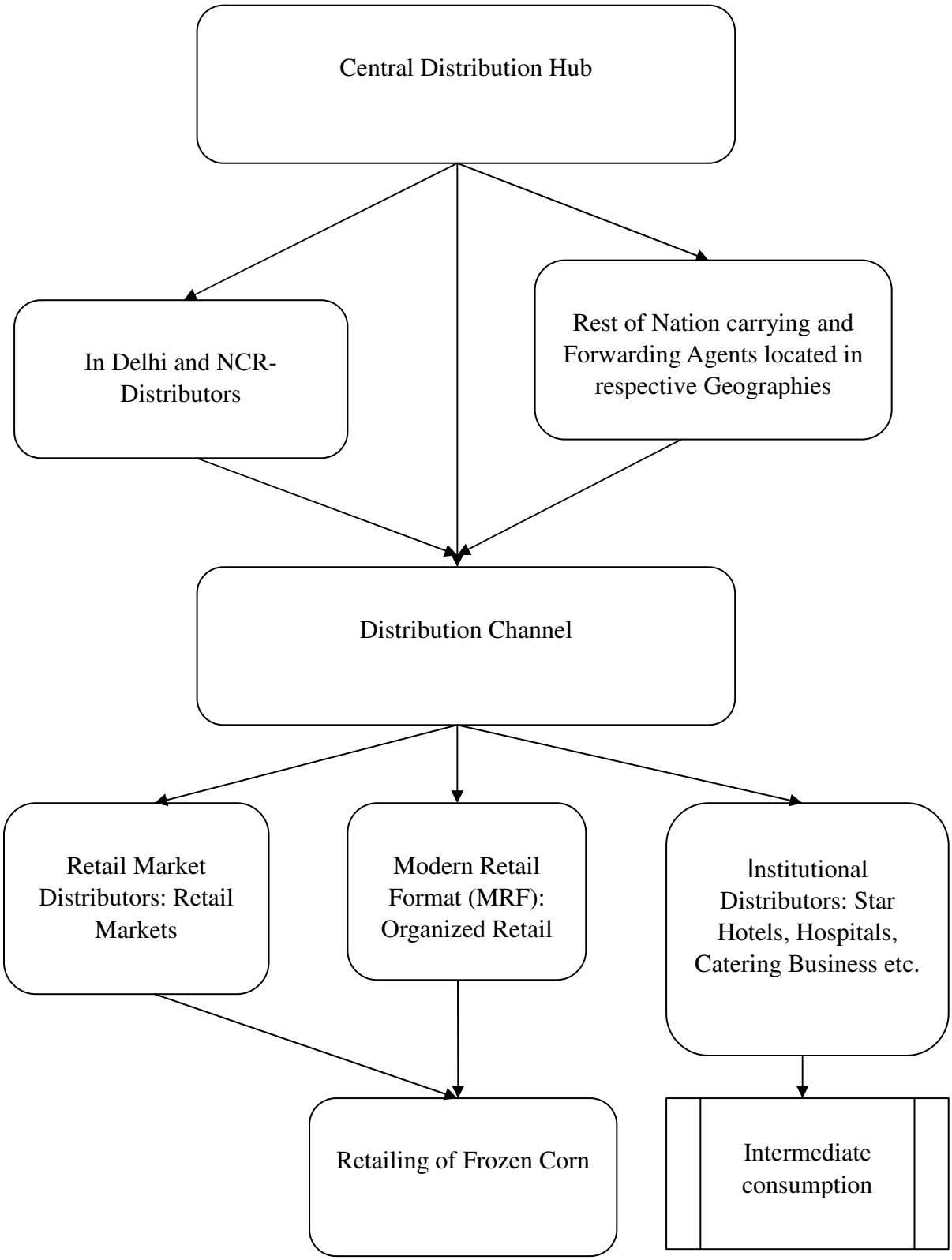

Figure 6.15 Channel of Distribution of A1

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6.8.1 SAP-LAP Analysis

Sushil (2000) has recommended the use of SAP-LAP methodology for critical examination of case studies. The SAP- LAP paradigm is depicted in figure 6.16 and the proposed framework of SAP-LAP paradigm in A1 is shown in figure 6.17. It is on the basis of flexible systems management (Sushil, 1997).

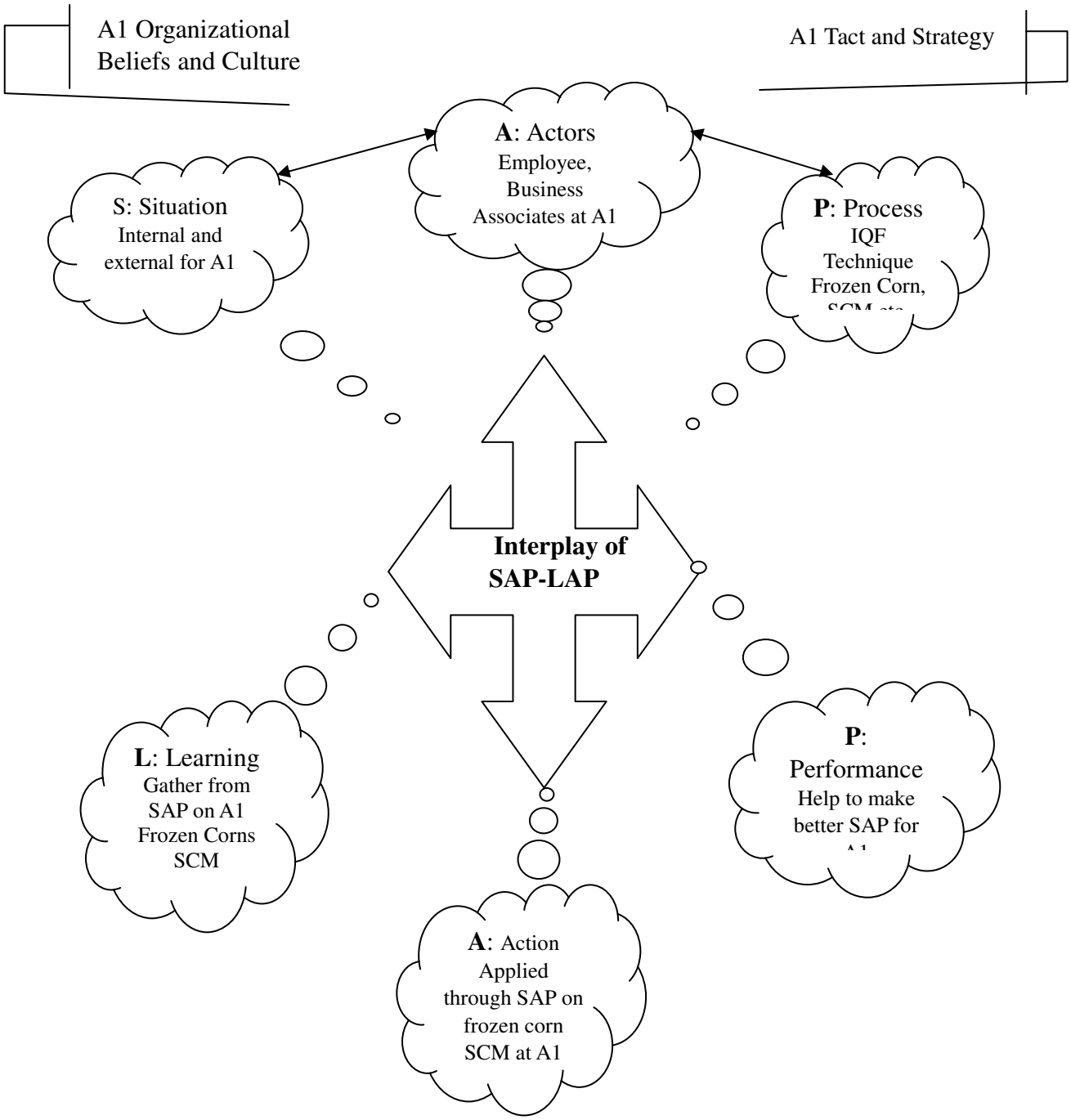

Figure 6.16 SAP-LAP Paradigm

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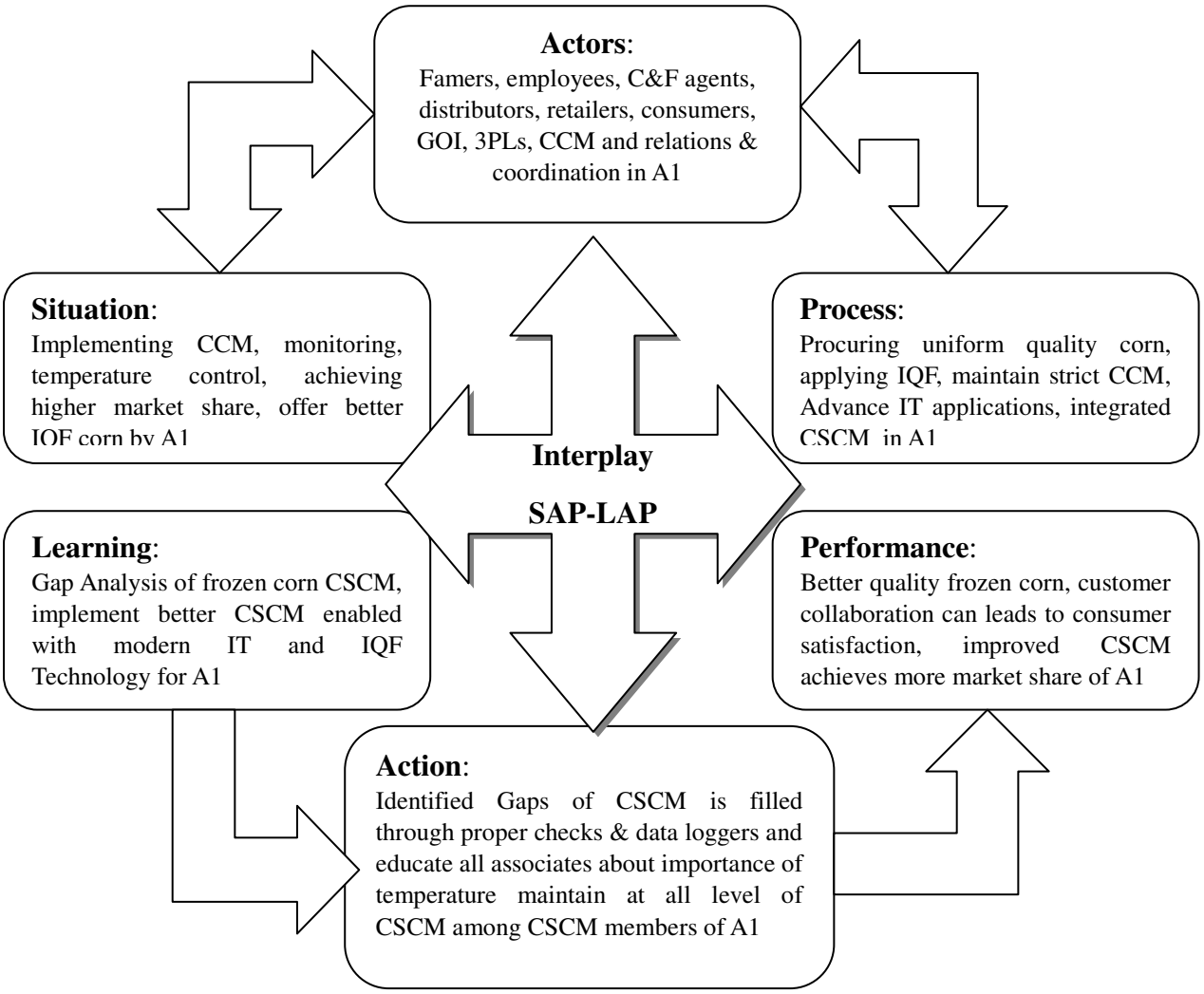

Figure 6.17 Proposed Framework of SAP-LAP Paradigm in A1

Note: CCM-Cold Chain Management, CSCM-Cold Supply Chain Management, data logger is device to monitor temperature fluctuations attached to cold chain equipments.

The SAP-LAP paradigms take into account three entities in a management context. Such as situation, actors and processes (SAP). It could be seen that a situation is to be dealt with an actor or set of actors through a process or a set of processes. The freedom of choice exits with an actor, who could be an individual, a group or the organization as a whole. The interdependence and interplay of situation, actor and process (SAP) lead to learning, actions and performance (LAP). The time was taken in handling the situation, which would result into the performance of the system (Sushil, 2000). With the new learning and actions the situation, actor and process might result in change into a new level. Such a dynamic interplay of SAP and LAP will act as the basis of ongoing managerial inquiry (Sushil, 2000).

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Table 6.14 Case Studies Facilitated through SAP-LAP

Authors	Year	Case studies facilitated through SAP-LAP Research Took	Applied to Sector
Charan	2012	Situation represents the scenario of the organization. Actors are the participants, influencing the situation to evolve different business processes. Based on SAP, various learning issues have been analyzed which lead to suitable action followed by impact on the performance of the supply chain of the organization.	Automotive organization
Goel et al.	2012	Application of e-governance Haryana Urban Development Authority (HUDA)	IT
Siddiqui et al.	2012	Supply chain management (SCM) practice in services is an ongoing process and needs continuous efforts on total quality management (TQM) practices and flexible systems practices fronts	Energy
Palanisamy	2012	To accommodate the variation in business and technological changes, organizational information system (IS) needs to be flexible	Information Systems
Shukla et al.	2011	A firm needs to develop effective coordination within and beyond its boundaries in order to maximise the potential for converting competitive advantage into profitability	automotive components manufacturer
Sahoo et al.	2011	To study the strategic technology management (STM) practices	Automotive
Garg et al.	2010	Flexible system management has brought a concept of flexibility in all spheres including maintenance management. Considerable literature is available on various facets of flexibility management, namely, production, supply chain, day-to-day activities, etc.	Maintenance
Ahuja et al.	2010	Building project management requires real time flow of information between all the project team members or the supply chain members	Information Communication Technology
Pramod et al.	2010	By the adoption of an appropriate change management scheme, organisations can improve their core competency	Telecomm
Suri	2008	computerisation programme of a central government department	IT
Arshinder et al.	2007	Supply chain coordination is concerned with managing dependencies between various supply chain members and the joint efforts of all supply chain members to achieve mutually defined goals.	Manufacturing

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The SAP-LAP paradigm incorporates both learning and action in a symbiotic manner coupled with performance. It is not only take into consideration optimization of processes, but also incorporates multiple perspectives of various participating actors in a managerial process. Thus, SAP-LAP analysis offers a learning and interpretive framework of inquiry into the problem under consideration. Therefore the organization which is in the process of adopting new technologies SAP-LAP framework could prove to be a useful methodology for analyzing the problem. The adoption of new cold chain practices and new technologies is desirable. Thus the SAP-LAP analysis could be best fit for the analysis of the present case study of A1. The company was ranked fifth in the market with 4% value share in 2012. The company benefits from strong positions in ice cream, where it had a value share of 11% in 2012 and dairy products, where its share was 9%. The company generates most of its dairy sales from North India, especially New Delhi and its surrounding areas. Table 6.15, demontartes the A1's product wise sales contribution.

Table 6.15 A1's Product wise Sales Contribution

Product Range	Value Share %	Rank
Dairy	9	2
Ice Cream	11	3
Frozen Processed Food	20	1
Oil and Fats	1	20
Dried Processed Food	1	17
Cheese Spread	1	13

Source: Euromonitor Report 2012

A1 is USD 1 billion company and a leading manufacturer of dairy products and processed foods. A1 has 20 acres of space for the processing of frozen fruits and vegetables in Delhi. A1 has build a pre-fabricated central distribution hub consisting of cold store chambers with different sets of temperature and humidity conditions suitable for storage of various fruits and vegetables. They manufacture tropical fruits pulps and concentrates of the highest quality in India and export fruits pulps & concentrates and fresh / frozen vegetables / fruits to over 40 countries worldwide including USA, Europe, Middle East, Russia and Far East Asia. A1's international marketing operations are managed by a dedicated export division that manages a network of international distributors and original equipment manufacturer (OEM)

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customers - supported by its state of art manufacturing plants and Innovation centre in India. It maintains superior quality through processing at ISO 9002, ISO 22000, FDA, FPO, Kosher, Halal, Global GAP, Ecoert, SGF and HACCP certified plants and GMP procedures are followed at all stage of processing.

Situation

- A1 is one of the leading manufacturers of frozen products. It is the offering best of quality processed food to Indian market.
- The cold supply chain is required for most of A1 products. It is complex in nature and unique one.
- Intensive cut throat competition observed especially with entry of global frozen food giant in Indian market.
- There is a steep increase in consumer demand for frozen foods especially in urban cities due to steep rise in double income households.
- CCM is required and based upon close coordination among channel partners
- Still distributors do less care for required temperature -18 degree for frozen corn
- They have less emphasis on stock rotation and hygiene of deep freezes
- The older glycol deep freezers must be replaced with newer ones
- As newer freezers are fiber base and energy efficient
- With higher turnover modern cold rooms replacing deepfreezers
- A1 have implemented advanced information technology tools for business management
- A1 have a strong distribution network in Delhi and NCR.
- It is one of the trusted brand in the processed food sector
- It was pioneered to start the sales of frozen food sector in India

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Actor

- Board of A1, Top Management, C.E.O, General Manager- Supply Chain Frozen, Manager –Frozen, Logistics Head- frozen and the supply chain department is main actors
- All the employees of A1 in general and in particular supply chain and logistics of department
- All the suppliers or business associates of A1
- C& F agents, distributors of A1 and retailers of A1

Process

- Major weakness that suppliers and distributors are connected to the processing plant through traditional means of communication like fax, telephones etc.
- The main raw material is peeled corn required for the production of frozen corn
- Existing CSCM requires up-gradation
- Domestically the sweet corn is sourced from Maharashtra
- Frozen corn manufacturing depends upon availability of fresh sweet corn, sales and marketing department's yearly sales projections
- A1 utilizes IQF a state of art technology for manufacturing frozen corn
- A1 deployed SAP in all the departments for better and faster communication
- The intranet is being used for connecting all the C&Fs and regional sales offices.
- Stringent quality control practices are applied, secured certifications like HACCP, ISO 14000 and ISO 22000

Learning

- In A1 the production planning is based upon availability of the right kind of sweet corn and sales & marketing sales projections
- Use of proper cold chain and space available for storage at retail can boost sales
- Implementing proper cold chain creates wonders for A1

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- The channel partner's awareness ,education and training on CCM is desired
- Creation for phasing out old set of deep freezes and replacing CCM with modern cold rooms required immediately
- The initial investment is a major hurdle in the process. The cost saving will be done on account of less energy consumption, reducing stock damages and selling more fresh stock, it in-turn increases sales and profitability
- Instead of monitoring of temperature abuse in CSCM, channel partners themselves made conscious efforts to become the temperature sensitive
- Ensuring 3PL vendors must follow the guideline of temperature maintenance
- Deploying data loggers to monitor CCM and ethics in CSCM can be expected
- The major challenge is streamline connectivity among distributors and their central distribution hub, C&F agents to encourage fast and correct communication
- Moreover IT will help in devolving nice informative web site for consumers and in future to began online sales

6.8.2 Discussions on SAP LAP Analysis of Frozen Corn Manufacturing

In this case study, manufacturing process and supply chain of frozen corn is discussed. It is a leading processed food marketers and manufacturers in India. This case study highlights crucial observations about the IQF of corn and cold supply chain management of frozen corn. The most important observation is that A1, has the most modern IQF plant for manufacturing frozen corn for the most demanding markets. The major challenges are awareness creation, educating and training of channel members especially third party logistics service providers (3PL) or transporters, distributors and retailers to maintain -18 degree temperature for frozen corn transportation and its storage to avoid frozen corn quality, shape, colour, hygiene conditions, nutrition value get deteriorated.

One of the limitations of cold chain management is that chain members for their meagre gains switch-off the cold chain equipments like cold rooms, deep freezes, reefer vans cooling systems to save electricity expenses or diesel for a few hours. Another limitation, there is always shortage of frozen storage space. Therefore, channel members do not hesitate in keeping the frozen corn stock outside the cold

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room or deep freezes for a few minutes or hours. It happened due lack of proper order processing, inefficient supply chain management and its planning. The company is connected using traditional means of communications like fax, telephones, cell phones etc. The distributor's orders still come on fax or over telephone. Once order is received and punched in computer system, it cannot be corrected in either of direction upward or downward. Even though A1 has shifted from FoxPro computing system till 1999-98 to Microsoft Navision in 2000-01 and most recently SAP in 2010-11. It had implemented within A1, its regional offices and supply chain depots. It has attained limited success. The channel numbers are still not connected through SAP. Thus the effective integration of the frozen cold supply chain is the most desirable to eliminate wastes. A1 has many gray areas in the cold supply chain management. It has ample opportunities to cobble together with channel members. It is vital to interact with logistics and supply chain management team at A1, distributors to make them aware about the benefits of maintaining ethical practices in cold chain for their own sake. It would be nice if they integrated SCM by implementing SAP at their end through limited support of firm. A1should utilize the modern technologies for effective implementation of its integrated cold chain management in long run. Figure 6.18 has depicted the comparison of frozen corn storage.

6.9 Conclusion

This chapter presents three cases which are summarised in the table 6.16. A brief about the case studies is mentioned on the six parameters such as the research objective of case to be conducted, theme of case study development, bases of selection of case study, defining information & data gathering processed, case study analysis and then reporting the case study.

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Table 6.16 Key Aspects of Case Studies

Case Studies / Parameters	I Frozen Products Indian Ltd.	II Food safety in India: A case of Deli Processed Food Products Ltd.	III Frozen Corn Manufacturing and its Supply Chain: Case study using SAP-LAP approach
Research Objective	To study the frozen peas supply chain management	Illustrates implementation of HACCP, food safety controls and its status in India	To study manufacturing process, supply chain of frozen corn and status of supply chain performance
Case-Study Development	Revolves around frozen peas storage, individual quick freezing technique and cold chain management.	Covers all the global food safety norms laid down by WTO such as goods manufacturing practices(GMP), good hygienic practice (GHP), hazard analysis critical control point (HACCP)	Scope of this case study to look at the frozen corn manufacturing utilizing IQF and supply chain management practices in India
Case Selection	Based on Importance of Cold Chain Management	Agenda of global food safety used to look at Indian stance on food safety measures	Scheme of Frozen corn and its status of supply chain performance analyzed
Information & Data Gathering	Detailed interactions with the concern Firm executives, expert opinion and secondary data used	Literature review and personal meeting with company quality head and production team, supported this exercise	Situation-actor-process(SAP),learning-action-performance (LAP) model applied to conduct case study
Data Analysis	Based on case facts, first hand information from Firm	Food safety practices studies at firm and their secondary reports analyzed	Visited the concern firm & plant to gather desired information for case
Case Reporting	Presented inform of research article using qualitative research approach satisfying contract and validity of case study.	Qualitative Case study research deployed to study & compared the global food practices, Indian stand and Indian firms approach in Dairy sector	Frozen Corn SCM practices in India scenario analyzed in qualitative manner using SAP-LAP technique

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Comparison of Frozen Corn Storage

Figure. A temperature required for frozen corn -18 degree

Figure B When corn kept out for 15 minutes at temperature + 35 to 40 degree, corn turned puffy & thawed

Figure C When corn kept out for 45 to 60 minutes at temperature + 35 to 40 degree, corn turned completely thawed and lost its freshness and sweetness

Figure D When corn kept out for 45 to 60 minutes at temperature + 35 to 40 degree, corn turned completely thawed and lost its freshness and sweetness , then again when the same corn was put in deep freezer for freezing, the cluster formation took place. It lost its fragrance, taste and appearance.

Figure 6.18 Comparison of Frozen Corn Storage

CHAPTER – 7

PERFORMANCE MEASUREMENT SYSTEM

7.1 Introduction

A performance measurement system (PMS) comprises of systematic methods of setting business goals together with periodic feedback reports that indicate progress against set goals (Simons, 2000). In order to be able to assess the success of supply chains, an adequate PMS needs to be developed. The measuring of the performance of processed food supply chains is rather difficult because they have many features that set processed food supply chain management (PFSCM) apart from general types of supply chains. The most of processed food (PF) is prepared from agri produce. It has seasonality effect and agri raw material is available at few geographical areas. The processed food demand is universal and throughout the year. Further food quality and food safety related aspects are unique to PFS, which is further compounded by short shelf life, deterioration in quality with time and need temperature control conditions. Aramyan (2007), also listed shelf life constraints for raw materials and perishability of products, long production throughput time, seasonality in production, sensitive properties like taste, odor, appearance, color, size and image, geographical distances, temperature sensitive processed food products etc. as important considerations in managing performance of PFSCM. In table 7.1 the generic features of the agriculture based processed food sector are discussed and elaborated. The list of features of processed food formed using literature review on food supply chain and extensive discussions with the processed food experts from corporate, academia and food researchers.

1. Seasonality of Raw Materials

The agriculture based processed food is prepared through using agriculture raw material like apple juices requires apple, frozen peas requires green peas etc. The apples are procured and stored during winter in India, so apples can be supplied to juice processor for whole year. The research on food supply chain (FSC) and its

Note: Performance Measurement System for Processed Food Sector, Vision: The Journal of Business Perspective (Under Review since December, 2013).

internationalisation is still a recent phenomenon and there are many opportunities for the food industry to benefit from SCM research and that are yet to be explored (Mena and Stevens, 2010). This is partly because the food industry has specific characteristics such as product perishability, product safety and traceability, product temperature sensitivity and seasonality of raw material etc. (Kittipanyangam et al 2011, Christopher et al., 2009; Soman et al., 2004; van der Vorse et al., 2001). This feature can cast a crucial impact on PFSCM.

2. Agriculture Produce Available at Specific Geographical Places

Agricultural produce are grown on certain geographical locations through the world. These locations are blessed with fertile soil, irrigation facilities and climatic conditions suitable for the agricultural produce grown in these geographies like in India, Uttar Pradesh is most suitable for sugar cane growth, wheat etc. and Himachal Pradesh's soil is most useful for growth of Apple, Pineapple, Pomegranate, Pear etc. The literature review, presented in current section serves a foundation of the key factors influencing food supply chain geographic dispersion decisions. The location decisions of food supply chains have been researched through three perspectives: sourcing, manufacturing, and distribution to the market (Flaherty, 1996). First, sourcing perspective involves decisions to either source raw materials/finished products from overseas or local suppliers (Trent and Monczka, 2005). Historically, cost has been regarded as the primary determinant of sourcing decisions (Peterson et al., 2000). This factor becomes important once labour costs are substantial part of production and unit costs (Kotabe et al., 2009). With substantial economies of scale, global demand for the same products can be meet through a single source globally (Kittipanyangam et al., 2011). Therefore, it is challenging to manage current feature in PFSCM.

3. Fresh Produce Quality Consistency

It is one of the major challenges in path of famers to market their agricultural produce to the retail. The fresh produces' quality, shape and appearance many not be uniform and consist. The transparency does serve the special purpose in food and agribusiness. Besides improving market efficiency, enhanced information exchange in the whole supply chain, consistent food quality, support of product differentiation, logistical and

process optimisation (van der Vorst et al., 2006) may serve operations management considerations. The food supply chains are intrinsically dynamic because of deterioration and variation of food products quality, production and distribution management (Grunow et al., 2010). Characteristics of food products change over time and this has important implications for the management of processes in the supply chain (e.g. products which are closest to their expiration date should be sold first, at retailer level, often at reduced prices). Inherent quality variation of biological products between lots and even on the level of the individual product and unpredictable output, pose challenges for sorting, processing (e.g. differences in sugar content or fat percentage) and distribution (Trienekens et al., 2012). Moreover, different actors in the food chain as well as different consumers and consumer groups have different perspectives on food product attributes, posing extra challenges to the alignment of processes in the chain management.

4. Demand Throughout the Year

The fresh products like corn, peas, mangos, apples and organs etc. are seasonal in nature. In the modern society these products are desired in daily life round the year. Moreover, these products are available at specific geographical places as mentioned previously. The demand of such products is catered through processed food sector throughout the year. It is possible through value addition in fresh produce either by traditionally method through heat treatment or now a day through use of cold chain. Zanoni et al. (2012), studied the role of energy in catering round the year demand of fresh products and also ensures quality products availability.

5. Demand in All Geographies

Delhi's demand for fresh fruits and vegetables few years back use to cater through its national capital region agriculture fields in Indian. It implies that until then they had been the main source of fruits and vegetables for Delhi. The cities were disconnected from its surrounding agriculture farms despite well developed transportation, rapid growth of globalized agriculture food systems via the internationalization of markets and mass retailing (Morgan et al., 2006). Similar issue was studied observed in Paris city by Aubry et al., (2013). It is largely because two reasons first, agricultural farms near big cities sold against hefty amount of money and secondly, urbanization took

place on agricultural land that pushed agriculture further away. This gap of supplies is partiality managed through the processed food sector and major portion is managed through supplies of fresh produce from distant states of India. Therefore, the cost of fruit and vegetable are keep on increasing. Geographic proximity relates to the distance between producers and consumers. That explains importance of demand across all geographies.

6. Requirement of Availability in Local Markets

The food is desired by all urban as well as rural areas irrespective of their economic status. Therefore, development of nearby food supply chains is extremely needed for effective and efficient demand management. Short supply food chains (SSFCs) have been central to a wide range of research on the recent emergence of alternative forms of agriculture and food supply in countries (Aubry et al., 2013). They have often been linked with the so-called quality turn in food as they are associated, among others, to more traditional, locally embedded and sustainable farming practices (Ilbery and Maye, 2005a). Some authors (Watts et al., 2005) have nevertheless shown that this link is not automatic, as the local alone is not a guarantee of a strong turn to quality based production. In relation to these alternative food chains or networks, SSFCs induce forms of food relocation through the shortening of supply chains. Parker (2005) characterizes these chains by the very small number of intermediaries between producers and consumers and by the short geographical distance between them. In other words, SSFCs are about the rebuilding of proximity between producers and consumers. SSFCs have very different forms direct selling in farmers' shops or on farmers' markets, box schemes, internet selling etc. This way the availability of food products close to consumer is for most required by PFSCM.

7. Quality and Safety Issues as Products Related to Human Health

All consumers would like to consume safe, healthy and consistent quality food. It is because of changing consumer consumption pattern globally. Produce can become contaminated with microbial pathogens by a wide variety of mechanisms. Contamination leading to food-borne illness has occurred during production, harvest, processing and transporting as well as in retail and foodservice establishments and in the home kitchen (FDA, 2010). Some significant sources of pathogenic

microorganisms on fresh produce may occur at pre and post-harvest. The classification of sources of bacteria's mentioned in table 7.1 (FDA, 2010). These potential sources of microbial pathogens need to be adequately controlled in order to manage the level of incidence of food-borne illness outbreaks. The increasing number of food-borne outbreaks associated with fresh produce would urge the supply chain to look into implementing HACCP from plough to plate. The new and emerging food-borne disease outbreaks can be controlled by on-farm preventative actions and on farm HACCP implementation (Soon et al., 2012).

That is why, a special treatment of food products in PFSCM needed.

Table 7.1 Classification of Sources of Pathogenic Micro-organisms

Pre-harvest	Post-harvest
• Soil • Irrigation water • Inadequately composted manure • Dust • Farm and non farm animals • Human handling • Water for other uses (pesticides, foliar treatments, growth hormones	• Workers at Farm, food handlers • Harvesting equipment • Containers/field to packing shed • Farm and non farm animals • Dust • Washing water • Sorting, packing, cutting and further-processing equipment • Transport vehicles • Improper storage (temperature, physical environment) • Improper packaging • Cross contamination with other foods in storage, preparation and display areas • Improper display temperature • Improper handling after wholesale or retail purchase • Cooling water and hydro-cooling

8. Temperature Sensitive Produce

The temperature sensitive produce like fruits and vegetable in fresh, frozen form, ice-creams, dairy products etc. requires special type of cold chain. The distribution and storage of frozen food fall into the category of cold chains, in which the products are kept at low temperature so as to preserve their quality. In cold chains energy should be appropriately used to prevent food products deterioration over time, avoiding their value decrease (e.g., due to spoilage of perishable products) and guaranteeing quality preservation and the nutritional value of food itself could be related to some important nutrients characteristics (e.g., vitamin C level for several vegetables, sugar level for several fruits, proteins for meat, etc.), which begin to deteriorate immediately upon harvest or butchery: the aim of cold chains is both to preserve quality and to limit the loss in value over the following stages of the chain from the field to the consumer (Zanoni et al.,2012). The temperature sensitive PF deserves special attention by PFSCM managers.

9. Product Quality Changes with Time

This is true in case of fresh produce and processed food products channelized through FSCM. These products have their certain life span. The fresh fruits and vegetables are plucked few days before their full ripen state so that their shelf life can be enhanced. In case of banana, it is plucked when banana is turning from green to light yellow colour. The banana is stored in ripening chamber at temperature below plus 14 degree celsius. Thus, PFSCM ensures that banana will be full ripen, pale yellow colour, sweet in taste and ready for end consumer to consume. The sizeable amount of time is lost during logistics. It may result in loss of food produce during transportation and storage. Therefore, it is advised for lesser food miles. This is directly or indirectly instrumental in increase cost to the end consumer. It is paradoxical alongside the current trend of food markets becoming increasingly global in nature. The markets are witnessing a counter-trend with a growing interest in local food. Evidence of this local food trend is apparent in many areas. The food activist discourse discusses creating food sheds (Kloppenburg et al., 1996) and reducing food miles (Pretty et al., 2005), and literature is writing about the practice and politics of food system localisation (Alonso and O'Neill, 2010; Coderre et al., 2010). A studied conducted by

Mirosa et al. (2012) had been indicating the similar trends and results. Thus, locally managed food is the best solution in this regard.

10. Hygiene Maintenance from Production to Retail

The basic and pre requisite for quality and safe food is that food ought to be prepared hygienically. It must be fit for human consumption. All the food safety regulations and standards are directly or indirectly addressing the mentioned pre requisite for food e.g. hygiene maintenance across all the stages that food travel form growers to retailers. The CODEX recommended international code of practice – General Principles of Food Hygiene (CAC, 1997) identified the principles of food hygiene. These standards are applicable at all stages of the food supply chain i.e. site selection, planting, growing, harvesting, transport, post-harvest processing, distribution, retail or food service stages to the point of purchase by the consumer. The aim of the code of practice was to promote the steps that needed to be taken to ensure that food is safe and suitable for human consumption.

The harvesting and processing of fresh produce usually involves direct handling by agricultural workers. Humans represent a significant source of pathogens that can be readily transferred to produce and subsequently to consumers. The most crucial risk associated with handling is the possible introduction of enteric viruses, organisms such as Hepatitis A virus (Wheeler et al., 2005). This risk can be mitigated through routine vaccination of farm workers (Science Daily, 2009). During the post harvest phase industrial workers hygiene can be affected by the availability and accessibility of wash and toilet facilities. This issue can be resolved through making available required wash and toilet facilities rigorous and appropriate training of staff (Manning et al., 2013).

11. Organizations Responsibility Even for Product Deteriorate at Customers Place

The food manufacturers and marketers should educate consumers about the handling and storage of food products at home. Here the labeling on the product usage can be of great help in creating awareness about the subject. If consumers are not educated about the right type of storage of products than product quality may get deteriorate at place of consumption. Therefore, best strategy for organizations is to create proper

awareness through adequate labeling about the continents, handling and keeping in proper type of environment (dry or cold chain).

Consumers in Europe reported that information on the product packaging and the source of information can influence their feelings of trust about the content of the information. A decreased trust in the information then becomes a source of hesitation and lack of confidence in buying the specific product that carries the information (Pieniak et al., 2007, Altintzoglou et al., 2012). Therefore, firms ought to create desired level of awareness among their clients.

12. Conscious Use of Nutrition in Products

This is the sole responsibility of manufacturer as well as of food processors to add and keep nutrients in food as per food law and food safety standards. In this manner the food organizations can maintain healthy relations with their consumers. The consumer reports mostly are motivated, at least in part by health considerations when making food choices. These health-motivated consumers are more likely to seek information to help them assess the healthfulness of various food options (Hess et al., 2012). Graham et al., (2012) concluded nutrients are positioned according to health relevance. The PFS should demonstrate their socially responsive behaviour w.r.t subject matter.

13. Long and Cost Intensive Product Development

In the food sector launching of new product is always dreamed by producers and desired by consumers. This condition is posse's huge amount of challenge for PFS. As new product development is always a long and high cost intensive process. It is also true that food companies to become successful continuously strive for launching new product development (NPD).

More than 95 per cent of the money invested in the development, design and marketing of new products does not produce actual returns. Therefore, it is crucial for businesses to conduct comprehensive planning and management of new products to boost their competitiveness (Yuan et al., 2012).

14. Maintaining Varieties according to Consumers Taste, Preferences and Pack Size

The food products are available in large number of variants. It comes in various pack size such as small, medium and large. It is the trend of market to offer such a huge range of food products to compete with intense competition. It is effort towards creation of product differentiation among homogenous looking wide verities of eatables for example various brands of chocolates. Packaging a product in different sizes (Cohen, 2008) is seen to be a good way of segmenting the market (Gerstner and Hess, 1987). Varieties in package sizing and pricing have been linked to consumers' consumption rate as well as storage and transaction costs. The focused on package size as a strategic tool was shifted towards the downsizing as a competitive response to super sizing (Anonymous, 2006, Sy-Changco et al., 2011). Today's market is characterized with intense competition pressure as well as high level of turbulence and uncertainty. This is happening due to smart and vigilant customer. Diverging needs of customers represent intense competition and uncertainty. Customers are becoming more demanding, expecting better customized products and better customer service than what was in the past. The high competition pressure urges companies to shorten product life cycles, increase product variety and to adapt to technological changes more quickly than they did in former times (Tejpal et al. ,2013). This feature needs to be tackle by PFSCM with extra consciousness.

15. Small, Bulky, Delicate Products

The food products are mostly small in size, bulky or voluminous and delicate in nature. Therefore, food supply chain need to play crucial role in carrying the food stuff from source to end consumer with care. Sardana (2013), examine the case of Danone yogurt supply chain. The Danone yogurt is perishable in nature and has a shelf life of 72 hours. It possesses a thick consistency at chilled temperatures (ideally below plus 8 degree celsius) and loses its consistency, becomes semi-solid when exposes to higher temperature more than plus 8 degree celsius. Besides running yoghurt do not generate value for the consumers. Therefore, the yogurt supply chain depicts the marketers needed to manage the network carefully because yogurt comes in small and bulky packs. The product is of delicate nature due to two reasons, first its temperatures sensitivity and shelf life. That's why it calls for appropriate action by PFSCM.

16. Shorter Shelf Life

The short shelf life of food item varies from 24 hours to few months depending upon nature of food products. For example, fresh milk has 24 hour, yogurts 72 hours and snack food 4 months. It causes a tremendous pressure on supply chain right from production to selling point and afterward for liquidating the stocks before its expiry or rotating the stock from slow selling point to fast selling place. Perishable foods are normally replenished on a daily basis by the supplier or distributors. Consumers' willingness to pay for perishable foods decreases as they approach the end of their shelf lives, since the perceived risk of a loss of freshness increases (Tsiros and Heilman, 2005). In common-sense, if a consumer checks the expiry dates and prices of perishable foods, he or she will be unlikely to purchase a product with a shorter remaining shelf-life if the price is the same as one with a longer remaining shelf-life (Chung et al., 2013). It is the whole sole responsibility and accountability of PFSCM to make available reliable products to consumers.

17. Merchandizing

Food merchandizing can be decisive factor in profitability of retail sector. Because of better merchandizing the visibility and appeal to consumers improves many fold which in-turn instrumental in liquidating the food stock. Merchandizing can also be called are retail positioning. Given this inherent value, retail positioning research has frequently appeared in literature (de Bruyn and Freathy, 2011). Guan et al.(2012), states the superior retail positioning firms can reduce the replacement rate; improves their gross margin; mange buyer goal adjustment and consumer satisfaction can be enhanced.

18. Packaging

Shelf life of food is integrally related to its packaging; both product conditions and the package should be considered (Yam et al., 2005). In recent years, the major driving force for innovation in food packaging technology. The packaging functions as silent salesmen. Because of dynamic changes in consumers purchase pattern, there is change in retail and distribution practices globally (Sonneveld, 2000). Modified atmosphere packaging (MAP) and active packaging (AP) technologies are being developed. AP is an innovative concept that can be defined as a mode of packaging in

which the package the product and the environment interact to prolong shelf life or enhance safety or sensory properties, while maintaining the quality of the product (Singh et al., 2011).

19. Ability to Identify the Sources of Supplies

The back tracking of the products right from its origin is the most desired in case of any food hazards event. In order to achieve food safety certifications it is mandatory to maintain traceability records in black and white at all the levels of food chain be it farmer, principle or logistics service provider or retailers. International Standard Organisation (ISO) definite traceability is the ability to trace the history, application or location of an entity by means of recorded identifications (Kelepouris et al., 2007; Karlsen et al., 2013). The definition of food traceability, forces that drive the implementation of food traceability, technological innovations, benefits of food traceability and barriers to the implementation of food traceability were investigated (Bosona et al., 2013). Food trade is one of the largest global businesses today and traceability throughout the food supply chains has gained considerable important over the years (Thakur and Hurburgh, 2009). It is mandatory to record the information about the product right from its source to consumption, so that in case of a food crisis it is possible to trace back to source of contamination and to perform a targeted recall of potentially affected food items. Current status is that many food producers have good often electronic traceability systems internally but exchange of information between the links in the supply chain is very time-consuming or difficult due to the diversity and proprietary nature of the respective internal systems (Storoy, 2013). In todays' modern world traceability is desired for certifications and the same feature can be used as unique selling proposition (USP).

20. Broken, Damaged and Expired Products at Distributors and Retailers

All the replacements like broken, damage and expiry required to be managed by principle organizations with in their policy of replacement. The long-term success of manufacturer marketing actions often depends not only on consumer response, but also on retailer and competitor reaction (Pauwels, 2007).

Table 7.2 Features of Agri Processed Food Supply Chains

S.No.	Generic Features of Agri Processed Food Supply Chains	Implications for SCM
1.	Seasonality of Raw Materials	Need huge warehousing
2.	Agri produce available at specific geographical places, procurement of fresh produce at collection centre	Call for efficient and quick transportation supported by IT
3.	Fresh produce not consistent	Need facilities for sorting and grading
4.	Demand throughout the year	Maintain stocks for offseason
5.	Demand in all geographies	Establishing Global and National Distribution Network
6.	Requirement of availability in local markets	Efficient and responsive retail network
7.	Quality and Safety issues as products related to human health	Food Quality and Safety Certifications. Compliance to HACCP and other global standards
8.	Temperature sensitive produce and Products	Cold Chain Management
9.	Product quality changes with time	Stock rotation from slow to fast moving sales point
10.	Hygiene maintenance from production to retail	Training and Awareness
11.	Organizations responsibility even for product deteriorate at customers place	Creating awareness among consumers for using desired storage at home, Proper labeling and instruction on packs
12.	Conscious use of nutrients in products	Knowledge & Information's
13.	Long and Cost intensive Product Development	Investment in R&D
14.	Maintaining varieties according to consumers taste and preferences and requirements of pack sizes	Continuous innovations -New products and portfolios
15.	Small, bulky, delicate products	Improved means for handling inventory
16.	Shorter shelf Life	Better inventory management and quick replenishment
17.	Merchandizing	Focus on Sales Promotions
18.	Packaging	Require Advance Technology
19.	Ability identify the sources of supplies	Traceability
20.	Broken, damaged and expired products at distributors and retailers	Reverse Logistics for damaged/ expired products
21.	High creation of packaging waste. Packaging used to maintain freshness and ease of logistics	Reverse logistics for packaging material
22.	Intense competition from Retail giants	Competitor Mapping

21. High Creation of Packaging Waste and it Ought to Act as Ease of Logistics

It is always presume that packaging is unnecessary evil of modern days marketing. It creates a huge wastage of material that is hazardous for environment. Therefore, it is the responsibility of marketers to use recyclable material in packaging. There are two types of packaging. One is called primary package e.g bulk packaging and second one is secondary package e.g individual pack. It is always advised that primary packaging ought to be standardized and uniformed in nature. The strength of standardised packaging is that it makes easier to develop efficient logistics systems because uniform packages are easy to store and transported (Sonneveld, 2000, Hellstro¨m et al. 2011).

22. Intense Competition from Retail Giants

An increase in the internationalisation of retail companies and markets appears to be one of the most significant trends in today's business environment (Vida and Fairhurst, 1998). Large retail operations are increasingly international in their operations and orientation. The changing nature of the international business environment calls attention to the impediments to internationalisation (Evans et al., 2008). The retailer aiming to expand its business in a global market faces with the complexity and uncertainty inherent in the dynamic nature of the market new business environments, unfamiliar consumer preferences, location choices for performing business activities and effective co-ordination of global operations (Yu et al., 2012). All these activities lead to intense competition from retail giants to small time food sellers.

7.2 Performance Measure for PFSCM

Tung et al. (2011), Malina and Selto (2001) and Whorter (2003) assessed the effectiveness of PMSs based on organizational processes (e.g. communicating strategic objectives, creating strategic alignment, motivating employees and serving as a management control device) as opposed to financial performance. The current techniques by Tiwari et al. (2010) for attaining a better understanding of internal business processes and knowledge intensive operations is also suggested by Baxter et al. (2009).

The questionnaire development and its administration, was explained in chapter 3 in detail. The responses were received on various parameters of performance measurement system, presented in table 7.3. The performance measures are divided into five categories namely quality, cost, flexibility, dependability and innovations.

Table 7.3 Significance and Ease of Implementation Score of the PMS for PFSCM

Processed Food Supply Chain Performance Measures		Significance		Implementation	
		Mean	SD	Mean	SD
A Quality					
1.	No. of defects per unit produced (period)	4.74	0.55	3.41	0.79
2.	No. of products returned per unit sold	4.72	0.60	3.25	0.86
3.	No. of suppliers used	4.59	0.71	3.23	0.87
4.	Lead time from defected to correction	4.57	0.66	3.33	0.97
5.	Setting global quality standards	4.68	0.55	3.48	0.97
B Cost					
6.	Scrap Losses per work centre	4.44	0.70	3.35	0.96
7.	Average inventory turnover	4.42	0.77	3.13	0.92
8.	Employees turnover	4.50	0.68	3.26	0.92
9.	No. of orders not delivered on time	4.62	0.66	3.44	0.94
10.	Down time due to machine breakdown	4.56	0.67	3.46	0.93
C Flexibility					
11.	Labour skill set	4.60	0.66	3.49	0.89
12.	Average production lot size	4.48	0.69	3.25	0.90
13.	No. of customized services available	4.44	0.75	3.24	0.98
D Dependability					
14.	Average service response time	4.61	0.65	3.44	0.97
15.	Percentage of delivery promises kept	4.58	0.62	3.44	0.91
16.	No of Delayed Shipments	4.57	0.61	3.44	0.93
17.	No. of stock outs	4.59	0.62	3.42	0.93
E Innovation					
18.	Annual investment in R&D	4.74	0.62	3.75	1.04
19.	Percentage of automated processes	4.56	0.67	3.22	0.85
20.	No. of new products / services launched	4.38	0.80	2.94	0.96
21.	No of process steps required per product	4.29	0.94	2.87	1.01

7.2.1 Quality

Quality related measures are the most important measures in food sector. It is critical to maintain safety and quality standards. The food quality is one of the important features for promoting food consumption. Grunert (2005), it normally refers not only to the physical properties of food products but also to the way the product is perceived by the final consumer. It can include not only microbial aspects but also texture or flavour. Trienekens and Zuurbier (2008) expect that quality assurance will dominated by production, distribution and that the costs for certification, auditing. The quality assurance may evoke responses like technological innovation to create higher efficiency and reduce costs. In food quality, contamination is a big challenge. This is further classified by FSSAI (2012), Zach et al. (2012) had seen the issue of contamination from two perspectives (a) accidental contamination (where education, standards development and certification and infrastructure investment would help with prevention efforts) and (b) intentional contamination (fraud and economic adulteration), for which monitoring, traceability, and information sharing might discourage opportunism.

7.2.2 Cost

In the competitive market place, it is important to provide products at a competitive price which can be possible only through proper cost control at all stages of the supply chain. Gunasekaran et al. (2001) have provided an overview of the various performance metrics across the supply chain and have described sources using these performance metrics. Researchers have associated the supply chain performance with measures in the following diverse ways: qualitative or quantitative, cost and non-cost, resource utilization, flexibility, visibility, trust and innovativeness resources, outputs and flexibility, supply chain collaboration efficiency; coordination efficiency and configuration, input, output and composite measures, strategic, operational or tactical focus, supply chain operations reference (SCOR) model (plan, source, make, deliver and return or customer satisfaction); whether they measure cost, time, quality, flexibility, innovativeness, key performance measures and metrics in supply chain scorecard approach, sustainability/green and financial/non-financial. However, there are a limited number of articles that deal with performance measures and metrics in a supply chain environment (Gunasekaran and Kobu, 2007). According to Gopal et al. (2012), the majority of supply chain measures are economic and quantitative (cost, customer, responsiveness, and productivity) rather than qualitative.

7.2.3 Flexibility

Flexibility in the system is required to adopt changes in the external and internal environment. Flexibility helps to produce different volume sizes economically, change product mix, introduce new products and changes in the existing products etc. There are various types of flexibilities in the supply chain. It is important to incorporate the appropriate type of flexibility in the system. The role of flexibility is crucial for better performance. Neely et al.(1995), Shepherd and Gunter (2006) divide the measures into quality, time, flexibility and cost. All the supply chain performance measurement systems do realize the role if flexibility for better performance of supply chain.

7.2.4 Dependability

Dependability of supplies is another important dimension in customer service. The need of the market is minimum lead time, no stock outs and minimum service response time. The growing relevance of trust is linked to the growing relevance of uncertainty. In other words, uncertainty is actually a core aspect of trust. According to Vollan (2011), trust consists of expectation having a positive influence on the social actor and is formulated under conditions of uncertainty. Tejapal et al. (2013) furnished 30 odd definitions of trust where as the most suitable definition for current research is definition given by Grandison and Sloman (2000), introduces context and is unique in referring to the competence to act (instead of actions, themselves): trust is the firm belief in the competence of an entity to act dependably, securely and reliably within a specified context.

7.2.5 Innovations

Technological changes and the competition are the main drivers of innovations. No organization can survive without bringing new products and new formats of services which are more efficient, effective and customer centric. Investment in R&D is a good indicator of the focus of the organization towards innovations. But to monitors the results and outcome of R&D efforts, it is important to see the new products and services launched, improvement in processes through automations and through process innovations by reducing the steps to reduce the manufacturing lead time. New technological developments in the field of food supply chain such as time-temperature

integrators can be used to improve temperature monitoring throughout the distribution system (Giannakourou and Taoukis 2003). This supports to improve shelf life estimation with a chain perspective. Raab et al. (2008) and Dalgaard et al. (2002) had discussed the role of temperature control supply chain for pork and poultry chains for fish chains. Innovation is increasingly considered as a process of co-production (Hartwich and Negro, 2010; Jasanoff,2004) where-by actors along a value chain or working in a particular domain of interest interact, co-operate and co-ordinate their activities to generate new knowledge, technologies and practices for desired change (Klerkx et al.,2013)

7.3 Results and Discussion

The respondents were asked to rate the performance measure divide into five major categories: quality, cost, flexibility, dependability and innovation with respect to PFSCM on two way continuum, first on its significance and then on its ease of implementation. The rating had been done on five point likert scale, in the first continuum of significance 1 stands for not at all significant, 5 implies highly significant and second continuum of implementation, 1 stands for difficult to be implemented, 5 implies for easy to implement or already implemented.

With respect to the significance of the performance measures, the important measures are the number of defects per unit produced with a mean score of 4.74 on scale of 5, number of products returned per unit sold (4.72), setting quality global standards (4.68). The maximum variations was shown by number of process step required per product (SD = 0.94).

With respect to implementation, the second continuum, the maximum mean scored was obtained by annual investment in R&D (3.75), followed by labour skill set (3.49), down time due to machine breakdown (3.46). The highest variation was depicted by Annual investment in R&D (SD = 1.04).

An important observation can be made from the table 7.2, that for most of the performance measures, the score on the significance is more than 4, whereas the respondents have apprehensions regarding their implementation as their the maximum score is 3.75. Respondents feel the importance but at the same time they are finding it difficult to implement.

7.4 Significance and Ease of Implementation Matrix

Further analysis is carried out to identify the performance measurement system (PMS) which are significant but difficult to measures. For this purpose, the PMS are divided into four categories as shown in figure 7.1. Significance of the PMS is taken on the X-axis. Median value of the significance of the PMS is calculated. The PMS with significance value higher than median value are taken as highly significant, whereas PMS with significance value less than median are taken as low significant. Similarly, the importance of PMS is taken on Y-axis and on the basis of median value, PMS are divided into easy to implement and difficult to implement categories. In this way, the four categories are listed:

a) Highly Significant and Easy to Implement

The performance measures which are important and which have been implemented by the organizations are falling in this category. Nine performance measures like defects/unit, annual investment in R&D, numbers of orders not delivered on time, etc. are taken as significant by the respondents and they have been implemented. Since a large number, nine, performance measures are falling in this category implies that a good PMS is in place having a good number of significant PMs in the system for monitoring and controlling the supply chain.

b) Highly Significant but Difficult to Implement

This category is the most important from the improvements in the PMS view point and also for improving the PFSCM. This category has those performance measures which are significant, yet the organizations are not able to implement. On close observation, the performance measures in this category are related to quality and are required for the purpose of compliance to International Standards and export to Western and European countries. The three performance measures falling in this category are number of products returned per unit sold, identity of suppliers used and lead time from defected to correction.

Number and type of product returned is an important performance measure for the purpose of process control. At present, the field staff is empowered to settle the claims of the defective products at distributor and retailer place, but data is not maintained for the type of item, size of packing, its packing date etc. and thus it is not possible to identify the batches and the processes creating more defectives in the supply chain.

Identification of supplier used is an important requirement for traceability purpose. It is required that for every end product reaching in the hands of consumer, the company must have the complete information regarding sources of raw materials. One of the important objectives of any food traceability system is to ensure product safety and quality. The most important elements of traceability have been identified as unique identification, lot integrity, product transformations and data collection and retrieval (Bechini et al., 2008). Thus organization must implement the necessary technologies and information systems to maintain the records for the identification of suppliers.

In addition, governments are imposing legislations that enforce traceability of food products during all stages of production, processing and distribution (e.g., European Parliament and Council, 2002). Despite the importance of traceability, the reality is that in complex, interconnected food supply chains, complete traceability is more the exception than the rule (Miller 2009). Schwägele (2005) argues that traceability has to be in food companies' interest and not just seen as legislation that has to be followed. Some recent literature follows this by discussing how the introduction of traceability might actually be used to add value to the operations of a company (Wang et al. 2009a). Several factors relevant in relation to food safety risks relate directly to distribution management. In an extensive list of critical safety factors, Van Asselt et al. (2010) found for instance the number of chain participants and the distribution of products to be of particularly strong impact.

In the process, defects do occur and organizations should have good quality control system in place to immediately detect the defects and to take a corrective action. It is also required to maintain the records of such situations and the time taken to bring back the process. This type of performance measure is useful to decide the replacement of machine, change of technology, process improvement as strategic interventions and better maintenance, better quality control, more close monitoring as operational interventions. These interventions are possible only if such events are monitored through the PMS.

c) Less Significant and Easy to Implement

The performance measures in this category are those which the organizations are maintaining presentably but simultaneously feel that they are not very important. Where ever possible a relook can be given regarding the continuation of these performance measures in the PMS. This category of undesired performance measures is unnecessarily

consuming resources and sometimes misleads the management in measuring overall performance.

d) Less Significant and Difficult to Implement

A good number of performance measures are falling in this category, which are not significant and the organizations have not implemented them. No action is required as this is a good situation that less important parameters are not monitored.

Ease of Implementation	Less Significance	High Significance
High	• Down time due to machine breakdown • Scrap losses per work centre	• No. of defects per unit produced • Annual investment in R&D • Setting quality global standards • Average service response time • Labour skill set • No. of stock outs • Percentage of delivery promises kept • No of delayed Shipments
Less	• Percentage of automated processes • Employees turnover • Average production lot size • No. of customized services available • Average inventory turnover • No. of new products / services launched • No of process steps required per product	• No. of products returned per unit sold • Identity of suppliers used • Lead time from defected to correction

Figure 7.1 Significance vs Ease of Implementation Matrix of PMs for PFSCM

7.5 Holistic and Balanced PMS for PFSCM

SCM regards the holistic, process-oriented, cross company management and coordination of processes regarding material and product flows as well as complementary, initiating and accompanying information flows (Fritz and Hausen, 2006). To manage such systems, a holistic and balanced approach is required. Balance Score card (BSC) is an approach in the context of business organization as a whole in which performance measurement system contains several strategic and operational; financial and non financial; and internal

process oriented as well as external customer oriented matrices that tell the organisation how it is performing against set targets. In general, a typical balance score card (BSC) has four perspectives: finance, customer, internal business process and learning and growth.

In the present research, quality, cost, flexibility, dependability and innovations are taken as five perspectives to measure the performance of the PFSCM. These perspectives represent an aggregation of the most common approach used in the study of performance management. The quality aspect is important parameter in measuring performance of processed food because a good quality food is an indicator of safer food. Therefore, manufacturers should give maximum focus through the process of PFSCM. Flexibility is the second parameter considered in present research for performance measurement system for PFSCM. It is concerned with number of labour skill set, average production size and number of customized services offered.

Therefore PFS should regularly impart training, try to enhance capacity utilization and offer customized services to their elite customers. Dependability is another parameter used for designing performance system. It comprises of average service time, percentage of delivery promises kept, number of delays and stock-outs. It is really challenging for PFS to simultaneously reduce the service time, reduce the delays and keep most of delivery commitments in time. It requires excellent coordination among all the PFSCM member to achieve the said target. Cost is another crucial parameter in design of PMS for PFSCM as all the said actions can only be possible with judicial use of all the resources that incur cost.

Cost incurs during scrap losses, average inventory turnover, employment turnover, number of orders not delivered in time and machine break down time. It is one of the challenging task to achieve target performance within given budget and cost. Innovation is the fifth parameter in the development of PMS and is required in cut throat competition faced by food firms. It includes annual investment in R&D, percentage of automated processes, number of NPDs etc. PFS is required to continually innovate to survive. This tact can be useful in managing not only the cost of all the operations but all save time and money.

The Radar diagram of the significance of the broad categories of PMS is given in figure 7.2 and the ease of implementation show in figure 7.3. Figure 7.4 illustrates the proposed conceptual research model for holistic and balanced PMS.

The figure 7.2 is depicting the Rader graph for the processed food supply chain performance measures for its significance level.

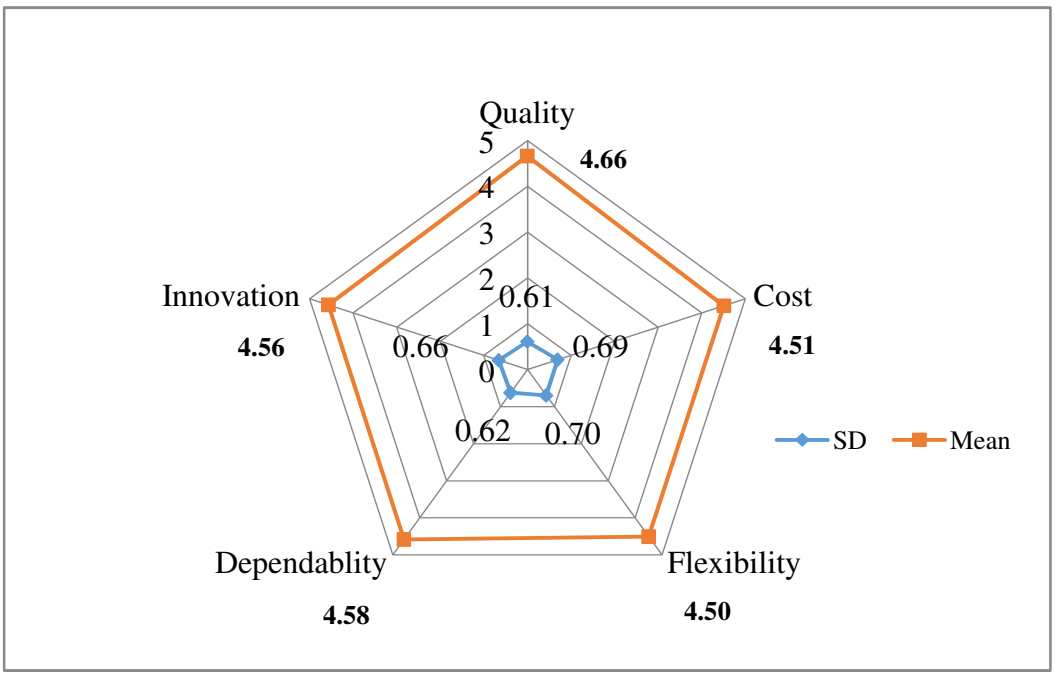

Figure 7.2 Radar Diagram of Significance of Performance Measures

The figure 7.3 is depicting the Rader graph for the processed food supply chain performance measures for its implementation level.

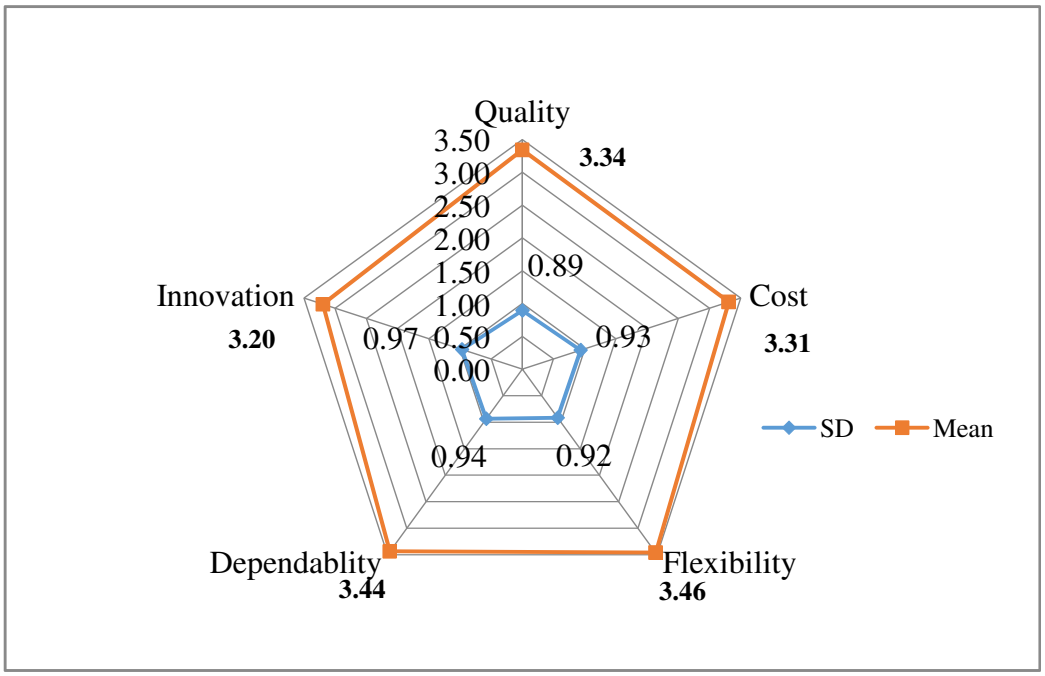

Figure 7.3 Radar Diagram of Ease of Implementation of Performance Measure

Hypothesis Testing:

Relative importance of Quality = Relative importance of Cost= Relative importance of Flexibility= Relative importance of Dependability= Relative importance of Innovations.

The model is used to test the hypothesis that all five perspectives are equally important for the success of PFSCM.

One way ANOVA test is applied on the mean value of the five broad areas performance measures and the results are given in table 7.4. The table shows the p value of the test as 0.33, which is more than 0.05. This indicates that at five percent level of significance, there is no evidence to reject the hypothesis that there is a difference in the significance of the five broad areas of performance measures. This is a good conclusion that the PFS in India is giving same importance to all the parameters of a holistic and balanced PMS.

Table 7.4 Results of the ANOVA test on the Significance of the Difference in Importance of Performance Measures

One Way ANOVA SUMMARY						
ANOVA						
Source of Variation	SS	df	MS	F	P-value	Fcrit
Between Groups	1.35	4.00	0.34	1.15	0.33	2.38
Within Groups	367.14	1255.00	0.29			
Total	368.49	1259.00				

The model is presented in figure 7.5. It is based on analysis of data collected in primary survey defected in table 7.3

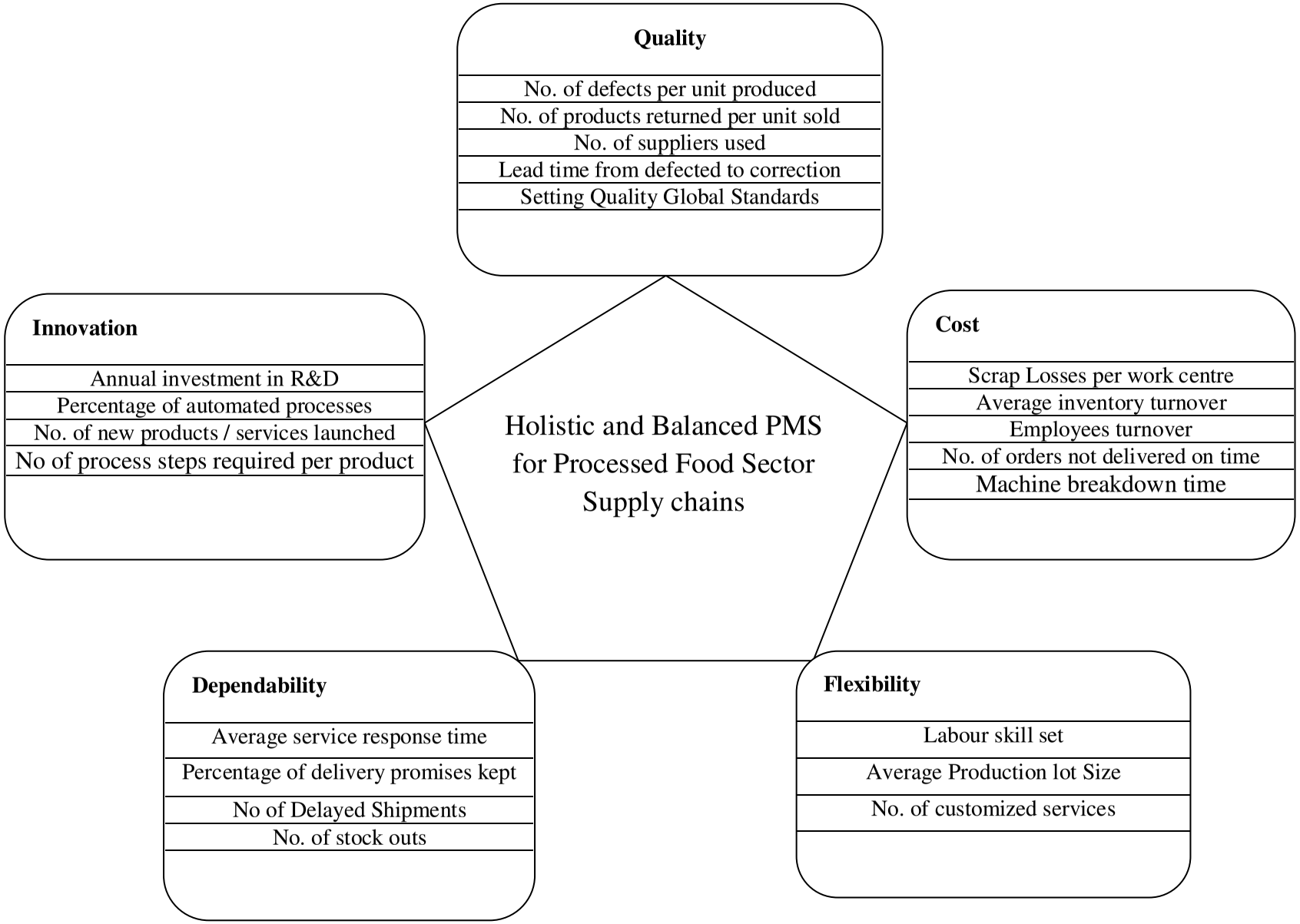

Figure 7.4 Proposed Holistic and Balanced PMS for PFSCM

CHAPTER – 8

CONCLUSIONS

8.1 Introduction

The food processing sector is playing crucial role in Indian economic development. It acts as a bridge between agriculture and manufacturing sector of Indian economy. In 1991, Indian economy got liberalized and it had induced new foreign trade opportunities for processed food sector. The processed food sector has begun to produce ready to eat food, pet bottled and tetra packed beverages, dairy products, frozen fruits, vegetables, marine and meat products. A developed food processing sector is expected to increase in farm prices. It in turn translates into increased rural income, reduce agri-wastage, ensure value addition, promote crop diversification, generate employment opportunities as well as export earnings. With such a large and diversified production base coupled with low manpower cost and modern technology, the Indian food processing sector is poised for growth. Its advantages are yet to be leveraged optimally.

India is the second largest producer of agriculture produce in the world. The raw material supplies are in abundance. Agriculture is an important sector in the Indian economy, accounting for about 18% of the GDP, employing nearly 60% of the total Indian work force. The down side of the agriculture sector is large amount of wastages of the farm products, fruits, vegetables, etc. The reasons for high wastages are twofold, first lack of proper, adequate storage facilities and second low levels of food processing capacity. The processing of fruits and vegetables is too low at 2 per cent, around 35 per cent in milk, 21 per cent in meat and 6 per cent in poultry products. It is quite below by international standards, as processing of agriculture produce is around 40 per cent in China, 30 per cent in Thailand, 70 per cent in Brazil, 78 per cent in the Philippines and 80 per cent in Malaysia.

The focus on food processing sector, which is just one link in the multi tiered food supply chain can be justified by the fact that it has big potential to reduce agri wastages, provide food security to society and easy to use food for working professionals. The scope of ready to cook vegetables, soups, juices, meat, bakery items and cooking ingredients like garlic, ginger, onion pastes and packed spices increased many fold. All these are due to

economic prosperity and the need for ready to cook food products. The food processing has tremendous export potential, enabling the farmer to add value to produce both in terms of quantity and quality. They can adhere to the requirements and standards of the market at all stages of value chain, processing and retail. It can create rural supply chain infrastructure in terms of creation of cold chain, warehousing, food parks etc.

The rapid growth and immense capability of the information technology has brought new ways of dealing with old supply chain problems. A primary benefit of IT is more efficient way of exchanging information and data, which results in supply chain coordination, and facilitation of logistics activities. Furthermore, significant cost reduction opportunities are created, as a result of the improved supply chain coordination. In food supply chains, traceability of the raw materials and processes are very important from food safety perspectives. For exports to western and European countries, it is mandatory and here IT tools like RFID and GPS can help to achieve this requirement.

The motivation behind the research was as follows:

- Processed food sector (PFS) is very important for Indian economy
- On one side PFS helps to reduce the food wastages and on other hand it ensures food security
- Value added by PFS helps to increase the income of the farmers and make food products available round the year and across nation
- Due to the changes in the demography, the demand of processed food is expected to rise
- Nuclear families, working women and high disposable income are the drivers to boost the demand

A questionnaire based primary research was conducted by taking responses from executives of processed food manufacturers, distributors, retailer, cold chain and logistics providers. A small proportion of consumers, academicians, researchers and business associations are also included. A total of 252 responses were received and analyzed using statistical tools and techniques with the help of Statistical Package for Social Science (SPSS) version 21 software.

8.2 Major Research Contribution and Key Findings

The major contributions made and key findings of the present research are as follows:

1. Supply Chain management of the Processed Food Sector is very important for reducing wastages of agri produce, better returns to the farmers for their produce, food safety, meeting requirements of the society in providing food products in all seasons all geographies and economic growth.

2. A comprehensive literature review is conducted to examine the current state of research and research gaps. Large number of meetings and discussions were held with the executives of the food processing and related industries to identify the needs of the industry and make the research relevant and useful. The main countries where PFSCM research was carried out are North America, Europe and Australia. The developing economics in order to grow faster must undertake and promote the research in PFSCM as being depicted by China, India etc.

3. An empirical research was conducted to identify the perceived benefits of processed food sector for consumers, farmers and economy.

4. Along with identifying the benefits of the PFS, the study identified the challenges and counter measures to be taken for the growth of domestic demand and export potential. The major issues in the growth of PFS are :

5. The key aspects related to PFS studied in this research are food quality and food safety, logistics and cold chain management, information technology and traceability and performance measurement system. The processed food products have short shelf life and many products need specific temperature conditions (like -18 C or 4-6 C). Under such requirements, Cold Chain Management where products are stored and transported under controlled conditions of temperature and humidity are very essential.

6. Information technology for the efficient management of supply chain is playing a key role in all sectors and PFS is no exception. Along with facilitating planning and control, demand forecasting, inventory planning, replenishment etc., in food sector, IT play a very critical role of traceability i.e. when required it should be

possible for every food product to know the source of raw material, manufacturing facilities used, compositions and ingredients added, process parameters etc.

7. Food quality and food safety are the fundamental requirements of food sector. Hazards assessment and control, standardization, implementation of best practices are some of the issues examined in this research.

   The results and discussions indicate that all the global food safety norms laid down by WTO such as goods manufacturing practices (GMP), good hygienic practice (GHP), hazard analysis critical control point (HACCP), had been developed to embody principles of safe food processing sector globally. India had also developed their food safety norms as per laid down principles by WTO.

8. Three case studies related to SCM of PFS are carried to study the best practices, manufacturing and supply chain management issues and role of key players.

9. Under current research, an empirical testing was performed to find, was there a difference among nine schemes or incentives being offered by MOFPI or all these were of similar nature? The second was to present the relative importance of schemes, by arriving at relative ranking. The nine schemes constitute the basic framework for promotion of Indian processed food sector by MFPI.

   There was significant difference in the impact of all nine schemes or incentives offered by MOFPI. FDI up to 100% in food infrastructure such as food park, cold chain, warehousing etc.,(FDI) was ranked first, Fruits & vegetables, dairy machineries were completely exempted from excise duty (EED) ranked second , Customs duty on refrigerated goods transport vehicles has been reduced (CDG) ranked third, Scheme for Human Resource Development, Training Centres (SHD) ranked fourth, Income tax rebate up to 100% of profits for five years and 25% of profits for the next five years for setting up of new agro-processing industries to process and package F&V (ITR) fifth ranked, Scheme for quality assurance, codex standards and R&D (SQA) and Central excise duty on preparation of meat, poultry and fish and yeast is completely exempt (CED) tied and ranked sixth, Up to a maximum of 24% foreign equity is allowed in SME(SME) ranked at seventh, No industrial license required for food & agro processing industries except for

beer, alcohol & wines, cane sugar, hydrogenated animal fats & oils etc. (NIL) ranked eighth.

10. The present research had crafted a holistic and balanced performance measurement system suitable for processed food sector supply chain and it was validated by using empirical study and statistical testing. It can be used to appraise the performance of processed food supply chain organizations globally.

8.3 Research Implications

The key findings of research had contributed to body of supply chain literature in general and the processed food supply chain management in particular. The findings of current research validate some of important and widely discussed aspects of processed food supply chain and also set out interrelations among many of these aspects. The results of current research demonstrate that effective and efficient processed supply chain in India can reduce the fresh fruits and vegetables waste. This way processed food supply chain's performance will be enhanced and improves Indian economics status. These evidence support the objectives of processed food supply chain as a comprehensive and vital strategy that can built and sustain competitive advantage which ultimately leads to good business performance of processed sector.

8.4 Implication to Academia

- The research presents the various aspects of Indian processed food supply chain like food quality and safety, logistics and information technology and performance measurement system.
- The research had presented literature review dedicated to processed supply chain management. The study had identified research gaps in the literature which may form the basis of future research on processed food.
- The primary research was conducted using structured questionnaire that can be utilized for future research on processed food and other sectors.
- The sector specific research is always full of challenges and this exercise encourages academia to conduct similar research in other sectors of economy with diverse options and perspectives

8.5 Implication to Corporate

- The present research will help in analyzing the future scenario for policy frame works under different business and economic environment. By this, right policy can be framed for the growth of processed food to benefit the farmers, society and economy. It can be applied to many other sectors for similar purposes.

- The corporate managers can use the present research findings for developing better processed food supply chains, incorporating features like RFID for traceability, cold chain and appropriate performance measures.

- The present research has a focus on food quality and food safety in the processed food sector as it has identified the practices and implementation framework which would help in successful implementation of global food safety standards.

8.6 Limitation of Present Research and Scope for Further Work

The present research work is not free from limitations due to time and resources. Some of the research limitations and the further scope of research are as follows.

- As with other empirical studies, only a small segment of supply chain of processed food sector was covered in the survey. Though the efforts had been made to make the sample a representative one, still due to the fact that respondents are from Delhi and NCR, have its own limitation.

- The various aspects are measured based on the perceptions of the respondent which reflects their opinion based on their work experiences and responsibilities handled by them.

- The processed food sector is very vast and has several aspects and areas of study. In this research the major focus was only on food quality and food safety, logistics and information technology and performance measurement system.

- Though the questionnaire was very comprehensive and good sample size of respondents was achieved and several statistical tools were applied to get insights and verify different hypothesis but still there is a scope of further investigation and analysis.

8.7 Conclusion

In order to develop and maintain competitive advantage, Indian processed food sector must enhance skill such as capacities to plan, design food processing and manufacturing techniques and soft skills like management, control of products and meeting customer expectations. To improve the current situation of processed food sector, firms must change their organizational structures, relationships with their business associates, apply advance technologies and implement effective performance measurement system. The challenges for managers are to make processed food popular, adopt global food safety standards through implementing global processed food supply chain practices. The supply chain managers must be involved in deciding technological tools and polices to offer greatest strategic values for processed food supply chain.

Since improvement in any sector is a continuous process, the research may continue to incorporate new issues and supply chain practices in meeting challenges of quality sensitive globally competitive processed food sector. The organizations ought to be continually developed and adjust to the dynamic business environment for their survival.

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Education

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- Pursuing Full time Doctoral Programme (Ph.d) in Processed Food Supply Chain Management from Delhi Technological University, Formerly known as Delhi Collage of Engineering July 2010 –till date, India
- Completed course work in Doctoral Program with 82.25 % in 2011(Courses done TQM, ILM, IBE,RM)
- M.B.A. in International Business from Indian Institute of Foreign Trade, New Delhi, India, 2005-08
- Post Graduate Diploma in Sales & Marketing from DAV College, New Delhi, India, 1996-97
- B.A.(H) Economics from PGDAV College, New Delhi, India, 1995

Memberships

- Academy of International Business (AIB), Michigan State University
- System Dynamics Society
- Logistics Information and Navigation Centre (LINC), Australian

Research and Teaching Experience

- Currently doing full time research (Doctoral programme) in the area of Global Supply Chain Management from Delhi Technological University, Formerly known as Delhi Collage of Engineering

- Worked as Assistant Professor [pre revised scale Rs.12000-18300] with Apeejay School of Management in Dept. of International Business from Sept. 2008 till 15th July 2010

- Taught following subjects at MBA level:
  International Business, International Marketing, International Trade operations, International Logistics, Global Supply Chain Management, Export documentation and procedure, Sales & Distribution Management

Training Progammes Conducted 2008-2010

- Involved in Conducting Training on Export Development Programme (EDP) for National Centre for Design and Product Development in Delhi, Agra, Firozabad, Jaipur, Jodhpur, Covering "How to start exports, export marketing & export documentation & procedures"

- Impart Training on Export Marketing, Export documentation and Procedure, Sales & distribution at MSME Institute, Delhi

Industry Experience

12 years of qualitative experience in the areas of Marketing, Business Development, Business Planning, Key Account Management and Sales in the FMCG industry

- Sr. Business Development Officer, Mother Dairy India Ltd. (May 2003- Sept. 2008)

- Sales Officer -B2B, Frito Lay India (Pepsi Co. Holding),(May 2000- May 2003)

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