ADISS ABABA INSTITUTE OF TECHNOLOGY(AAIT)
SCHOOL OF MECHANICAL AND INDUSTRIAL ENGINEERING POST GRAGUATE PROGRAM STREAM OF INDUSTRIAL ENGINEERING

SUPPLY CHAIN PERFORMANCE IMPROVEMENT MODEL IN ETHIOPIA MEAT PROCESSING INDUSTRY

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DECLARATION

I hereby declare that the work which is being presented in this thesis entitled, **"SUPPLY CHAIN PERFORMANCE IMPROVEMENT MODEL IN ETHIOPIA MEAT PROCESSING INDUSTRY"** is original work of my own, has not been presented for a degree of any other university and all the resources of materials used for the thesis have been duly acknowledged.

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Abstract

This paper describes the measurement of supply chain performance in Ethiopian meat processing industries. SCM is a process for designing, developing, optimizing, and managing the internal and external components of the supply system in a manner that is consistent with the overall firm's objectives and strategies. Performance measurement is the process of quantifying effectiveness and efficiency of action. The Ethiopia meat processing industries has many supply chain problems. The main reason for these problems could be the lack of conceptual framework and lack of measure supply chain performance among meat processing industries. These challenges impact on the country's current share in the global export market for meat is less.

Aware of these problems, this study was conducted mainly to evaluate supply chain performance regarding performance measurement indicators of meat processing companies in Ethiopia Then determining the key indicators of companies' performance measurement by using the analytic hierarchy process (AHP) to improve supply chain performance for industries. The study uses the concept of decision making levels and supply chain macro processes as its approach to the study of the supply chain performance measurement. Questioner survey and semi structural interviews were used to collect the data for this study.

The whole finding involves the analysis of an overall supply chain performance from three supply chain macro processes; supplier relationship management, internal supply chain management and customer relationship management based on strategic, tactical and operational decision making levels. It was evident that the internal supply chain management was the most preferred supply chain macro process in Ethiopia meat Processing industries. These results in the meat Processing industries intended to concentrate on its internal supply chain since it was the most important for the companies. The results also proposed that supplier relationship management was the least important to those companies compared with others.

Keywords: supply chain management, performance improvement model, analytic hierarchy process, meat processing industry

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Contents

Abstract iii

Acknowledgements iv

List of abbreviation ix

CHAPTER ONE 1

1. INTRODUCTION 1

1.1. Background of the study 1
1.2. Statement of the Problem 2
1.3. Research Question 3
1.4. Objectives 3
1.5. Scope and Limitation of the Study 4
1.6. Significance of the study 4
1.7. Organization structure of the thesis 5

CHAPTER TWO 6

2. LITERATURE REVIEW 6

2.1. Introduction 6
2.2. Supply chain management 7
2.3. Supply chain performance measurement 14

CHAPTER THREE 47

3. RESEARCH METHODOLOGY 47

3.1. Introduction 47
3.2. Research strategies (methods and sources of data collection) 47
3.3. Data analysis strategies 50

CHAPTER FOUR 53

4. BACKGROUND OF ETHIOPIAN MEAT PROCESSING INDUSTRIES 53

4.1. Introduction 53
4.2. Ethiopian Meat and Dairy Industry Development Institute 54
4.3. Export Abattoirs in Ethiopia 56
4.4. Main Export Markets for Ethiopian Meat 57
4.5. Supply Chain for Meat and Live Animals of Ethiopia 57
4.6. Market Structure and Description Channels of Ethiopia 63
4.7. Ethiopia Live Animal and Meat Export Performance 64

CHAPTER FIVE 67

5. CONCEPTUAL FRAMEWORK MODEL DEVELOPMENT 67
5.1. Introduction 67
5.1. The performance measurement indicators in the framework 68
5.1. Evaluation of Supply Chain Performance of Ethiopian meat processing industry 71
CHAPTER SIX 95
6. DATA ANALYSIS AND RESULT AND DISCUSSION 95
6.1. Data analysis using AHP 95
6.2. Pair wise comparison and Check the consistency of Supply chain macro process 98
6.3. SRM pair-wise comparison and weight calculation (Appendix4)..... 100
6.4. ISRM pair-wise comparison and weight calculation (Appendix5) 102
6.5. CRM pair-wise comparison and weight calculation (Appendix6) 105
CHAPTER SEVEN.....108
CONCLUSION AND RECOMMENDATION 108
7.1. Conclusion 108
7.2. Recommendation 110
References 113

List of Appendix

Appendix 1 116
Appendix 2 120
Appendix 3 130
Appendix4 140
Appendix5 143
Appendix6 147

List of tables

Table2.1: summary of supply chain performance measurement frameworks 22
Table 2.2: Performance measurement factors for supply chain performance measurement 25
Table4.1: Export abattoirs industries in Ethiopia *(industry minister)*..... 56
Table4.2: Livestock Population by LMD Region (2010-2011 data) 59
Table4.3: Meat and live animal export (2003-2007) compared to total agricultural..... 66
Table 5.1: The performance measurement factors in supplier relationship management 68
Table 5.2: The performance measurement factors in internal supply chain management..... 69
Table 5.3: The performance measurement factors in customer relationship management..... 71
Table: 6.1 the Saaty Rating Scale 97
Table6.2: pair-wise comparison and weight calculation of supply chain macro process..... 98
Table 6.3: RCI values for different values of *n* 99
Table6.4: pair-wise comparison and weight calculation of supply chain macro process..... 99
Table 6.5 key indicators of supplier relationship management 102
Table6.6 key indicators of internal supply chain relationship management..... 105
Table 6.7 key indicators of customer relationship management..... 107

List of figures

Figure 2.1 Typical Supply Chain network [36] 8
Figure 2.2 supply chain network process in manufacturing area..... 11
Figure 2.3 Hierarchy of Supply Chain Decision levels [36]..... 13
Figure3.1 Research process 52
Figure 4.1supply chain network for Ethiopia livestock and meat processing [13]..... 58
Figure 4.2 Market structure (source: meat and dairy sector) 64
Figure4.3 a) Ethiopian meat export performance, 2000/01- 2008/09 b) Ethiopian meat export performance, 2000/01- 2008/09 [13] 65
Figure5.1 conceptual Framework model 68
Figure5.3 SI in tactical level 75
Figure 5.5 SRM in strategic level 77
Figure5.6 a) Dirty facility with significant build up of filth and b) the walls, Floors and ceilings in disrepair and Carcass contaminated by fecal material..... 79
Figure 5.7 Facility in tactical level 80
Figure 5.8Refrigerated Meat Transporting Truck..... 81
Figure5.9 Live Animal Transporting Trucks 82
Figure 5.10 HR in strategic level 85
Figure 5.11 ISRM in strategic level..... 87
Figure 5.12 CRM in strategic level..... 94
Figure 6.1 Generic hierarchic structures..... 96

List of abbreviation

ACDI Agricultural Cooperatives Development International

AGP Agricultural Growth Program

AHP Analytic hierarchy process

BSC Balanced scorecard

CR Consistency ratio

CRM Customer relationship management

CSF Critical success factor

CSA Central Statistics Agency of Ethiopia

EDI Electronic data interchange

EMA End Market Analysis

EMDTI Ethiopian Meat and Dairy Technical Institute

EMS Environmental management standard

ERP Enterprise resource planning

EPQ Economic production quantity

ESA Ethiopian Standards Agency

FDI Foreign Direct Investment

FMS Flexible manufacturing system

GOE Government of Ethiopia

HR Human resources

ICT Information and Communications Technology

IMF International Monetary Fund

ISCM Internal supply chain management

ISO International Organization for **S**tandardization

IQR Internal quick response

KPI Key performance indicator

LMD Livestock Market Development

LMIS Livestock Market Information System

MA Market analysis

ME Market equity

MLA Meat and Live Animals

MOA Ministry of Agriculture

MOI Ministry of Industry

MT Metric tone

OIP Optimal inventory policy

PO Purchasing order

SCC Supply Chain Council

SCOR Supply chain operations reference

SPS-LMM Sanitary and Phytosanitary and Livestock and Meat Marketing

TPM Total preventive maintenance

TQM Total quality management

USAID United States Agency for International Development

VAS Value added service

WU warehouse utilization

CHAPTER ONE
1. INTRODUCTION

1.1. Background of the study

Many organizations today are forced to increase their global market share in order to survive and sustain growth objectives. At the same time, organizations must defend their domestic market share from international competitors. The challenge is how to expand the global logistics and distribution networks in order to ship products to customers who demand them in a dynamic and rapidly changing set of channels. Strategic positioning of inventories is essential, so that the products are available when the customer wants them (Eva Klemencic; *2006*). Long-term competitiveness therefore depends on how well the company meets customer preferences in terms of service, cost, quality, and flexibility, by designing the supply chain, which will be more effective and efficient than the competitors (Sunil Chopra and Peter Meindl;. *2006*) Supply chain is an integrated procedure in which raw materials convert into finished products, then being delivered into customers (Beamon, 1999).

Supply chain management is an important multi-disciplinary topic in modern business management and research. It enhances organizational productivity and profitability through a revolutionary philosophy to managing the business with sustained competitiveness (Gunasekaran *et al*., 2004). Supply chain management has become increasingly important to businesses which supply goods and services to the end customers (Waller, 2003). Performance measurement is the process of quantifying effectiveness and efficiency of action *(Neely et al., 1995)*. Measurement the performance of entire supply chains allows for "tracking and tracing" of effectiveness and efficiency failures and leads to more informed decision making with regard to chain design. Therefore, this thesis is intended to improve supply chain performance in meat processing industries a more holistic approach by combining both supply chain macro processes and decision making levels.

The Ethiopian economy has an agrarian economy in which the livelihood of about 85% of the population directly or indirectly depends on the agricultural sector. The agriculture productions have been important elements of economic activity since the industrial revolution. From that, Meat production offers opportunity to serve a vast export market as well as Ethiopia's domestic market. Ethiopia has potential to increase the volumes and values of domestic and export sales of meat and meat products. However, Ethiopia current share in the global export market for meat is

quite small. In order to achieve greater sales and exports, followed by improving supply chain performance the main purpose of this thesis is supply chain performance improvement model in Ethiopia meat processing industry.

1.2. Statement of the Problem

Ethiopia has the 10th largest livestock inventory in the world; the country also has the largest number of livestock in Africa. Live animal and meat exports are an important growing sector of international trade for Ethiopia. However, the country's current share in the global export market for meat is quite small. In 2011, the volume of global meat exports was estimated at USD 105 billion. Whereas, Ethiopia accounted for less than one percent of this total (0.75 percent or USD 79 million) of this most was low-value. This rank leads Ethiopia to the 43rd largest meat exporter. However, the government's Growth and Transformation Program (GTP), launched in 2010-2011, has established annual export goals of 111,000 metric tons of meat and 2,000,000 live animals by 2015, increases of nearly four-fold on 2011 numbers. Ethiopia has seen some progress in the volumes exported increasing from 5880 MT in 2007 to 17,666 MT in 2011 but the numbers are not nearly as high as anticipated or desired to meet the aggressive targets laid out in the GTP.

Therefore, the volume of export has not been not up to the expected growth level. These mainly attributable to different cases like; *Unreliability of supply,* a consequence of the lack of integration within the Ethiopian livestock value chain. It happens due to traditional livestock production, marketing systems and the abattoirs' specific purchasing systems increases vertical integration through buyer-seller contracts or companies that involve actors at different levels of the value chain that will enable better planning to meet the needs for the export market. *Poor quality and lack of computation,* The main problem of Ethiopia Abattoirs in this concern is not cooperating with suppliers to maximize quality and animals value to assure greater supply. In addition, Actors in the value chain have little understanding of meat quality standards which are exported to the markets and willing to higher pay which leads to the traders retain less competition within the value of chains in the market and pricing power.

*Lack of Information, Organizational Linkage and coordination***,** A globally integrated, well-managed meat and live animal value chain will require numerous IT and mobile applications and tools for business management, traceability, access to market and price information, access to technical information, point of sale payment, etc. In Ethiopia live stock and meat processing

industry, there is lack of information sharing and integration among the management persons of the sectors up to the farmers in addition, Ineffective information interchange between the sector and supplier (farmers), meat industries and customers. Moreover, the low level of trust affects coordination in the chain, In addition *Weak policy management and lack of price incentive* Policies and regulations are needed that encourage live animal and meat value chain competitiveness and growth, value adding investment and new business formation within the value chains and improved productivity.

In Ethiopia some cases the introduction of policy regulation is sudden, has not been fully discussed, and planned with the value chain actors. The market does not offer producers a variety of choices as to how to raise and own the animal so that best practices can emerge be accepted, finally *Lack of modern livestock transport service system and refrigerated transport* Land transport of animals is often undertaken using non-livestock and non-sanitized transport vehicles. As a result, livestock are handled in a manner that encourages injury and maximizes stress and disease transmission throughout the journey leading to the reduction in the sanitary standard and quality of meat of slaughter animals.

1.3. Research Question

In order to achieve the objective of this study is answering the results of this research questions that addressed here.

1. How to identify performance measurement factors?
2. How to develop a frame work for performance measurement system?
3. What are the key performance indicators for measuring performance supply chain of meat processing industry?
4. How to improve the supply chain performance of Ethiopian meat processing industries?

1.4. Objectives

1.4.1. General objective

The main objective of this thesis is supply chain performance improvement model in Ethiopia meat processing industry..

1.4.2. Specific objective

- To identify performance measurement factors
- To develop a conceptual framework based on proposed performance measurement indicators.

- To evaluate supply chain performance in relation to performance measurement indicators of meat processing in Ethiopia
- To determine the key indicators of meat processing performance measurement by using the analytic hierarchy process.
- To propose a recommendation improve of the supply chain performance measurement

1.5. Scope and Limitation of the Study

The aim of this thesis is to focus on the Ethiopian meat processing industries of the supply chain performance measurement. The supply chain performance will be improved across decision making levels (strategic, tactical and operational) with combining supply chain network process. And also the study purpose to identify performance measurement indicators against each supply chain macro processes; enables companies to make enhanced supply chain management decisions at strategic, tactical and operational levels and measures the performance of case study organizations against each performance measurement factor.

The researcher faced in conducting this research was insufficient finance allocation to investigate more facts and information and also limited availability of other sorts of resource such as internet access, printer access & etc... as well as from the case companies, some companies are not willing to give data, not all case companies allowed to visit the industries, Taking long time to respond, Limitation of understanding some specific questions and Fear of workers to openly and freely to fill the questionnaires.

1.6. Significance of the study

The significance of this research is to explore a solution to problems related to supply chain performance area in Ethiopia meat processing industry. It can improve performance measurement of supply chain. It will try to address the problems associated with supply chain performance of the companies by identify performance measurement inductors and to measure performance against each performance measurement factors to improve supply chain performance. Besides, it is significant in creating awareness to Ethiopian meat industries. It will be also determination of the efficiency and effectiveness of an existing system or to comparing competing alternative systems.

1.7. Organization structure of the thesis

This research report is organized as follows. It starts with the front matters (title page, abstract and content outlines) and then follows the main chapters. The first Chapter discusses background of the study, objectives of the study, problem statement research questions scopes, significance, limitations and how the whole thesis is organized or structured**.** Chapter two deals with the literature review it explains the academic approaches and key concepts use in the study. It presents literature on supply chain management, performance measurement and supply chain performance measurement. These key concepts and approaches help to establish and justify the study's theoretical basis and they assist in an understanding of the subsequent supply chain performance measurement that was improved for the study. These keys areas of literature also provide insights into the character of, and influences on, supply chain performance measurement in the livestock and meat processing industries.

Chapter three describes the research methodology**.** It explains the theoretical position for researching the supply chain performance measurement. The study uses a case study qualitative and a qualitative research approach which is explained in the chapter. There are details of each of the research methods used and of the processes of data collection employed in the fieldwork. Chapter four discusses Background of Ethiopia live stock and meat institute it will give a review of institute and meat industries and the case company's background such as, company profile, organizational structure, mission, objectives, location, types of product produced, types of service provided to customers, customer supplier relationship, and so on.

Chapter five incorporates data analysis and the findings of study are also interpreted. In this chapter discuss detailed analysis of the performance measurement in order to understand the supply chain performance of the case study companies by using the supply chain performance measurement system. The detailed analysis of the supply chain performance measurement was based on the performance measurement indicators. The final chapter contains discussion of the findings and recommendations made based on the results of the study.

CHAPTER TWO

2. LITERATURE REVIEW

2.1. Introduction

This literature review examines key concepts and approaches used in the study. This study examines supply chain performance measurement for manufacturing sector (meat processing industry). Many papers on performance measurement in SCM have been published in the past decades. However, we consider those papers that regard with SCM as a whole entity in the review. The literature survey has been undertaken using online databases relating to publishers such as Emerald, Elsevier, Taylor & Francis, Springer. The review was limited in the time period between 1999 and 2013. Some journal articles have been selected as the base of this review using the following procedure was conducted to select qualified papers for review.

At the first step, some keywords and sentence strings, such as "SC performance measurement", "SC assessment", "SC evaluation for food manufacturing sector" "SCM and Hierarchical analysis model)", "SCM and SCOR (Supply chain operations reference)", and "SC management and BSC (Balanced scorecard based model)" and so on, were queried in the above-mentioned databases to acquire a list of papers fitting into our research objective. Non-referred articles, such as editorial notes, prefaces, industrial reports and book reviews, were excluded from the preliminary search process. To ensure the holistic view to SCM the second step was performed with the further filter the preliminary search results by screening titles and keywords of the identified articles. The third step was accomplished by reviewing the abstract and conclusion if the reminded papers, and even (if necessary) reading the details to removing incompetent ones.

In general, three interconnected themes in this literature review, supply chain management, performance measurement and supply chain performance measurement. The review begins with a discussion of supply chain management, including definitions and development, Supply Chain Decisions level. The second review considers the performance measurement. This performance measurement perspective assists in understanding the relationships between performance measurement and supply chain management. Finally, the review focuses on supply chain performance measurement.

2.2. Supply chain management

Supply chain is a network of facilities and distribution options that performs the functions of procurement of materials, transformation of these materials into intermediate and finished products, and the distribution of these finished products to customers. Supply chains exist in both service and manufacturing organizations, although the complexity of the chain may vary greatly from industry to industry and firm to firm Sunil (Chopra and Peter Meindl;*.2006*). Realistic supply chains have multiple products with shared components, facilities and capacities. The flow of materials is not always along an arbores cent network, various modes of transportation may be considered, and the bill of materials for the end items may be both deep and large (Sunil Chopra and Peter Meindl, *.2006*). Supply chain is Life cycle processes comprising physical, information, financial, and knowledge flows whose purpose is to satisfy end-user requirements with products and services from multiple linked suppliers(Jayashankar M. Swaminathan; *.2000*).

Supply chain management is typically viewed to lie between fully vertically integrated firms, where a single firm and those own the entire material flow where each channel member operates independently. Therefore, coordination between the various players in the chain is a key in its effective management (Jayashankar M. Swaminathan; *.2000*) Supply chain management is a concept that originated in the manufacturing industries in the early 1980s. It is developed from innovations such as just in time (JIT) (Vrijhoefvand Koskela, 2000) and total quality management (TQM) (Wong and Fung, 1999). Supply chain management has shifted the emphasis from internal structure to external linkages and processes, and is dependent on the interaction between the organization and its external environment, with strong feedback linkages and collective learning. It is seen as a set of practices aimed at managing and coordinating the whole supply chain from raw material suppliers to end customers (Slack *et al.*, 2001), which develop greater synergy through collaboration along the whole supply chain (New and Ramsay, 1997).

And also, Supply chain management (SCM) is the management of a network of interconnected businesses involved in the ultimate provision of product and service packages required by end customers (Chen et.al, 2004). SCM spans all movement and storage of raw materials, work-in-process inventory, and finished goods from point of origin to point of consumption. (Jayashankar M. Swaminathan; *.2000*).Advanced productivity, innovation and competitive success (APICS) dictionary defined SCM as the "design, planning, execution, control, and monitoring of supply

chain activities with the objective of creating net value, building a competitive infrastructure, leveraging worldwide logistics, synchronizing supply with demand, and measuring performance globally." Other common and widely accepted definitions of SCM include the following.

- According to Global Supply Chain Forum, SCM is the integration of key business processes across the supply chain for the purpose of creating value for customers and stakeholders (Lambert, 2005).
- According to the Council of Supply Chain Management Professionals (CSCMP), Supply chain management encompasses the planning and management of all activities involved in sourcing, procurement, conversion, and logistics management. It also includes the crucial components of coordination and collaboration with channel partners, which can be suppliers, intermediaries, third party service providers, and customers. In essence, supply chain management integrates supply and demand management within and across companies such as sourcing raw materials and parts, manufacturing and service, warehousing and inventory tracking, order entry and management, distribution across all channels. Mentzer et al (2001) also explained supply chain management as managing of a set of supply chains directly linked by one or more of the upstream and downstream flows of products, services, finances, and information from a source to a customer.

From these definitions it is clear that supply chain management comprises all activities, processes and relationships included the flow of material, finance and information from end to end of the supply chain partners.

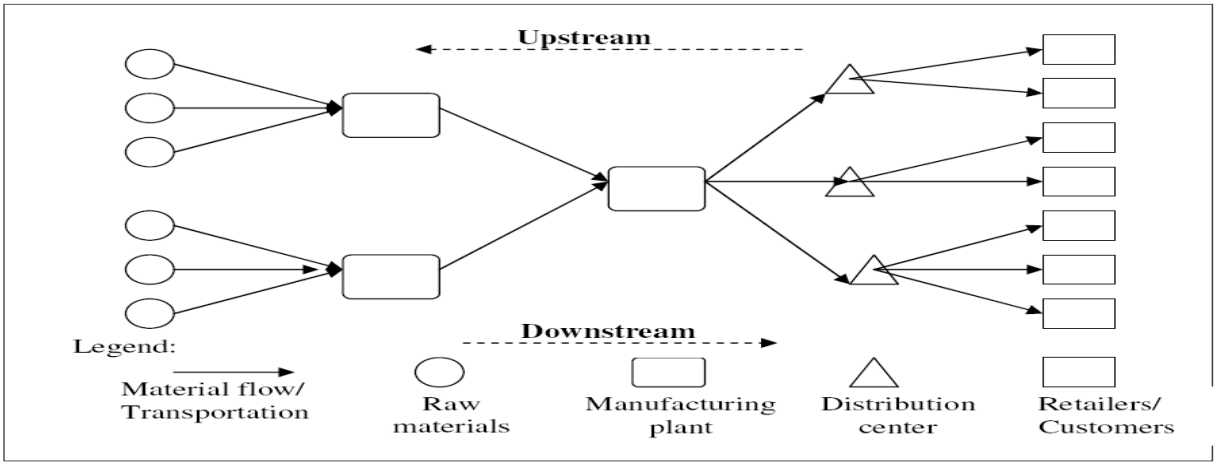


Figure 2.1 Typical Supply Chain network [36]

All supply chain network can be classified into the following three macro processes: supplier relationship management which represents for all processes that focus on the interface between the company and its suppliers; internal supply chain management which represents for all processes that are internal to the company; and customer relationship management which represents for all processes that focus on the interface between the company and its customers The three macro processes manage the flow of information, product, and funds required to generate, receive, and fulfill a customer request (Chopra and Meindl, 2004). Customer relationship management and supplier relationship management form the critical links in the supply chain and the internal supply chain management process is coordinated through them. Each of the macro processes is cross-functional and cross-firm. Cross-functional teams are used to define the structure for managing the process at the strategic level and implementation at the operational level (Lambert *et al.*, 2005).

Supplier relationship management process

The supplier relationship management provides the structure for how relationships with suppliers are developed and maintained (Croxton *et al.*, 2001). Cross-functional teams tailor product and service agreements with key suppliers (Lambert *et al.*, 2005).

Supplier relationship management macro process aims to arrange for and manage supply sources for various goods and services. Supplier relationship management processes include the evaluation and selection of suppliers for various products; negotiation of pricing and delivery terms with suppliers; the placement of replenishment orders; sharing of demand and supply plans with suppliers; and communication regarding new products and orders with suppliers (Croxton *et al.*, 2001).

Internal supply chain management process

The internal supply chain management macro process aims to fulfill demand generated by the customers in a timely manner and at the lowest possible cost (Chopra and Meindl, 2004). Internal supply chain management process needs to balance the customers' requirements with the company's supply capabilities, which includes forecasting demand and synchronizing it with production, procurement, and distribution (Vollmann *et al.*, 1997).

A key to effective internal supply chain management is to meet customer requirement in terms of order fulfillment. Effective order fulfillment requires integration of the firm's manufacturing, logistics, and marketing plans. The company should develop partnerships with key members of

the supply chain to meet customer requirements and reduce total delivered cost to customer (Kumar and Sharman, 1992). Moreover, the internal supply chain management process deals with making the products and establishing the manufacturing flexibility needed to serve the target markets, which includes all activities necessary for managing the product flow through the manufacturing facilities and for obtaining, implementing, and managing flexibility (Lambert *et al.*, 2005). Internal supply chain management processes include the planning of internal production by deciding which products to carry at each warehouse; planning of storage capacity for the location and size of warehouses; preparation of demand and supply plans by defining inventory management policies; and fulfillment of actual orders by picking, packing and shipping that orders (Croxton *et al.*, 2001).

Customer relationship management process

The customer relationship management provides the structure for how relationships with customers are developed and maintained (Croxton *et al.*, 2001). Management identifies key customers and customer groups to be targeted as part of the company's business mission. Cross-functional customer teams tailor product and service agreements to meet the needs of key accounts, and segments of other customers (Lambert *et al.*, 2005). Customer relationship management macro process aims to generate customer demand and facilitate the placement and tracking of orders. Customer relationship management processes include pricing; the preparation of catalogues and other marketing materials; sales; management of the web site; order management and management of the call centre that takes orders and provides service (Croxton *et al.*, 2001).

From the fact that all three macro processes are serving the same customer, for a supply chain to be successful, it is crucial that the three macro processes are well integrated (Croxton *et al.*, 2001). The organizational structure of the firm has a strong influence on 135 the success or failure of the integration effort. In most common companies, purchasing oversees the supplier relationship management macro processes, manufacturing handles the internal supply chain management macro processes and marketing is in charge of the customer relationship management macro processes – with very little communication among them (Chopra and Meindl, 2010). It is not unusual for marketing and manufacturing to have two different forecasts when making their plans. The lack of integration hurts the supply chain's ability to match supply and demand effectively, leading to dissatisfied customers and high costs. Thus, companies should

structure a supply chain organization that mirrors the macro processes and ensures good communication and coordination among the owners of processes that interact with each other (Chopra and Meindl, 2007).

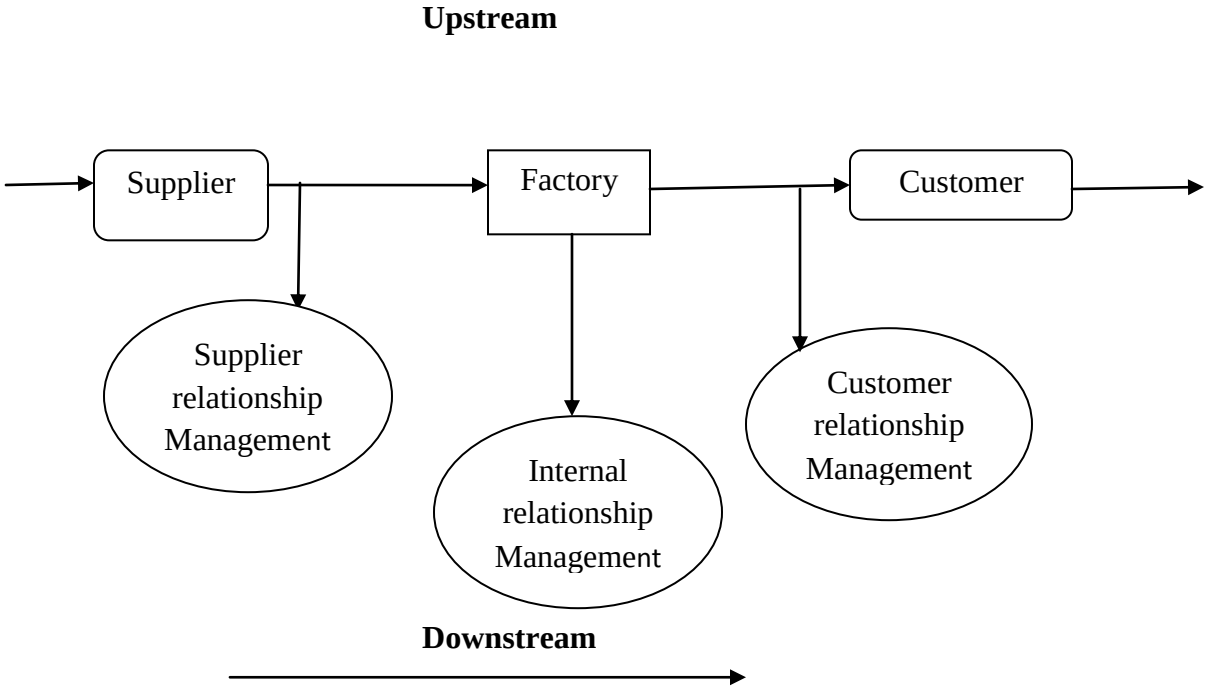


Figure 2.2 supply chain network process in manufacturing area

2.2.1. Supply Chain Decisions level

There is a close connection between the design and management of supply chain flows (information, product and funds) and the success of a supply chain (Chopra and Meindl, 2004). In contrast, the failure of many businesses can be attributed to weaknesses in their supply chain strategy and operation. Successful supply chain management requires many decisions relating to the flow of information, product, and funds (Chopra and Meindl, 2004). Each decision should be made to raise the supply chain profitability (supply chain surplus), the difference between the revenue generated from the customer and the overall cost across the supply chain (Chopra and Meindl, 2010). These decisions fall into three categories or levels: strategic, tactical and operational; depending on the authority decision level, the frequency of each decision and the time frame which a decision level has an impact. As a result, each category of decisions must consider uncertainty over the decision level (Chopra and Meindl, 2007).

Strategic decision making level

During this level, given the marketing and pricing plans for a product, a company decides how to structure the supply chain over the next several years (Chopra and Meindl, 2010). Strategic decisions made by top level management decision makers include whether to outsource or perform a supply chain function in-house, the location and capacities of production and warehousing facilities, the products to be manufactured or stored at various locations, the modes of transportation to be made available along different shipping legs and the type of information system to be utilized (Gunasekaran *et al*., 2004). A firm must ensure the supply chain configuration supports its strategic objectives and increases the supply chain surplus during this level. Supply chain strategic decisions are typically made for the long term (a matter of years) and are very expensive to alter on short notice. Consequently, when companies make these decisions, they must take into account uncertainty in anticipated market conditions over the next few years (Chopra and Meindl, 2007).

Tactical decision making level

For decisions made during this level, the time frame considered is a quarter to a year. Therefore, the supply chain's configuration determined in the strategic level is fixed (Chopra and Meindl, 2010). This configuration establishes constraints within which tactic must be done. The goal of tactic is to maximize the supply chain surplus that can be generated over the tactical level given the constraints established during the strategic level. Companies start the tactical level with a forecast for a coming year (or a comparable time frame) of demand in different markets (Chopra and Meindl, 2010). Tactical decisions made by mid-level management decision makers include making decisions regarding which markets will be supplied from which locations, the subcontracting of manufacturing, the inventory policies to be followed, and the timing and size of marketing and price promotions (Gunasekaran *et al*., 2004).

Tactic establishes parameters within which a supply chain will function over a specified period of time. In the tactical level, companies must include uncertainty in demand, exchange rates, and competition over this time level in their decisions (Chopra and Meindl, 2007). Given a shorter time frame and better forecasts than the strategic level, companies in the tactical level try to incorporate any flexibility built into the supply chain in the strategic level and exploit it to optimize performance. As a result of the tactical level, companies define a set of operating policies that govern short-term operations (Gunasekaran *et al*., 2004).

Operational decision making level

The time frame here is weekly or daily, and during this level companies make decisions regarding individual customer orders. At the operational level, supply chain configuration is considered fixed, and tactic policies are already defined (Chopra and Meindl, 2010). The goal of supply chain operations is to handle incoming customer orders in the best possible manner. During this level, operational decisions made by low level managers include allocate inventory or production to individual orders, set a date that an order is to be filled, generate pick lists at a warehouse, allocate an order to a particular shipping mode and shipment, set delivery schedules of trucks and place replenishment orders (Gunasekaran *et al*., 2004). Because operational decisions are being made in the short term (minutes, hours, or days), there is less uncertainty about demand information (Chopra and Meindl, 2007). Given the constraints established by the configuration and tactic policies, the goal during the operational level is to exploit the reduction of uncertainty and optimize performance (Huan *et al.*, 2004).

The strategic, tactical and operational decision making levels of a supply chain have a strong impact on overall profitability and success. It is fair to state that a large part of the success of firms can be attributed to their effective supply chain strategic, tactical, and operational decision making levels (Gunasekaran and Kobu, 2007). The reason for studying the performance measurement system and performance measurement factors at the strategic, tactical, and operational levels is to make the right decisions so that they can support each other in achieving the overall goals and objectives of an organization. The success of strategy formulation depends upon the degree of alignment of strategies at different levels (Gunasekaran and Kobu, 2007).

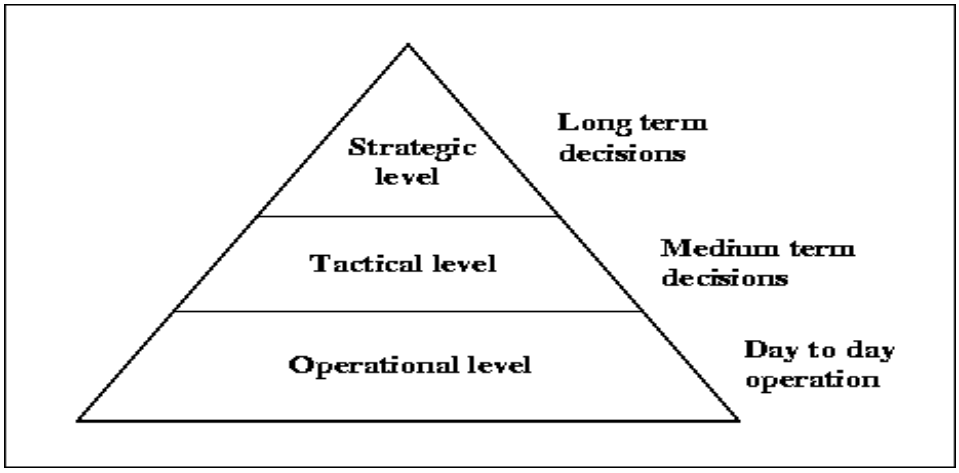


Figure 2.3 Hierarchy of Supply Chain Decision levels [36]

2.3. Supply chain performance measurement

Performance measurement is defined as the process of quantifying effectiveness and efficiency of action (Neely *et al.*, 1995). Effectiveness is the extent to which a customer's requirements are met and efficiency measures how economically a firm's resources are utilized when providing a pre-specified level of customer satisfaction. Performance measurement systems are described as the overall set of factors used to quantify both the efficiency and effectiveness of action. Sink and Tuttle (1989) claim that "you cannot manage what you cannot measure" Many manufacturing and service organizations have used performance measures and measurement systems to determine their performance. The excellent overview of performance measurement provided by Neely *et al.* (1995) has been widely cited in recent research into supply chain performance measurement systems and metrics (e.g. Beamon, 1999; Beamon and Chen, 2001; Gunasekaran *et al.*, 2001, 2004). This research is extensive review of the **literature concentrates** on the issues surrounding supply chain performance measurement which involves the variety of:

1. ***frameworks Supply chain performance measurement of the review articles***
2. ***Performance measurement factors for supply chain performance measurement also sometimes known as performance metrics, critical success factors (CSFs) or key performance indicators (KPIs) and***
3. ***Approaches and techniques of the review articles***

2.3.1. Frameworks Supply chain performance measurement of the review articles

The performance of supply chain management is required to measure with respect to some standard models or frameworks. Beamon (1999) presents an overview and evaluation of the performance measures used in supply chain models and also presents a framework for the selection of performance measurement systems for manufacturing supply chains. Three types of performance measures (resources, output and flexibility) are identified as necessary components in any supply chain performance measurement system, and flexibility quantitative measurement approach for supply chains are proposed. However, it lacks of system thinking, in which a supply chain must be measured widely across the whole.

Gunasekaran *et al*. (2001) illustrate and discuss different performance measures and metrics of the supply chain management with the help of a framework that gives cohesive picture to address what needs to be measured, and how it can be dealt with. The framework is classified into

strategic, tactical and operational levels of management. The metrics are also divided into financial and non-financial so that a suitable costing method based on activity analysis can be applied. However, due to the large number of metrics and measures given in the framework, firms find it difficult to use. Not many firms use all metrics and measures in day-to-day business operations. Also, the framework does not provide guidelines to priorities these metrics. Further, firms require a comprehensive way to analyses their operations from every angle that covers all perspectives of business.

Chan and Qi (2003) propose an innovative performance measurement method to contribute to the development of supply chain management from five core processes: supplying, inbound logistics, core manufacturing, outbound logistics and marketing & sales. These process-based systematic perspectives are employed to build an effective model to measure the holistic performance of complex supply chains (cross organization). Fuzzy set theory is introduced to address the real situation in judgment and evaluation processes. However, this proposed model overlooks the decision making ability across strategic, tactical and operational levels.

Otto and Kotza (2003) design suitable metrics to measure the effectiveness of supply chain management in six unique sets of supply chain metrics from six perspectives on supply chain management. Each perspective follows a particular set of goals, which consequently leads to a particular set of performance metrics. The various perspectives refer to these disciplines, which contributed the most to the development of supply chain management: system dynamics, operations research or information technology, logistics, marketing, organization and strategy. Each perspective has its very own notion of a supply chain, its standard problems and solutions, and its performance metrics. However, all the metrics are not used in business practice to measure supply chain performance.

Gunasekaran *et al*. (2004) develop a framework to promote a better understanding of the importance of supply chain management performance measurement and metrics.

The proposed framework considers the measurement of supply chain processes (plan, source, make and deliver) with respect to strategic, tactical and operational levels and evaluates a score for prioritize for each metric by three level: highly, moderately, and less important level from an empirical study of selected British companies. It lacks identifying critical success factors for the whole supply chain system. Furthermore, for evaluating the score, the organization, suppliers and customers should come together to discuss how they will address the measurement and

improvement of supply chain management performance. Industry consortiums, consultants and researchers could be helpful in promoting supply chain management performance measurement generally, and in developing measures and measurement techniques specifically.

Huang *et al.* (2005) summarize the supply chain operations reference (SCOR) model, its benefits along with illustrative case stories and describe a computer-assisted tool to configure supply chain threaded diagram per SCOR specification. Supply chain configuration is an integral part in SCOR project implementation. Currently, the configuration of 'as-is' or 'to-be' threaded-diagram describing a supply chain is done manually. To automate this process, a computer-assisted configuration tool has been developed and described in this paper. However, the configuration tool can so far only deal with a single manufacturing facility of a company. It does not take into account the interactions among multiple manufacturing facilities. Thus, this research limits to only single manufacturing facility of a company for studying.

Aramyan *et al.* (2007) propose conceptual framework that founds to be useful for measuring performance of the Dutch-German tomato supply chain. From the case study, it is concluded that four main categories of performance measures (efficiency, flexibility, responsiveness and food quality) are identified as key performance components of the tomato supply chain performance measurement system. This study also develops an integrated performance measurement system that contains financial as well as non-financial indicators combined with the specific characteristics of agri-food supply chains. Given the fact that the framework was evaluated in one particular case study (the Dutch-German tomato supply chain), caution is needed when generalizing the results. It also can be the limitation of this research to investigate only one Food Company.

Berrah and Cliville (2007) propose to build performance measurement systems by linking an overall performance expression to elementary performance. The overall performance is associated to a global objective whose break-down provides elementary objectives. Elementary performances are thus aggregated in a corollary way. This study deals with the supply chain performance formalization as it uses the performance indicators extend form Gunasekaran *et al.* (2004). These main strategic, tactical and operational indicators respect to SCOR model's processes: plan, source, make and deliver. The case study concerns a bearing company with its suppliers and deliverers. The overall performance expression results from the aggregation, by the weighted arithmetic mean (WAM), of the involved elementary performances. Besides, the multi

attractiveness categorical based evaluation technique (MACBETH) methodology has been applied to the performance expression of the four main processes of a supply chain. Indeed, this methodology gives a structured framework, which links the elementary performance expression to the overall performance. Factually, the SCOR model is originally founded on five distinct management processes, namely: plan, source, make, deliver and return. This study, however, the return process is not consider on the supply chain overall performance propose model.

Bhagwat and Sharma (2007a) develop a balanced scorecard (BSC) for measuring and evaluating day-to-day business operations of supply chain management from following four perspectives: finance, customer, internal business process and learning and growth. Three case studies develop and apply in small and medium sized enterprises (SMEs) in India. The balanced scorecard developed in this paper provides a useful guidance for the practical managers in evaluation and measuring of supply chain management in a balanced way and proposes a balanced performance measurement system to map and analyze supply chains. However, addition research is recommended in order to determine whether the proposed perspectives and measures are a necessary and sufficient set.

Jammernegg and Reiner (2007) discuss the opportunities and challenges for improving the performance of supply chain processes by coordinated application of inventory management and capacity management. The propose technique by using process simulation to approach a supplier in the telecommunication and automotive industry, where a manufacturer (production facility) is located in a country with low labor costs and high worker deployment flexibility. Using process simulation, the authors demonstrate how the coordinated application of methods from inventory management and capacity management result in improved performance measures of both intraorganizational (costs) and interorganizational (service level) objectives. But it lacks to view the whole supply chain process as this research concentrates only costs and service level.

Yeh *et al.* (2007) propose a modified 2-tuple fuzzy linguistic computing (FLC) model to evaluate the performance of supply chain management. In this model, the management implication of high precision setting involving in the Six Sigma: define measure, analyze, improve and control (DMAIC) processes is employed to construct the evaluation framework. The original 2-tuple fuzzy linguistic representation model is modified as the proposed model to provide the aggregation algorithm toward ensuring the consistent property. In this study, the Delphi method is used to precisely integrate the experts' opinions on criterion selection, weighting identification

and performance appraisal that are realistically expressed by fuzzy linguistic variables. The modified 2- tuple FLC technique is formed by utilizing a geometric operator and a couple of new symbol translation functions to aggregate precisely the 2-tuple terms involved. However, this framework lacks of combining the decision making levels.

Hwang *et al.* (2008) investigate the sourcing processes and their accompanied performance metrics in the SCOR model version 7.0 by using the stepwise regression model. The regression model was applied to examine the sourcing process of SCOR at level 2 and its performance metrics. The results obtained were further extended for discussion on the sourcing process of level 3. The researchers develop the questionnaire survey to collect empirical information from the thin film transistor-liquid crystal display (TFT-LCD) industry in Taiwan. In addition, this study also elaborates the institutionalization of the SCOR model and justifies the project planning system based on the SCOR model. However, this research concentrates on SCOR model version 7 only. When the newly developed version comes out, this study will have to consider for revision again.

Robb *et al.* (2008) propose and develop a model exploring the relationship between supply chain or operations practice and operational or financial performance by using a structural equation model with China furniture manufacturers of study. The industry is of particular interest in that, while labor productivity remains relatively low, exports have undergone substantial growth. The research highlights the relative importance of supply chain and operations practices and shows that the impact of practice on business performance is mediated by capabilities on operations dimensions. Another key finding is that practices are related to the importance placed on various dimensions the strongest link being between human resources and innovation, thus training can be seen to be a key to securing competitive advantage. The limitation of this research is it studied only operations dimension performance, not for the whole supply chains.

Theeranuphattana and Tang (2008) revisit the recent work of Chan and Qi (2003) which proposed an innovative performance measurement method for supply chain management. This research aims to propose a more user-friendly alternative performance measurement model by using fuzzy logic technique. The performance measurement model is a combination of two existing methods: Chan and Qi's model and the supply chain operations reference (SCOR) model. To demonstrate the applicability of the combined approach, actual SCOR level 1 performance data and the measurement information from a case supply chain are collected and

processed by Chan and Qi's measurement algorithm. These two methods complement each other when measuring supply chain performance. However, only one Thai manufacturing company case study is presented to demonstrate the measurement and the application of the performance measurement method.

Zhu *et al.* (2008) aim to empirically investigate the construct of and the scale for evaluating green supply chain management (GSCM) practices implementation among manufacturers., the measurement scale instrument in the form of a survey questionnaire developed from the various literature sources and interview academics and practitioners among Chinese manufacturers. Two measurement models of GSCM practices implementation were tested and compared by confirmatory factor analysis. The multiitem five-point Likert measurement scales using to evaluate the different facets of green supply chain management practices implemented and evaluate their strengths and weaknesses. However, this study concentrates only environmental performance with operational performance, not for the whole supply chain performance.

Cai *at el.* (2009) propose a framework using a systematic approach to improve the iterative key performance indicators (KPIs) accomplishment in a supply chain context. The proposed framework quantitatively analyzes the interdependent relationships among a set of KPIs. This framework can provide an effective approach to managing supply chain performance in a dynamic environment. A KPI accomplishment cost transformation matrix (PCTM) analysis proposes in this paper, it is a new extension of the existing eigen structure analysis methods, work transformation matrix (WTM) derived from the design structure matrix (DSM) model from engineering to business performance management. However, the results from PCTM analysis method should not be adopted as direct decisions, but as supporting information for decision making.

Chae (2009) offers an industry-oriented, practical approach to performance measurement in supply chain management contexts and proposes key performance metrics which can be easily adapted for different businesses. A list of essential key performance indicators (KPIs) is presented. Potential KPIs develop for each of the SCOR model's four meta-process (plan, source, make and delivery) and have to be hierarchically grouped such as primary and secondary metrics. The review of industry standards and best practices in supply chain performance measurement suggest that 'less is better' as to developing performance metrics. Companies should focus on only a small list of KPIs which are critical for their operations management, customer service,

and financial viability. The lack of this development model is the return process not consider in this work.

Chia *et al.* (2009) apply the balanced scorecard (BSC) approach on the logistics industry for measuring supply chain performance. This research empirically examines what senior supply chain executive's measure and how they perceive performance measurement from a balanced scorecard. A survey designed from the four perspectives of the balanced scorecard framework is conducted on senior executives involved in the supply chain functions of client firms, and those executives from the logistics service provider industry. This study suggests that the measurement of performance of supply chain entities could be improved by using a more balanced perspective as provided for by the BSC framework. Further, the results show an apparent lack in the focus on drivers of strategic future performance, as implied in the results of the measurement of internal business processes and learning and growth indicators. These two perspectives contain measures that create future value, and address the development of core competencies but they were not as well measured. The limitation of this work is the sizes of some respondent clusters are smaller than others. Hence, the results may not be representative of the individual clusters.

Rodriguez *et al.* (2009) propose the quantitative relationships performance measurement system (QRPMS) that clearly establishes traceability between a group of strategic objectives and associated key performance indicators (KPIs). This study presents a unique proposal able to objectively identify and quantify relationships between KPIs defined within a performance measurement system base on the balanced scorecard (BSC), that offering additional information to managers to make cross enterprise decisions. Then, the research projects KPIs upstream in the performance measurement system, establishing meaningful cause and effect relationships at the objectives levels. The proposed model is applied to a baby clothing manufacturer in Spain. As the research studied only one manufacturing company, it may be the disadvantage for this paper.

Thakkar *et al.* (2009) propose an integrated supply chain performance measurement framework for the case of small and medium scale enterprises (SMEs) in India using set of qualitative and quantitative insights gained during the case study research. The proposed framework integrates the features of balanced scorecard (BSC) and supply chain operation reference (SCOR) model to deliver a comprehensive performance measurement framework for SMEs. It also outlines the detailed guideline for the implementation and use of the framework. This research reports set of performance indicators for the supply chain processes like source, make and deliver in SMEs. It

also relates the measures with various supply chain cycles like procurement, manufacturing, replenishment and customer order, but it does not consider in decision making levels.

Bigliardi and Bottani (2010) develop a balanced scorecard (BSC) model that is designed and delimited for performance measurement in the food supply chain. The research provides a structured performance measurement system tailored for the food supply chain. The BSC model developed could serve as a reference for the food industry, to establish applicable performance appraisal indicators. The study starts from the literature concerning performance measurement and metrics, the food industry and the BSC model, the relevant financial and non-financial indicators, suitable to be used for companies belonging to the food industry. Then, indicators are submitted to a panel of experts, which operate following the Delphi technique, to gather possible suggestions or amendments. In its final form, the resulting BSC model is tested on two companies operating in the food industry, for a final validation. However, the fact that a specific industry field (the food industry) is examined could be seen as a limitation of the work as the results presented are not suitable to be generalized or extended to other contexts.

Flynn *et al.* (2010) study the relationship between three dimensions of supply chain integration, operational and business performance, from both a contingency and a configuration perspective. This research defines supply chain integration as the degree to which a manufacturer strategically collaborates with its supply chain partners and collaboratively manages intra- and inter-organizational processes, in order to achieve effective and efficient flows of products and services, information, money and decisions, to provide maximum value to the customer. In applying the contingency approach, hierarchical regression is used to determine the impact of individual supply chain integration dimensions (supplier, internal and customer integration) and their interactions on performance. In the configuration approach, cluster analysis is used to develop patterns of supply chain integration, which are analyzed in terms of supply chain integration strength and balance. Analysis of variance is used to examine the relationship between supply chain integration pattern and performance. However, it overlooks the decision making ability across strategic, tactical and operational levels.

Lin *et al.* (2010) present a proposed model which addresses the drivers of innovation in channel integration in supply chain management of Taiwan qualified high-tech manufacturers. This research surveys the previous studies of strategy orientation, the innovation in channel integration and supply chain performance to construct a theoretical model and hypotheses

specifications. The study tests the measurement model for overall factors with a confirmatory factor analysis (CFA) through AMOS 7.0 analysis. The results indicate that a significant relationship has been established between market orientation (customer focus, competitor-oriented and cross-functional coordination) and supply chain performance. However, this model only concentrates on innovation perspective.

Mazroui and Seyed (2013) present a proposed model performance measurement on supply chain management for Iran's machine-woven carpet industry. In this research Explanatory and confirmatory factor analysis was adapted. And also Indicators used to measure supply chain performance had been classified into customer; cost, product, financial, supplier, employee and chain supply after performing explanatory factor analysis. And all of these indicators and factors were validated in confirmatory factor analysis. Then they were valued separately through AHP method through which customer and supplier groups showed closer connection to supply chain performance

Fattahi and Nookabadi (2013) analyze the characteristics and performance of the meat supply chain by focusing on developing a model for measuring the meat supply chain's performance in the province of Isfahan, Iran. In this research using a combination of literature review, Delphi approach and case study research, the paper examines part of the meat supply chain that consists of three industrial slaughterhouses, two cold rooms, three factories and more than 20 supermarkets and it then presents a framework to assess the performance of the industry in the region. Results show for this study that there are six main criteria required to measure the meat industries Performance

Table2.1: summary of supply chain performance measurement frameworks

Author(s)	**Framework or measurement area**	**Remarks**
Beamon (1999)	Supply chain processes	**Pro:** Identify three types of performance measures and propose flexibility quantitative measurement approach for supply chains **Con:** Lack of system thinking of measuring supply chain widely across the whole
Gunasekaran *et al.* (2001)	Decision making levels	**Pro:** Combine decision making levels with financial and non-financial criteria **Con:** Too many number of metrics and measures
Chan and Qi	Supply chain	**Pro:** Identify five core processes as holistic complex supply chain measurement and introduce fuzzy set

(2003)	processes	theory for judgment and evaluation processes **Con:** Overlook on the decision making ability
Otto and Kotza (2003)	Supply chain perspectives	**Pro:** Design six unique sets of supply chain metrics to measure the effectiveness of supply chain management **Con:** All the metrics are not used in business practice to measure supply chain performance
Gunasekaran *et al.* (2004)	Decision making levels	**Pro:** Consider supply chain processes with respect to decision making levels **Con:** Need collaboration from all stakeholders of supply chain system to evaluate the framework
Huang *et al.* (2005)	Supply chain operations reference (SCOR) model	**Pro:** Summarize SCOR model and describe a computer-assisted tool to configure supply chain **Con:** Limit to one manufacturing company for studying
Aramyan *et al.* (2007)	Financial versus non-financial	**Pro:** Develop an integrated performance measurement system that contains financial as well as non-financial indicators **Con:** Investigate only single food company
Bhagwat and Sharma (2007a)	Balanced score card perspective	**Pro:** Develop a balanced scorecard for supply chain management and apply in SMEs in India **Con:** Need to determine the proposed perspectives and measures
Jammernegg and Reiner (2007)	Intraorganizational versus Interorganizational	**Pro:** Deal with performance measurement and improvement of supply chain processes by coordinated application of inventory management and capacity management **Con:** Lack to view the whole supply chain process as concentrate only costs and service level
Yeh *et al.* (2007)	Six Sigma (DMAIC) processes	**Pro:** Propose a modified 2-tuple fuzzy linguistic computing (FLC) model to evaluate the performance of supply chain management **Con:** Lack of combining the decision making levels
Hwang *et al.* (2008)	SCOR model	**Pro:** Aim to find out important SCOR sourcing performance metrics by using the stepwise regression model **Con:** Concentrate on SCOR model version 7 only as version 11 will launch soon this year
Robb *et al.* (2008)	Operations practice and performance	**Pro:** Propose a model exploring operations practice and performance of supply chain management **Con:** Study only operations dimension, not for the whole supply chains

Theeranuphattana and Tang (2008)	Combined Chan and Qi (2003) model and SCOR model	**Pro:** Develop a practical and efficient measurement model by incorporating the strengths of two different models **Con:** Present only one Thai manufacturing company case study
Zhu *et al.* (2008)	Green supply chain management	**Pro:** Investigate green supply chain practices implementation **Con:** Concentrate only environmental performance with operational performance
Cai *at el.* (2009)	Supply chain processes	**Pro:** Propose a framework using a systematic approach to improving the KPIs in a supply chain context **Con:** Result from PCTM analysis can use as only supporting information for making decision, not as direct decision
Chae (2009)	SCOR model	**Pro:** Offer a practical approach to performance measurement and propose key performance metrics **Con:** The return process is not consider in this work
Chia *et al.* (2009)	Balanced score card perspective	**Pro:** Apply the balanced scorecard approach on the logistics industry to measure performance of supply chain **Con:** The sizes of respondent clusters are differently
Rodriguez *et al.* (2009)	Balanced score card perspective	**Pro:** Propose the quantitative relationships performance measurement system base on the balanced scorecard **Con:** Study only one manufacturing company
Thakkar *et al.* (2009)	Integrated balanced score card and SCOR model	**Pro:** Develop an integrated performance measurement framework for supply chain evaluation and planning in SMEs **Con:** Do not consider in decision making levels
Bigliardi and Bottani (2010)	Balanced score card perspective	**Pro:** Develop a balanced scorecard model for measuring performance in the food supply chain **Con:** Examine only specific industry field (the food industry)
Flynn *et al.* (2010)	Supply chain integration, operational and business performance	**Pro:** Study the relationship between three dimensions of supply chain integration, operational and business performance **Con:** Overlook the decision making ability
Lin *et al.* (2010)	Supply chain innovation	**Pro:** Propose a model of innovation drivers in channel integration in supply chain management **Con:** Concentrate on innovation perspective only
Fattahi and	Decision making	**Pro** Combine decision making levels with financial

Nookabadi (2013)	levels	and non-financial criteria **Con** Concentrate only strategic and tactical

A review of previous research in relation to supply chain performance measurement framework has highlighted that the attention of many researchers has often focused on single area of performance , while research on a combined approach for the whole performance of supply chain management have been relatively neglected. Concerning these research gaps, this research, therefore, is intended to provide a more holistic approach to the study of supply chain performance measurement framework by combining both supply chain macro processes and decision making levels and taking a cross organizational approach. These concepts are used in supply chain management research in general, but they have not been applied together before to supply chain performance measurement framework. This approach will help to understand the holistic perspective on supply chain performance. The framework will provide a balanced horizontal (cross-process) and vertical (hierarchical decision) view on supply chain performance.

2.3.2. Performance measurement indicators for supply chain performance measurement

The role of performance measurement factors or critical success factors is the feedback in the supply chain management (Chae, 2009). Measuring supply chain performance reveals the gap between planning and execution and helps companies to identify potential problems and areas for improvement. However, it is recognized that developing performance measurement factors, is very challenging and a set of practical guidelines is not readily available for companies and supply chain management practitioners (Lambert and Pohlen, 2001). The performance measurement factor is the term for an element, activity or variable that is required for an organization to achieve its mission (Rockart and Bullen, 1981). For this study, therefore, these performance measurement factors refer to the number of areas in which the companies should consider when they measure the performance of supply chain.

Table 2.2: Performance measurement factors for supply chain performance measurement

Author(s)	**Measurement area**	**Performance measurement factors**
Beamon (1999)	Resources	Total cost of resources used - Total cost of distribution including transportation and handling costs - Total cost of manufacturing including labor, maintenance, and re-work costs - Inventory costs associated with held inventory: inventory investment, inventory obsolescence,

		work-in-process inventories, finished goods inventories - Return on investment (ROI)
	Output	Sales - Profit - Fill rate: target fill rate achievement, average item fill rate - On-time deliveries: product lateness, average lateness of orders, average earliness of orders, percent on-time deliveries Backorder or stock-out, Stock-out probability, number of backorders, number of stock-outs, average backorder - Customer response time - Manufacturing lead time - Shipping errors - Customer complaints
	Flexibility	- Reductions in the number of backorders - Reductions in the number of lost sales - Reductions in the number of late orders - Increased customer satisfaction - Ability to respond to and accommodate demand variations - Ability to respond to and accommodate periods of poor manufacturing performance - Ability to respond to and accommodate periods of poor supplier performance - Ability to respond to and accommodate periods of poor delivery performance - Ability to respond to and accommodate new products, new markets or new Competitors
Gunasekaran *et al.* (2001)	Strategy	Total supply chain cycle time - Total cash flow time - Customer query time - Level of customer perceived value of product - Net profit versus productivity ratio Rate of return on investment - Range of product and services - Variations against budget - Order lead time - Flexibility of service systems to meet particular

		customer needs - Buyer-supplier partnership level - Supplier lead time against industry norm - Level of supplier's defect free deliveries - Delivery lead time - Delivery performance
	Tactical	Accuracy of forecasting techniques - Product development cycle time - Order entry methods - Effectiveness of delivery invoice methods - Purchase order cycle time - Planned process cycle time - Effectiveness of master production schedule - Supplier assistance in solving technical problems - Supplier ability to respond to quality problems - Supplier cost saving initiatives - Supplier's booking in procedures - Delivery reliability - Responsiveness to urgent deliveries - Effectiveness of distribution planning schedule
	Operational	Cost per operation hour - Information carrying cost - Capacity utilization - Total inventory as: incoming stock level, work-in-progress, scrap level, finished goods in transit - Supplier rejection rate - Quality of delivery documentation - Efficiency of purchase order cycle time - Frequency of delivery - Driver reliability for performance - Quality of delivered goods - Achievement of defect free deliveries
Chan and Qi (2003)	Supplying (delivery)	Delivery cost - Delivery reliability: timeliness, error-free - Delivery flexibility; Frequency, amount
	Inbound logistics (transportation)	Transport cost - Transport productivity - Transport flexibility - Facility utilization
	Core manufacturing (international manufacturing operations)	-Product quality - Operation cost – Efficiency - Flexibility - Productivity

	Outbound logistics (warehousing)	Warehouse costs - Inventory flow rate - Inventory accuracy - Stock capacity - Facility utilization
	Marketing and sales (customer order processing and delivery)	-Response time - Order fill rate - Order flexibility; frequency, amount - Delivery reliability: timeliness, error-free
Otto and Kotza (2003)	System dynamics	Capacity utilization - Cumulative inventory level - Stock-outs - Time lags - Time to adapt - Phantom ordering
	Operations research or information technology	Logistics costs per unit - Service level - Time to deliver
	Logistics	Integration - Lead times- Order cycle time - Inventory level – Flexibility
	Marketing	Customer satisfaction - Distribution costs per unit - Market share or channel costs
	Organization	Transaction costs - Time to network - Flexibility - Density of relationships
	Strategy	Time to network - Time to market - ROI of focal organization
Gunasekaran *et al.* (2004)	Strategy - Plan -Source - Make/assembly -Deliver	Level of customer perceived value of product - Variances against budget - Order lead time - Information processing cost - Net profit versus productivity ratio - Total cycle time - Total cash flow time - Product development cycle time N/A -Range of products and services -Flexibility of service system to meet customer needs - Effectiveness of enterprise distribution planning schedule
	Tactical - Plan - Source	Customer query time - Product development cycle time - Accuracy of forecasting techniques - Planning process cycle time - Order entry methods - Human resource productivity -Supplier delivery performance - Supplier lead time against industry norm

	- Deliver	-Supplier pricing against market - Efficiency of purchase order cycle time - Efficiency of cash flow method - Supplier booking in procedures - Percentage of defects - Cost per operation hour - Capacity utilization - Utilization of economic order quantity - Flexibility of service system to meet customer needs - Effectiveness of enterprise distribution planning schedule - Effectiveness of delivery invoice methods - Percentage of finished goods in transit - Delivery reliability performance
	Operational - Plan - Source - Make/assembly - Deliver	- Order entry methods - Human resource productivity - Efficiency of purchase order cycle time - Supplier pricing against market - Percentage of defects - Cost per operation hour - Human resource productivity index - Quality of delivered goods - On time delivery of goods - Effectiveness of delivery invoice methods - Number of faultless delivery notes invoiced - Percentage of urgent deliveries - Information richness in carrying out delivery - Delivery reliability performance
Huang *et al.* (2005)	Delivery reliability	- Delivery performance - Fill rates - Perfect order fulfillment
	Responsiveness	- Order fulfillment lead times
	Flexibility	- Supply chain response time - Production flexibility
	Cost	- Cost of goods sold - Total supply chain management cost - Value-added employee productivity - Warranty or return processing costs
	Assets	- Cash-to-cash cycle time - Inventory days of supply - Asset turns
Aramyan *et al.*	Efficiency	- Production costs - Transaction costs - Profit - Return on investment – Inventory

(2007)	Flexibility	- Customer satisfaction - Volume flexibility - Delivery flexibility – Backorders - Lost sales
	Responsiveness	- Fill rate - Product lateness - Customer response time - Lead time - Customer complaints - Shipping errors
	Food quality - Product quality - Process quality	- Sensory properties and shelf-life: appearance, taste, shelf life - Product safety and health: salubrity, product safety - Product reliability and convenience: product reliability, convenience - Production system characteristics: traceability, storage and transportation conditions, working conditions - Environmental aspects: energy use, water use pesticide use, recycling or reuse - Marketing: promotions, client service, display in stores
Berrah and Cliville (2007)	Same as Gunasekaran *et al.* (2004)	Same as Gunasekaran *et al.* (2004)
Bhagwat and Sharma (2007a)	Finance perspective	- Supplier cost saving initiatives - Delivery reliability - Cost per operation hour - Information carrying cost - Supplier rejection rate - Net profit versus productivity ratio - Rate of return on investment - Variations against budget - Buyer-supplier partnership level - Delivery performance
	Customer perspective	- Customer query time - Level of customer perceived value of product - Range of products and services - Order lead time - Flexibility of service systems to meet particular customer needs - Buyer-supplier partnership level - Delivery lead time - Delivery performance - Effectiveness of delivery invoice methods - Delivery reliability - Responsiveness to urgent deliveries - Effectiveness of distribution planning schedule - Information carrying cost - Quality of delivery documentation - Driver reliability for performance - Quality of delivered goods - Achievement of defect free deliveries

	Internal business process perspective	- Total supply chain cycle time - Total cash flow time - Flexibility of service systems to meet particular customer needs - Supplier lead time against industry norms - Level of supplier's defect free deliveries - Accuracy of forecasting techniques - Product development cycle time - Purchase order cycle time - Planned process cycle time - Effectiveness of master production schedule - Capacity utilization - Total inventory cost: incoming stock level, work-in-progress, scrap value, finished goods in transit - Supplier rejection rate - Efficiency of purchase order cycle time - Frequency of delivery
	Innovation and learning perspective	- Supplier assistance in solving technical problems - Supplier ability to respond to quality problems - Supplier cost saving initiatives - Supplier's booking in procedures - Capacity utilization - Order entry methods - Accuracy of forecasting techniques - Product development cycle time - Flexibility of service systems to meet particular customer needs - Buyer-supplier partnership level - Range of products and services - Level of customer perceived value of product
Jammernegg and Reiner (2007)	Costs (Intraorganizational)	- Shipping costs - Inventory carrying costs - Transportation costs
	Service level (Interorganizational)	- Service level (fill rate) of finished goods storage - Distribution centre delivery performance - Work in process pallets (manual production manufacturer to distribution centre)
Yeh *et al.* (2007)	Customer satisfaction Improvement	- Improve delivery efficiency toward customer demands - Improve delivery efficiency toward promises - Decrease lead time for completing orders - Improve service quality - Improve response to customer demands
	Business process and information	- Improve purchasing process - Improve data validity

	integration	- Strengthen information sharing - Increase stock turnover - Increase supply chain response - Improve efficiency for order processing - Shorten lead time for raw material providing - Decrease prediction errors - Increase flexibility of production schedule - Lower material shortage - Decrease payment time
	Organization innovation Capability	- Production innovation - Cooperative design capability increasing - Innovation in production process - Diversification in products - Market entry lead time decreasing - Customization capability increasing
	Enterprise profit increasing	- Increase marginal profits of supply chain - Increase quality of material supply - Lower stock costs - Lower purchase costs - Lower operation costs - Increase cash turnover - Increase sales volume - Increase asset rewards ratio
	Human resource Management	- Increase working efficiency - Increase employee's capability in learning new knowledge - Increase employee's adaptation for changes - Increase positive interaction between employee and the environment - Increase employee capability in independently completing a task
Hwang *et al.* (2008)	Reliability	- Perfect order fulfillment
	Responsiveness	Order fulfillment cycle time
	Flexibility	- Upside supply chain flexibility - Upside supply chain adaptability - Downside supply chain adaptability
	Cost	- Supply chain management cost - Cost of goods sold
	Asset management	- Cash-to-cash cycle time - Return on supply chain fixed assets
Robb *et al.* (2008)	Operations dimension Performance	- Delivery dependability - Product reliability - After-sale service - Consistent quality - Product durability - Low production cost - Production time - New products - Delivery time - New product development time - Product mix flexibility - Volume

		flexibility - Modification flexibility
	Human resources factors	- Improve worker safety - Motivate workers - Increase supervisor training - Provide more worker training - Give workers a broader range of tasks - Heavily involved in product design decisions from production personnel - The worker's skills at doing their own jobs - Level of training given to workers - Training workers to manage different stages of the production process - Consulting with workers in deciding the production schedule - Having no role for workers in improving the manufacturing process - Give workers more planning responsibility
Theeranuphattana and Tang (2008)	Reliability	- Perfect order fulfillment
	Responsiveness	- Order fulfillment cycle time
	Flexibility	- Upside supply chain flexibility - Upside supply chain adaptability - Downside supply chain adaptability
	Cost	- Supply chain management cost - Cost of goods sold
	Asset management	- Cash-to-cash cycle time - Return on supply chain fixed assets - Return on working capital
Zhu *et al.* (2008)	Environmental performance	- Reduction of air emission - Reduction of waste water - Reduction of solid waste - Decrease of consumption for hazardous, harmful or toxic materials - Decrease of frequency for environmental accidents - Improvement of an enterprise's environmental situation
	Eco performance	- Decrease cost for materials purchasing - Decrease cost for energy consumption - Decrease fee for waste treatment - Decrease fee for waste discharge - Decrease fine for environmental accidents
	Operational performance	- Increase delivered on time - Decrease inventory levels - Decrease scrap rate - Promote products' quality - Increase product line - Improve capacity utilization
Cai *at el.*	Resource	- Total supply chain management costs - Distribution costs - Inventory costs - Manufacturing costs - Total

(2009)		turnover costs - Information management costs - Value-added employee productivity - Warranty costs - Return on investment
	Output	- Sales (or profit) - Rates of stock-outs (lose sales) - Fill rate: target fill rate achievement, average item fill rate - Order fulfillment lead time - Percent of on-time deliveries - Perfect of order fulfillment - Customer satisfaction - Rates of customer complaints - Planned process cycle time - Cash-to-cash cycle time
	Flexibility	- Supply chain responsiveness - Manufacturing flexibility - Procurement flexibility - Logistics flexibility - Delivery flexibility - New products flexibility - Information systems flexibility
	Innovativeness	- Rates of sales in new products - Number of new products launched - Process improvement - Supply chain stability
	Information	- Information accuracy - Information timeliness - Information availability - Information sharing
Chae (2009)	Sales and marketing	- Forecast versus order - Forecast volatility - Inventory days of supply at sales subsidiaries
	Production	- On time departure from manufacturing subsidiaries - Production plan versus result - Inventory days of raw material supply - Inventory days of (finished goods) supply at manufacturing subsidiaries - On time arrival to sales subsidiaries (or distribution centers) from manufacturing subsidiaries
	Purchasing	- Supplier fill rate - Automatic purchasing order (PO) rate
	Operation strategy	- Forecast accuracy - Planning cycle - Inventory days of supply - Cash-to-cash cycle
	Financial perspective	- Return on investment - Gross revenue - Profit before tax - Cost reduction
	Customer perspective	- Market share - Number of customers retained - Customer satisfaction
	Business processes Perspective	- Quality of services - New services implemented per year

		- On time delivery - Waste reduction
	Learning and growth Perspective	- Employee satisfaction - Employee turnover per year - Number of suggestions implemented per employee yearly - Money invested in employee training yearly
Rodriguez *et al.* (2009)	Financial perspective	- Net benefit (sales) - Turnover increment - Costs of structure - Financial indebtedness - Final stock of cloths per campaign
	Customer perspective	- Customer average order - Number of customers that ask for repetition divide by number of total customers - Number of repeating requests per model and customer divide by number of customers that ask for repetition - Percentage of annulled models - Efficacy of the model - Global efficacy of each collection per intermediary - Average order per intermediary - Number of new customers captured - Number of orders per week (sales speed) - Increment of customers - Number of captured customers that are already customers of other enterprise of the organization divide by number of new customers - Number of non-accomplished orders divide by total number of orders - Number of customers that make a claim divide by total number of customers - Number of claims per model and customer divide by total number of customers that make a claim - Increment of incidences occurred between the last two years - Average reaction time to one customer's claim
	Internal perspective	- Stock variability - Percentage of return item per model - Percentage of customer acceptation - Total number of exited models divide by total number of produced models - Number of clothes with deviations respect to the standard scaled - Customer accomplishment degree - Deviation between the order date and the reception date - Total number of innovative clothes divide by total number of produced clothes - Number of innovative successful clothes divide by

		total number of innovative clothes - Number of re-processed clothes divide by total number of clothes - Number of customers buying a determined style divide by total number of customers - Number of annulled catalogues divide by total number of catalogues
	Learning and growth perspective	- Number of critical processes totally documented divide by total number of critical processes - Number of critical processes controlled by the follow-up tool divide by total number of critical processes - Number of yearly training hours divide by number of yearly work hours - Hours needed of real training (detected by the enterprise) divide by hours needed of theoretical training (that employees think they should have) - Number of established inter-areas work or communication protocols divide by number of essential processes - Establishment of inter-areas work or communication protocols (Yes/No) - Number of inter-areas personnel interchanges divide by number of areas susceptible of interchange within the enterprise - Development of an incentive plan (Yes/No) - Number of employees that know exactly the objective to be reached divide by total number of employees
Thakkar *et al.* (2009)	Customer service	- Service quality - Product quality - Timely delivery - Responsiveness - Order fill rate - After sales service - Perfect order fulfillment
	Finance and marketing	- Profit margins - Pre-tax return on assets - After tax return on investment - Return on investment - Return on assets - Total supply chain cost - Growth in market share - Return on capital employed - Improved cash flow - Warranty or returns processing cost
	Internal business	- Inventory turnover ratio - Throughput time - Percentage scrap - Accuracy of documentation - On-time delivery - Unit cost reduction
	Innovation and learning	- Flexible work force - Product innovation - Process innovation - Information sharing across supply chain - Training to managers and workers - Vendor development initiatives - Design modification based on customer requirements

Bigliardi and Bottani (2010)	Financial perspective	- Information carrying cost - Supplier cost saving activities - Variations against budget - Cost per operation hour - Return on investment
	Customer perspective	- Customer query time - Order lead time - Distribution lead time - Distribution performance - Delivery reliability - Effectiveness of distribution planning schedule - Quality of delivery goods - Customer perceived value of product - Flexibility of service system to meet particular customer needs - Responsiveness to urgent delivery
	Internal process perspective	- Accuracy of forecasting techniques - Purchase order cycle time - Planned process cycle time - Effectiveness of master production schedule - Supplier rejection rate - Total inventory cost - Frequency of delivery
	Learning and growth Perspective	- Supplier assistance in solving technical problems - Supplier ability to respond to quality problems - Buyer-supplier collaboration in problem solving - Order entry method - Level of information sharing
Flynn *et al.* (2010)	Supplier integration	- Level of information exchange with supplier through information networks - Establishment of quick ordering systems with supplier - Level of strategic partnership with supplier - Stable procurement through network with supplier -Participation level of supplier in the process of procurement and production - Participation level of supplier in the design stage - Sharing production schedule of major supplier with company - Sharing production capacity of major supplier with company - Sharing available inventory of major supplier with company - Sharing production plan of company with major supplier - Sharing demand forecasts of company with major supplier - Sharing inventory levels of company with major supplier - Helping major supplier to improve process to better meet company's needs
	Internal integration	- Data integration among internal functions - Enterprise application integration among internal

		functions - Integrative inventory management - Real-time searching of the level of inventory - Real-time searching of logistics-related operating data - Utilization of periodic interdepartmental meetings among internal functions - Use of cross functional teams in process improvement - Use of cross functional teams in new product development - Real-time integration and connection among all internal functions from raw material management through production, shipping and sales
	Operational performance	- Quickly modify products to meet major customer's requirements - Quickly introduce new products into the market - Quickly respond to changes in market demand - Outstanding on-time delivery record to major customer - Lead time for fulfilling customers' orders - Provide a high level of customer service to major customer
	Business performance	- Growth in sales - Return on sales - Growth in return on sales - Growth in profit - Growth in market share - Return on investment (ROI) - Growth in RO
Lin *and li et al.* (2010)	Innovation	- Flexibility of delivery systems to meet the customer needs - Strengthen the supplier partnerships - Cost competitiveness - Shorter order cycles - Flexible customer response
Fattahi and Nookabadi (2013)	Financial	-Turnover, -Personnel Costs, -Overhead cost, -Transporting costs , -Production cost per unit, -Deterioration costs , -materials, -Inventory holding costs -Investment return , -exhibitions, Export quantity
	Efficiency	-Water consumption , -Energy consumption , Inventory quantity , -Production line breakdown -Inventory holding -Lost sale -Recycling defected materials -Production quantity -Production time -quantity Gas consumption -Investment returning time Diversity/time -Fast order fill rate Production cycle efficiency -Suitable distribution plan Nutrient Using new technology -New product's production time
	Flexibility	-Packaging Lead time -Customer response system Emergency delivery -Delivery location Delivery frequency -Production quantity

		-Production quantity Production mix and formula Operation process
	Quality and safety	-Product returns Storage conditions -Materials inspection and testing -Handling conditions -Appearance -Shelf life -Location temperature -Production quantity -Final product inspection and testing -Environmental hygiene -Possibility of tracing -Hygienic certification-Labeling documentary -Chemical agents consumption -Nutrient
	Customer service	-Delivery on -No. of representatives -Customer complaints -Market share -Customer satisfactory -Customer loyalty -Reputation of brand name -Customer response time -Participating in exhibitions
	Coordination in chain	-Partnership satisfaction -Communication time horizon -Cooperation -On time information -sharing in planning

2.3.3. Supply chain management performance measurement approaches and techniques

There have been relatively few attempts to systematically collate models for evaluating the performance measurement of supply chains Moreover, there is argument over the most appropriate way to categories them. Gunasekaran and Kobu (2007) have classified or categorized performance measurement according to several different approaches

1. Map model –framework
2. Balanced score card perspective
   (Financial, customer, internal business process, and learning and growth)
3. Components of performance measures
   (Resource, output, and flexibility)
4. Location of measures in supply chain links
   (Plan, source, make, and deliver)
5. Decision making levels
   (Strategic, tactical, and operational)
6. Nature of measures
   (Financial and non-financial)
7. Measurement base
   (Quantitative and non-quantitative)
8. Traditional vs. modern measures
   (Function-based and value-based)

In general, reviewing the literature of supply chain performance measurement we categorized the models in three groups. These groups are **Hierarchical based approach, Process based approach, and Perspective based approach.**

Hierarchical based approach

This model of performance measurement system evaluates performance through various hierarchical levels of the organization. Hierarchical model can be used in three aspects: metrics, criteria and processes. Hierarchical metrics were first proposed by Gunasekaran et al. (2001). They presented a framework in which metrics are classified into strategic, tactical and operational levels of management. Gunasekaran *et al*. (2001), based on literature survey, develop a framework of performance that distinguishes measures according to classis decision horizons: strategic, tactical and operational. The complexity of supply chain management prompts them to compile a list of the most indicative performance metrics for each hierarchical level. The authors underline the influence of hierarchical level measures to achieve the objectives of each hierarchical level. Financial indicators that include intangible elements are most appropriate for the strategic level (Gunasekaran and Kobu, 2007). In additon, Gunasekaran *et al*. (2004) developed a framework for supply chain management in case of performance measurement and metrics. The framework considers the measurement of supply chain processes (e.g. plan, source, make and deliver) with respect to strategic, tactical and operational levels, evaluates a score for prioritize for each metric by three levels: highly, moderately and less important levels from an empirical study of selected British companies.

Bhagwat and Sharma (2009, 2007b) and Bhagwat et al. (2008) employ strategic, tactical and operational levels of management in their hierarchical PMS of SCM and classified metrics by these three level. Thakkar et al. (2009) advised users to classify metrics into strategic, tactical and operational level, after extracting metrics in various categories of BSC. Chan and Qi (2003a, 2003b) decomposed supply chain to six core business processes including supplier, inbound logistics, manufacturing, outbound logistics, marketing and sales, and end customers. These processes could be decomposed to sub processes or functions. In other word, SC processes that need to be measured can be grouped into these six core processes with the corresponding functions of firms and departments.

Process based approach

According to the importance of the operational dimension, it is important to clearly understand the activities and key processes of the supply chain to better structure performance measures. Integrating key processes from the final customer to the suppliers is crucial to supply chain management. To recognize the multidimensionality of the supply chain, researchers and practitioners have sought to develop new approaches that can take into account the performance of key operational processes in the supply chain. Some SC models are developed based on their process. Process based refer to those that take SC as a set of processes (such as manufacturing, logistic, inventory management and etc.) and sub processes which are composed of a set of activities. This fact that supply chain management is a set of management processes has been recognized by many other researchers, such as La Londe (1997) and Ross (1998).

Chan and Qi (2003a) proposed a cross boundary process-based model with the idea of managing key processes of supply chains. Chan and Qi, (2003b) they have studied the feasibility of PMS in supply chain based on process-based approach and measures. The authors proposed a process based approach, with the objective of identifying the participants and analyzing the network structure of supply chain. Theeranuphattana and Tang (2008) applied two process based model SCOR and Chan and Qifor demonstrating their model. Thakkar et al. (2009) used SCOR processes at the various levels to report set of performance measures for the supply chain processes in Small and medium scale enterprises (SMEs).

Gunasekaran et al (2001) and Gunasekaran et al (2004) presented a framework for performance measures and metrics, considering the four major supply chain processes (plan, source, make/assemble, and deliver). Parkan and Wang (2007) addressed the process based framework proposed by Gunasekaran et al (2004) for using in measurement of SC performance over a number of time periods.

Berrah and Cliville´ (2007) modeled supply chain according to the SCOR model, with its five main processes. Then they had built their PMSs by linking an overall performance expression to elementary ones. Lin and Li (2010) constructed their models based on SC processes and sub processes and used six-sigma metrics to evaluate the performance across the entire supply chain.

Perspective based approach

Perspective based measurement model was developed by Otto and Kotzab (2003). They take all the possible perspectives of a supply chain into account and provide measures to evaluate each

perspective. The authors defined a perspective as a unique view of what SCM is about. The authors proposed a goal-oriented approach suggesting six perspectives on SCM each of which follows a particular set of goals, which consequently leads to a particular set of performance metrics. These perspectives are: Systems Dynamics, Operations Research/Information Technology, Logistics, Marketing, Organization and Strategy. Two main perspective based models are SCOR based and BSC based models.

Supply chain operations reference (SCOR) based model

The SCOR model (Supply Chain Council 2006) was introduced in 1996 and includes five basic processes including plan, source, make, deliver, and return. Also, it represents thousands of performance metrics characteristics in reliability, responsiveness, flexibility, cost, and asset attributes. These attributes are characteristics of the supply chain that permits it to be analyzed and evaluated against other supply chains with competing strategies. The SCOR model is the only supply chain framework that links performance metrics, best practices and software requirements to a detailed business process model (Ramaa et al. 2009). Some of the performance articles used the perspectives and or attributes and or metrics of SCOR in developing their models.

Cai et al. (2009) proposed a framework using a systematic approach to improve the iterative key performance indicators accomplishment in a supply chain context. The proposed framework quantitatively analyzed the interdependent relationships among a set of key performance indicators. The framework includes a systematic approach that helps to analyze and select the right key performance indicator groups and strategies for their accomplishment, to improve supply chain performance. Considering the complicated characteristics of supply chains, the authors used a process-oriented SCOR model to identify the basic performance measures and the key performance indicators in their methodology. Berrah and Cliville´ (2007) with the aim of SC performance formalization modeled it according to the SCOR model, with its five main processes (Plan, Source, Make, Deliver and return).

HWong et al. (2007) used SCOR metrics as input and output variables of data envelopment analysis (DEA) model. The authors employed some of the metrics in levels 1-3 of SCOR and then used the DEA as a tool to analyze these variables to evaluate supply chain efficiency. And Wong et al. (2008) for discussing an application study on supply chain performance measurement in stochastic environment used input, output and intermediate variables (metrics)

that were categorized according to the performance metrics listed in the SCOR. Theeranuphattana and Tang (2008) proposed a model with the aim of more user-friendly SC performance measurement model than the model proposed by Chan and Qi (2003b). For this, the authors employed SCOR model and combined it with Chan and Qi model. They demonstrated that these two methods complement each other when measuring SC performance.

Balanced scorecard based model (BSC)

Kaplan and Norton (1992) have proposed the BSC approach as a tool for performance evaluation through four perspectives of financial, internal business process, customer, and learning and growth. Some of performance articles used the BSC perspectives in model development.

Bhagwat and Sharma (2009) studied required performance metrics and developed a model for SC performance evaluation. They used BSC approach to analyze their operations from every angle that covers all perspectives of business.

Bhagwat and Sharma (2007b) constructed a hierarchical model and put BSC perspectives in the lowest level as alternatives. They presented a methodology that can help firms to prioritize and formulate viable performance measurement strategies in the volatile and complex global decision environment from different BSC perspectives. In another paper Bhagwat et al. (2008) referred to this model and developed a methodology to optimize the overall performance measurement of SCM for SMEs. In yet another paper Bhagwat and Sharma (2007a) presented a BSC model for supply chain management in their framework that is structurally similar to the BSC framework proposed by Kaplan and Norton. In this paper, the BSC has applied metrics that was proposed by Gunasekaran et al. (2001) with the intent to evaluate SCM performance comprehensively. Four perspectives of the BSC were applied to these metrics or in another words the different metrics were fitted into four different perspectives of BSC to give a balanced picture of SCM performance evaluation.

Bigliardi and Bottani (2010) proposed a generic BSC model for supply chain management by focusing on the specific context of the food supply chain. The authors identified key performance indicators in the context of BSC and applied the Delphi technique for obtaining a high degree of consensus on the key indicators in their model. Then the authors offered the final results of Delphi technique as BSC model and tested it on two companies, operating in the food industry for validation.

Developing a performance measurement tool set (performance measurement factors) involves a rather complicated process and can be very challenging for ordinary businesses (Chan and Qi, 2003; Aramyan *et al.*, 2007). A typical firm already has a certain number of performance metrics such as return on investment (ROI) for assessing its financial performance, but supply chain related performance metrics have not been widely adopted and businesses are typically uninformed of them. Companies often find that there is a lack of practical guidelines on how to develop performance metrics (Lapide, 2000). Therefore, this research will bridge these gaps by developing supply chain performance measurement framework or model to improve performance measurement comprises performance measurement factors with respect to supplier relationship management, internal supply chain management and customer relationship management. The performance measurement factors are further organized hierarchically across the decision making levels (strategic, tactical and operational).

Techniques

Analytic hierarchy process (AHP)

The Analytical Hierarchy Process (AHP), is a decision making tool proposed by Saaty in 1980. It was developed to reflect the way people naturally behave and think, thus it can help in describing the general decision operation by decomposing a complex problem into a multi-level hierarchic structure of objectives, criteria, sub-criteria and alternatives. Bhagwat and Sharma (2007b) prioritized SCM metrics and different performance metric levels with the help of the analytical hierarchy process. In their paper, AHP is also used to prioritize the different BSC perspectives for SCM evaluation. For pair-wise comparison in AHP, the authors used a survey methodology.

Chan (2003) used AHP to make decisions based on the priority of performance measures. The author outlines the application and particularly the pair-wise comparison which helps to identify easily the importance of different performance measurements and then applied AHP to choose the optimum supply chain.

Yang (2009) in order to build implement model of SC performance evaluation system, proposed logarithm triangular fuzzy number-AHP method expanding from fuzzy environment and developing from traditional AHP method for using in evaluation of integrative performance evaluation index system.

Bhagwat and Sharma (2009) explained how an integrated AHP-PGP (pre-emptive goal programming) model can be used in performance measurement while optimizing the overall

performance. The authors used AHP and PGP techniques to determine the required performance measures and provide the values of the performance metrics to optimize the overall performance, respectively. These optimized values of the performance metrics will help the decision maker to identify and focus on performance metrics, which are crucial for overall PM of the system.

Bhagwat et al. (2008) applied AHP and linear programming techniques to optimize the overall performance measurement of SCM for SMEs. By considering the hierarchy proposed in Bhagwat and Sharma (2007b), the authors used AHP to prioritize SCM parameters in the model. Then based on the prioritization of the performance measures and performance at different decision levels, they developed a linear programming model to optimize the overall performance measurement of SCM for SMEs.

Data envelopment analysis (DEA)

Data Envelopment Analysis (DEA) was originally proposed by Charnes *et al.* (1978) as a linear programming, nonparametric technique, used to measure the relative efficiency of peer decision making units with multiple inputs and outputs, and thus to perform analysis of how efficiently a company operates. Wong and Wong (2007) and Wong et al. (2007) with the aim of measuring internal supply chain performance used data envelopment analysis and developed two DEA models to measure SC efficiency based on inputs and outputs variables. These two models were technical efficiency and cost efficiency. The authors addressed that technical efficiency reflects the ability of a firm to obtain maximum output from a given set of input, and cost efficiency is equivalent to the opportunity cost.

Wong and Wong (2008) gave motivation of using DEA in addressing supply chain benchmarking. The authors first reviewed problems in supply chain benchmarking, existing tools used in benchmarking, problems in existing tools and then justified that DEA can be used as a benchmarking tool for supply chain performance measurement. Wong et al. (2008) proposed a framework employing Monte Carlo simulation and DEA to measure supply chain efficiency in a stochastic environment. The authors introduced a DEA model to measure the supply chain efficiency by considering the entire value chain. Since the DEA supply chain model can only be used to measure supply chain efficiency in a deterministic environment (because it requires all data to be known) and it is not able to operate in a stochastic environment (where the data are uncertain), the authors utilized Monte Carlo simulation to handle stochasticity in the data and addressed its simplicity as their motivation of selecting this technique.

Yang et al. (2009) considered that the performance of a supply chain is attributed to two main factors: the performances of all supply chain members, and the cooperation and harmony of its members. The authors defined two types of supply chain production possibility sets and based upon those, proposed a supply chain constant return to scale DEA model to appraise the overall technical efficiency of supply chains. Wong (2009) supplements the proposed framework in Wong et al. (2008) by adding genetic algorithm technique to it. He presented a genetic algorithm-based heuristic technique to improve the prediction of the SC performance measurement.

Delphi

Delphi technique is a systematic, interactive forecasting method, which allows obtaining forecasts from an independent panel of experts, over two or more rounds.

Bigliardi and Bottani (2010) with the aim of developing a model for supply chain management by focusing on the specific context of the food supply chain identified key performance indicators with literature review, concerning SCM, performance measurement and food supply chain. The authors adopted the Delphi technique with the aim of obtaining a high degree of consensus on the key performance indicators to be included in their model.

CHAPTER THREE

3. RESEARCH METHODOLOGY

3.1. Introduction

This chapter discusses the research methodology of the study. It describes the research design, research approaches, data collection and analysis strategies employed to answer the research questions. The research design or process followed in this study consisted of the following steps. At the initial stage of the research, problems were identified from preliminary review of the literature. This process involved stages of revision of the original ideas until gaps were identified within the area of research interest. Several potential research questions were generated from the research problems. The literature was thoroughly checked to determine whether those questions had been answered. The research aim was then identified based on the final selection of research questions, and the research objectives were derived from the main aim, being refined several times in the process. Then, to answer the research aim, literature was further studied to establish an appropriate theory. Key concepts or variables involved in the subject of research were identified.

3.2. Research strategies (methods and sources of data collection)

3.2.1. Sources of Data Collection

The data use for the study is based on both primary and secondary sources; the **primary** sources of data are collected through observation, Literature review, questionnaires and face-to-face interview. The **Secondary** sources of data are use from different relevant books, manuals, available documents, organizational chart, magazines, manuals, and published and unpublished Articles.

Observation: An observation will take place on Ethiopia meat processing industries to know the practical problems faced for time utilization & their attitude towards dedication, involvement and commitment for the tasks.

Literature review: - Different reliable books, articles and Internet websites referred that states review of literatures pertaining to the subject matter to develop understandings and concepts. The literature review concentrated on several areas. This begins with a discussion of supply chain management; the review then considers the performance measurement. This performance measurement perspective assists in understanding the relationships between performance

measurement and supply chain management. Then, the review focuses on supply chain performance measurement that involves on the issues of Supply chain performance measurement historical approach, proposes, characteristic, models or approaches and Performance measurement factors for supply chain performance measurement. Finally the review discussion of Supply chain management on Ethiopia livestock and meat**.**

Questionnaire design

Without a logical and reasonable questionnaire, the whole process of the future analysis will be garbage-in –garbage-out (Leedy et al., 2005). In this study, a structured questionnaire was developed. The rational for this approach and the quantitative questionnaire was that the quantitative (descriptive survey) method allows direct investigation of the perception of respondents involved in SCM practices (Leedy et al, 2005). According to Leedy et al (2005), survey research is a commonly used method and large amount of information can be collected and quantitatively described. It also allows a researcher to measure what cannot be observed and investigate relationships between dependent and independent variables.

The main reasons the researcher to select the descriptive survey approach was that:

- This survey method is the most economical method of obtaining information via email and postal service from a sample that is geographically widespread area (Leedy et al., 2005).
- Descriptive survey study is not time taking to collect data from large populations

Therefore, the questionnaires were carefully designed to reflect each of the themes in the research's conceptual framework and its elements as well as with the research aim and objectives. Thus, the target questionnaires of this study were divided into three categories: the respondents from purchasing department to represent the relationship with supplier, the respondents from marketing department to represent the relationship with customer, and the respondents from production department to represent the internal supply chain of the company. Five point Likert scale was used to measure the respondents` strength of likelihood with the research variables.

The Likert scale does not provide an accurate measure of attitude towards a topic, but helps place different respondents relative to each other in terms of the intensity of their attitude towards an issue (Kotrar et.al, 2005). The Likert scale used in this research is expressed as categories, not numerical points. The following conversions were used

1 = poor/ nil **2 = fair/low** **3 = good/moderate**

4 = very good/ high **5 = excellent/ very high**

As well as, in this study semi-structured interview was developed. The target interviewees of this study were to understand the overall of case companies supply chain management and to measure the supply chain performance on supply chain macro processes, the top management of case study companies.

Research Sample (Case Study)

According to Robson (1993), a case study is a strategy for doing research which involves the empirical investigation of a particular contemporary phenomenon within its real life context using multiple sources of evidence. Case study research typically is employed to explore real life events over which the researcher has little control, and where the boundaries between the context and events are not readily evident (Yin, 1994). It consists of a detailed investigation, often with data collected over a period of time, of one or more organizations, or groups within organizations, with a view to providing an analysis of the context and processes involved in the phenomenon understudy (Hartley, 1994). The aim of selecting a case study was to focus on specific case areas. In this study, the researcher used five case study meat processing companies in Ethiopia. They are Luna, Mojo modern, organic, helimex, ELFORA. The five case study companies were selected on the basis of the following criteria. In Ethiopia six operational export abattoirs industries (Luna, Mojo Modern, Organic, Helimex, Elfora, Abergele) however, at this time only these five case companies to export meat.

3.2.2. Methods of data collection

For producing empirical research, there are two methods of data collection: Qualitative and Quantitative. These two methods have their own strength and weakness. The qualitative method permits researchers to study selected issues in detail. Approaching fieldwork without being constrained by predetermined categories of analysis contributes to the depth, openness, and detail of qualitative inquiry. This method, however, typically produces a wealth of detailed information about a much smaller number of people and cases, which in turn increases understanding of the cases and situations studied but reduce generalization.

The quantitative method, on the other hand, requires the use of standardized instruments so that the varying perspective and experiences of the people can fit a limited number of predetermined response categories, to which numbers are assigned. The advantage of quantitative method is to

measure the reaction of many people to a limited set of questions. Thus, it facilitates comparison and statistical aggregation of the data, which in turn gives a broad and generalized set of findings presented succinctly and parsimoniously therefore, in this study quantitative and qualitative method using questioner survey and interview as the main data gathering method. Qualitative data were used for studying supply chain characteristics of each case study company, and identifying their supply chain performance. By contrast, quantitative data were used for measuring performance of case study companies.

3.3. Data analysis strategies

Data analyses depend on both the objectives of the study and the nature of the variables in the data collected. The data that were collected from case study companies had both qualitative (words) and quantitative (numbers). Qualitative data were used for studying supply chain characteristics of each case study company, and identifying their supply chain performance. Quantitative data was used for measuring performance of case study companies, and analyzed by the analytic hierarchy process (AHP).

The analytic hierarchy process is a multi-criterion decision making tool developed by Saaty (1980). It was developed to reflect the way people naturally behave and think, thus it can help in describing the general decision operation by decomposing a complex problem into a multi-level hierarchic structure of objectives, criteria, sub-criteria and alternatives. Specifically, the AHP is a general measurement theory that depends on the values and judgments of individuals and groups. AHP is a systematic procedure for representing the elements of any problem, hierarchically. According to Jagdev *et al*. (2004) since decision making in the strategy formulation domain is often fraught with uncertainty, the decision maker should be able to express a degree of belief and confidence in its judgment. AHP provides a theory and a corresponding methodology, which support the modeling of unstructured problems. The major advantage of the hierarchical structure is that it allows for a detailed, structured and systematic decomposition of the overall problem into its fundamental components and interdependencies, with a large degree of flexibility. AHP has been often adopted in order to measure the performance of a SC. To do that, three performance levels are required: the strategic, tactical and operative ones.

AHP has been used in a wide range of applications such as operations management decision making (Partovi *et al*., 1990), risk of projects management (Dey *et al.*, 1994), plant layout (Dweiri and Meirer, 1996), quality function deployment (Bergquist and Abesysekera, 1996), new

product screening (Calantone, 1999), part-machining grouping (Ziilal and Arikan, 2000), benchmarking project management (Dey, 2002), performance assessment (Jagdev *et al*., 2004), project evaluation and selection (Dey, 2004, 2006), material selection (Dweiri and Al-oqla, 2006), operational performance measurement (Dey *et al.*, 2006) and site selection (Dey and Ramcharan, 2008). AHP involves 7 steps

1. *Problem decomposition and hierarchy construction:* The top level of the hierarchy is the overall objective. The next level is the criteria. Below this level are the sub criteria.
2. *Determine alternatives:* The decision alternatives are constructed and added to the lowest level of the hierarchy.
3. *Pair-wise comparison:* Pair-wise comparison aims at determining the relative importance of the elements in each level of the hierarchy. It starts from the second level and ends at the lowest level. The decision maker needs to express the preference between each pair of the elements.
4. *Weight calculation:* Mathematical normalization methods are used to calculate the priority weights for each level.
5. *Consistency check:* A consistency ratio (CR) is calculated. If it is greater than 10 per cent, then the decision maker is not consistent in making the pair-wise comparison. The decision maker should review the comparison and make adjustment.
6. *Hierarchical synthesis*: The calculated priority weights at different hierarchy levels are integrated to allow overall evaluation of the alternatives.
7. *Determine priority for all alternatives:* The alternative with the highest overall priority weight is chosen (Huan *et al.*, 2004).

This research proposes the use of the analytic hierarchy process as aid in measuring the performance of supply chain of participating organizations in the following explanation.

- A subjective decision process can be formalized owing to the hierarchy structure. This leads to accurate decisions.
- Ensures consistency of the decision judgment.
- Clearer understanding of the problem by dividing it into sub-problems.
- The comparison may be made by teams or an iterative process until an agreement is reached by the team members.

Conclusions and recommendation based on the collected data and findings, important conclusions and recommendations are forwarded.

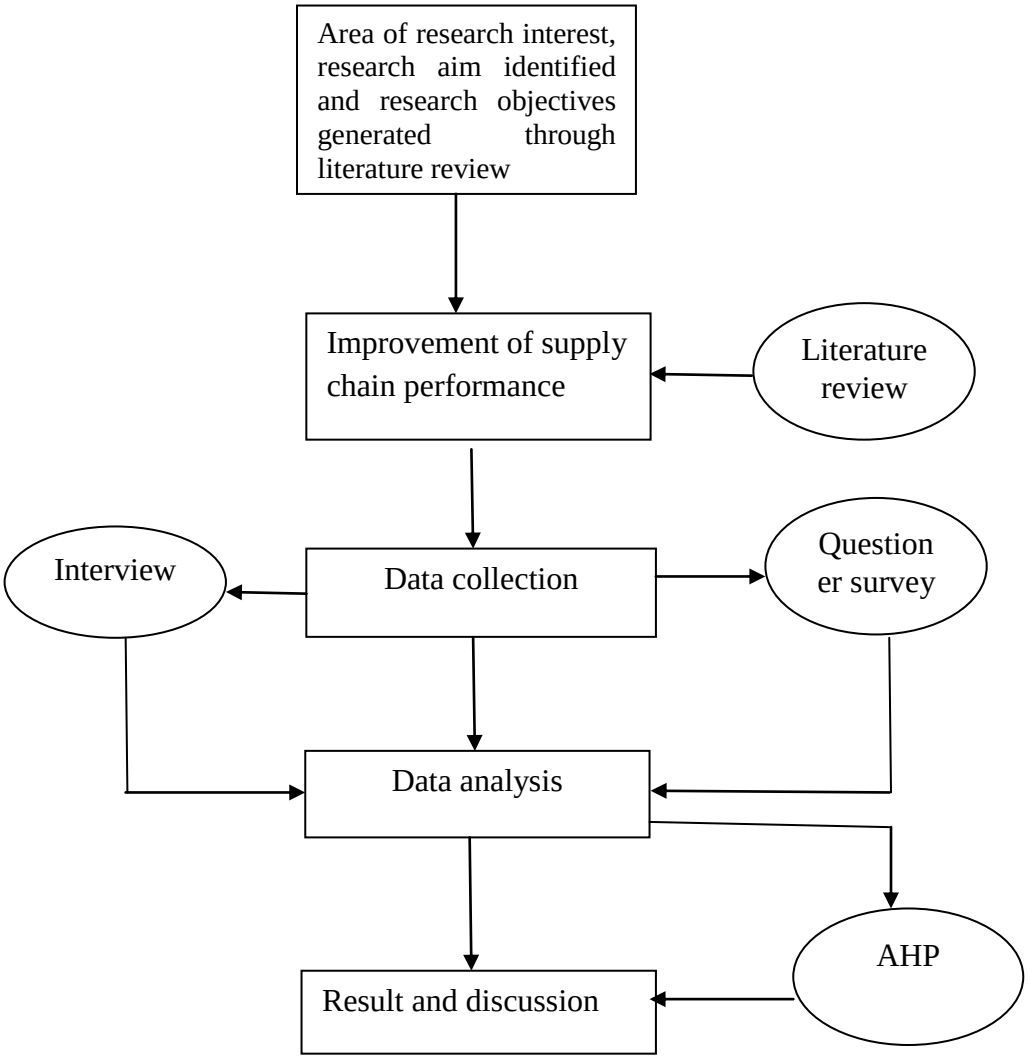


Figure3.1 Research process

CHAPTER FOUR

4. BACKGROUND OF ETHIOPIAN MEAT PROCESSING INDUSTRY

4.1. Introduction

During the last four years (2003–07) the Ethiopian economy grow at an average rate in excess of 5.5%. This growth has been attributed mainly to an expansion in agriculture, export trade, industry, construction and other service sectors *(Diary and livestock and meat developing institute).* Ethiopia has the tenth largest livestock inventory in the world as the country has the largest number of livestock in Africa; Ethiopia has much to gain from the growing global market for livestock products. Livestock is central to the Ethiopian economy, contributing 20% of the GDP, supporting the livelihoods of 70 % of the population and generating about 11% of annual export earnings. The country has comprising 49 million cattle, 25 million sheep, 22 million goats, 7.58 million equines, 0.76 million camels and 38 million poultry. There were 17.7 million cows and heifers older than three years *(Trade bulletin issue1, (2010) Ethiopian's meat and live animal exports*) Animal ownership is ubiquitous throughout Ethiopia, including the AGP wore as in the Highlands.

The majority of Ethiopia's livestock is found in the highlands, 95 percent of the livestock supplied for export is supplied by the pastoral and agro-pastoral areas of Afar, Somali and Borena. The country has been earning foreign currency by exporting meat (mainly chilled shoats' carcass and also frozen in minimal) and live animals namely cattle, sheep, camels and goats to major destination markets of UAE, KSA, Yemen and Egypt. As the country has the largest number of livestock in Africa, Ethiopia has much to gain from the growing global market for livestock products. The meat from Ethiopia is known by its organic nature and preferred by most of our customers from Middle East Countries. This is because cattle's are reared by farmers in extensive system free of any fattening chemicals and hormones. *(Diary and livestock and meat developing institute and Industry minister)*

A substantial progress has been achieved in improving the livestock and meat export sub-sector in general and increasing the foreign currency earnings from the sector in particular, as a result of several efforts exerted by Ethiopian government and partners. The former Livestock Marketing Authority (LMA) paved the way for the development of both domestic and export livestock market. Likewise, the establishment of USAID funded Ethiopia Sanitary & Phyto

sanitary Standards and Livestock & Meat Marketing Program (SPS–LMM) in 2005 and Ethiopia Meat & Dairy Technology Institute in January 2008, are the major measures taken to support private sector to immediately increase sales and profitability and provide them with tools for long –term success *(Trade bulletin issue1, (2010) Ethiopian's meat and live animal exports)*

Technical assistance and training provided by SPS-LMM has improved productivity, market transparency and infrastructure essential for meat and live animal exports. SPS-LMM interventions have included assessment of feed resources, introduction of "best cost" total mixed rations, livestock market information, dairy beef production, design and specifications for international standard feedlots and abattoirs, cost analysis for road/sea refrigerated meat transport and management of the cold chain for processing and transport of meat products to meet requirements of international markets. Moreover, SPS-LMM has organized observation missions to Texas, Morocco, Kenya and South Africa, from which Ethiopian exporters and Ethiopian government development agents have learned from the practical experiences of successful commercial feedlot and abattoir operators. Trade missions to Egypt, Kingdom of Saudi Arabia, United Arab Emirates, Yemen, Bahrain, Kuwait, Oman, Cote d'Ivoire, Ghana and DR Congo, and participation of Ethiopian exporters at 2009 and 2010 GULFOOD Fairs, identified market preferences, and created an opportunity for private sectors to establish contact with new and potential buyers. *(Trade bulletin issue1, (2010) Ethiopian's meat and live animal exports and A desk study end market analysis of Ethiopian livestock and meat micro report #164)*

4.2. Ethiopian Meat and Dairy Industry Development Institute

Meat export industry is one of the sectors that have been given development priorities by the Ethiopian government. In the last few years, several factors have altered the livestock-marketing landscape in Ethiopia. There has been considerable development in the private livestock export industry. The number of modern livestock export firms established in the country has been on the rise. There has also been a growing demand and expanding export market for livestock products, particularly goat meat, from Ethiopia. The primary destinations include Middle Eastern and Gulf State nations (*Diary and livestock and meat developing institute)*

The Government of Ethiopia has recently elaborated a number of agricultural policies and strategies aimed at creating and enabling an environment for investments in the sub-sector, the main thrust of which is to promote labour-based technologies and land capitalization aimed at production for both the domestic and international markets. The Government of the Federal

Democratic Republic of Ethiopia (GFDRE) recognizes livestock as one of the country's key economic resources. The government's policy aims to increase in-country value addition by encouraging meat exports over live animal exports. In January 2010, the Ministry of Agriculture and Rural Development (MOARD) launched a request for Expressions of Interest (EOI) for the completion of the Livestock Development Master Plan. This plan—initiated in 2004 but stalled at the baseline phase after the second phase was rejected—was originally intended to support meat production for both the domestic and export markets and encompass technology packages for meat production, the establishment of disease-free zones and a standardized sanitary and phytosanitary (SPS) system. The development of these plans has proven difficult, yet government targets for exports remain ambitious. The GFDRE's current aim is to increase meat exports from 8,000 MT to 30,000 MT per year, which—given the low dressing rate of sheep and Goats will require a significant increase in beef exports. Indeed, beef is expected to account for two-thirds of the overall exports *(Diary and livestock and meat developing institute*)Support ***for meat production and marketing***, as well as for live animals, has been mainly a government activity in the past but has taken various organizational forms (Azage Tegegne et al, 2006). The Livestock and Meat Board (LMB) was the first institution to be set up, under the Imperial Government, to provide services to meat and livestock in 1964. The Livestock Marketing Authority (LMA) was established in 1998 but was dissolved in 2004. LMA, during its short life, played a major part in the establishment of the private sector Live Animals and Meat Exporters Association which is overseen by the Ministry of Trade *(Diary and livestock and meat developing institute*).

In order to overcome these challenges and increase in-country value addition, the Ethiopian Government is committed to supporting meat exports. Yet such exports remain small in volume, constrained by inefficiencies in purchasing, poor animal handling and inadequate facilities at the abattoir and export level. These factors all contribute to low meat quality and unreliable supply—which are the major complaints of Gulf importers regarding Ethiopian meat *(Trade bulletin issue1,(2010) Ethiopian's meat and live animal exports)*

To this end the Federal Democratic Republic of Ethiopia (FDRE) has established the Ethiopian Meat and Dairy Technology Institute [EMDTI] under the Ministry of Agriculture (MoA), with a vision stated as "Ethiopian livestock and livestock products preferred and competitive in the global market". Its mandates are written in a regulation issued by the House of Peoples

Representative of the parliament of FDRE. It was learned that one of EMDTI's mandate is the facilitation of provision of land for livestock processing purposes in the capital Addis as well as in all the regional governments. *(Diary and livestock and meat developing institute*) Ethiopian Meat and Dairy Industry Development Institute are working with the following **objectives:**

- Capacity building of the major actors in the sector, that is, the abattoirs, the service providers etc by providing different trainings, showing new working systems and by providing information on new technologies,
- The second objective of EMDIDI is to expand markets of different livestock products (mainly meat). This is done to expand the existing markets and reach new and better paying markets.
- The third major objective is encouraging and facilitating investment in the sector. This is believed that the meat production capacity and technology base of the industry will change significantly. This could also ensure producer quality and higher price of meat and livestock produces from Ethiopia.

4.3. Export Abattoirs in Ethiopia

Table4.1: Export abattoirs industries in Ethiopia *(industry minister)*

Name of the abattoir		**Location**	**Establish-ment Year**	**slaughtering capacity heads**		**Land area of the abattoir**	**Current status**
				sheep and goat/day	Cattle **/8hrs**		
HELMEX		DEBRE ZEIT	2006	2000	200	56000m^2	Operational
ELFORA	ELFORA DEBRE ZEIT	DEBRE ZEIT	1973	2000	280	42000m^2	Operational
	ELFOR METEHA	METEH AREA	1998	2,200	-	50000m^2	Operational
	REA	Melge wendo	1960	1400	300	3280000m	
LUNA		MOJO	1995	1,600	120	50000m^2	Operational

MOJO MODERN EXPORT ABATTOIR	MOJO	2008	2,330	-		Operational
ORGANIC EXPORT ABATTOIR	MOJO	2006	1500	100	20000m^2	Operational
ABERGELLE EXPORT SLAGHTER HOUSE	MEKELLE	2010	**1,600**	240	55000m^2	Operational
ASHRAFE INDUSTRIAL GROUP	BAHIR DAR	2004	1,500	300	55000 m^2	Under construction
SAMI	DEBRE ZEIT	-	-	-	-	Under construction
PETRAM	DEBRE ZEIT	-	-	-	-	Under construction

4.4. Main Export Markets for Ethiopian Meat

- United Arab Emirates
- Saudi Arabia
- Angola
- Egypt
- Bahrain

4.5. Supply Chain for Meat and Live Animals of Ethiopia

The Ethiopian meat and live animal value chains have developed over the years into a series of complex constituents involving various actors that include producers, collectors, small private and cooperative fatteners/feedlots, various (and in some places, numerous) middlemen, livestock trading cooperatives, individual traders and exporters. Some of the meat and live animal exporters collect animals through their own purchasing agents assigned to major livestock markets and other small and large scale traders *(A desk study end market analysis of Ethiopian livestock and meat micro report #164)*

For live animal trade, purchase agents of exporters in turn collect animals either from collectors, small traders, livestock trading cooperatives, farmer groups, or directly from producers; who then have the option of selling their animals to the collectors in their village, small traders, and livestock trading cooperatives. Some farmers also form groups and supply animals to the market. Other than the domestic channel, foreign national live animal exporters-importers collect animals

directly from the collectors in most of the livestock markets using licensed Ethiopian traders *(A desk study end market analysis of Ethiopian livestock and meat micro report #164)*

The general value chain for meat and live animals trading and exporting is depicted in below Figure. *(Trade bulletin issue1, (2010) Ethiopian's meat and live animal exports)*

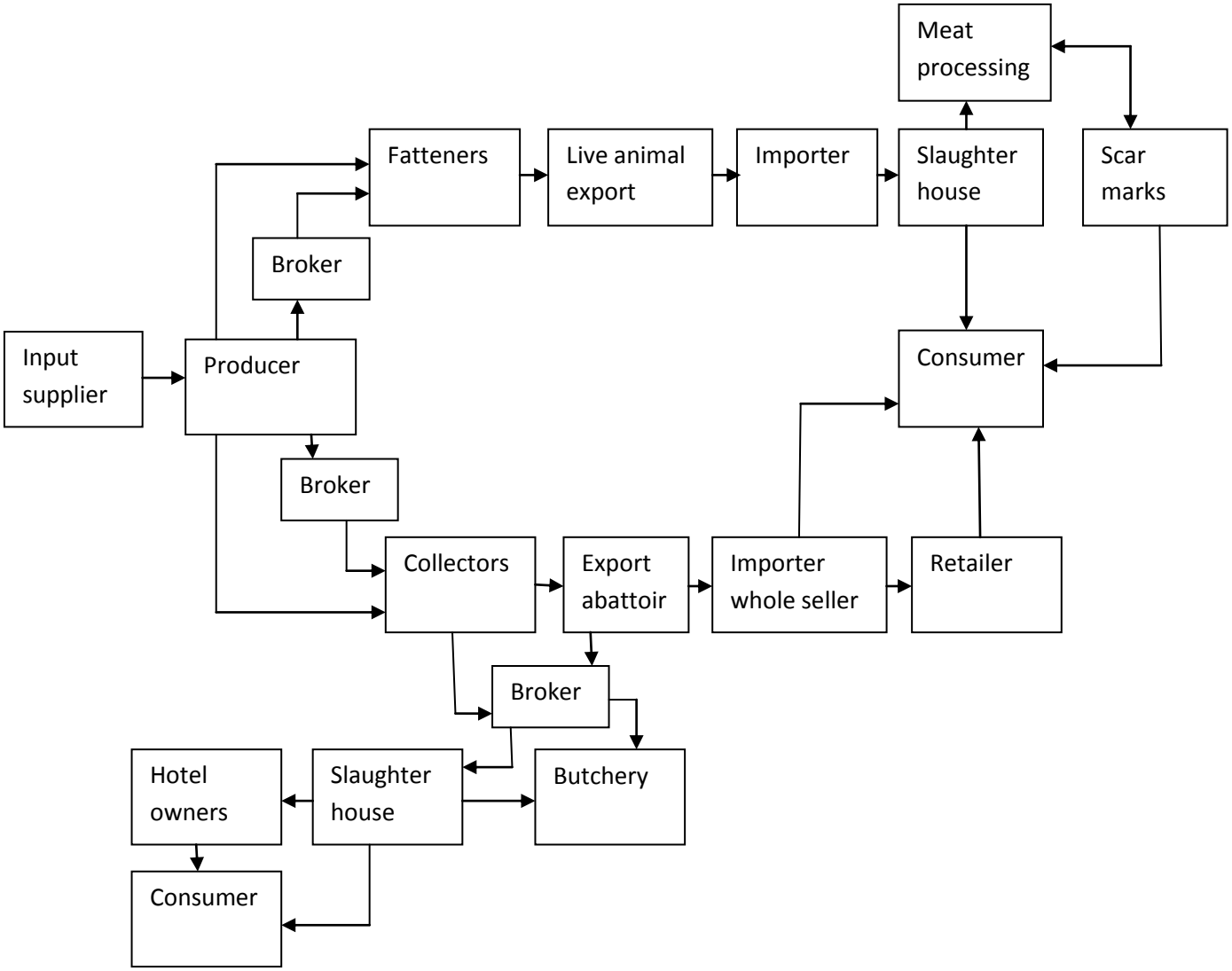


Figure 4.1supply chain network for Ethiopia livestock and meat processing [13]

Live Animal and Meat Supply Chain Actors

Producers: Highland and Pastoral

Ethiopia has the largest livestock herd in Africa, household livestock holdings particularly in non-pastoral areas is usually small. On average, highland households own between zero and three head of cattle or shoats. The largest share of meat and live animals for export are produced by lowland pastoralists: they account for 90% of all such production in Ethiopia however; there

is a growing share of highland animals entering the export supply chain. Producers rear cattle, shoats, and camel, in order of importance. They are often located in rural areas where access to market and infrastructure is insufficient *(Trade bulletin issue1, (2010) Ethiopian's meat and live animal exports)*

Although the majority of Ethiopia's livestock is found in the highlands, 95 percent of the livestock supplied for export is supplied by the pastoral and agro-pastoral areas of Afar, Somali and Borena. A large percentage of the cattle and beef meat exported from Ethiopia originates in Borena, and this area stages a fierce purchasing competition between live animal and meat exporters. This is likely due in large part to consumer preferences for Boran cattle and is facilitated by Borena Zone's relative ease of access from the feedlots and abattoirs in Adama (Nazreth), Modjo and Bishoftu (Debre Zeit). In Ethiopia cattle, goats, sheep, camel and poultry, are used as resource base for meat production. In general, the regions with the largest livestock populations in Ethiopian are Oromiya, Amhara and SNNP, with Tigray at a distant fourth. Table 4.2 Below breaks out the livestock population by the four regions *(Diary and livestock and meat developing institute and Industry minister)*

Table4.2: Livestock Population by LMD Region (2010-2011 data)

Regions	**Cattle**	**% of total**	**Sheep**	**% of total**	**Goats**	**% of total**	**Camels**	**% of total**
Ethiopia	52,129,017	24,221,384	22,613,105	979,318	Ethiopia	52,129,017	24,221,384	
Amhara	13,354,797	26%	8,227,862	34%	5,189,432	23%	55,626	6%
Oromia	22,481,530	43%	8,618,970	36%	7,226,944	32%	310,420	32%
SNNP	10,437,409	20%	3,865,819	16%	3,506,210	16%	0	0%
Tigray	3,539,395	7%	1,121,537	5%	2,874,520	13%	35,946	4%

Market and pricing information is difficult and often impossible to come by. Hence pricing received by the producers, when they go to market, is either the previous week's price or not the best price they could obtain if they had access to better and more timely information. Large animal herds are considered signs of affluence and prestige, especially in pastoral areas, so many producers only go to market when they encounter financial difficulties or face drought. Not only does this keep product off the market and represents sub-optimal production management, but it

also limits the ability of the producer to set a favorable price because he is either selling into a distressed market or he is not in a position to negotiate a fair price.

Collectors

These important market agents collect animals, usually from remote locations and gather animals to the producer areas where watering points are founds. Pastoralists and highland livestock owners typically sell their livestock to small traders in bush markets or primary markets. They are mostly independent operators who use their local knowledge and social relationships, family, clan and friends to collect animals.

Traders purchase animals on a sight basis, without the use of scales. Experienced traders can estimate the weight of sheep and goats—and sometimes even the dressing weight of cattle—to near accuracy. In turn, they become an important source for big and small-scale traders and livestock trading cooperatives, which lack the local knowledge and relationships. They are usually constrained by a financial capacity that limits their operations and keeps them within a narrow geographic range

The collectors are not always good sources of market information, however, and they may take advantage of a producers' limited knowledge of the markets. This can lead to distortional pricing, almost always benefiting the collector. Designing and implementing dependable information dissemination mechanisms is essential in order to develop significant levels of trust and cooperation among producers and other market actors in remote areas.

Livestock marketing cooperatives, whose membership is primarily small traders, are also involved in purchasing animals in bush markets or primary markets. They offer small traders certain economies of scale and access to larger traders or even export abattoirs (such as ELFORA), but are challenged by a lack of business skills and, frequently, a reliance on a single buyer. Feedlots, abattoirs and live animal exporters purchase livestock in secondary markets, either through their own purchasing agents or from traders, or occasionally from cooperatives. Several abattoirs report having had negative experiences sourcing livestock from cooperatives due to cooperatives' reported lack of understanding of market requirements, inability to supply the required quantity in a timely fashion, and inability to meet contract terms. This is likely the reason why some abattoirs currently do not purchase from cooperatives.

Feedlots

The feedlot/fattening operations include small scale private feedlots and those that operate larger facilities aimed at animal exporting. Some operate according to generally accepted SPS requirements and rules and regulations of animal quarantine, while others, particularly the smaller ones, do not. Feedlots generally purchase livestock, either through their own purchasing agents or from traders; they will also purchase from cooperatives on occasion. Feedlots generally purchase cattle; both young and older animals, fattening young animals primarily for sale to export abattoirs and older animals (more than five years old) for the domestic market. Feedlots are primarily located in and around urban areas. Feedlot operators noted a number of challenges to our research team, including policy-related issues that greatly affect the industry. There is not enough land available for feed production around cities and towns, and infrastructure such as roads, electric power and water are inadequate.

traders

Large traders, which are few in number, are those who are permanently operating in the live animal and meat value chain business and are known for purchasing large numbers of animals from a variety of sources in order to supply their key buyers (abattoirs and live animal exporters). Usually just one or two big traders will operate in a certain area and they'll often divide the markets among themselves, thereby reducing competition and increasing prices. The larger traders will use their own capital and act as a source of funding to their collectors. Most big traders are indigenous to the area in which they operate and they have extensive experience in the market in these areas.

Smaller traders, on the other hand, are large in number relative to big traders. At times, they are the only outlet to markets that many smaller collectors have. Unlike the larger traders, small traders have little working capital which results in their collecting limited numbers of animals on a weekly or even biweekly basis. They often use rented vehicles to transport the animals to abattoirs. Some small traders have relations with the larger traders and will often feed animals into the larger traders' networks; especially for the export market. The small traders lack access to the detailed market information that large traders possess, thus creating a situation where the small traders do not have accurate market information which further compounds the problem of limited market information.

Cooperatives:

Livestock cooperatives are located throughout the livestock production areas in Ethiopia; however, few exist in highland areas. Most of the livestock cooperatives operate in the shoats market because of the low financial requirement of shoats compared with cattle and camel. Livestock trading cooperatives have been established primarily to operate as a marketing arm for their members; they rarely work as a backward link for input suppliers to producers, although it was observed that some cooperative have begun attempting to work on input supplies. A number of problems plague livestock cooperatives including dysfunctional organizational setup and management systems, dependence on few buyers, a shortage of working capital, lack of market information inadequate training and conflicts of interest by cooperative directors, many of whom are also livestock traders themselves. The cooperative do not have an equal level of business skill; most of them lack entrepreneurial skills required to compete in the market with individual traders.

Brokers/Middlemen:

An important feature of the livestock marketing system in most of the livestock markets in Ethiopia is the involvement of brokers/middlemen in many segments of the marketing chain. They match buyers and sellers and facilitate transaction, and in some cases they indeed provide for a valuable service. Throughout the field work for this study, many teams identified several situations in which the channel from producer to final market would include one to three brokers/middlemen. Each successive middleman took a larger fee and added little if any value. Most of these middlemen were simply aggregators. This could be eliminated if proper wholesale markets or auction houses were established, nullifying the need for producers and other brokers to sell into larger pools of animals. In some market areas, particularly in remote rural locations, brokers not only provide an important service but are critical links to the markets for small holders.

Abattoirs/Butchers

In Ethiopia all of the existing abattoirs have facilities for sheep and goats, but facilities for cattle are limited in all of the abattoirs and none of the export abattoirs are currently exporting beef. These abattoirs get their animals supplied by traders or through their agents. When the demand is high and the supplies are limited from their usual sources, some of them buy animals from big traders at their factory gate. Upon arrival animals undergo physical examination and are rested for two to three days in a holding area where they receive feed and water. Before slaughtering,

they are held in lair age for 12 to 24 hours with access to water but not feed. During their stay in the lair age, animals undergo ante mortem or pre-slaughter examination. Animals that pass the examination are slaughtered using the Halal procedure. Afterward the carcass is chilled at -2 to 2 degrees Celsius for 24 hours. In most cases slaughtering is done when abattoirs receive orders from their customers. The only processing that local abattoirs do is put the carcass in stockinet for shipping. Depending on demand and availability of freight, carcasses are loaded onto trucks fitted with coolers and transported to the airport. All of the export abattoirs have their own trucks which they use for transporting. Upon arrival at the airport, the chilled carcasses are transferred to cold stores and held there until loaded onto the airplane shortly before the flight time.

4.6. Market Structure and Description Channels of Ethiopia

Most livestock markets in the study areas are administered by the respective towns' municipalities. Most woredas have just one livestock market and it is usually in the capital of the woreda. These are known as secondary markets and feed into the terminal markets which are located in the large, regional cities. Some secondary market places are fenced but do not have any infrastructure. Others have not even fencing; merely a designated area from which market activities are conducted. In some cases, the same fenced area is used for both large and small ruminants in others; separate enclosures are used for the different species two security personnel are assigned at each gate along with a tax collector. The trucks which transport the animals to the Addis Ababa market for instance. *(A desk study end market analysis of Ethiopian livestock and meat micro report #164)*

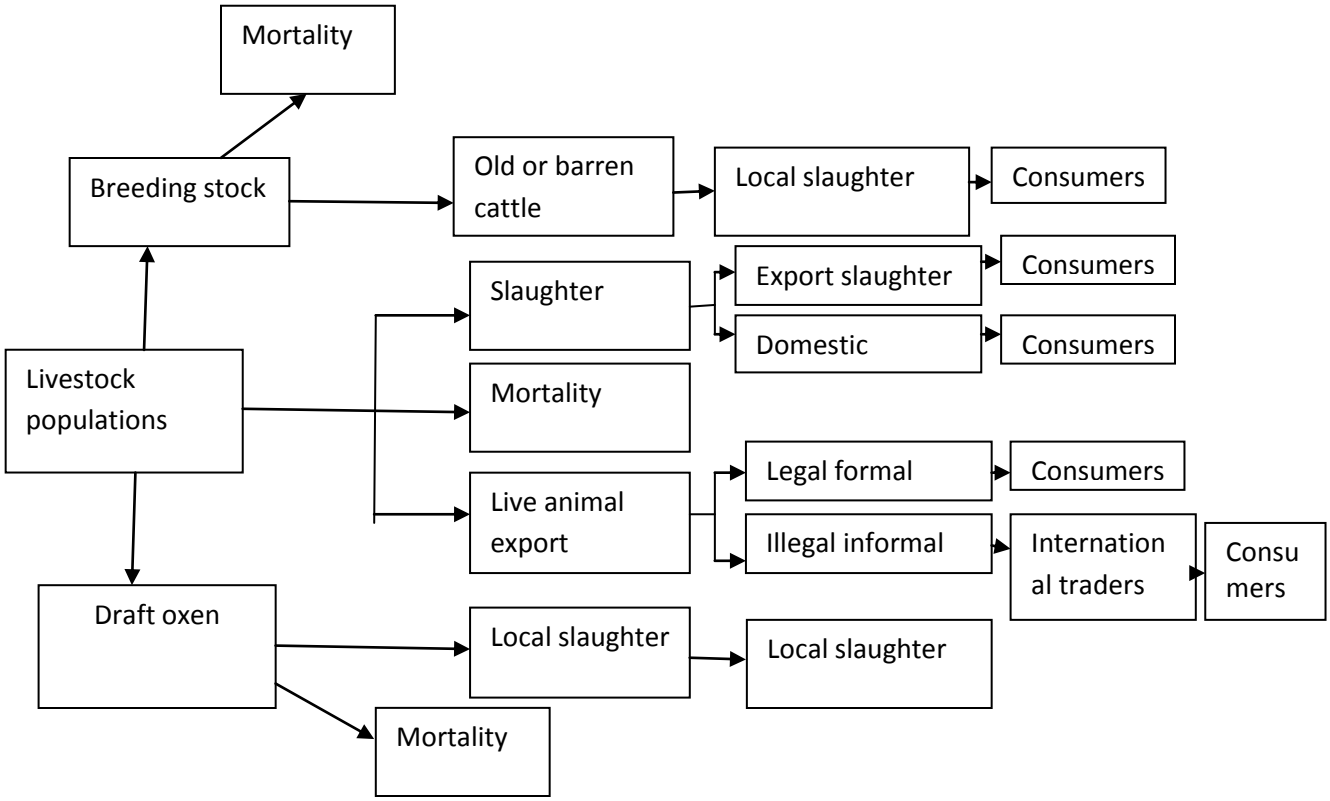


Figure 4.2 Market structure (source: meat and dairy sector)

4.7. Ethiopia Live Animal and Meat Export Performance

The Government of the Federal Democratic Republic of Ethiopia (GFDRE) recognizes livestock as one of the country's key economic resources. The government's policy aims to increase in-country value addition by encouraging meat exports over live animal exports. According to Ethiopian Revenues and Customs Authority's meat and live animal export performance data, meat export volume increased from 870 tons in 2000/01 to 7,468 tons in 2008/09. The country's export performance reached its peak in 2005/06 by exporting 7,917 tons of meat. In the same period under review, the meat export (chilled shoats carcass) value has picked up from USD 1.7 million to USD 27 million *(Trade bulletin issue1, (2010) Ethiopian's meat and live animal exports)* During the nine months, July 2009–March 2010, USD 85.5 million was earned from export of 7,018 tons of meat. During January–March 2010, Ethiopia generated USD 31.1 million by exporting 2,654.3 tons of meat (mainly chilled shoats carcass).

Comparison of the export performance of January-March 2010 with October-December 2009 showed that the volume and value of exported meat significantly increased during this quarter. Meat export volume and value increased by 17% and 19%, respectively. Similarly, as compared to similar quarter of the previous year (January-March 2009), the meat export volume and value increased by 49% and 42, respectively. *(Trade bulletin issue1, (2010) Ethiopian's meat and live animal exports)*

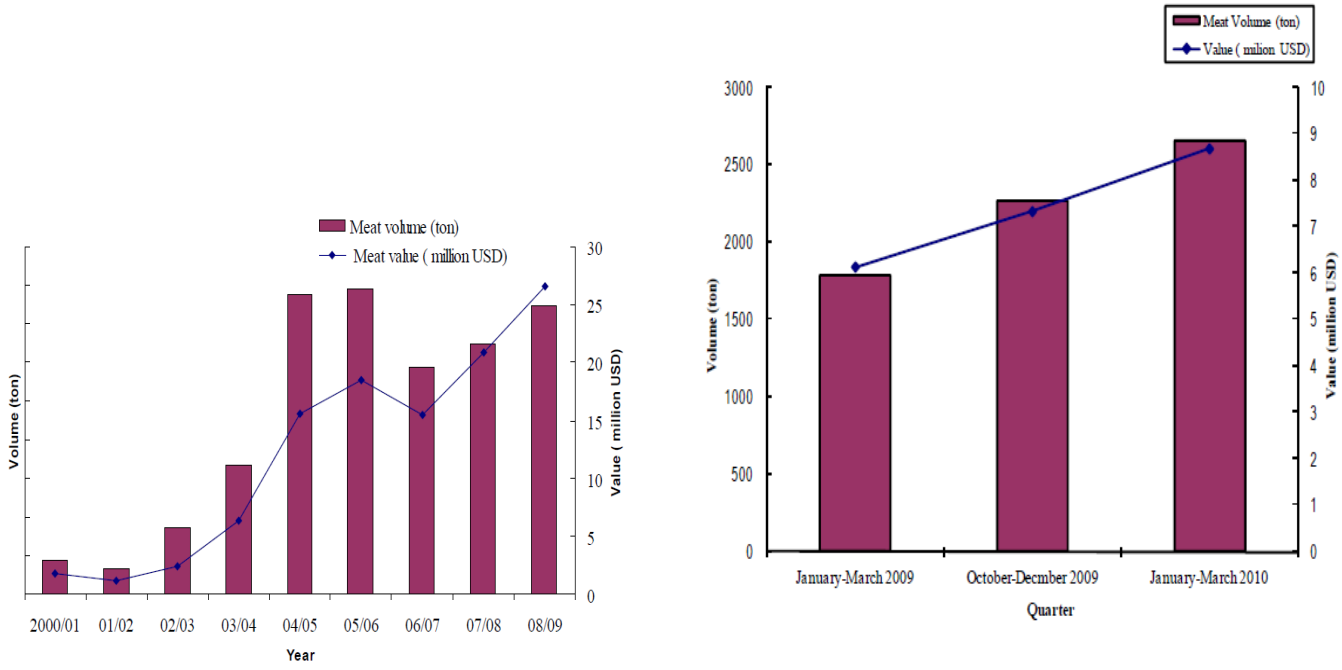


Figure4.3 a) Ethiopian meat export performance, 2000/01- 2008/09 b) Ethiopian meat export performance, 2000/01- 2008/09 [13]

In January 2010, the Ministry of Agriculture and Rural Development (MOARD) launched a request for Expressions of Interest (EOI) for the completion of the Livestock Development Master Plan. This plan—initiated in 2004 but stalled at the baseline phase after the second phase was rejected—was originally intended to support meat production for both the domestic and export markets and encompass technology packages for meat production, the establishment of disease-free zones and a standardized sanitary and phytosanitary (SPS) system. The development of these plans has proven difficult, yet government targets for exports remain ambitious. The

GFDRE's current aim is to increase meat exports from 8,000 MT to 30,000 MT2 per year. *(Trade bulletin issue1, (2010) Ethiopian's meat and live animal exports)*

In 2011, the volume of global meat exports was estimated at USD 105 billion, and Ethiopia accounted for less than one percent of this total (0.75 percent or USD 79 million), of which most was low-value. This ranked Ethiopia as the 43rd largest meat exporter. However, the government's Growth and Transformation Program (GTP), launched in 2010-2011, has established annual export goals of 111,000 metric tons of meat and 2,000,000 live animals by 2015, increases of nearly four-fold on 2011 numbers. Ethiopia has seen some progress in the volumes exported, increasing from 5880 MT in 2007 to 17,666 metric ton in 2011 but the numbers are not nearly as high as anticipated or needed to meet the aggressive targets laid out in the GTP. *(Meat and dairy sector)*

Table4.3: Meat and live animal export (2003-2007) compared to total agricultural

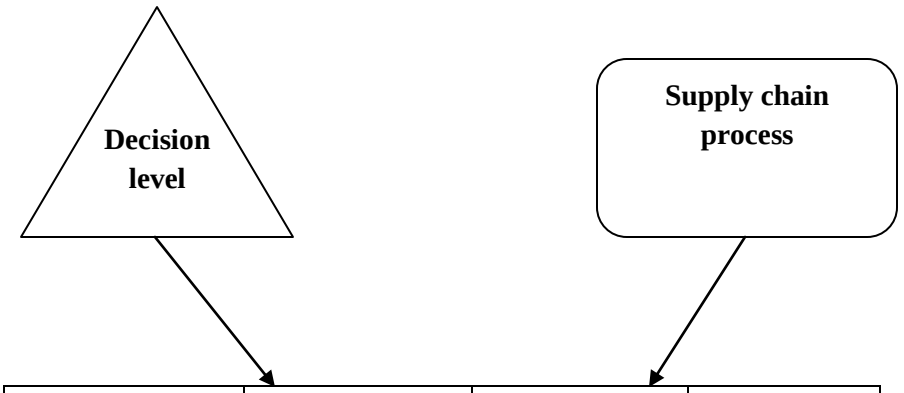
Year	**Meat (tons)**	**Million (USD)**	**Live animal (Quantity of Heads)**	**Million (USD)**	**Total livestock (Million USD)**	**Total Agricultural products (Million USD)**	**Livestock from Agricultu re (%)**
2011	27,780	100	582,698	150	250	2,665	9.4
2012	55,550	200	1,048,857	270	470	3,419	13.7
2013	69,440	250	1,552,173	400	650	4,308	15.1
2014	83,330	300	1,940,217	500	800	5,391	14.8

CHAPTER FIVE
5. CONCEPTUAL FRAMEWORK MODEL DEVELOPMENT

5.1. Introduction

A key aim of this research was to focus on the Ethiopian meat processing industries of the supply chain performance measurement, include a comprehensive set of performance indicators. Therefore, this chapter identifies and evaluates performance measurement indicators in relation to improve of the supply chain performance in Ethiopia meat processing company. These performance measurement factors were identified by combining both decision making levels and supply chain processes for measuring the performance of supply chain management system. The combination of decision making levels and supply chain processes was used to guide the fieldwork, notably in developing the topics in the questions for the Questionnaires and interviews with respondents. The questions reflected the detailed elements of each topic.

The supply chain performance will be improved across decision making levels with combining supply chain network process. The performance measurement indicators are identified in the decision making level and supply chain network processes: three decision making levels in strategic, tactical and operational; and three supply chain processes on supplier relationship management (SRM) from upstream, internal supply chain management (ISCM) with company and customer relationship management (CRM) from down stream. Therefore, from combination of both decision making levels and supply chain processes framework or structure has been developed. The framework allows the researcher to evaluate its potential application for the performance measurement of supply chain system in case study companies.



	SRM	ISCM	CRM
Strategic			
Tactical			
Operational			

Figure5.1 conceptual Framework model

5.1. The performance measurement indicators in the framework

The performance measurement indicators that contained in the framework are indentified on the three supply chain macro processes along with three decision making levels Based on the literatures review. Performance measurement indicators for supply chain performance measurement see in literature review the initial performance measurement indicators are identified to represent supply chain process steps. Then, to finalize a suitable set of performance measurement indicators depend on the literatures review.

The performance measurement indicators in supplier relationship management process

The performance measurement indicators of the supplier relationship management process are categorized hierarchically in three decision making levels: strategic, tactical and operational.

Table 5.1: The performance measurement factors in supplier relationship management

Performance measurement indicators of SRM		
Strategic	**Tactical**	**Operational**
Quality supplier selection	***Supplier performance***	Quality of products, Delivery performance, Overall reliability

	Selection process	Robust selection criteria, Clear scope, specification, and criteria for selection, Effective negotiation, Right contract
	Green supplier	Environmental policy, Design, Manufacturing, Reverse logistics
Supplier integration	***Coordination and resource sharing***	Operations, Decision making, Production planning
	Information integration	Information sharing, Collaborative planning, Joint demand forecasting, Standardized means of communication across functions and suppliers
	Organizational relationship	Designing and maintaining of communication channels, Risk sharing, Common objective and teamwork
	Use of information technology	State of art system in place, System's effectiveness, System improvement
Effective procurement processes	***Effective communication with production***	Developing right material specification, Identifying right suppliers for specific materials
	Effective management of purchase selection	Segregation of materials as per value and criticality, Maintaining up-to-date supplier database, Making purchase decision accordingly
	Effective contract administration	Contract selection, Inspection and verification, Payment, Evaluation

Performance measurement indicators in internal supply chain management process

The performance measurement indicators of the internal supply chain management process are categorized hierarchically in three decision making levels: strategic, tactical and operational.

Table 5.2: The performance measurement factors in internal supply chain management

Performance measurement indicators of ISHM		
Strategic	**Tactical**	**Operational**
Facility	***Capacity utilization***	Percentage of capacity utilization
	Efficiency	Capital cost, Operating cost
	Flexibility	Ability to change product produced
	Quality	State of art technology, Continuous Improvement possibility

	Reliability	Environment friendly, Safety, Availability or effective maintenance
Inventory	***Optimal inventory policy***	Decrease inventory levels, Decrease inventory costs, Shared inventory with supplier, Shared inventory with customer
	Warehouse utilization	Raw materials, Finished products, Spares and maintenance materials
Transportation	***Capacity utilization***	Percentage of capacity utilization
	Efficiency	Capital cost, Operating cost
	Reliability	Adhering to delivery schedule, Environment friendly, Safety, Availability or effective maintenance
Internal integration	***Information integration***	Improve data validity, Information system Flexibility, Information accuracy, Enterprise application integration Real-time monitor, Information sharing
	Internal quick response	Strengthen information sharing, Information timeliness, Information availability
	Use of information technology	State of art system in place, System's effectiveness, System improvement
	Efficiency	Capital cost, Operating cost
Human resources	***Motivation***	
	Safety	
	Training	
	Innovation and learning	
Operations	***Operational performance***	Flexibility, Customer services, Consistence quality, Reliability, Waste reduction
	Environmental performance	Environmental policy, Environmental audit, Energy consumption, Emission, Reverse logistics
	Innovation	State of art technology, Continuous improvement

The performance measurement indicators in customer relationship management process

The performance measurement indicators of the customer relationship management process are categorized hierarchically in three decision making levels: strategic, tactical and operational

Table 5.3: The performance measurement factors in customer relationship management

Performance measurement indicators of CRM		
Strategic	**Tactical**	**Operational**
Customer service	***Responsiveness***	Quality, Innovation, Customer satisfaction
	Customer order processing and delivery	Response time, Order fill rate, Order flexibility, Delivery performance
	Handling customer complaints	System in place, Number of complaints Received, Number of response made
	Value added service	Flexibility of services to meet particular customer needs, After sales services
Customer integration	***Extent of cooperation to improve quality***	New product and service development, Regular operations, Under contingency
	Information integration	Information sharing, Collaborative planning, Joint demand forecasting, Standardized means of communication across functions and customers
	Organizational relationship	Designing and maintaining of communication channels, Risk sharing, Common objective and teamwork
	Use of information technology	State of art system in place, System's effectiveness, System improvement
Demand forecasting	***Forecasting system in place***	State of art technology, Forecasting model, Forecasting process
	Decision making	Governance, Fast decision making
	Reliability of demand data	Accuracy of forecasting techniques, Improve response to customer demands, Decrease prediction errors, Forecast volatility, Increase employee's adaptation for changes
Market analysis	***Market equity***	Percentage of market share, Percentage of change, Trend
	Customer acquisition	Percentage of increase, Critical zone
	Customer retention	Percentage of shift, Critical zone
	Government policy over market equity	Subsidy of raw materials, Equal trade opportunity, Knowledge sharing among public and private sectors

Incorporated our indicators which were identified from the above tables, into the survey questionnaire and interviews **(Appendix 1and2**)

5.1. Evaluation of Supply Chain Performance of Ethiopian meat processing industry

From the data collections evaluate the supply chain performance in relation to performance measurement factors in the five case study meat processing companies: the supply chain

performance is discusses based on two main concepts: the supply chain macro processes and the decision making levels

5.1.1. Evaluation of Supplier relationship management

The supplier relationship management provides the structure for how relationships with suppliers are developed and maintained (Croxton *et al.*, 2001). This supplier relationship management process represents for all processes that focus on the interface between the company and its suppliers (Chopra and Meindl, 2004).in this study based on the proposed supply chain performance measurement framework supplier relationship management has three performances measurement factors in strategic decision making level. They are quality supplier selection, supplier integration and effective procurement processes.

5.1.1.1.Quality supplier selection

Quality supplier selection refers to key criteria to select the suppliers that qualify the company's standard of quality. Under quality supplier selection, there are three performance measurement factors in tactical decision making level. They are supplier performance, selection process and green supplier.

Supplier performance

Supplier performance refers to a measurement to describe how good a supplier can deliver raw materials to production facilities on time and in good conditions (Chan *et al.*, 2003).

The Ethiopia meat processing industry they have no specific suppliers. The companies collect animals through their own purchasing agents assigned to major livestock markets and other small and large scale traders. Two of the export abattoirs that are currently in operation buy more than 90% of their animals at the factory gate, whereas the other three operating export abattoirs use a number of different mechanisms for collection including their own agents, and through livestock trading cooperatives. Purchase agents of exporters in turn collect animals either from collectors, small traders, livestock trading cooperatives, farmer groups, or directly from producers; who then have the option of selling their animals to the collectors in their village, small traders, and livestock trading cooperatives. Some farmers also form groups and supply animals to the market. Therefore delivery performance and overall reliability of suppliers are very good, Quality of products are good.

Selection process

Selection Process refers to the process to select the quality suppliers including selection criteria and negotiation. The Ethiopia meat processing industries they have no specific suppliers but

Purchase agents before purchasing animals from a specific area, price, the private animal health personnel representing the traders must contact the local veterinary officers at *woreda* levels to collect information on the livestock disease situation in the source area. This is done to minimize the risk of purchasing infected or sick animals. Based on the collected information, individual animals should be visually inspected for physical fitness, body condition, hair coat, alertness, salivation, eye discharge, mouth lesions, lameness and any other abnormalities.

Green supplier

Green supplier refers to the environmental issues to evaluate and choose the suppliers. The Ethiopia meat processing industries is strongly regulated by the government including the environmental agencies. Ethiopia was improving all its systems to meet international standards and rated Ethiopia as a country with an "improving animal health system." All of the operating export abattoirs in Ethiopia are certified for Halal. However, small traders, livestock trading cooperatives, farmer groups etc are not certified. But Purchase agents before purchasing animals from a specific area, the private animal health personnel representing the traders must contact the local veterinary officers at woreda levels to collect information on the livestock disease situation in the source area.

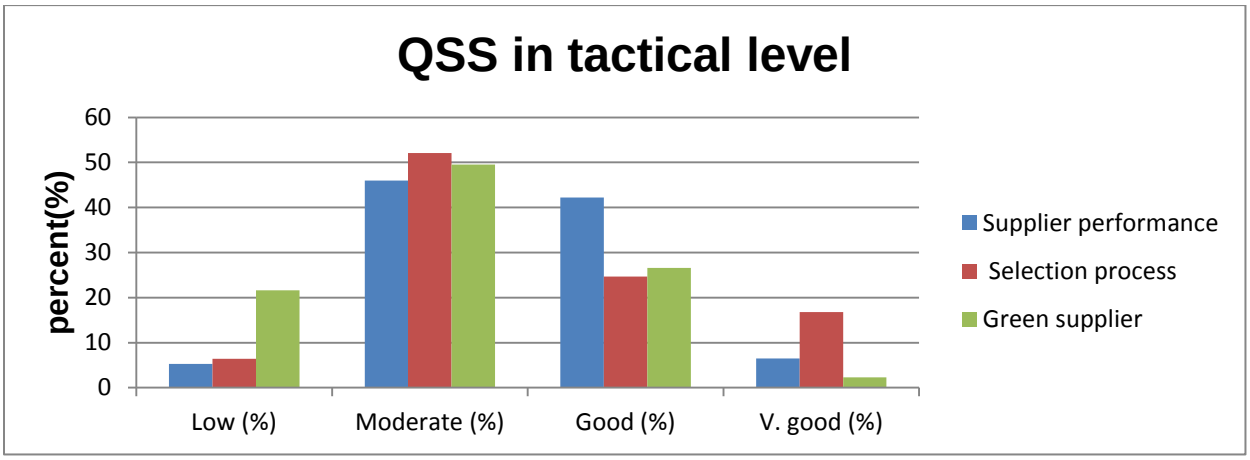


Figure5.2. QSS in tactical level

5.1.1.1.Supplier integration

Supplier integration refers to a collaborative relationship between company and supplier which recognizes some degree of interdependence and cooperation on a specific project or for a specific purchase agreement (Ellram, 1991). Under supplier integration, there are four performance

measurement factors in tactical decision making level. They are coordination and resource sharing, information integration, organizational relationship and use of information technology.

Coordination and resource sharing

Coordination and resource sharing refers to the cooperation and sharing in resource with supplier. The meat processing companies has co-coordinators in purchasing department to cooperate with Purchase agents directly the purchase agents has good relationship with its suppliers The suppliers also cooperate very well. The Purchase agents will do anything to meet the order specification. The Purchase agents also customize their products to meet companies' specification cordially. The meat processing companies also has exposed business information with some strategic supplier by company purchase agents such as information related with trends in animals and price.

Information integration

Information integration refers to the extent to which all functions between company and supplier can pass information smoothly.

The meat processing companies shares its sale forecast and production plan information with Purchase agents. Then, Purchase agents can plan and prepare their materials for the company the Purchase agents will try to contact suppliers directly by itself as well as some times using phon. but most of Ethiopia meat processing industries not using traditional communication system like telephone, fax and e-mail for information integration.

Organizational relationship

Organizational relationship refers to the management of communication channels with supplier including shared objective and risk.

The Ethiopian meat processing industries closely works with its major suppliers y its own purchasing agents in order to address any uncertainty within the supply chain e.g. change in demand, price. The purchasing department director of the meat processing Companies and its purchasing agent always has meetings to discuss problems they currently facing together. Therefore, purchasing agent keeps contact with suppliers by itself or telephone.

Use of information technology

Use of information technology refers to the capability of the current company's information technology system.

The Ethiopian meat processing industries not uses information technology. Because in most export industries of Ethiopia, livestock are sold through 'eyeballing' between the suppliers and the purchasing agents making the role of the broker limited to facilitation and counseling for the traders who are new to a particular market place and traders who are infrequent visitors or not familiar with the local situation. As well as Most suppliers (farmers) in Ethiopia are often located in rural areas where access to market information, technology solutions, physical infrastructure such as roads and consistent electricity is lacking However, sometimes using telephone contact between suppliers and companies.

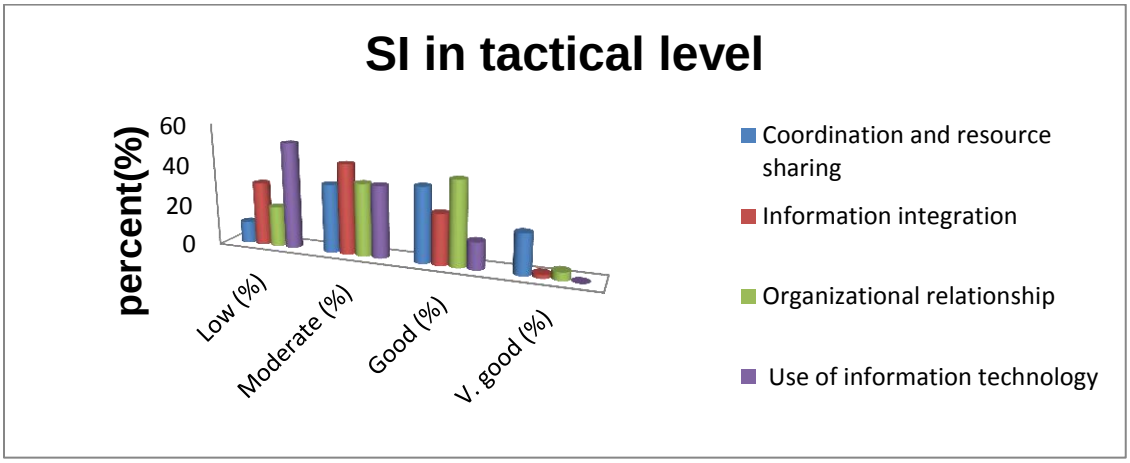


Figure5.3 SI in tactical level

5.1.1.1.Effective procurement processes

Effective procurement processes refers to the efficiency of the whole purchasing process to obtain the right materials from suppliers. Each performance measurement factor contains their related performance measurement factors in tactical level. Under effective procurement processes, there are three performance measurement factors in tactical decision making level. They are effective communication with production, effective management of purchase selection and effective contract administration.

Effective communication with production

Effective communication with production refers to the procurement of specific materials for production department. All Ethiopian export abattoirs animals, e.g. Sheep, goat, need modifications to respond to the customer needs. In such situation, the industries specify detailed requirements and then ask the purchasing agents to make some samples. Then the purchasing agents collect animals either from collectors, small traders, livestock trading cooperatives, farmer

groups' etc based on quality and price. In general there is no problem in communication with production.

Effective management of purchase collection

Effective management of purchase collection refers to the administration of material classification and supplier database update. Purchase collection has not been applied in most Ethiopia meat processing industries because, as the number of supplier is many. Dynamic evaluation of purchase collection and performance of supplier is not practiced in formal ways. The companies purchasing agents has to monitor each supplier when animals are delivered to maintain the overall performance of suppliers. The purchasing agents have to check whether supplier follows the agreement. At this time it is different when dealing business with new supplier. More strict criteria are applied with them when comparing with existing supplier. Such criteria are quality, price, and capability of transportation and reliability of communication.

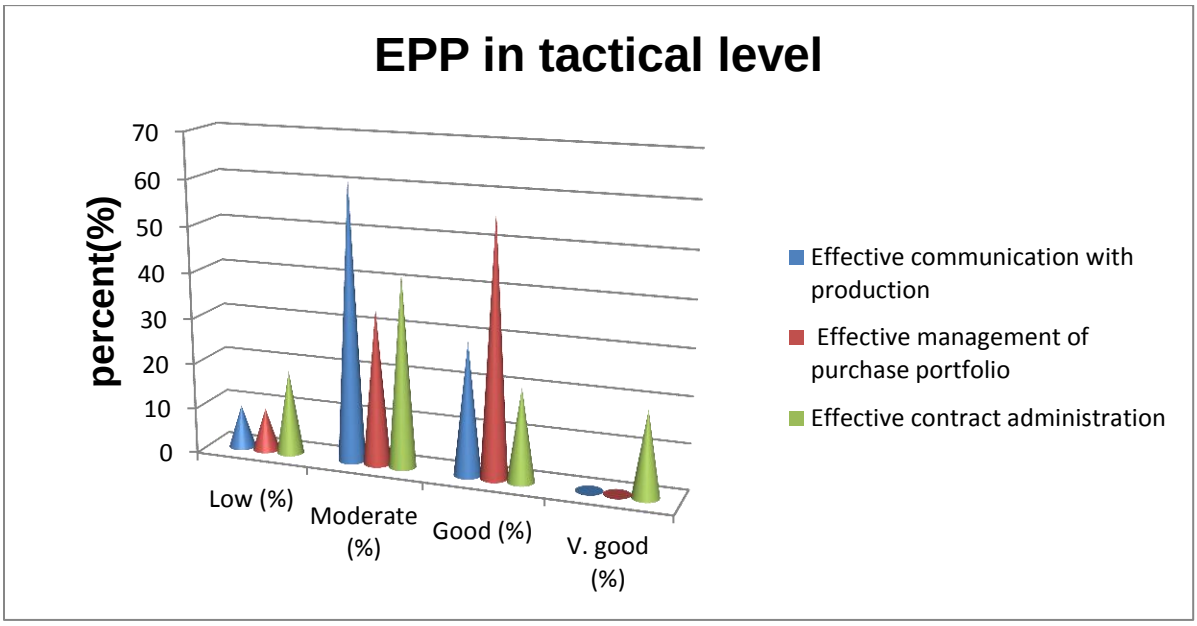


Figure 5.4 EPP in tactical level

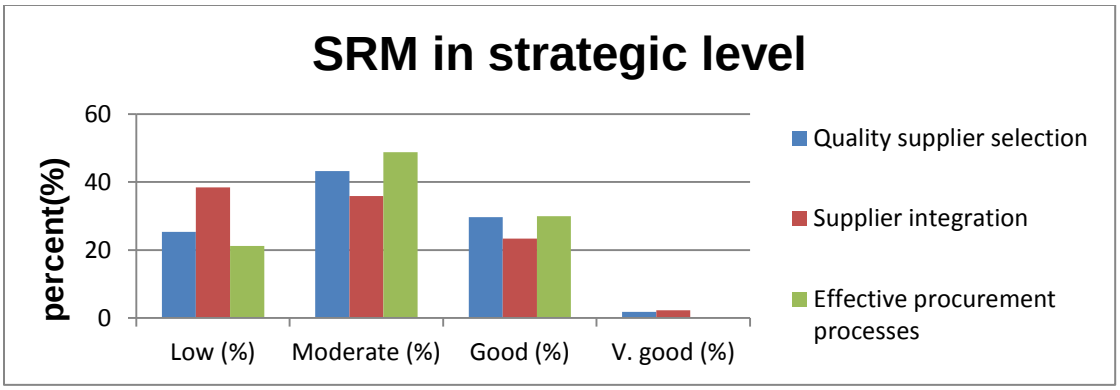


Figure 5.5 SRM in strategic level

5.1.1. Evaluation of Internal supply chain management

The internal supply chain management process represents for all processes that are internal to the company (Chopra and Meindl, 2004). This internal supply chain management aims to fulfill demand generated by the customers in a timely manner and at the lowest possible cost (Chopra and Meindl, 2004). In this study Based on the developed framework internal supply chain management has six performance measurement factors in strategic decision making level. They are facility, inventory, transportation, internal integration, human resources and operations.

5.1.1.1.Facility

Facility is the actual physical location in the supply chain network where product is stored, assembled, or fabricated (Chopra and Meindl, 2007). Under facility, there are five performance measurement factors in tactical decision making level. They are capacity utilization, efficiency, flexibility, quality and reliability.

Capacity utilization

Capacity utilization directly affects the speed of response to customer demand through its impact on flexibility and lead-time. The Ethiopia meat processing industries currently use around 60 percent of its full capacity utilization, the critical constraint in optimum capacity utilization is the case of a many of order. This can cause a high cost per unit, quality of product transportation lack of good skill manpower high price of products etc. but the companies; encouraging to increase capacity utilization thereby lowering costs, improving cost competitiveness and providing more raw material for leather producers; and introducing proper and improved feeding, fattening, animal health care and other services while encouraging foreign and domestic investment at all points along the value chain

Efficiency

Efficiency measures how well the facility is utilized. The challenge of efficient use of facility is the case of shortage of labor force. This problem can affect to the production process. Thus, the Ethiopia meat Processing Companies has tried to substitute labor force with workers skill and machine (knives) the machine is designed to facilitate work and have versatility. The industries plans to increase the productivity as this can reduce the labor cost. The labor cost is about some percent of product cost. The productivity can be increased by providing instrument to help facilitate work and designing the appropriate instrument for specific jobs such as specific knives for live animal cutting. But most industries do not have good instrument material skilled workers and a planning for full preventive maintenance. The skilled workers can support an increase of efficiency .Therefore the industries have a shortage of activities to reduce a damage of production. In additional, a statistical analysis has not been applied. Thus, there cannot view the damage as a whole perspective.

Flexibility

Flexibility indicates the degree to which the facility can respond to a changing environment and extraordinary demand requests. The Ethiopia meat Processing Companies reacts during sudden demand fluctuation by planning ahead and forecasting production capacity during festivals and high orders. There should be an adaptation of work process or the Companies should move the place of production to facilitate work and respond the needs of customers. If the companies can apply flexible manufacturing system, it can improve the problem. However, the sale sector from marketing department has to deal and take order from customers by avoiding any problems which can affect production and delivery.

Quality

Quality refers to technology and the process to improve facility performance. The Ethiopia meat Processing Companies measures equipment performance from the duration of production. But Current processed meat exports are low value products and of low quality and also Quality standards are poor. None of the abattoirs have developed or started to introduce quality control programs, Handling, loading and transporting of live animals in most cases are in humane as this practice will affect the quality of meat and welfare of the animals the Ethiopian export abattoirs do not follow strict code of conduct regarding animal handling and this is seriously affecting the quality of meat, it does not have physical separation between clean and dirty areas. In addition, it

does not have ceiling over the area between kill floor and chillers and over the de-boning room. The facility also lacks refrigeration facility in the de-boning room and no dock seal and refrigeration along the shipping area. In general the Ethiopia meat processing industries have low quality.

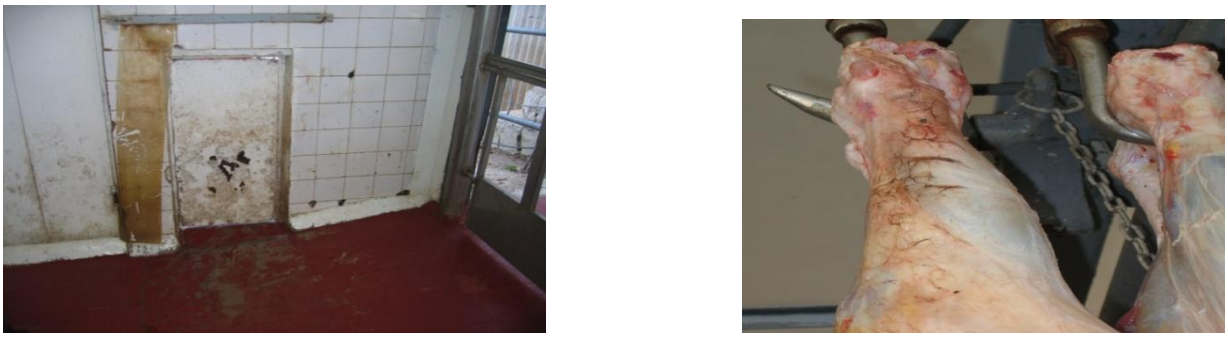


Figure5.6 a) Dirty facility with significant build up of filth and b) the walls, Floors and ceilings in disrepair and Carcass contaminated by fecal material

Reliability

Reliability refers to the trustworthiness of the facility including its kindly with environment and safety. Most the Ethiopia meat processing industries can be an assurance that the environmental management and waste management. All the abattoirs dispose of liquid and solid wastes in a very simple manner irrespective of the country's directives for ways and locations of waste disposal. Few export abattoirs are testing the quality of water on limited occasions.

As a result, the microbiological quality of water that is being used in all export abattoirs is not regulated at all. The Ethiopia meat processing industries rates safety level is good. Several of the export abattoirs are designed to handle beef carcass in quarters as opposed to halves and this has an added risk of microbiological contaminations as a result of bacterial growth, In most export abattoirs, although chilling rooms are fitted with thermometers, some of them lack thermograph to register minimum and maximum temperatures. As a result, the chilling process of meat is not properly regulated. On the other hand, the maturity of meat is not checked by measuring the level of pH in sampled meat although all the export abattoirs have trained man power in Good Hygienic Practices and HACCP principles.

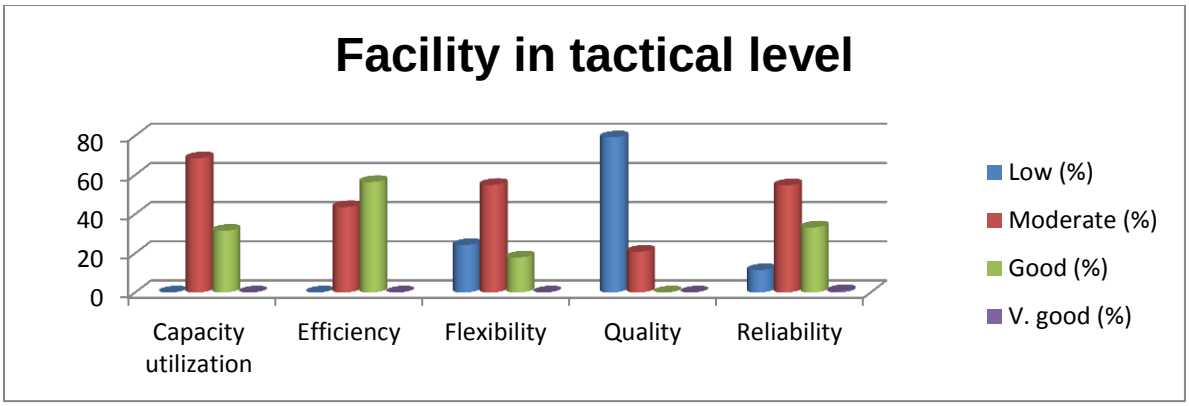


Figure 5.7 Facility in tactical level

5.1.1.1.Inventory

Inventory encompasses all raw materials, work in process, and finished goods within a supply chain. Changing inventory policies can dramatically alter the supply chain's efficiency and responsiveness (Chopra and Meindl, 2004). Under inventory, there are two performance measurement factors in tactical decision making level. They are optimal inventory policy and warehouse utilization.

Optimal inventory policy

Optimal inventory policy refers to the policy to improve inventory management. All the Ethiopia meat processing industries type of production is made to order so three types of inventory including: Raw materials, Finish goods products and Ingredient, have to be fulfilled in order to produce products in time. The work with suppliers to provide materials must be quick and focus on continues inventory policy. The industries measures performance of inventory management from turnover of inventory Turnover of inventory must be high as there are limited storages. Also, the type of production is made to order so only few of live animals can be stocked. all industries manages risks during inventory level optimization by buying raw materials when their prices are low. However, there is stock during the fluctuation of order and some materials have to be kept in warehouse.

Warehouse utilization

Warehouse utilization refers to the usage of warehouse for all inventory materials. All export industries having ware house for the raw materials (live animal) and finished product (cold room). They are separately kept with separate staff to take care them. Animals kept with good standard. There is a control of temperature as they have an effect on quality of raw materials.

5.1.1.2.Transportation

Transportation entails moving inventory from point to point in the supply chain.

Transportation can take the form of many combinations of modes and routes, each with its own performance characteristics (Chopra and Meindl, 2010). Under transportation, there are four performance measurement factors in tactical decision making level. They are capacity utilization, efficiency, flexibility and reliability.

Capacity utilization

Capacity utilization directly affects the speed of response to delivery order through its impact on flexibility and deliverability

Land transport of animals is often undertaken using non-livestock and non-sanitized transport vehicles so the facility is very low. From abattoirs to airport, chilled carcasses are transported by refrigerated trucks for final shipment. The four export operating firms have vehicles of different load capacities. The capacities of each abattoir vary from 2,100 to 2,920 carcass equivalent at any one time with aggregate capacities of transporting 11,920 carcass equivalent. At the time of the assessment, At the time of the assessment, there are 15 refrigerator trucks of which ELFORA has 5 trucks Mojo & HELMEX 4 each and Luna 2. It is only ELFORA that has the capacity of transporting frozen products to sea port if export via sea is considered. For large production volumes particularly, beef, ocean transport will be necessary for competitiveness in the market.

Figure 5.8Refrigerated Meat Transporting Truck

Flexibility

Flexibility may be measured as the ability to change or react with little penalty in time, effort, cost, or performance. The Ethiopia meat processing industries transportation is not flexible because land transport of animals is often undertaken using non-livestock and non-sanitized transport vehicles. As a result, livestock are handled in a manner that encourages injury and maximizes stress and disease transmission throughout the journey. This reduces the sanitary standard and quality of meat of slaughtered animals and the cost of transportation is high. Unlike

the traditional mode of transport, trekking, the export abattoirs use designated and ordinary trucks both for shoats and larger animals. A review of the existing livestock transport facilities of the abattoirs indicates that the bulk of livestock transport is by ordinary trucks with no facilities. ELFORA & HELMEX own respectively seven and two designated transport facilities. In addition, there are no small trucks to carry materials and finished products between factories and its warehouse and enough refrigerated tracks.

Figure5.9 Live Animal Transporting Trucks

5.1.1.1.Internal integration

Internal integration refers to a collaborative relationship within company which recognizes some degree of interdependence and cooperation on a specific project (van Hoek, 2001). Under internal integration, there are four performance measurement factors in tactical decision making level. They are information integration, internal quick response, use of information technology and efficiency.

Information integration

Information integration refers to the extent to which all functions within company can pass information smoothly. The Ethiopia meat processing industries measures information system performance from a quantity of error of sending information and delay in sending information between companies and customers. There is limited capacity of mailbox in e-mail of employees and also its not IT links all business functions altogether and the speed of internet is not stable, sometimes it is very slow. Therefore, Staffs are a key to run working system as there has not been fully automatic information technology. Main information is from various departments and can support decision of administration team. Those data are not entirely integrated with

customers or suppliers as some are critical and the companies do not want competitors have an access to its system. Thus in case of huge file, space is not enough to keep such file.

Internal quick response

Internal quick response refers to the sharing and availability of information between related departments in company. All Ethiopia meat processing industries strengthens information sharing further by developing industries own intranet system but the speed of internet is not stable, sometimes it is very slow. The contact is using calling and e-mailing for sending information.

Use of information technology

The role of information technology is shifting from a general passive management enabler through databases, to a highly advanced process controller that can monitor activities and decide upon an appropriate route for information (Gunasekaran *et al*., 2004). Modern information technology, through its power to provide timely, accurate and reliable information, has led to a greater integration of modern supply chains than possible by any other means. All Ethiopia meat processing industries uses for effective operation of internal communication process system Faxing, e-mailing and calling are the key communications of the companies.

Efficiency

Efficiency measures how well the internal supply chain is integrated by considering the related costs. All Ethiopia meat processing industry E-mailing and calling are key communication as they allow exactness and speed. Customer can also directly contact with executive in case of emergency issue but the internet access law therefore cost high.

5.1.1.1.Human resources

Human resources refer to the management of employees' improvement for a better company's internal supply chain. Under human resources, there are four performance measurement factors in tactical decision making level. They are motivation, safety, training and innovation and learning.

Motivation

Motivation refers to the method to inspire employees to improve their ability. all most all Ethiopia meat processing companies Encouragements for employees are offering welfare and fringe benefits as primary labor law. Incentive is also provided for employees but different in their level of employment. In addition, there is supporting activity which helps to increase

employees' connection and loyalty to organization additionally supports capacity development in order to extend employees knowledge and develop them to be ready for the company business growth. During a high peak of order, offering over-time and bonus payment is used to motivate workers.

Safety

Safety refers to the degree to which the risks can reduce from work process. The safety procedure all Ethiopia meat processing companies has in place to ensure the working environments is notifying safety regulation and applying them with restrict. All export company certified (HALAL) and this can assure the standard of safety for workers. Safety equipment such as belt to support back, a pair of shoes covered with metal, clothes to prevent chemical materials are provided sufficiently.

Training

Training refers to the process to provide the professional skill to the work force. All the export abattoirs have trained man power in Good Hygienic Practices and HACCP principles all companies compensates the skill gap when new person replaced a high skilled retired person by providing training. On job training is also provided. On job training is tested and designed by related departments companies measures human performance by evaluating participants both pre and post training program. Then a week after the training, the department of participants will evaluate whether the previous evaluation is appropriate with that department and staff. It is because staffs are different in skill and capacity. The manager of each department is person who justifies and co-works with human resource department. Overall, there is annual test and there is co-working among departments in order to assign an appropriate key performance indicator. In issue of hardworking, it can be measured with on time reporting to work.

Innovation and learning

Innovation and learning refer to the management of increasing employee's capability in learning new knowledge. All Ethiopian meat processing companies has system in place for listening to everybody, collecting their thoughts, and displaying their ideas and innovation. The companies encourage human resources to be innovative and keep tradition of learning by ordering direct from the executive committee. Some companies have employed activity and guidance of Kaizen system in order to stimulate employees to develop their skills, be promoted towards upper position, and build pride among employees.

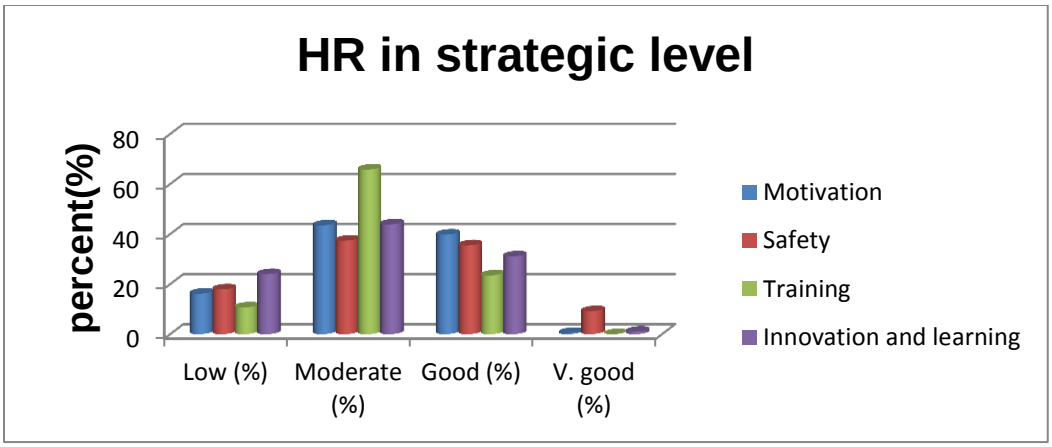


Figure 5.10 HR in strategic level

5.1.1.1.Operations

Operations refer to operational performance and environmental performance of the company including company's operational improvement. Under operation, there are three performance measurement factors in tactical decision making level. They are operational performance, environmental performance and innovation.

Operational performance

Operational performance measures the quality, flexibility, and reliability of company's procedure. The Ethiopia meat processing companies reacts with uncertain demand fluctuation by developing workers to be versatile and this can help substitute other positions when needed. The criteria that the companies considering to measure reliability are products produced with food standard assurance, including HACCP (Hazard Analysis and Critical Control Point) and GHP (General Hygiene Practices). Materials usage cannot be reduced as products must be standard. The companies try to reduce mistakes in production and mistakes from workers. Example, the process of slicing cattle needs skilled workers. Otherwise, job has to be re-done.

The companies reduce waste by adding value for some unused materials such as bony carcass without flesh, hair and dirt on carcasses, dark color. All measures process efficiency by comparing actual versus planned through put time. There has been a summary report every week in order to further improve. A summary report is also passed on to top management. The reasons have to be clarified if the goal is not fulfilled maximizes throughput by having heads to control in every level. These heads work closely with their workers and can react immediately for sudden problems.

Environmental performance

Environmental performance relates to the environmental issues of the operational processes. More concerns of environment friendly issue in global market competition and more legal issues related to environment affect suppliers and all Ethiopia meat industries have good environmental policies and green productivity. But all companies cooperates with public sectors to let them initially assess the companies environment not using ISO standards by this reason Several of the export abattoirs are designed to handle beef carcass in quarters as opposed to halves and this has an added risk of microbiological contaminations as a result of bacterial growth and also all export abattoirs have limited or no system for maintaining individual carcass, viscera and head identity for the purpose of retaining, rejection or recalling of diseased animals from the export chain. The companies to reduce energy consumption are Turn off electricity break time and Use machine appropriately with types of job.

Innovation

Innovation refers to technology and the way to improve operating performance of the company. Training and initiation of innovative thinking are provided for staffs in order to build dignity among them and build atmosphere of learning in company. The Ethiopia meat processing industries learns from its errors all the time. The companies realize that it is difficult to get rid of human error which is beyond its control. The best way to cope with this problem, in its idea, is to make the system tighter. When something bad happens, the companies first examine the system and procedure to identify the flaws and then change the procedure accordingly. By doing so, the company improves its operation processes every time the company learns a new thing.

In most export abattoirs, chilling rooms are fitted with thermometers, some of them lack thermograph to register minimum and maximum temperatures. As a result, the chilling process of meat is not properly regulated. On the other hand, the maturity of meat is not checked by measuring the level of pH in sampled meat. As well as many of the export abattoirs have significant cracks, crevices and spaces beneath the doors. Besides to this, there is no system designed to control rodents that would transmit various types of pathogens (small organize such as virus, bacteria).

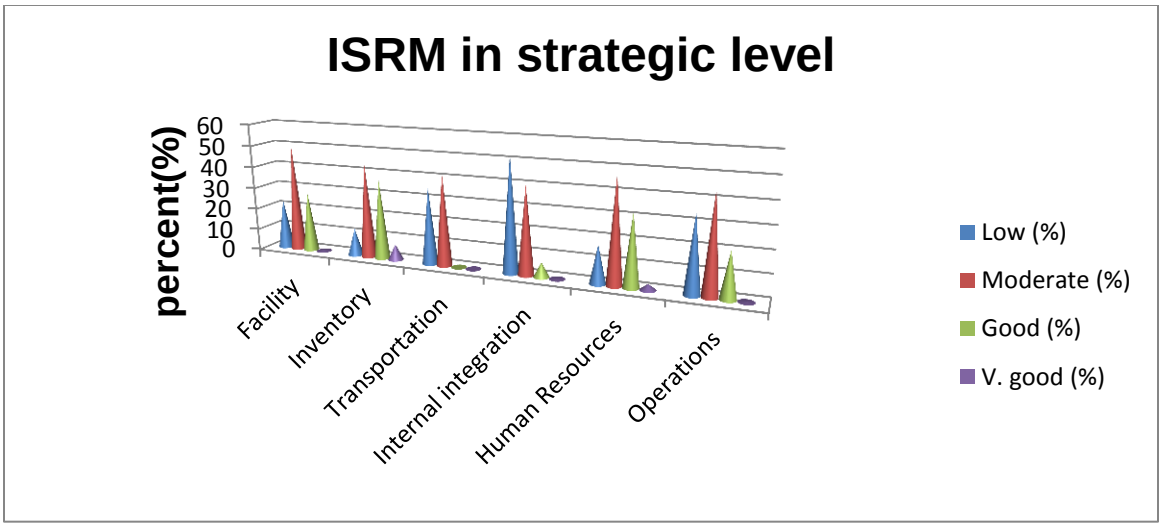


Figure 5.11 ISRM in strategic level

5.1.1. Evaluation of Customer relationship management

The customer relationship management provides the structure for how relationships with customers are developed and maintained (Croxton *et al.*, 2001). This customer relationship management process represents for all processes that focus on the interface between the company and its customers (Chopra and Meindl, 2004). Customer relationship management macro process aims to generate customer demand and facilitate the placement and tracking of orders (Croxton *et al.*, 2001). Based on the proposed framework, customer relationship management has four performance measurement factors in strategic decision making level. They are customer service, customer integration, demand forecasting and market analysis.

5.1.1.1. Customer service

Customer service refers to the provision of labor and other resources, for the purpose of increasing that value that buyers receive from their purchases and from the processes leading up to the purchase (Aramyan *et al.*, 2007). Under customer service, there are four performance measurement factors in tactical decision making level. They are responsiveness, customer order processing and delivery, handling customer complaints and value added services.

Responsiveness

Responsiveness relates to the way it takes for a firm to respond to a customer query with the required information. It is not unusual for a customer to enquire about the status of order, potential problems on stock availability or delivery. A fast and accurate response to those requests is essential in keeping customers satisfied (Gunasekaran *et al*., 2004).

The type of Ethiopia meat processing manufacturing is made to order with 90 percent of the total products so the business strategy with respect to customer service of the companies is to respond the customers' needs. Also, other business strategies are delivery products at right time, a fixed price and made products as customers' demands. To measure and improve the quality of customer service, the companies provide a survey to customers to evaluate the customers' satisfaction. However, the Ethiopia meat processing industries needs more complicated integrated customer relationship management (CRM) system to integrate customers with its supply demanded quantity, quality meat, price of production and procurement.

Customer order processing and delivery

Customer order processing and delivery aim to providing the requested products with a short lead-time. The Ethiopia meat processing industries a systematic approach to process customer's requirements a process of customer order begins when customer gives of specification. Then, a department of production will plans and examines its competence of production. The total order cycle time (from order entry to delivery) of the Ethiopia meat processing industries is about one month for regular products and about two or three months for new products. The typical order fill rate of the companies is classified into the quantity of products with the rate of 90 percent, the time with the rate of 80 percent.

However, there might have some delay about two or three weeks during the peak period. The companies usually deliver the products to customers, only a few of them come to get their products by themselves. Sometimes the companies have a problem of the quality of meat, packaging material which does not meet the needs of customers. The criteria that all Ethiopia meat processing industries considers to measure the delivery performance are time and quantity. However, sometime customers provide no sufficient time for the company to deliver products at right time. If customers provide the companies more time the company then can work more efficiently.

Handling customer complaints

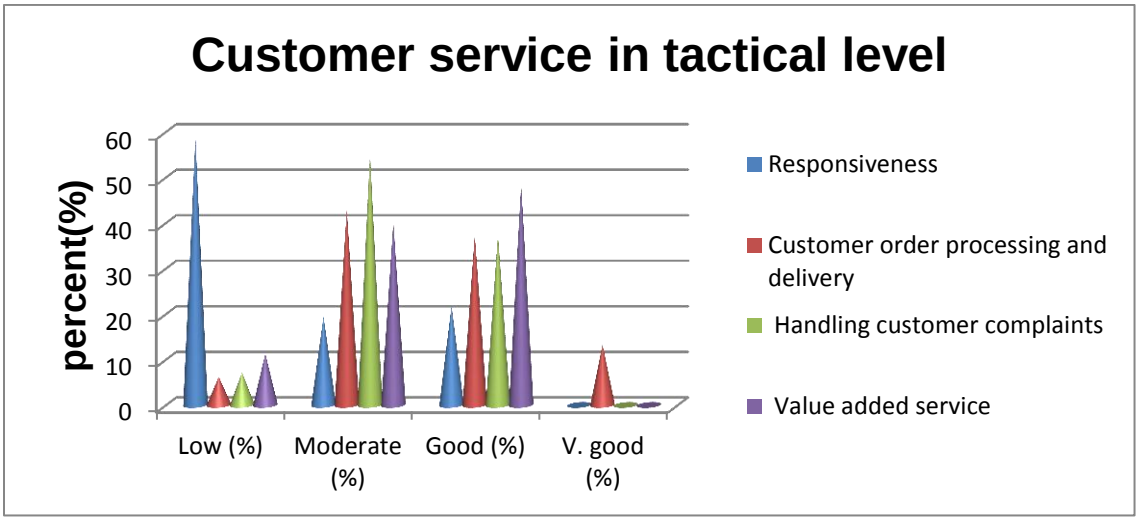
Handling customer complaints refers to the process to deal with registered complaints from customers about product or service.

Most customers are existing customers and a deal of business is based on trust between the companies and customers. Thus, Ethiopian meat processing industries have been some of complaints. The majority of complaints are from customer's example bony carcass without flesh,

hair and dirt on carcasses, dark color, price, waiting time, and packaging material as a result, the companies try to reduce the number of complaint by using a system to compare between the sale volume and the amount of complaints from customers. To decide which complaint need urgent response, the companies and government would consider if that complaint is very serious and problem has negative impact on consumers. However, the companies respond to every complaint from customers.

Value added services

Value added service refers to the services to satisfy customer needs in both before and after sales. The Ethiopia meat processing industries introduces tailored contribution facility for its loyal customers in companies website, and also the companies provides visualization opportunities to the customers by visit the company and In the process of value creation, the Ethiopia meat processing industries creates and delivers value to customers by informing issue concerning the consuming on package. After sales service that the companies gives to customers is to provide additional information when customers require and, the company will ask for customers' feedback periodically and follow them in order to provide more facility.



5.1.1.1.Customer integration

Customer integration refers to a collaborative relationship between company and customer which recognizes some degree of interdependence and cooperation on a specific project or for a specific order agreement (Ellram, 1991). Under customer integration, there are four performance measurement factors in tactical decision making level. They are extent of cooperation to improve quality, information integration, organizational relationship and use of information technology.

Extent of cooperation to improve quality

Extent of cooperation to improve quality refers to the collaboration with customers to improve products' quality and to develop new product in both normal situation and under contingency.

The customer integration is very importance to all Ethiopia meat processing industry. It helps the companies to improve product innovation performance and quality performance. There is cooperation between the companies and customers by letting customers to visit the factory, sharing their opinions. This can encourage coordinated working, for example customers can share their opinion to specify the quality of products to meet their needs. Thus, the companies gains information from customers and utilize that information to improve products. The current company website has only product information not an online catalogue. The companies update information once there is any new information, without any setting the time frequency. Also, the company cannot provide this product catalogue with the explanation of price and shipping cost because of the variable cost of materials and variable exchange rate.

Information integration

Information integration refers to the extent to which all functions between company and customer can pass information smoothly

All Ethiopia export abattoirs have dedicated sales team to remain in touch with customers in order to not only dynamically discovering their requirements, but also helping them to modify their products. A communication and exchange of data are made before business deal as customer wants to make sure that products are produced upon the requirement. Data and other details are sent use fax and e-mail. Customer can inspect each stage of production any time such as ability of production upon specification and on time production. Interviews revealed that there are a few issues that need to be addressed in order to improve information integration with the customers. These evolve mainly due to fast change in customers' requirements, and customers often change their requirements even after placing the orders. Therefore, the companies have good information integration.

Organizational relationship

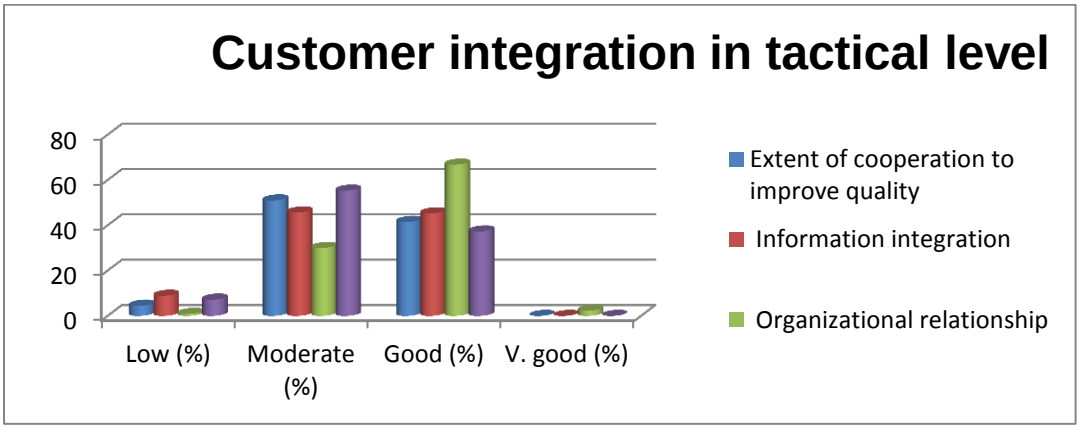
Organizational relationship refers to the management of communication channels with customer including shared objective and risk.

The organizational relationship between customers and the Ethiopia meat processing industry is good. But there have not been a department to take care of organization relationship with the

customers because of a few numbers of current customers and a good relationship between the companies and its customers. Also, has no plan to emphasize on extending a number of customers. An extension of customers may cause a problem of production as there is a variety of needs per individual customer. However, all companies maintain common objective and team work across the supply chain through continuous collaboration, cooperation and coordination with its existing customers and Work with customers and help customizing their requirements. So have weak evidence of risk sharing.

Use of information technology

Use of information technology refers to the capability of the current company's information technology system. Information system used to service customers is fully integrated within the company's all departments. As discussed previous, the system is contemporary and effective for the internal use within companies. Mostly traditional communication systems such as telephone, fax and e-mail are used for keeping contact between the company and its customers. All Ethiopia meat processing industries has not obtainable online direct sale arrangement.



5.1.1.1.Demand forecasting

Generally, supply chain planning relies on forecast data, which becomes the basis for its production, material sourcing, inventory management and all other activities in supply chain (Chae, 2009). Demand forecasting usually takes demand data from salespeople who receive sales and demand information from customers. Under demand forecasting, there are three performance measurement factors in tactical decision making level. They are forecasting system in place, decision making, and reliability of demand data.

Forecasting system in place

Forecasting system in place refers to the current forecasting system of the company including its technology and process. All Ethiopia meat processing industry uses a simple forecast model utilizing historical data to predict the future. In other words, the company predicts levels of demand and sales for a particular period, based on past records over the same period. To increase accuracy, the companies also modify the prediction based on further information gathered from its joint business enterprise parties.

Decision making

Decision making refers to the degree of transparency and speed of decision. Ethiopia meat processing industries will inform customers its decision before the company works on it. As the role of governance in the companies on decision making process, it is a policy of company that the executive committee has to share their decision. The companies measure its effectiveness on direction and control during the process of decision making and considering related factors. Then, the company measures its effectiveness again after the decision has been made. This can help to compare the results before and after the decision process. The challenges for any fast decision making process in the companies are various risk factors related in system because there is no evaluation and planning for the results that would be occurred from the fast decision making.

Reliability of demand data

Reliability of demand data refers to the trustworthiness of the demand data including its accuracy of forecast and decreasing of errors and volatility. The average Ethiopia meat processing industry accuracy in demand forecasting process is about 80 percent. In addition working based on the existing information of customers, the companies Processing Company keeps communication with them in order to gain additional information for reducing prediction error. However, there is still no appropriate prediction error for the company. Also, the companies have still needed more demand from customers for its capacity utilization.

5.1.1.2.Market analysis

Market analysis refers to the degree of company's market share and total number of customers including the government policy that affects the policy of company. Under market analysis, there are four performance measurement factors in tactical decision making level. They are market equity, customer acquisition, and customer retention and government policy over market equity.

Market equity

Market equity refers to the number and the movement of market share. The average percentage of market shares the Ethiopia export abattoirs is weak holds in the overall market with respect to competitors. The export abattoirs, which focus on exporting shoats' carcasses Middle Eastern markets (Egypt Saudi Arabia Bahrain Kuwait) faced with competition from Australia, New Zealand, Brazil, India and Pakistan, Ethiopian meat sells at the low end of the market in these countries. But Ethiopian meat sells at the low end of the market in these countries. The market is segmented according to incomes, with higher income populations preferring freshly slaughtered meat, while lower-income populations (particularly low-income expatriates) select for low-cost meats that are usually frozen. This is also the segment of the population that consumes chilled Ethiopian shoat carcasses as well as many importers report having ceased purchasing meat from Ethiopia as a result of their dissatisfaction with quality (complaints of foreign material as well as dark cutting as a result of "improper handling of slaughter animal, inappropriate sanitation, careless packing and transportation")

Customer acquisition

Customer acquisition refers to the number of customer increase and its source. All Ethiopia meat processing industries has focused on keeping existing customers rather than identify new customers. All companies' strategy is market development. That is, the company tries to find new ways or new customers who can use adjust the manufacturing to be matched with new customers' demand from the past and the companies gained new customers from the recommendation of existing customers. Thus, it is important to keeping existing customers as they could contribute to new customers.

Customer retention

Customer retention refers to the number of customer remain and its base. All Ethiopia meat processing industry works to keeping of existing customers focuses on their satisfaction. all responds to individual customers with primary concern on quality and prompt delivery. But still now in all export abattoirs having some customer dissatisfaction this cause dissatisfaction among customers and majority of company's customers is existing customers.

Government policy over market equity

Government policy over market equity refers to the support from government and equal opportunity in the market. The Government of the Federal Democratic Republic of Ethiopia (GFDRE) recognizes livestock as one of the country's key economic resources. In order to overcome these challenges and increase in-country value addition, the Ethiopian Government is committed to supporting meat exports for both the domestic and export markets and encompass technology packages for meat production, the establishment of disease-free zones and a standardized sanitary and phytosanitary (SPS) system.. Yet such exports remain small in volume, constrained by inefficiencies in purchasing, poor animal handling and inadequate facilities at the abattoir and export level. These factors all contribute to low meat quality and unreliable supply.

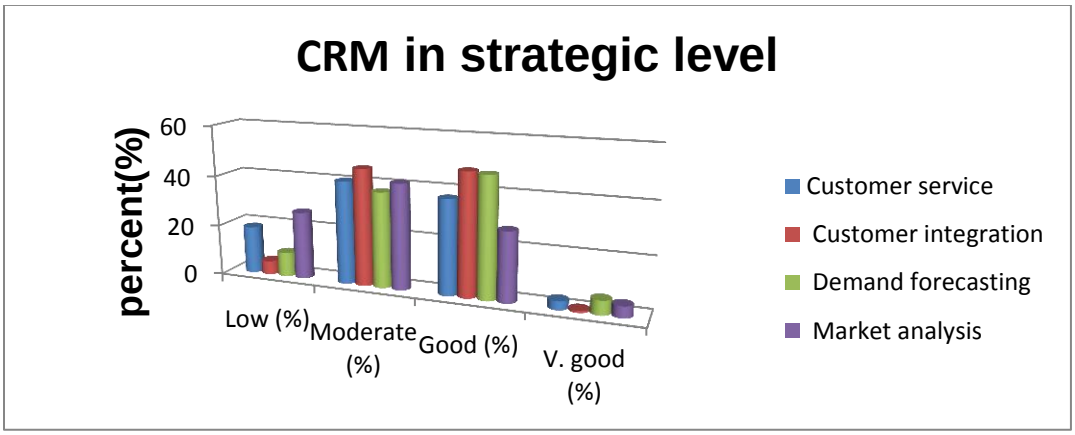


Figure 5.12 CRM in strategic level

CHAPTER SIX

6. DATA ANALYSIS AND RESULT AND DISCUSSION

6.1. Data analysis using AHP

The analytic hierarchy process (AHP) is a systematic procedure for representing the elements of any problem hierarchically (Saaty, 1980). AHP uses pair-wise comparison of the same hierarchy elements in each level (criteria or alternatives) using a scale indicating the importance of one element over another with respect to a higher level element (Saaty, 1980). AHP can be the best tool for prioritizing and choosing the best performance measurement factors for day-to-day business operations. Moreover, the AHP approach provides a quantitative hierarchical framework for performance measurement.

This research presents the use of AHP to measure the supply chain performance because it provides a flexible and easily understood way of analyzing complicated problems. The AHP is a multiple criteria decision making technique that allows subjective as well as objective factors to be considered in the decision making process (Dey, 2002). The AHP allows the active participation of decision makers in reaching agreement, and gives managers a rational basis on which to make decisions. AHP is a multi-criteria decision method that uses hierarchical structures to represent a problem and then develop priorities for alternatives based on the judgment of the user (Saaty, 1980).

Define the unstructured problem and developing the AHP hierarchy

The first step in the AHP procedure is to decompose the decision problem into a hierarchy that consists of the most important elements of the decision problem (Boroushaki and Malczewski, 2008). In this step the complex problem is decomposed into a hierarchical structure with decision elements (objective, attributes i.e. criterion map layer and alternatives). The study divides the measurement in to three parts based on the supply chain macro processes: supplier relationship management, internal supply chain management and customer relationship management. The performance measurement of each supply chain macro process is decided by performance measurement factors in the hierarchy: strategic, tactical and operational level. These performance measurement factors are divided into intermediate levels of performance measurement factors for different decision levels in the hierarchy. The problem is to decide which of the five case studies Ethiopia meat processing companies. The hierarchic representation of a problem is as follows: The first step is the decomposition or structuring of the problem as a hierarchy. In the

first (or top) level is the overall supply chain performance. In the second level are the factors or criteria of supply chain macro processes, which contribute to the goal (overall performance measurement system), in the third level are the sub-criteria of performance measurement factors in strategic decision making level, in the fourth level are the sub sub-criteria of performance measurement factors in tactical decision making level then in the fifth level are the sub -sub-criteria of performance measurement factors in operational decision making level finally at (bottom) level are the five case study companies, which are to be evaluated in terms of the criteria, sub-criteria, and sub sub-criteria in the second, third and fourth levels.

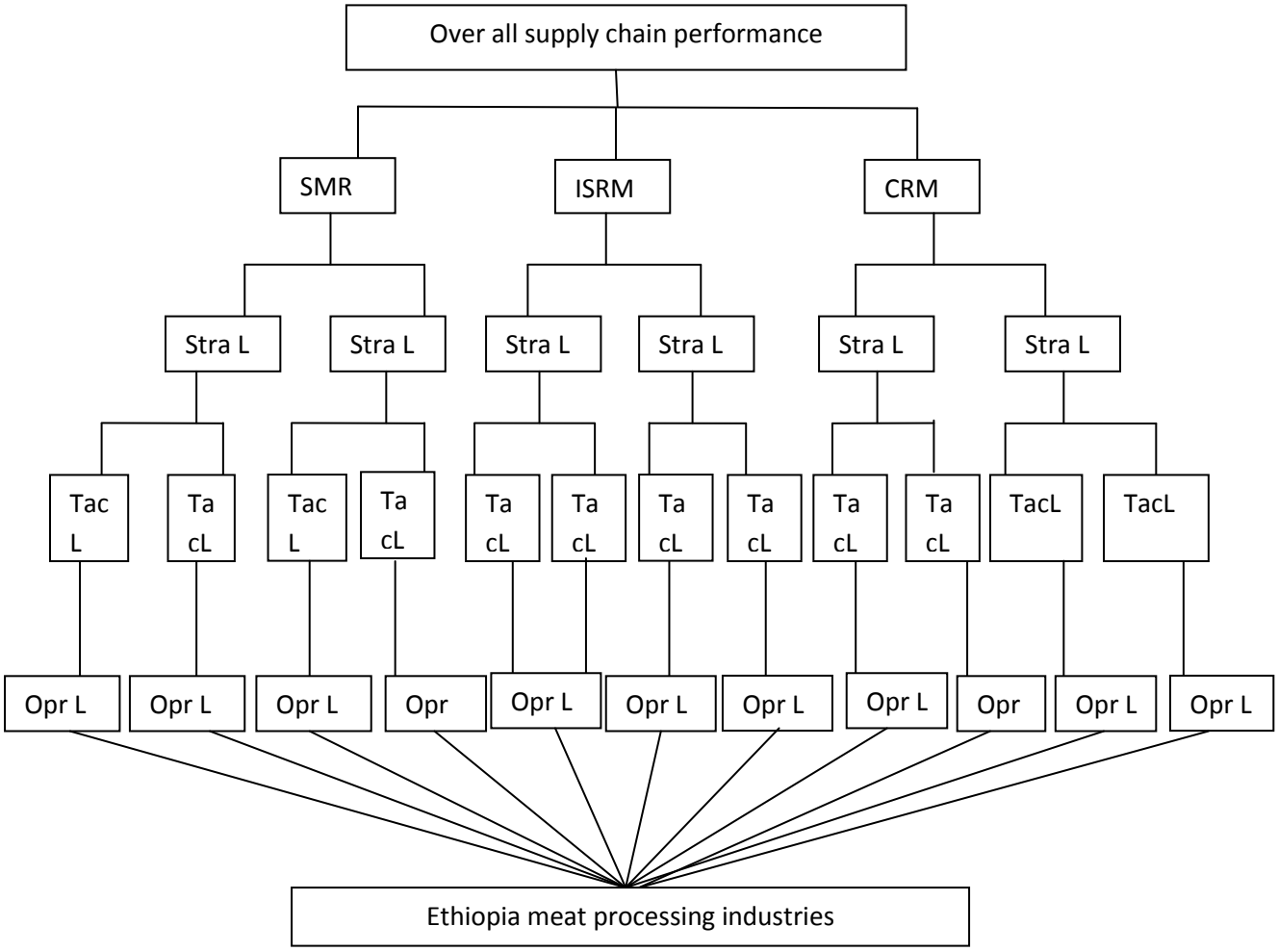


Figure 6.1 Generic hierarchic structures

In the AHP, elements of a problem are compared in pairs with respect to their relative impact ('weight' or 'intensity') on a property they share in common (Bhagwat and Sharma, 2007b). **Pair-wise comparisons** are reduced to a matrix form. When sets of elements are compared with each other a square matrix is produced.

The square matrix has an equal number of rows and columns together with eigenvectors and eigenvalues (Bhagwat and Sharma, 2007b). The reason for this computation is that it gives a way to determine quantitatively the relative importance of factors. The factors with the highest values are the ones that should be concentrated on for developing a plan of action. For this study, AHP structures the problem hierarchically and a matrix is arranged to compare the relative importance of criteria in the second level with respect to the overall objective or focus of the first level. Similar matrices are further constructed for pair-wise comparisons of each sub-criterion in the third level with respect to the criteria in the second level.

Then, similar matrices are constructed for pair-wise comparisons of each sub sub-criterion in the fourth level with respect to the sub-criteria in the third level. Finally, similarly matrices are also constructed for pair-wise comparisons of each alternative in the fifth level with respect to the criteria, sub-criteria and sub sub-criteria of the second, third and fourth levels respectively. The tables of pair-wise comparison and weight calculation are shown for performance measurement factors in supplier relationship management, internal supply chain management and customer relationship management of general Ethiopia meat processing industries.

Pair wise comparison and Check the consistency

The processes to measure supply chain performance of Ethiopia meat processing companies are shown in pair-wise comparison and weight calculation tables below. Then, to compare their supply chain performance, a summary of priorities with respect to supply chain macro processes is showed in Table6.2. A sample of how this study arrived to the rating in the AHP and the rating results is discussed below. In Table of pair-wise comparison for the Ethiopia meat processing companies, the cells of the matrix have been filled in with the subjective judgments using equal performing, low performing chains, medium performing Chains, high performing chains and very high performing chains. Pair-wise comparison scales from questioner survey and based on the preference and perception of the criteria for the overall performance measurement.

Table: 6.1 the Saaty Rating Scale

Intensity of Importance	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective
2	Weak importance of one over another	Experience and judgment slightly favor one

		activity over another
3	Intermediate values between the two adjacent judgments	When compromise is needed
4	Essential or strong importance	Experience and judgment strongly favor one activity over another
5	Demonstrated importance	An activity is strongly favored and its dominance demonstrated in practice

6.2. Pair wise comparison and Check the consistency of Supply chain macro process

The step of weight calculation is in Table of weight calculation; the value in each cell from pair-wise comparison table was divided by the sum of value from all cells in the same column. For example, in cell SRM (row) and SRM (column), 0.125 came from 1 divided by (the sum of SRM's column that came from 1+4+3). In the same way other cells of the matrix were also filled in such as in cell SRM (row) and ISCM (column), 0.437came from 1/4 divided by (the sum of ISCM's column that came from 1/4+1+1/2); and in cell SRM (row) and CRM (column), 0.099 came from 1/ divided by (the sum of SRM's column that came from 1/3+2+1). By the same method calculate the entire pair-wise comparison table.

Then, the result of the priorities with respect to supply chain macro processes was calculated. For SRM, the priority weight 0.201 that calculated from the average value of row SRM in column SRM, ISCM and CRM (value in column SRM plus value in column SRM plus value in column SRM then divided by the number of column) (0.125+0.437+0.099/3).

Table6.2: pair-wise comparison and weight calculation of supply chain macro process

SCPROS	**SRM**	**ISRM**	**CRM**
SRM	1	1/4	1/3
ISCM	4	1	2
CRM	3	1/2	1

SCPROS	**SRM**	**ISRM**	**CRM**	**Weight**
SRM	0.125	0.142	0.099	**0.122**
ISCM	0.500	0.571	0.600	**0.557**
CRM	0.375	0.276	0.333	**0.328**
				Sum=1.00

Finally, the consistency is checked. If the consistency ratio (CR) is greater than 10 percent, then the pair-wise is not consistent in making the comparison. The pair-wise comparison should review and make adjustment. For this purpose, Saaty defined the consistency ratio (CR) as

CR = *CI/RI* *CI* = consistency index

RI = random index

The consistency index (CI) is given by $\mathbf{CI = \lambda_{max}-n/n-1}$ n = number of matrix

Where, λ_{max}, is the largest eigenvalue of the n x n reciprocal pair wise comparison matrix. Saaty showed that if a decision maker is perfectly consistent (i.e., aik = aij ajk for all i,j,k = l,..., n), X,, = n (CI = 0) and if the decision maker is not perfectly consistent, then X,,, > n. To measure this consistency, Saaty proposed a consistency ratio.

Where RI is the average value of CI obtained from 500 positive reciprocal pair wise comparison matrices whose entries were randomly generated using the 1 to 9 scale. Saaty considers that

Table 6.3: RCI values for different values of *n*

n	**1**	**2**	**3**	**4**	**5**	**6**	**7**
RI	**0**	**0**	**0.58**	**0.90**	**1.12**	**1.24**	**1.32**

Therefore, from the above Pair-wise comparison calculate λ_{max}, CI and CR

Table6.4: pair-wise comparison and weight calculation of supply chain macro process

SCPROS	**SRM**	**ISRM**	**CRM**	**Weight**	**λ max**	**CI**	**CR**
SRM	0.125	0.142	0.099	**0.122**	3.0375	0.01878	3.23%
ISCM	0.500	0.571	0.600	**0.557**			
CRM	0.375	0.276	0.333	**0.328**			
				1.000			

Therefore, for the Ethiopia meat processing industries from the above Table6.4 of pair-wise comparison internal supply chain management (0.557) is perceived to be the most important criterion followed by customer relationship management (0.328) and supplier relationship management (0.122). It makes known that performance measurement at the internal supply chain management process is the most important whereas the measurement at supplier relationship management process rated least important. It also suggests that performance measurement factors that reflect the internal supply chain management process are preferred. Moreover, it is interesting to note that performance measurement at the customer relationship management

process has been preferred over performance measurement at the supplier relationship management process. It shows that performance measurement factors that reflect the customer relationship management play more significantly than performance measurement factors for the Supplier relationship management. By the same method calculate SRM, ISRM and CRM.

6.3. SRM pair-wise comparison and weight calculation (Appendix4)

Supplier relationship management of Ethiopia meat processing industry companies At **strategic** decision making level (table4.1), it is observed that supplier integration factor (0.610) is found to be the most preferred followed by effective procurement processes factor (0.271) and quality supplier selection factor (0.119). It reveals that the Ethiopia meat processing companies considers the supplier integration is the most important in its supplier relationship management. At **tactical** decision making level, from quality supplier selection (table4.2), supplier performance (0.571) is perceived to be the most preferred factor followed by green supplier (0.285) and selection process (0.143). It discloses that supplier performance factor is the most important while selection process factor is the least important.

At **operational** decision making level, from supplier performance (table4.3), Quality of products (0.477) is perceived to be the most preferred factor followed by overall reliability (0.350) and Delivery performance (0.172). It discloses that Quality of products factor is the most important while Delivery performance is the least important. Then from green supplier (table4.4), manufacturing (0.435) is perceived to be the most preferred factor followed by Design (0.333) and Environmental policy (0.223). It discloses that manufacturing factor is the most important while Environmental policy is the least important. Finally from selection process (table4.5), clear scope, specification and criteria for selection (0.538) is perceived to be the most preferred factor followed by Effective negotiation (0.297) and robust selection criteria (0.158). It discloses that Clear scope, specification and criteria for selection factor are the most important while robust selection criteria is the least important.

At **tactical** decision making level, from supplier integration factor (table4.6), Use of information technology (0.513) is perceived to be the most preferred factor followed by Information integration (0.263) Organizational relationship (0.142) and Coordination and resource sharing (0.079). It review that Use of information technology factor is the most important while Coordination and resource sharing factor is the least important. At **operational** decision making level, from Coordination and resource sharing factor (table4.7), Production planning (0.44) is

perceived to be the most preferred factor followed by Decision-making (0.325) and Operations (0.235). It reviews that Production planning factor is the most important while Operations is the least important. next from Information integration factor (table4.8), Standardized means of communication (0.507) is perceived to be the most preferred factor followed by Information sharing (0.223), Joint demand forecasting (0.165) and Collaborative planning (0.151). It reviews that Standardized means of communication factor is the most important while Collaborative planning is the least important. As well as from Organizational relationship factor, Risk sharing (0.624) is perceived to be the most preferred factor followed by Designing and maintaining of communication channels (0.210) and Common objective and team work (0.138). It reviews that Risk sharing factor is the most important while Common objective and team work is the least important. Finally from Use of information technology factor (table4.9), System improvement (0.608) is perceived to be the most preferred factor followed by System's effectiveness (0.273) and State of art system in place (0.12). It reviews that System improvement factor is the most important as system in place is the least important.

At **tactical** decision making level, from effective procurement processes (table4.10), both Effective communication with production and effective management of purchase portfolio are equally (0.4) desirable to be the most preferred factors followed by effective contract administration (0.2). It mentions that effective contract administration factor is the least important. At **operational** decision making level, from Effective communication with production (table4.11), developing right material specification (0.4) is indicated to be the most preferred factor followed by Identifying right suppliers for specific (0.2). It founds that developing right material specification factor is the most important while identifying right suppliers for specific factor is the least important. As from effective management of purchase portfolio factor (table4.12), Segregation of materials as per value and criticality (0.549) is perceived to be the most preferred factor followed by Making purchase decision accordingly (0.241) and Maintaining up-to-date supplier database (0.211). It reviews that Segregation of materials as per value and criticality factor is the most important as maintaining up-to-date supplier database is the least important. Finally, from effective contract administration factor (table4.13), Payment (0.458) is perceived to be the most preferred factor followed by Inspection and verification accordingly (0.415) and Contract selection (0.137). It reviews that Payment factor is the most

important as Contract selection is the least important. Therefore from the above discussion the key indicators of SRM are seeing in table 6.5.

Table 6.5 key indicators of supplier relationship management

key indicators of SRM		
Strategic	**Tactical**	**Operational**
➢ **Supplier integration**	➢ ***Supplier performance*** ➢ ***Use of information technology*** ➢ ***Effective communication with production*** ➢ ***Effective management of purchase selection***	➢ Quality of products Clear scope, specification, and criteria for selection ➢ Standardized means of communication ➢ Risk sharing ➢ System improvement ➢ Developing right material specification ➢ Segregation of materials as per value and criticality

6.4. ISRM pair-wise comparison and weight calculation **(Appendix5)**

At strategic decision making level (table5.1), it is observed that internal integration factor (0.342) is found to be the most preferred followed by Transportation factor (0.187), Operations factor (0.177), Facility factor (0.143), Inventory factor (0.088) and Human Resources factor (0.063). From that Ethiopia meat processing industries consider internal integration is the most important in its internal supply chain management while Human Resources factor is the least important.

At **tactical** decision making level, from facility (table5.2), Quality (0.484) is identified to be the most preferred factor followed by Reliability (0.172), Flexibility (0.165), capacity utilization (0.106) and efficiency (0.066). It displays that Quality factor is the most important while efficiency factor is the least important. At **operational** decision making level, from flexibility and quality (table5.3) is State of art technology (0.557) perceived to be the most preferred factor followed by Safety (0.287) and Ability to change product produced (0.122). It discloses that State of art technology of products factor is the most important while Ability to change product produced is the least important. Then, from Reliability (table5.4) is Availability or effective

maintenance (0.574) perceived to be the most preferred factor followed by Continuous improvement possibility (0.321) and Environment friendly (0.139). It discloses that Availability or effective maintenance factor is the most important while Environment friendly is the least important.

At **tactical** decision making level, from inventory (table5.5), optimal inventory policy (0.667) is known to be the most preferred factor and warehouse utilization (0.333) is the least preferred factor. At **operational** decision making level, from optimal inventory policy (table5.6) is Decrease inventory levels (0.385) perceived to be the most preferred factor followed by Decrease inventory costs (0.266), shared inventory with customer (0.209) and shared inventory with supplier (0.106). It reveals that Decrease inventory levels factor is the most important whereas Shared inventory with supplier factor is the least important. Then from warehouse utilization (table5.7) is Raw materials (0.5) perceived to be the most preferred factor followed by both Spares and maintenance materials and Finished products (0.25). It reveals that Raw materials levels factor is the most important.

At **tactical** decision making level, from transportation (table5.8), Efficiency (0.310) is identified to be the most preferred factor followed by both Flexibility and Reliability (0.247) and Capacity utilization (0.197). It displays that Efficiency factor is the most important while Capacity utilization factor is the least important. At **operational** decision making level, from flexibility and Reliability (table5.8) is Safety (0.414) perceived to be the most preferred factor followed by Availability or effective maintenance (0.214), Environment friendly (0.192), Adhering to delivery schedule (0.122) and Ability to change delivery modes (0.059) It discloses that Safety factor is the most important while Ability to change delivery modes is the least important.

At **tactical** decision making level, from internal integration (table5.9), internal quick response (0.333) is identified to be the most preferred factor followed by Information integration (0.275), Efficiency (0.207) and Use of information technology (0.128). It displays that Internal quick response factor is the most important while Use of information technology factor is the least important. At **operational** decision making level, from information technology (table5.10), Information sharing (0.255) is desirable to be the most preferred factor followed by Enterprise application integration (0.237), Information system flexibility (0.229), Improve data validity (0.086) and Real-time monitor (0.064). It realizes that information integration factor is the most important while efficiency factor is the least important. Next from internal quick response

(table5.11), Strength information sharing (0.625) is concerned to be the most preferred factor followed by Information timeliness (0.238), and Information availability (0.137). It expresses that Strengthen information sharing factor is the most important whereas Information availability factor is the least important. Finally from Use of information technology (table5.12), System's effectiveness (0.532) is known to be the most preferred factor followed by State of art system in place (0.424) and System improvement (0.230). It indicates that System's effectiveness factor is the most important while System improvement factor is the least important. At **tactical** decision making level, from human resources (table5.13), Training (0.459) is desirable to be the most preferred factor followed by Innovation and learning (0.232), Safety (0.176) and Motivation (0.088). It mentions that Training factor is the most important whereas Motivation factor is the least important.

At **tactical** decision making level, from operations (table5.14), Operational performance (0.478) is indicated to be the most preferred factor followed by Environmental performance (0.360 and Innovation (0.172). It founds that Operational performance factor is the most important while Innovation factor is the least important. At **operational** decision making level, from Operational performance (table5.15), Consistence quality (0.454) is desirable to be the most preferred factor followed by Flexibility (0.252), Reliability (0.231), Waste reduction (0.141) and Customer services (0.130). It realizes that Consistence quality factor is the most important while Customer services factor is the least important. From Environmental performance (table5.16), Environmental audit (0.255) is found to be the most preferred factor followed by Emission and Reverse logistics (0.233), Energy consumption (0.118) and Environmental policy (0.054). It proposes that safety factor is the most important whereas innovation and learning factor is the least important. Finally, from Innovation (table5.17), State of art technology (0.667) is concerned to be the most preferred factor followed by Continuous improvement (0.333). It claims that State of art technology factor is the most important. As a result from the above discussion the key indicators of ISRM are seeing in table 6.6.

Table6.6 key indicators of internal supply chain relationship management

key indicators of ISRM		
Strategic	**Tactical**	**Operational**
➢ **Internal integration**	➢ ***Quality*** ➢ ***Optimal inventory policy*** ➢ ***Efficiency*** ➢ ***Information integration*** ➢ ***Training*** ➢ ***Operational performance***	➢ State of art technology ➢ Availability or effective maintenance ➢ Decrease inventory levels ➢ Raw materials ➢ Safety ➢ Strengthen information sharing ➢ State of art system in place ➢ Consistence quality ➢ Environmental audit

6.5. CRM pair-wise comparison and weight calculation (Appendix6)

At **strategic** decision making level (table6.1), it is described that Market analysis factor (0.505) is found to be the most preferred followed by Customer service factor (0.227), Demand forecasting (0.124) and Customer integration factor (0.136). It expresses that the Ethiopia meat processing industries determines the Market analysis factor is the most important in its internal supply chain management.

At **tactical** decision making level, from customer service (table6.2), Responsiveness (0.499) is indicated to be the most preferred factor followed by Value added service (0.299), Handling customer complaints (0.166) and Customer order processing and delivery (0.073). It founds that Responsiveness of demand data factor is the most important while Customer order processing and delivery factor is the least important. At **operational** decision making level, from Responsiveness (table6.3), Quality (0.0.523) is perceived to be the most preferred factor followed by Customer satisfaction (0.304) and Innovation (0.173). It discloses that Quality factor is the most important while Innovation factor is the least important. Next from Customer order processing and delivery (table6.4), Order flexibility (0.432) is known to be the most preferred factor followed by Order fill rate (0.285), Delivery performance (0.183) and Response time (0.129). It exposes that Order flexibility factor is the most important whereas Response time factor is the least important

Then, from handling customer complaints (table6.5), System in place (0.572) is desirable to be the most preferred factor followed by Number of complaints received (0.297) and Number of response made (0.164). It realizes that System in place factor is the most important while

Number of response made factor is the least important. Finally from Value added service (table6.6), Flexibility of services to meet particular (0.75) is concerned to be the most preferred factor followed by customer needs (0.25)

At **tactical** decision making level, from Customer integration (table6.7), Information integration (0.439) is identified to be the most preferred factor followed by Use of information technology (0.283), Extent of cooperation to improve quality (0.179) and Organizational relationship (0.099). It displays that Information integration factor is the most important while Organizational relationship factor is the least important. At **operational** decision making level, from Extent of cooperation to improve quality (table6.8), new product and service development (0.623) is known to be the most preferred factor followed by under contingency (0.239) and Regular operations (0.138). It exposes that new product and service development factor is the most important whereas Regular operations factor is the least important. Then, from Information integration (table6.9), Information sharing (0.409) is indicated to be the most preferred factor followed by Joint demand forecasting (0.304), Standardized means of communication across functions (0.202) and Collaborative planning (0.079). It founds that Information sharing factor is the most important while Collaborative planning factor is the least important. As well as from Organizational relationship (table6.10), Risk sharing (0.557) is perceived to be the most preferred factor followed by common objective and teamwork (0.32) and Designing and maintaining of communication channels (0.158). It advises that Risk sharing factor is the most important while designing and maintaining of communication channels factor is the least important. Finally, from Use of information technology (table6.11), both State of art system in place and System's effectiveness (0.4) is shown to be the most preferred factor followed by System improvement (0.2). It explains that both State of art system in place and System's effectiveness factor is the most important.

At **tactical** decision making level, from demand forecasting (table6.12), Decision making (0.537) is identified to be the most preferred factor followed by Forecasting system in place (0.268) and Reliability of demand data (0.195). It displays that Decision making factor is the most important while Reliability of demand data factor is the least important. At **operational** decision making level, from Forecasting system in place (table6.13), State of art technology (0.621) is known to be the most preferred factor followed by Forecasting model (0.25) and Forecasting process (0.159). It exposes that State of art technology factor is the most important whereas Forecasting

process factor is the least important. Next from Decision making (table6.14), Fast decision making (0.75) is perceived to be the most preferred factor followed by Governance (0.25). It reveals that Fast decision making factor is the most important. Finally from Reliability of demand data (table6.15), Increase employee's adaptation for changes (0.388) is known to be the most preferred factor followed by Forecast volatility (0.278), Accuracy of forecasting techniques (0.127), Improve response to customer demands (0.105) and Decrease prediction errors (0.084). It indicates that Increase employee's adaptation for changes factor is the most important while Decrease prediction errors factor is the least important.

At **tactical** decision making level, from market analysis (table6.16), Market equity (0.456) is identified to be the most preferred factor followed by Government policy over market equity (0.303), Customer retention (0.146) and Customer acquisition (0.095). It displays that Market equity factor is the most important while Customer acquisition factor is the least important. At **operational** decision making level, from Market equity (table6.17), Percentage of market share (0.619) is known to be the most preferred factor followed by Percentage of change (0.224) and Trend (0.156). It exposes that Percentage of market share factor is the most important whereas Trend factor is the least important. Finally from Government policy over market equity (table6.18), Equal trade opportunity (0.537) is known to be the most preferred factor followed by Subsidy of raw materials (0.268) and Knowledge sharing among public and private sectors (0.195). It indicates that Equal trade opportunity factor is the most important while Knowledge sharing among public and private sectors factor is the least important. Consequently from the above discussion the key indicators of CRM are seeing in table 6.7.

Table 6.7 key indicators of customer relationship management

key indicators of CRM		
Strategic	**Tactical**	**Operational**
➢ **Market analysis**	➢ ***Responsiveness*** ➢ ***Information integration*** ➢ ***Decision making*** ➢ ***Market equity***	➢ Quality ➢ flexibility ➢ System in place ➢ New product and service development ➢ Information sharing ➢ Risk sharing ➢ System improvement ➢ Fast decision making ➢ Forecast volatility ➢ Percentage of market share ➢ Equal trade opportunity

CHAPTER SEVEN
CONCLUSION AND RECOMMENDATION

7.1. Conclusion

From the research findings, we can conclude that Ethiopian meat processing industries Supply chain performance measurement. Ethiopia has the tenth largest livestock inventory in the world, and also the country has the largest number of livestock in Africa. Live animal and meat exports are an important and growing sector of international trade for Ethiopia. Though, the country's current share in the global export market for meat is quite less. Meat export industry is one of the sectors that have been given development priorities by the Ethiopian government. The number of modern meat export firms established in the country has been on the rise. But still now the volume of export has not been up to the expected growth level. The main reason for these could be the lack of conceptual framework and lack of measure supply chain performance among meat processing industries.

This study has examined performance of supply chain management in five case study companies in the Ethiopia meat processing industries: The study uses the concept of decision making levels and supply chain macro processes as its approach to the study of the supply chain performance measurement. By combining both decision making levels and supply chain macro processes, the study explored the holistic performance of supply chain management. The main purpose of this research was to evaluate and improve supply chain performance in the companies. As well as to achieve the Objective, literature was critically reviewed on performance measurement and performance measurement factors for supply chain performance measurement. Then, the conceptual framework was developed based on key concepts from this literature review.

This framework will provide a balanced horizontal (cross-process) and vertical (hierarchical decision). The researcher Questioner survey and semi structural interviews, observation, and secondary data analysis, was used to collect the data for this study. Analyzed the data by the analytic hierarchy process, AHP helps to identify and compare the important of the performance measurement factors.

A first finding involves the analysis of an overall supply chain performance from three supply chain macro processes. It was evident that internal supply chain management was the most preferred supply chain macro process for the Ethiopia meat Processing industries. These results

showed that the industries intended to concentrate on its internal supply chain as it is the most important for the companies. The results also proposed that supplier relationship management was the least important to these companies compared with others.

Second finding concerns the measurement of supply chain performance by analyzing performance measurement factors in supplier relationship management. At strategic decision making level, Ethiopia meat processing companies that supplier integration was the most important factor whereas quality supplier selection was the least important factor. This result revealed that the companies gave a significant role on the supplier integration. Then, at tactical level, Ethiopia meat processing companies that use of information integration was the most important factor from supplier integration in strategic level. Finally, at operational level Ethiopia meat processing companies that system improvement was the most important factor from use of information integration in tactical level.

Third finding concerns the measurement of supply chain performance by analyzing performance measurement factors in internal supply chain management. At strategic decision making level, Ethiopia meat processing companies that internal integration, facility and transportation was the most important factor whereas human resources was the least important factor. This result revealed that the companies gave a significant role on the internal integration, facility and transportation. Then, at tactical level, Ethiopia meat processing companies that use of quality and internal quick response was the most important factor from internal integration, facility in strategic level. Finally, at operational level Ethiopia meat processing companies that strength information sharing and state of art technology was the most important factor.

The final finding concern the measurement of supply chain performance by analyzing performance measurement factors in customer relationship management. At strategic decision making level, Ethiopia meat processing companies that market analysis was the most important factor whereas Customer integration factor was the least important factor. This result revealed that the companies gave a significant role on the market analysis. Then, at tactical level, Ethiopia meat processing companies that use of market equity was the most important factor from market analysis in strategic level. Finally, at operational level Ethiopia meat processing companies that percentage of market share was the most important factor from market equity in tactical level.

7.2. Recommendation

The main recommendations derived from this empirical study could be:

- **Facilitate consistent and price competitive supply of slaughter animals** by enhancing productivity, removing trade distorting measures; and creating strong marketing linkages between the processing industry and producer cooperatives, feedlot operators and licensed livestock traders.
- **Improvement in the content and quality of livestock extension services**. Livestock extension services in general and marketing in particular will be strengthened with special focus on the pastoral areas. The producers will be technically supported with the use of available feed resources; livestock handling, market information, livestock selection, market linkages with potential buyers; continuous awareness creation activities for changing the producers to market oriented production system etc.
- **Establish Support Institution** For increasing the value and profitability of the Ethiopian meat industry by enhancing demand for the products in export markets and consistent supply of livestock and meat through a dynamic partnership of all stakeholders, an institution coordinating the activities and providing supports to meat animals' producers, feedlot operators, processors, feed producers and processors, transporters, exporters, sector associations shall be established.
- Promote and strengthening marketing cooperatives the marketing/management skills of livestock producers and their cooperatives will be upgraded so that market links between the producers, licensed traders and export operators strengthened. Exploiting the traditional clan based livestock marketing systems, structuring participatory market supply chains, developing and encouraging a unified livestock pricing system in the supply chain will be another approach to increasing supply to export abattoirs.
- **Develop up to date and enforceable legal provisions on meat inspection, quarantine, animal welfare and establishment of veterinary council/board**
- Review meat processing, packing and transport facilities under cold chain technologies
- **Propose standard meat processing plant in general and fabricating beef in particular. Estimate the related investment costs and the requirement for skilled manpower.**

- **Establish a model slaughterhouse for teaching purposes**. For building the capacities of the meat industry in general and that of the export in particular; a modern and model slaughterhouse with adequate facilities of processing shoat and beef carcasses
- **Assist the development of cost effective livestock** and meat transport services for transporting by road/sea to target destinations, Support designated modern livestock transport service system Promote and support cold chain transport of meat & meat products by road and sea. Developing and strengthening market infrastructures and Establish an empowered institution through the involvement of the private sector to provide support to the market participants on the value chain from production to the export destinations
- Ethiopian meat exporters' existing export strategy is trading limited product to similar market segment in a few countries. As a result, the meat export industry fully depends on export of chilled shoats carcasses to few countries, making the business risky and vulnerable. And also Ethiopian Meat Producers Exporters Association (EMPEA) is very weak and lacks the capacity to increase the value and profitability of the Ethiopian meat exporting industries by enhancing demand for their products in export markets through a dynamic partnership of all stakeholders." Hence, **establishment of an institution working to create new opportunities and develop existing international markets for Ethiopian meat should be pursued with earnest.** Creating awareness of the consumers and demand for Ethiopian products in the export markets.
- Market segmentation is playing a more important role in defining business approaches. Absence of products diversifications, market expansions and segmentation has low the country's export volume. And also Ethiopian exported shoat's carcasses are characterized as inconsistent and unreliable supplies; low reputations; poor quality meat (bonny carcass with thin flesh layer) and unhygienic products leading to short shelf life. As the products are also sold under the brand names of other competing countries, the awareness of the consumers about the products is relatively low. Therefore, to change the perceptions of the existing markets and to capture relatively substantial market shares and penetrate new markets, the following actions are worth undertaking.
    - Conduct promotional campaigns. Develop, establish and promote the "Ethiopian Brand" for Ethiopian meat products associated with reputation for consistently meeting desired quality and sanitary standards. The development of the Brand focusing on quality and

sanitary standards shall be carried out by an expatriate professional marketing consultant in collaboration and support of Ethiopian meat processors and exporters

- Development of advertising materials and Website development focused the website for promoting marketing of meat products shall be developed and accessed.
- Trade Missions to potential new importing countries and Trade fairs the exporters will be facilitated and supported to participate at major and important trade fairs to conduct business with buyers face to face, using an opportunity for promoting Ethiopian meat and livestock products and familiarizing with the promotional activities of other exporting countries.
- Establish Grades and standards. Using an international consultant grades and standards for slaughter stock and export meat products
- Adopt the experience of the competing countries.

7.3. Direction for future research

It is important to acknowledge limitations of the present study that may provide opportunities for future research. This study was conducted only through the questionnaire survey. But the deeper insights can be obtained by conducting in-depth interviews with various decision makers who have close relations with supply chain partners. So, generalization of these results is limited. Therefore, the future studies can take these limitations into account.

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APPENDIXES

Appendix1

Interview questions for studying the overall supply chain performance and measuring the performance of supply chain on supply chain macro process.

A. Background information

1. Please describe what do you do in your job? Composition of Department and Qualification
2. How many years have you involved in company?

B. Company information

1. What is your company profile?
2. Type of products your company produce
3. What is an Average annual sale of your company in millions (Birr).

   Under 10 ___ 11 to 25 ___26 to 50 ___ 51 to 100 __>100 ____
4. What is an Average annual net profit of your company in millions (Birr).

   Under 5 ___6 to 10____11 to 20 ___21 to 30 ___ 31 to 50 __>50 ___

C. Supplier relationship management

1. How many major suppliers do you have in your operations system?
2. Do you measure your supplier performance? If yes, which criterion is/are used by your plant for supplier selection: If no, please give reason?
3. Do you have any supplier related issues and challenges? If yes, please explain.

Supply chain integration

4. Do you have any information or risk sharing, or any integration related issues with your supplier? If yes, please explain.
5. Do you have any information sharing or any integration related issues within your company? If yes, please explain.
6. Do you have any information or risk sharing, or any integration related issues with your customer? If yes, please explain.

D. Internal supply chain management

Facility

1. What is the actual production capacity of your plant?
2. What are your facility strategies?
3. Do you have any facility related issues and challenges? If yes, please explain.

4. Do you measure your facility performance? If yes, what criteria do you consider for facility performance measurement? If no, please give reason

Capacity utilization (Tactical level)

5. What are the constraints in your optimum capacity utilization?
6. How do you optimize your idle time caused by non scheduled work or end of shift?

Inventory

7. What are your inventory policies (in general)?
8. Do you have any inventory related issues and challenges? If yes, please explain.
9. Do you measure your inventory performance? If yes, what criteria do you consider for inventory performance measurement? If no, please give reason.
10. How do you reduce your inventory cost?
11. How do you manage your risks during inventory level optimization?

Transportation

12. Do you own your transportation? Or is it the third party logistics (both inbound and outbound)?
13. What criteria do you consider while making the above decision?
14. What are your logistics strategies?
15. Do you have any transportation related issues and challenges? If yes, please explain.
16. Do you measure your transportation performance? If yes, what criteria do you consider for transportation performance measurement? If no, please give reason.
17. How reliable is your logistics to address market needs?
18. What are the challenges to achieve delivery schedule?
19. How do you mark your present performance in terms of meeting delivery schedule?
20. How do you ensure that your transportation systems are environment friendly?

Information

21. What technology do you use for managing information across the supply chain?
22. What are the obstacles to coordinate in your supply chain?
23. What criteria do you consider while selecting a specific IT system for managing your supply chain?
24. Do you have any information related issues and challenges? If yes, please explain.

25. Do you measure your information system performance? If yes, what criteria do you consider for information system performance measurement? If no, please give reason.
26. What do you do to further strengthen information sharing?
27. What are your general comments about timeliness of information?
28. How effectively can your system collect information and distribute to concerned place?

E. Customer relationship

Customer

1. Who are your customers? (General customer characteristics)
2. Do you have any customer related issues and challenges? If yes, please explain.
3. Do you measure your customer performance? If yes, what criteria do you consider for customers performance measurement? If no, please give reason.

Competitor

4. Who are your competitors?
5. What are your competitive strategies?
6. What are your competitive advantages over your competitors?

Demand forecasting

7. In what way demand forecasting is carried out in your company?
8. Is there any specific forecasting model for short term and long term forecasting for your products?
9. What criteria do you consider to select a specific model for forecasting?

F. Environmental or green supply chain

1. What is your company's environmental policy?
2. What role of environmental initiatives has your company involved in?
3. What are the reasons and main drivers behind these initiatives?
4. What criteria do you consider when making environmental decisions?
5. Do you think your company needs any help in taking environmental decisions? If yes, what kind of help do you reckon your company need?
6. What are the environmental concerns with your supplier?
7. What are the environmental concerns for your operations system?
8. What are the environmental concerns with your customer?

9. Do you measure your environmental or green supply chain performance? If yes, what criteria do you consider for environmental or green supply chain performance measurement? If no, please give reason.

Customer order processing and delivery

10. What is the total order cycle time?
11. What is your typical order 'fill rate'?
12. What are the factors or constraints to achieve required fill rate?

Market equity

13. Who are your main competitors?
14. What is the percentage of market share you hold in the overall market with respect to your competitors?
15. What is your targeting market?
16. How do you differentiate product in order to get competitive advantage?
17. What is the percentage of market equity change regarding to economic crunch?

Appendix 2

Questioner survey

ADDIS ABABA UNIVERSITY

ADDIS ABABA INSTITUTE OF TECHNOLOGY (AAiT)

SCHOOL OF MECHANICAL & INDUSTRIAL ENGINEERING

POST GRADUATE PROGRAM IN INDUSTRIAL ENGINEERING

Questionnaire for "supply chain performance improvement model in Ethiopia meat processing industry ''

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Advisors: Dr. Gulilat & **Co-advisor**: Mr. Yared Lemma

TO----------

Dear Sir/Madam,

The objective of this Questionnaire / Survey is to study the current level of supply chain performance evaluation and improvement as well as to identify the critical success factors (CSFs) for supply chain performance improvement. The information gained from the survey will hopefully be of use in developing suitable strategies and guidelines for successful supply chain performance. I would be very grateful if you could spend a few minutes answering the attached questionnaire. All the questions are designed for quick and easy response

I would also like to assure you that all responses given will be treated as STRICTLY CONFIDENTIAL and used for RESEARCH PURPOSES ONLY. If you need further clarification, please feel free to contact me at address given above. Thank you in advance for your cooperation.

With Regards, ***mieraf welay***

A. General Instructions and Information

Indicate to what extent your company experiences the following measures of performance for your company's supply chain process and the importance between each supply chain process indicators.

- Most of the questions can be answered by simply making a circle on **only one best answer** for each question.
- Please provide more information in the comments block if you wish to clarify something that is very important to my research.
- Please answer **all** questions.
- The number represents the following: 1 = excellent/ very high
  2 = very good/ high
  3 = good/moderate
  4 = fair/low
  5 = poor/ nil

Your personal data (it is not necessary to write your name)

Note: Please, give your suggestion for the points that are applicable in the company.
Please, give short or brief answers for subjective questions.
If the space is not enough, you can write your answer on the back of the paper.

B. Back ground information

1. Your present job function (mark all that apply):
   _____ Investor/Owner
   _____ General manager
   _____ Manufacturing / Production manager
   _____ Marketing manager
   _____ Other (please indicate _____)
2. Your educational level
   _____ Below diploma
   _____ Diploma
   _____ First Degree
   _____ Second degree
   _____ PHD

C. Questionnaires

1. Questions of supply chain performance on supplier relationship management (Purchasing department)

1.1. Quality supplier selection (Strategic level)					
1.1.1. Supplier performance (Tactical level)					
The expectation of receiving quality material from our suppliers	**1**	**2**	**3**	**4**	**5**
We have performance measurement in place	**1**	**2**	**3**	**4**	**5**
Preventive procedure to avoid reoccurrence	**1**	**2**	**3**	**4**	**5**
We and our supplier keep stock ready for routine and urgent requirement in warehouse	**1**	**2**	**3**	**4**	**5**
We and our sc partners keep each other informed about events or changes that may affect the other partners.	**1**	**2**	**3**	**4**	**5**
Comment					

1.1.2. Selection process (Tactical level)					
We used selection criteria choosing our supplier	**1**	**2**	**3**	**4**	**5**
We have standard procedure in place and effective negotiation	**1**	**2**	**3**	**4**	**5**
We regularly solve problems jointly with our suppliers	**1**	**2**	**3**	**4**	**5**
The level of trust between our firm and suppliers	**1**	**2**	**3**	**4**	**5**
We entered into long term contract Arrangement with dependable suppliers.	**1**	**2**	**3**	**4**	**5**
Comment					
1.1.3. Green supplier					
Environmental policy of our company	**1**	**2**	**3**	**4**	**5**
We keep track our supplier being maintain procedure on environmental issue	**1**	**2**	**3**	**4**	**5**
To insure all ethical issues take in for consideration during procurement process	**1**	**2**	**3**	**4**	**5**
We arrange to take back our product for reengineering or for proper disposal	**1**	**2**	**3**	**4**	**5**
Comment					

1.2. Supplier integration (Strategic level)					
1.2.1. Coordination and resource sharing (Tactical level)					
Cooperate with supplier to improve operation process	**1**	**2**	**3**	**4**	**5**
Our company helps suppliers to take any critical decision	**1**	**2**	**3**	**4**	**5**
Our company inform supplier in advanced for an extra requirement of material due to sudden or planned requirement	**1**	**2**	**3**	**4**	**5**

We have good coordination and understanding to facilitate urgent requirement between the company and supplier	**1**	**2**	**3**	**4**	**5**
Our department works in close coordination with supplier	**1**	**2**	**3**	**4**	**5**
Comment					
1.2.2. Information integration (Tactical level)					
The information flow between our firm and suppliers is reliable and complete	**1**	**2**	**3**	**4**	**5**
Information sharing is the extent to which critical and proprietary information is communicated to suppliers	**1**	**2**	**3**	**4**	**5**
Information exchange between our supplier and us is timely.	**1**	**2**	**3**	**4**	**5**
We inform suppliers in advance of forecast of demands	**1**	**2**	**3**	**4**	**5**
We have enough effective communication process	**1**	**2**	**3**	**4**	**5**
Comment					
1.2.3. Organizational relationship (Tactical level)					
We have good communication with our supplier	**1**	**2**	**3**	**4**	**5**
We share risk with our supplier	**1**	**2**	**3**	**4**	**5**
We have good business objective	**1**	**2**	**3**	**4**	**5**
Comment					
1.2.4. Use of information technology (Tactical level)					
We used good information system during procurement process	**1**	**2**	**3**	**4**	**5**
We used state of art e-business (electronic business) in place with our supplier	**1**	**2**	**3**	**4**	**5**
We find any gap or think of any further improvement	**1**	**2**	**3**	**4**	**5**
Comment					

1.3. Effective procurement processes (Strategic level)					
1.3.1. Effective communication with production (Tactical level)					
We have material specification in place to guide our supplier	**1**	**2**	**3**	**4**	**5**
The specification match to end customer required specification	**1**	**2**	**3**	**4**	**5**
We decide right specification and right quantity required for purchase	**1**	**2**	**3**	**4**	**5**
Mach with required specification with right supplier	**1**	**2**	**3**	**4**	**5**
Our supplier keep ready for getting required material to reduce supplier power	**1**	**2**	**3**	**4**	**5**
Comment					
1.3.2. Effective management of purchase portfolio (Tactical level)					
We keep safety inventory level of critical item	**1**	**2**	**3**	**4**	**5**
We actively alternative supplier to supply the critical item in emergency	**1**	**2**	**3**	**4**	**5**
We update our supplier database	**1**	**2**	**3**	**4**	**5**

Comment					
1.3.3. Effective contract administration (Tactical level)					
We entered into long term contract Arrangement with dependable suppliers.	**1**	**2**	**3**	**4**	**5**
We regularly solve problems jointly with our suppliers	**1**	**2**	**3**	**4**	**5**
The level of trust between our firm and suppliers	**1**	**2**	**3**	**4**	**5**
We include our key suppliers in planning and goal- setting activities	**1**	**2**	**3**	**4**	**5**
We actively involve our key suppliers in new product design and development processes	**1**	**2**	**3**	**4**	**5**
Comment					

2. Questions of supply chain performance on internal supply chain management (Production department)

2.1. Facility (Strategic level)					
2.1.1. Quality and Flexibility (Tactical level)					
Optimize our idle time caused by non schedule work or end of shift	**1**	**2**	**3**	**4**	**5**
The challenges of efficient use of our facility	**1**	**2**	**3**	**4**	**5**
we have a plan to reduce fixed cost	**1**	**2**	**3**	**4**	**5**
Our facility flexible is accommodating market uncertainties	**1**	**2**	**3**	**4**	**5**
The factors driving us to further improve	**1**	**2**	**3**	**4**	**5**
Comment					

2.1.2. Reliability (Tactical level)					
Our facility is reliable to address market needs and We control our waste	**1**	**2**	**3**	**4**	**5**
our facility environment friendly	**1**	**2**	**3**	**4**	**5**
We have documented safety or pollution control procedure for our company	**1**	**2**	**3**	**4**	**5**
There instruction for operation posted near each machine is	**1**	**2**	**3**	**4**	**5**
We have planned maintenance system in place	**1**	**2**	**3**	**4**	**5**
We maintain minimum stock level for critical spares	**1**	**2**	**3**	**4**	**5**

2.2. Inventory (Strategic level)					
2.2.1. Optimal inventory policy (Tactical level)					
We reduce our inventory cost	**1**	**2**	**3**	**4**	**5**
We manage our risks during inventory level optimization	**1**	**2**	**3**	**4**	**5**
In internal supply chain process our bottleneck locate in	**1**	**2**	**3**	**4**	**5**
we manage our inventory level during sudden fluctuation in customer demand	**1**	**2**	**3**	**4**	**5**
We have vendor managed inventory arrangement with in our supplier	**1**	**2**	**3**	**4**	**5**
Comment					

2.2.2. Warehouse utilization (Tactical level)					
We select suitable channel, scheduling, and location of warehouses using	1	2	3	4	5
We deal our obsolete raw material in our stock with	1	2	3	4	5
we improve our space utilization	1	2	3	4	5
The percentage of products not being immediately delivered after finished is	1	2	3	4	5
The percentage of the materials that are always being in 'work in progress' condition are	1	2	3	4	5
Comment					

2.3. Transportation (Strategic level)					
2.3.1. Reliability and Flexibility (Tactical level)					
Our logistics are reliable to address market needs	1	2	3	4	5
The challenges to achieve delivery schedule are	1	2	3	4	5
We mark our present performance in terms of meeting delivery schedule	1	2	3	4	5
We can ensure that our transportation systems are friendly with environment	1	2	3	4	5
The ways we follow to reduce transportation cost in normal situation and during high oil price are	1	2	3	4	5
We react during sudden demand fluctuations by	1	2	3	4	5
Comment					

2.4. Internal integration (Strategic level)					
2.4.1. Information integration (Tactical level)					
We agree our flexibility of information system being accordance with our business needs	1	2	3	4	5
We have real time monitoring system in use	1	2	3	4	5
Comment					

2.4.2. Internal quick response (Tactical level)					
To further strengthen information sharing we use	1	2	3	4	5
Our general comments about timeliness information is	1	2	3	4	5
Our system can collect information and distribute to concerned place effectively	1	2	3	4	5
Comment					

2.4.3. Use of information technology (Tactical level)					
We have state of art information system for effective operation of internal communication process	1	2	3	4	5
Our system is effective	1	2	3	4	5
We further improve our system using	1	2	3	4	5
Comment					

2.5. Human resources (Strategic level)					
2.5.1. Motivation and Safety (Tactical level)					
We motivate our staff and worker to get best out of them	**1**	**2**	**3**	**4**	**5**
We have continuous development process	**1**	**2**	**3**	**4**	**5**
To follow all safety regulation and have safe working environment we have safety procedure	**1**	**2**	**3**	**4**	**5**
We have our own system in place, And we follow the safety regulation of local government	**1**	**2**	**3**	**4**	**5**
We improve your human skill using	**1**	**2**	**3**	**4**	**5**
Comment					

2.6. Operations (Strategic level)					
2.6.1. Operational performance (Tactical level)					
Our operation react with fluctuation of uncertain demand using	**1**	**2**	**3**	**4**	**5**
We reduce material usage and waste using	**1**	**2**	**3**	**4**	**5**
We eliminate the non value adding activities between order and start of processing using	**1**	**2**	**3**	**4**	**5**
We have innovative operation process	**1**	**2**	**3**	**4**	**5**
We face challenges to maximize our throughput	**1**	**2**	**3**	**4**	**5**
Comment					

2.6.2. Environmental performance (Tactical level)					
Our environment policy	**1**	**2**	**3**	**4**	**5**
We have internal or external audit process	**1**	**2**	**3**	**4**	**5**
our plan to reduce energy consumption is	**1**	**2**	**3**	**4**	**5**
our alternative source of energy for consumption is	**1**	**2**	**3**	**4**	**5**
We manage our emission related issue using	**1**	**2**	**3**	**4**	**5**

3. Questions of supply chain performance on customer relationship management (Marketing department)

3.1. Customer service (Strategic level)					
3.1.1. Responsiveness (Tactical level)					
Our business strategy with respect to customer service	**1**	**2**	**3**	**4**	**5**
Our quality of customer service	**1**	**2**	**3**	**4**	**5**
We get feedback from customer about our effectiveness	**1**	**2**	**3**	**4**	**5**

We entered into long term contract Arrangement with dependable customer	**1**	**2**	**3**	**4**	**5**
Comment					
3.1.2. Handling customer complaints (Tactical level)					
We have documented procedure to deal with customer complain	**1**	**2**	**3**	**4**	**5**
We give opportunity to our customers to lodge a complaint	**1**	**2**	**3**	**4**	**5**
we dissolve a customer complaint as fast	**1**	**2**	**3**	**4**	**5**
We have a system in place to reduce the number of complaint	**1**	**2**	**3**	**4**	**5**
We give responses for every ten complaint being lodged	**1**	**2**	**3**	**4**	**5**
The criteria to decide which complaint needs urgent response is	**1**	**2**	**3**	**4**	**5**
Comment					
3.1.3. Value added service (Tactical level)					
In process of value creation, we create and deliver value to our customer using	**1**	**2**	**3**	**4**	**5**
We have value assessment method in place	**1**	**2**	**3**	**4**	**5**
Our understanding of where opportunities lie to create further value	**1**	**2**	**3**	**4**	**5**
We give a kind of service to our customer after sales	**1**	**2**	**3**	**4**	**5**
We know that customers are satisfied after they received sales service using	**1**	**2**	**3**	**4**	**5**
We charge them during after sales service	**1**	**2**	**3**	**4**	**5**
Comment					

3.2. Customer integration (Strategic level)					
3.2.1. Extent of cooperation to improve quality (Tactical level)					
The customer can integration help to improve our product innovation performance and quality performance using	**1**	**2**	**3**	**4**	**5**
We can interact with our customer to leverage advantage using	**1**	**2**	**3**	**4**	**5**
We often update our online catalogue	**1**	**2**	**3**	**4**	**5**
Our online catalogue readily explain the price and shipping cost	**1**	**2**	**3**	**4**	**5**
Our contingency approach regarding customer integration is	**1**	**2**	**3**	**4**	**5**
Comment					

3.2.2. Information integration (Tactical level)					
We organize information on our customer	**1**	**2**	**3**	**4**	**5**
we replicate the mind of customers and use this information to improve our customer relationship management activities	**1**	**2**	**3**	**4**	**5**
We maintain transparent with our customer about product quality and availability	**1**	**2**	**3**	**4**	**5**

We use strategy to get to customer and for customer to get us	**1**	**2**	**3**	**4**	**5**
We cooperate with our customer to develop joint demand forecasting	**1**	**2**	**3**	**4**	**5**
We identify, understand, and anticipate our customer's needs	**1**	**2**	**3**	**4**	**5**
Comment					

3.2.3. Organizational relationship (Tactical level)					
We use customer contact facility	**1**	**2**	**3**	**4**	**5**
We share our risk with our customer, we think it is required for better coordination	**1**	**2**	**3**	**4**	**5**
Our objective match with our customer's require	**1**	**2**	**3**	**4**	**5**
We achieve our objective	**1**	**2**	**3**	**4**	**5**
Comment					
3.2.4. Use of information technology (Tactical level)					
We have state of art arrangement for online direct sale, we earn revenue per year from online direct sale	**1**	**2**	**3**	**4**	**5**
We use state of art information technology for customer service	**1**	**2**	**3**	**4**	**5**
Comment					

3.3. Demand forecasting (Strategic level)					
3.3.1. Forecasting system in place (Tactical level)					
The demand forecasting carried out in our company is	**1**	**2**	**3**	**4**	**5**
specific forecasting model for short term and long term forecasting for our products	**1**	**2**	**3**	**4**	**5**
We consider criteria to select a specific model for forecasting	**1**	**2**	**3**	**4**	**5**
The percentage of errors we take in to consideration for our forecasting is	**1**	**2**	**3**	**4**	**5**
Comment					

3.3.2. Decision making (Tactical level)					
The role of governance on decision making process in our company	**1**	**2**	**3**	**4**	**5**
We measure its effectiveness on direction and control	**1**	**2**	**3**	**4**	**5**
The challenges for fast decision making process in our company is	**1**	**2**	**3**	**4**	**5**
We satisfy our customer demand using	**1**	**2**	**3**	**4**	**5**
We reduce prediction error	**1**	**2**	**3**	**4**	**5**
Comment					

3.4. Market analysis (Strategic level)					
3.4.1. Customer acquisition (Tactical level)					
the expected attrition rate of visitors in our website is	**1**	**2**	**3**	**4**	**5**
We have customer database	**1**	**2**	**3**	**4**	**5**
We build relationship with our targeted customer	**1**	**2**	**3**	**4**	**5**
Comment					

3.4.2. Customer retention (Tactical level)					
We have a strategy in the respect of retaining existing customer and creating new customer	**1**	**2**	**3**	**4**	**5**
Our customer purchase from us again	**1**	**2**	**3**	**4**	**5**
We build customer's loyalty and we reward them for being loyal customers	**1**	**2**	**3**	**4**	**5**
We expect to get return from our loyal customer	**1**	**2**	**3**	**4**	**5**
Our customer satisfaction index is	**1**	**2**	**3**	**4**	**5**
We have matrix to identify old product with new customer	**1**	**2**	**3**	**4**	**5**
Comment					

3.4.3. Government policy over market equity (Tactical level)					
Our government give us subsidy on raw material	**1**	**2**	**3**	**4**	**5**
We follow equal opportunity by ethics	**1**	**2**	**3**	**4**	**5**
We share our knowledge among public and private sectors	**1**	**2**	**3**	**4**	**5**
Comment					

THANK YOU VERY MUCH FOR YOUR VALUABLE TIME

Appendix 3

Survey Responses Summary to Questionnaires and Interviews for Holistic Supply Chain Performance Measurement in Ethiopian Meat Processing Industries

1. General Information

- **Total number of questionnaires distributed**: for purchasing department, production department, marketing department
- **Number of respondents**: 67 (92.5%)
- **Respondents service Years in the Plant**: all the respondent service year is above 1 year
- **Composition of Position**: Mangers, veterinaries, Supervisors, Sales Route Coordinators, Engineers, senior chemists, Mechanic, Foreman and Branch managers, and General Managers.
- **Composition of Department**: purchasing, Human resource, Production, Technical Commercial, Sales & Marketing, Finance, Quality Control,
- **Composition of Qualification**: Accounting, Management, Procurement & Supply, Applied Chemistry, Marketing, Mechanical and Electrical Engineering, industrial engineering.

2. Profile picture of the case companies

Abattoirs	Location	Initial production year	Type of animals slaughtered	Attainable daily capacity	Current Annual capacity	Expandable capacity
ELFORA	BISHOFTU (OROMIA)	1973	▪ Sheep and goats /for export / ▪ Cattle /for the domestic market/	1,200	249,600	599,040
HELMEX	MELGE WONDO (SOUTH)	1961	▪ Cattle	1,088	226,304	599,040
MOJO modern	BISHOFTU (OROMIA)	2001	▪ Sheep, camel, and goats	2,330	768,900	950,400
LUNA	BISHOFTU (OROMIA)	1998	▪ Sheep, goats and calves—at its old abattoir	1,600	361,600	650,880
ORGANIC	BISHOFTU (OROMIA)	2006	Sheep and goats	1000		

3. **Overall supply chain performance**

Supply chain macro processes	Low	Moderate	good	V. good	Total
Supplier relationship management	43	28.6	28.4	0	100
Internal supply chain management	52.1	36.4	11.5	0	100
Customer relationship management	40	50.9	9.1	0	100

4. **supplier relationship management**

Factors in strategic level	Low (%)	Moderate (%)	Good (%)	V. good (%)
Quality supplier selection	25.3	43.2	29.7	1.8
Supplier integration	38.4	35.9	23.4	2.3
Effective procurement processes	21.2	48.8	30	0

4.1. Quality supplier selection

Factors in tactical level	Low (%)	Moderate (%)	Good (%)	V. good (%)
Supplier performance	5.3	46	42.2	6.5
Selection process	6.4	52.1	24.7	16.8
Green supplier	21.6	49.5	26.6	2.3

4.1.1. Supplier performance

Factors in operational level	Low (%)	Moderate (%)	Good (%)	V. good (%)
Quality of products	55	37.3	6.6	1.1
Delivery performance	9.2	21.3	48.2	21.3
Overall reliability	5.5	31.6	50.9	12

4.1.2. Selection process

Factors in operational level	Low (%)	Moderate (%)	Good (%)	V. good (%)
Robust selection criteria	23.8	64	12.2	0
Clear scope, specification and criteria for selection	37.5	37.5	23.2	1.8
Effective negotiation	6.2	33.6	54.4	4.8

4.1.3. Green supplier

Factors in operational level	Low (%)	Moderate (%)	Good (%)	V. good (%)
Environmental policy	18	52.9	26.7	3.1
Design	42	19.8	23.4	14.8
Manufacturing	53	32	6.8	8.2
Reverse logistics	25.6	37.3	31.2	5.9

4.2. Supplier integration

Factors in tactical level	Low (%)	Moderate (%)	Good (%)	V. good (%)
Coordination and resource sharing	10.6	33.4	36.4	19.6
Information integration	31.1	43.9	24.6	1.8
Organizational relationship	19.7	35.3	40.9	4.1
Use of information technology	51.9	34.9	13.2	0

4.2.1. Coordination and resource sharing

Factors in operational level	Low (%)	Moderate (%)	Good (%)	V. good (%)
Operations	14.3	28.9	38.4	18.4
Decision-making	5.8	41.5	31.2	21.5
Production planning	11.6	31.2	38.4	18.8

4.2.2. Information integration

Factors in operational level	Low (%)	Moderate (%)	Good (%)	V. good (%)
Information sharing	32.9	36.7	25.5	4.9
Collaborative planning	16.2	45	36.4	2.4
Joint demand forecasting	21	61.5	17.5	0
Standardized means of communication	54.3	26.8	18.9	0

4.2.3. Organizational relationship

Factors in operational level	Low (%)	Moderate (%)	Good (%)	V. good (%)
Designing and maintaining of communication channels	21.4	41.1	37.5	0
Risk sharing	35.4	35.1	29.5	0
Common objective and team work	2.3	29.7	55.7	12.3

4.2.4. Use of information technology

Factors in operational level	Low (%)	Moderate (%)	Good (%)	V. good (%)
State of art system in place	42.9	44.6	12.5	0
System's effectiveness	51.3	31.5	17.2	0
System improvement	61.7	28.8	9.5	0

3.3. Effective procurement processes

Factors in tactical level	Low (%)	Moderate (%)	Good (%)	V. good (%)
Effective communication with production	9.4	61.6	29	0
Effective management of purchase portfolio	9.3	34.2	56.5	0
Effective contract administration	18.5	42.3	20.5	18.7

3.3.1. Effective communication with production

Factors in operational level	Low (%)	Moderate (%)	Good (%)	V. good (%)
Developing right material specification	9.5	64.2	26.3	0
Identifying right suppliers for specific	9.2	59.1	31.7	0

3.3.2. Effective management of purchase portfolio

Factors in operational level	Low (%)	Moderate (%)	Good (%)	V. good (%)
Segregation of materials as per value and criticality	9.2	59.5	31.3	0
Maintaining up-to-date supplier database	6	24.9	67.1	2
Making purchase decision accordingly	3.3	17.8	71.2	7.7

3.3.3. Effective contract administration

Factors in operational level	Low (%)	Moderate (%)	Good (%)	V. good (%)
Contract selection	0	10	15	75
Inspection and verification	0	81.9	18.1	0
Payment	9.5	55.3	35.2	0
Evaluation	64.7	21.5	13.8	0

4. internal supply chain management

Factors in strategic level	Low (%)	Moderate (%)	Good (%)	V. good (%)
Facility	23.1	48.7	27.6	0.6
Inventory	12.6	43.6	36.6	7.2
Transportation	34.9	41.8	23..3	0
Internal integration	52.8	40.1	6.7	0.4
Human Resources	17.2	47.6	32.5	2.7
Operations	34.6	44.3	20.7	0.4

4.1. Facility

Factors in tactical level	Low (%)	Moderate (%)	Good (%)	V. good (%)
Capacity utilization	0	68.5	31.5	0
Efficiency	0	43.6	56.4	0
Flexibility	24.2	54.9	17.9	0
Quality	79.2	20.8	0	0
Reliability	11.4	54.7	33.2	0.7

4.1.1. Flexibility and Quality

Factors in operational level	Low (%)	Moderate (%)	Good (%)	V. good (%)
Ability to change product produced	19.3	73.1	7.6	0
State of art technology	39.1	32.4	6.7	0
Continuous improvement possibility	25.9	34.6	39.5	0

4.1.2. Reliability

Factors in operational level	Low (%)	Moderate (%)	Good (%)	V. good (%)
Environment friendly	4.9	57.7	37.4	0
Safety	21.4	41.7	34.9	2
Availability or effective maintenance	8	64.8	27.2	0

4.2. Inventory

Factors in tactical level	Low (%)	Moderate (%)	Good (%)	V. good (%)
Optimal inventory policy	21.7	46.3	32	0
Warehouse utilization	3.5	40.9	41.2	14.4

4.2.1. Optimal inventory policy

Factors in operational level	Low (%)	Moderate (%)	Good (%)	V. good (%)
Decrease inventory levels	14.8	61.4	23.8	0
Decrease inventory costs	25.5	54.8	19.7	0
Shared inventory with supplier	19.1	31.7	49.9	0
Shared inventory with customer	27.3	37.8	34.9	0

4.2.2. Warehouse utilization

Factors in operational level	Low (%)	Moderate (%)	Good (%)	V. good (%)
Raw materials	8.6	31.8	44.4	15.2
Finished products	2.1	23.3	46.7	27.9
Spares and maintenance materials	0	67.5	32.5	0

4.3. Transportation

Factors in tactical level	Low (%)	Moderate (%)	Good (%)	V. good (%)
Capacity utilization	33.3	49.4.	17.3	0
Efficiency	22.2	38.5	39.3	0
Flexibility	42.3	40.6	17.1	0
Reliability	42	38.8	19.2	0

4.3.1. Flexibility and Reliability

Factors in operational level	Low (%)	Moderate (%)	Good (%)	V. good (%)
Ability to change delivery modes	18.9	53.1	28	0
Adhering to delivery schedule	41.7	38.9	19.4	0
Environment friendly	35.6	38.4	26	0
Safety	76.8	17.6	5.6	0
Availability or effective maintenance	37.2	46.2	16.6	0

4.4. Internal integration

Factors in tactical level	Low (%)	Moderate (%)	Good (%)	V. good (%)
Information integration	57.8	38.2	4	0
Internal quick response	62.5	35.1	2.4	0
Use of information technology	39.9	45.2	14.4	0.5
Efficiency	51.3	41.8	5.9	1

4.4.1. Information integration

Factors in operational level	Low (%)	Moderate (%)	Good (%)	V. good (%)
Improve data validity	52.3	43.1	4.6	0
Information system flexibility	64.1	33.2	2.7	0
Information accuracy	49.8	49.2	1	0
Enterprise application integration	64	32.9	3.1	0
Real-time monitor	55.2	44.8	0	0
Information sharing	61.4	26	12.6	0

4.4.2. Internal quick response

Factors in operational level	Low (%)	Moderate (%)	Good (%)	V. good (%)
Strengthen information sharing	70.4	26.9	2.7	0
Information timeliness	60.3	39.7	0	0
Information availability	56.8	38.6	4.6	0

4.4.3. Use of information technology

Factors in operational level	Low (%)	Moderate (%)	Good (%)	V. good (%)
State of art system in place	37.7	44.9	17.4	0
System's effectiveness	42.2	47.6	8.7	1.5
System improvement	39.7	43.2	17.1	0

4.5. Human resources

Factors in tactical level	Low (%)	Moderate (%)	Good (%)	V. good (%)
Motivation	16.2	43.5	39.8	0.5
Safety	17.9	37.4	35.5	9.2
Training	10.7	65.8	23.5	0
Innovation and learning	24	43.9	31.1	1

4.6. Operations

Factors in tactical level	Low (%)	Moderate (%)	Good (%)	V. good (%)
Operational performance	37.2	43	19.8	0
Environmental performance	29	40.8	30.2	0
Innovation	37.6	49.1	12	1.3

4.6.1. Operational performance

Factors in operational level	Low (%)	Moderate (%)	Good (%)	V. good (%)
Flexibility	42.3	39.8	17.2	0
Customer services	34.1	40	25.9	0
Consistence quality	47.9	35.2	16.9	0
Reliability	36.5	41.3	22.2	0
Waste reduction	24.9	58.4	16.7	0

4.6.1. Environmental performance

Factors in operational level	Low (%)	Moderate (%)	Good (%)	V. good (%)
Environmental policy	1.1	66.3	32.6	0
Environmental audit	52.2	16.8	31	0
Energy consumption	25.7	39.9	34.4	0
Emission	31.5	48.2	20.3	0
Reverse logistics	34.7	32.8	32.5	0

4.6.2. Innovation

Factors in operational level	Low (%)	Moderate (%)	Good (%)	V. good (%)
State of art technology	43.8	46.5	9.7	0
Continuous improvement	31.4	51.7	14.3	2.6

5. Customer relationship management

Factors in strategic level	Low (%)	Moderate (%)	Good (%)	V. good (%)
Customer service	18.8	40.5	37.2	3.4
Customer integration	5.4	45.9	47.9	0.8
Demand forecasting	9.6	37.5	47.2	5.6
Market analysis	26.7	41.4	27.3	4.5

5.1. Customer service

Factors in tactical level	Low (%)	Moderate (%)	Good (%)	V. good (%)
Responsiveness	58.8	19.4	21.8	0
Customer order processing and delivery	6.2	43.1	37.4	13.3
Handling customer complaints	7.2	55.3	37.3	0
Value added service	11.3	40.2	48.5	0

5.1.1. Responsiveness

Factors in operational level	Low (%)	Moderate (%)	Good (%)	V. good (%)
Quality	61.3	27.6	11.1	0
Innovation	59.6	10.5	29.9	0
Customer satisfaction	55.5	20.2	24.3	0

5.1.2. Customer order processing and delivery

Factors in operational level	Low (%)	Moderate (%)	Good (%)	V. good (%)
Response time	0	28.2	59.7	12.1
Order fill rate	6	67.5	21.6	4.9
Order flexibility	11	20	54.3	14.7
Delivery performance	7.8	56.8	13.8	21.6

5.1.3. Handling customer complaints

Factors in operational level	Low (%)	Moderate (%)	Good (%)	V. good (%)
System in place	10.7	67.6	21.7	0
Number of complaints received	7.5	67.6	24.9	0
Number of response made	3.4	31.4	65.2	0

5.1.4. Value added service

Factors in operational level	Low (%)	Moderate (%)	Good (%)	V. good (%)
Flexibility of services to meet particular	22.6	43.2	34.2	0
customer needs	0	37.2	62.8	0

5.2. Customer integration

Factors in tactical level	Low (%)	Moderate (%)	Good (%)	V. good (%)
Extent of cooperation to improve quality	4.5	51	41.5	0
Information integration	8.9	45.7	45.3	0
Organizational relationship	0.9	30	66.8	2.3
Use of information technology	7.2	55.3	37.3	0

5.2.1. Extent of cooperation to improve quality

Factors in operational level	Low (%)	Moderate (%)	Good (%)	V. good (%)
New product and service development	22.5	49.9	27.6	0
Regular operations	0	31.6	68.4	0
Under contingency	0	71.6	28.4	0

5.2.2. Information integration

Factors in operational level	Low (%)	Moderate (%)	Good (%)	V. good (%)
Information sharing	17.9	47.9	34.2	0
Collaborative planning	9.5	33.4	57.1	0
Joint demand forecasting	4.8	61.8	33.4	0
Standardized means of communication across functions and customers	3.3	40	56.7	0

5.2.3. Organizational relationship

Factors in operational level	Low (%)	Moderate (%)	Good (%)	V. good (%)
Designing and maintaining of communication channels	0	22	78	0
Risk sharing	1.4	36.8	59.7	2.1
Common objective and teamwork	0	31.4	62.8	5.8

5.2.4. Use of information technology

Factors in operational level	Low (%)	Moderate (%)	Good (%)	V. good (%)
State of art system in place	10.7	67.6	21.7	0
System's effectiveness	7.5	67.6	24.9	0
System improvement	3.4	31.4	65.2	0

5.3. Demand forecasting

Factors in tactical level	Low (%)	Moderate (%)	Good (%)	V. good (%)
Forecasting system in place	9.6	32.2	48.2	10
Decision making	12.3	34.9	52.8	0
Reliability of demand data	7.1	45.5	40.6	6.8

5.3.1. Forecasting system in place

Factors in operational level	Low (%)	Moderate (%)	Good (%)	V. good (%)
State of art technology	28.8	46.5	24.7	0
Forecasting model	0	31.3	56.1	12.6
Forecasting process	0	18.9	63.8	17.3

5.3.2. Decision making

Factors in operational level	Low (%)	Moderate (%)	Good (%)	V. good (%)
Governance	0	41.3	58.7	0
Fast decision making	24.6	28.5	46.9	0

5.3.3. Reliability of demand data

Factors in operational level	Low (%)	Moderate (%)	Good (%)	V. good (%)
Accuracy of forecasting techniques	0	55.6	39.5	4.9
Improve response to customer demands	4.6	39.7	51.8	3.9
Decrease prediction errors	10.4	38.9	31.2	19.5
Forecast volatility	0	64.3	35.7	0
Increase employee's adaptation for changes	15.6	64.4	18.8	1.2

5.4. Market analysis

Factors in tactical level	Low (%)	Moderate (%)	Good (%)	V. good (%)
Market equity	52.5	29.8	17.7	0
Customer acquisition	12	42.5	36.4	9.1
Customer retention	15.9	52.7	28.1	3.3
Government policy over market equity	26.6	40.4	27.1	5.9

5.4.1. Market equity

Factors in operational level	Low (%)	Moderate (%)	Good (%)	V. good (%)
Percentage of market share	76.3	17.9	5.8	0
Percentage of change	41.8	36	22.2	0
Trend	39.4	35.7	24.9	0

5.4.2. Government policy over market equity

Factors in operational level	Low (%)	Moderate (%)	Good (%)	V. good (%)
Subsidy of raw materials	19.6	35	41.8	3.6
Equal trade opportunity	48.6	32.7	12.3	3.4
Knowledge sharing among public and private sectors	10.9	52.4	26.1	10.6

Appendix4

Supplier relationship management pair-wise comparison and weight calculation

Table4.1: pair-wise comparison and weight calculation of SRM at strategic level

SRM	QSS	SI	EPP	Weight	λ max	CI	CR
QSS	1	1/4	1/3	0.119	3.064	0.03201	5.51%
SI	4	1	3	0.610			
EPP	3	1/3	1	0.271			
				1.000			

Table4.2: pair-wise comparison and weight calculation of QSS at tactical level

QSS	SP	SEP	GS	Weight	λ max	CI	CR%
SP	1	4	2	0.571	3.0572	0.0286	4.93
SEP	1/4	1	1/2	0.143			
GS	1/2	2	1	0.285			
				1.00			

Table4.3: pair-wise comparison and weight calculation of SP at operational level

SP	QP	DP	OR	Weight	λ max	CI	CR%
QP	1	2	2	0.477	3.0902	0.0451	7.77
DP	1/2	1	1/3	0.172			
OR	1/2	3	1	0.350			
				1.000			

Table4.4: pair-wise comparison and weight calculation of SEP at operational level

SEP	RSC	CSS	EN	Weight	λ max	CI	CR
RSC	1	1/3	1/2	0.158	3.0112	0.0056	0.96
CSS	3	1	2	0.538			
EN	2	1/2	1	0.297			
				1.000			

Table4.5: pair-wise comparison and weight calculation of green supplier at operational level

GS	EP	D	M	Weight	λ max	CI	CR%
EP	1	1/3	1/4	0.223	3.0739	0.0369	6.37
D	3	1	1/2	0.330			
M	4	2	1	0.435			
				1.000			

Table4.6: pair-wise comparison and weight calculation of supplier integration at Tactical level

SI	CRS	II	OR	UIT	Weight	λ max	CI	CR%
CRS	1	1/4	1/5	1/3	0.079	4.1243	0.0414	4.6
II	4	1	3	1/3	0.263			
OR	3	1/3	1	1/4	0.142			
UIT	5	3	4	1	0.513			
					1.000			

Table4.7: pair-wise comparison and weight calculation of CRS at operational level

CRS	O	DM	PP	Weight	λ max	CI	CR%
O	1	1/3	1	0.235	3.1027	0.0513	8.85
DM	3	1	1/3	0.325			
PP	1	3	1	0.44			
				1.000			

Table4.8: pair-wise comparison and weight calculation II at operational level

II	IS	CP	JDF	SMC	Weight	λ max	CI	CR%
IS	1	2	2	1/3	0.223	4.0632	0.0210	2.34
CP	1/2	1	1/2	1/4	0.151			
JDF	1/2	2	1	1/3	0.165			
CMC	3	3	4	1	0.507			
					1.000			

Table4.9 pair-wise comparison and weight calculation of OR at operational level

OR	DMCC	RS	COTW	Weight	λ max	CI	CR
DMCC	1	1/3	2	0.210	3.0255	0.0127	2.19 %
RS	3	1	4	0.624			
COTW	1/2	¼	1	0.138			
				1.000			

Table4.10: pair-wise comparison and weight calculation of UIT at operational level

UIT	SASP	SE	SI	Weight	λ max	CI	CR
SASP	1	1/3	1/4	0.120	3.1012	0.0506	8.73
SE	3	1	1/3	0.273			
SI	4	3	1	0.608			
				1.000			

Table4.11: pair-wise comparison and weight calculation of EPP at tactical level

EPP	ECP	EMPP	ECA	Weight	λ max	CI	CR%
ECP	1	1	2	0.4	3.000	0000	0
EMPP	1	1	2	0.4			
ECA	1/2	1/2	1	0.2			
				1.000			

Table4.12: pair-wise comparison and weight calculation of ECP at operational level

ECP	DRMS	IRSS	Weight	λ max	CI	CR
DRMS	1	2	0.4	2.000	0	0
IRSS	1/2	1	0.2			
			1.000			

Table4.13 pair-wise comparison and weight calculation of EMPP at operational level

EMPP	SMPV	MUSD	MPDA	Weight	λ max	CI	CR%
SMPV	1	3	2	0.549	3.0535	0.0267	4.61
MUSD	1/3	1	1	0.211			
MPDA	1/2	1	1	0.241			
				1.000			

Table4.14: pair-wise comparison and weight calculation of ECA at operational level

ECA	CS	IV	P	Weight	λ max	CI	CR%
CS	1	1/3	1/4	0.137	3.0917	0.0458	7.90
IV	3	1	1	0.415			
P	4	1	1	0.458			
				1.000			

Appendix5

Internal supply chain management pair-wise comparison and weight calculation

Table5.1: pair-wise comparison and weight calculation of ISCM at strategic level

ISCM	F	I	T	II	HR	O	Weight	λ max	CI	CR%
F	1	3	1/2	1/2	2	0.079	0.143	6.1347	0.0269	2.17
I	1/3	1	1/2	1/2	1	0.079	0.088			
T	2	2	1	1/3	4	0.158	0.187			
II	2	2	3	1	5	0.474	0.342			
HR	1/2	1	1/4	1/5	1	0.053	0.063			
O	2	2	1	1/3	3	0.158	0.177			
							1.000			

Table5.2: pair-wise comparison and weight calculation of Facility at tactical level

F	CU	E	F	Q	R	Weight	λ max	CI	CR
CU	1	2	1/3	1/5	1	0.106	5.0947	0.02367	2.11
E	1/2	1	1/3	1/4	1/4	0.066			
F	3	3	1	1/4	2	0.165			
Q	5	4	4	1	3	0.484			
R	1	4	1/2	1/3	1	0.172			
						1.000			

Table5.3: pair-wise comparison and weight calculation of FQ

FQ	ACPP	SAT	CIP	Weight	λ max	CI	CR%
ACPP	1	1/4	1/3	0.122	3.0234	0.0117	2.02
SAT	4	1	2	0.557			
CIP	3	1/2	1	0.321			
				1.000			

Table5.4: pair-wise comparison and weight calculation of Reliability at operational level

R	EF	S	AEM	Weight	λ max	CI	CR
EF	1	1/3	1/3	0.139	3.0405	0.0202	3.49
S	3	1	1/3	0.287			
AEM	3	3	1	0.574			
				1.000			

Table5.5: pair-wise comparison and weight calculation of Inventory at tactical level

I	OIP	WU	Weight	λ max	CI	CR
OPI	1	2	0.667	2.000	0	0
WU	1/2	1	0.333			
			1.000			

Table5.6 pair-wise comparison and weight calculation of OIP at operational level

OIP	DIL	DIC	SIWS	SIEC	Weight	λ max	CI	CR
DIL	1	2	3	2	0.385	4.0757	0.0252	2.8
DIC	1/2	1	2	2	0.266			
SIWS	1/3	1/2	1	1/3	0.106			
SIWC	1/2	1/2	3	1	0.209			
					1.000			

Table5.7: pair-wise comparison and weight calculation of WU at operational level

WU	RM	FM	SMM	Weight	λ max	CI	CR
RM	1	2	2	0.5	3.000	0	0
FM	1/2	1	1	0.25			
SMM	1/2	1	1	0.25			
				1.000			

Table5.8: pair-wise comparison and weight calculation of Transportation at tactical level

T	CU	E	F	R	Weight	λ max	CI	CR
CU	1	2	1/3	1/3	0.197	4.000	0	0
E	1/2	1	2	2	0.310			
F	3	1/2	1	1	0.247			
R	3	1/2	1	1	0.247			
					1.000			

Table5.9: pair-wise comparison and weight calculation of FR at operational level

FR	ACDM	ADS	EF	S	AEM	Weight	λ max	CI	CR
ACDM	1	1/4	1/3	1/5	1/3	0.059	5.000	0	0
ADS	4	1	1/3	1/3	1/3	0.122			
EF	3	3	1	1/4	1	0.192			
S	5	3	4	1	2	0.414			
AEM	3	3	1	1/2	1	0.214			
						1.000			

Table5.10: pair-wise comparison and weight calculation of internal integration at tactical level

II	IFI	IQR	UIT	E	Weight	λ max	CI	CR%
IFI	1	1	2	1	0.275	4.0526	0.0175	1.94
IQR	1	1	2	2	0.333			
UIT	1/2	1/2	1	1/3	0.128			
E	1	1/2	3	1	0.207			
					1.000			

Table5.11: pair-wise comparison and weight calculation of IFI

IFI	IDV	ISF	IA	EAI	RTM	IS	Weight	λ max	CI	CR%
IDV	1	1/4	2	1/4	1	1/3	0.086	6.0975	0.0195	1.57
ISF	4	1	2	1	2	1	0.229			
IA	1/2	1/2	1	1/4	1/3	1/4	0.064			
EAI	4	1	4	1	2	1	0.237			
RTM	1	1/2	3	1/2	1	1/3	0.116			
IS	3	1	4	1	3	1	0.255			
							1.000			

Table5.12: pair-wise comparison and weight calculation of IQR at operational level

IQR	SIS	IT	IA	Weight	λ max	CI	CR%
SIS	1	3	4	0.625	3.0912	0.0456	7.86
IT	1/3	1	2	0.238			
IA	1/4	1/2	1	0.137			
				1.000			

Table5.13: pair-wise comparison and weight calculation of UIT at operational level

UIT	SASP	SE	SI	Weight	λ max	CI	CR%
SASP	1	1/3	1	0.424	3.0214	0.0107	1.84
SE	3	1	2	0.532			
SI	1	1/2	1	0.230			
				1.000			

Table5.14: pair-wise comparison and weight calculation of Human resources at tactical level

HR	M	S	T	IL	Weight	λ max	CI	CR%
M	1	1/3	1/4	1/3	0.088			
S	3	1	1/3	1/3	0.176	4.0952	0.0317	3.52
T	4	3	1	2	0.459			
IL	3	3	1/2	1	0.232			
					1.000			

Table5.15: pair-wise comparison and weight calculation of Operations at tactical level

O	OP	EP	I	Weight	λ max	CI	CR
OP	1	2	2	0.478	3.0414	0.0207	3.56
EP	1/2	1	3	0.36			
I	1/2	1/3	1	0.172			
				1.000			

Table5.16: pair-wise comparison and weight calculation of Operational performance at operational level

OP	F	CS	CQ	R	WR	Weight	λ max	CI	CR
F	1	2	1/3	2	2	0.252	5.1477	0.0369	3.29
CS	1/2	1	1/4	1/3	3	0.13			
CQ	3	4	1	2	2	0.454			
R	1/2	3	1/2	1	2	0.231			
WR	1/2	1/3	1/2	1/2	1	0.141			
						1.000			

Table5.17: pair-wise comparison and weight calculation of EP at operational level

EP	EPO	EA	EC	E	RL	Weight	λ max	CI	CR
EPO	1	1/5	1/3	1/4	1/4	0.054	5.0879	0.0219	1.96
EA	5	1	3	2	2	0.255			
EC	3	1/3	1	1/3	1/3	0.118			
E	4	1/2	3	1	1	0.233			
RL	4	1/2	3	1	1	0.233			
						1.000			

Table5.18: pair-wise comparison and weight calculation of Innovation at operational level

O	SAT	CI	Weight	λ max	CI	CR
SAT	1	2	0.667	2.000	0	0
CI	1/2	1	0.333			
			1.000			

Appendix6

Customer relationship management pair-wise comparison and weight calculation

Table6.1: pair-wise comparison and weight calculation of CRM at strategic level

CRM	CS	CI	DF	MA	Weight	λ max	CI	CR%
CS	1	2	2	1/3	0.227	4.0895	0.0298	3.31
CI	1/2	1	1	1/3	0.136			
DF	1/2	1	1	1/4	0.124			
MA	3	3	4	1	0.505			
					1.000			

Table6.2: pair-wise comparison and weight calculation of Customer service at tactical level

CS	R	COPD	HCC	VAS	Weight	λ max	CI	CR
R	1	4	3	2	0.449	4.0543	0.0181	2.01
COPD	1/4	1	1/3	1/3	0.073			
HCC	1/3	3	1	1/3	0.166			
VAS	1/2	3	3	1	0.299			
					1.000			

Table6.3: pair-wise comparison and weight calculation of Responsiveness at operational level

R	Q	I	CS	Weight	λ max	CI	CR%
Q	1	2	3	0.523	3.0576	0.0288	4.9
I	1/2	1	1/3	0.173			
CS	1/3	3	1	0.304			
				1.000			

Table6.4: pair-wise comparison and weight calculation of COPD at operational level

COPD	RT	OFR	OF	DP	Weight	λ max	CI	CR%
RT	1	1/3	1/4	1/2	0.129	4.0854	0.0285	3.16
OFR	3	1	1/2	2	0.285			
OF	4	2	1	2	0.432			
DP	2	1/2	1/2	1	0.183			
					1.000			

Table6.5: pair-wise comparison and weight calculation of HCC at operational level

HCC	SP	NCR	NRM	Weight	λ max	CI	CR%
SP	1	2	3	0.572	3.0386	0.0193	3.32
NCR	1/2	1	2	0.297			
NRM	1/3	1/2	1	0.164			
				1.000			

Table6.6: pair-wise comparison and weight calculation of VAS at operational level

VAS	FSMP	CN	Weight	λ max	CI	CR%
FSMP	1	3	0.75	2.000	0	0
CN	1/3	1	0.25			
			1.000			

Table6.7:pair-wise comparison and weight calculation of Customer integration at Tactical level

CI	ECIQ	II	OR	UIT	Weight	λ max	CI	CR
ECIQ	1	1/2	2	1/2	0.179	4.0395	0.0132	1.46
II	2	1	3	3	0.439			
OR	1/2	1/3	1	1/4	0.099			
UIT	2	1/3	4	1	0.283			
					1.000			

Table6.8: pair-wise comparison and weight calculation of ECIQ at operational level

ECIQ	NPSD	RO	UC	Weight	λ max	CI	CR%
NPSD	1	4	3	0.623	3.0768	0.0384	6.6
RO	1/4	1	1/2	0.138			
UC	1/3	2	1	0.239			
				1.000			

Table6.9: pair-wise comparison and weight calculation of II at operational level

II	IS	CP	JDF	SCFC	Weight	λ max	CI	CR
IS	1	4	2	3	0.409	4.02517	0.00839	0.93
CP	1/4	1	1/4	1/3	0.079			
JDF	1/2	4	1	3	0.304			
SCFC	1/3	1/3	3	1	0.202			
					1.000			

Table6.10 pair-wise comparison and weight calculation of OR at operational level

OR	DMCC	RS	COTW	Weight	λ max	CI	CR %
DMCC	1	1/4	1/3	0.158	**3.0537**	**0.268**	**4.6**
RS	4	1	2	0.557			
COTW	3	1/2	1	0.32			
				1.000			

Table6.11 pair-wise comparison and weight calculation of UIT at operational level

UIT	SAP	SE	SI	Weight	λ max	CI	CR
SAP	1	1	2	0.4	2.000	0	0
SE	1	1	2	0.4			
SI	1/2	1/2	1	0.2			
				1.000			

Table6.12: pair-wise comparison and weight calculation of Demand forecasting at tactical level

DF	FCP	DM	RDD	Weight	λ max	CI	CR
FCP	1	1/3	2	0.268	3.000	0	0
DM	3	1	2	0.537			
RDD	1/2	1/2	1	0.195			
				1.000			

Table6.13: pair-wise comparison and weight calculation of FCP at operational level

FCP	SAT	FM	FP	Weight	λ max	CI	CR
SAT	1	3	3	0.621	3.0924	0.0462	7.96
FM	1/3	1	2	0.250			
FP	1/3	1/2	1	0.159			
				1.000			

Table6.14: pair-wise comparison and weight calculation of RDD at operational level

RDD	AFT	IRCD	DPE	FV	IEAC	Weight	λ max	CI	CR%
AFT	1	2	2	1/3	1/3	0.127	5.0342	0.0085	0.76
IRCD	1/2	1	2	1/3	1/4	0.105			
DPE	1/2	1/2	1	1/3	1/3	0.084			
FV	3	3	3	1	1/2	0.278			
IEAC	3	4	3	2	1	0.388			
						1.000			

Table6.15: pair-wise comparison and weight calculation of Market analysis at tactical level

MA	ME	CA	CR	GPOME	Weight	λ max	CI	CR%
ME	1	4	3	2	0.456	4.1264	0.0421	4.68
CA	1/4	1	1/2	1/3	0.095			
CR	1/3	2	1	1/3	0.146			
GPOME	1/2	3	3	1	0.303			
					1.000			

Table6.16: pair-wise comparison and weight calculation of Market equity at operational level

ME	PMS	PC	T	Weight	λ max	CI	CR%
PMS	1	4	3	0.619	3.0234	0.0117	2.02
PC	1/4	1	2	0.224			
T	1/3	1/2	1	0.156			
				1.000			